

Appendix M. Impact Avoidance and Minimization Measures

During the project planning changes were made and measures were incorporated into the construction plan to avoid or minimize impacts to wetlands and endangered species.

Weir No. 2

Avoidance of Impacts to Waters of the United States and to Federally listed species

Several project alternatives were considered to avoid impacts (see below)

- Size of construction area was reduced to minimize dewatered area and avoid impacts to streambed
- Planned removal of mature riparian trees was eliminated to avoid impacts to riparian forest

Minimization of Impacts to Waters of the United States and to Federally listed species

- The boundaries of staging areas were modified to minimize impacts to Giant Garter Snake habitat by moving them farther from aquatic habitats
- Project scheduling was altered to restrict construction to periods that would avoid impacts to Giant Garter Snake by restricting all activity to Giant Garter Snake active season.
- Project schedule was modified to avoid impacts to fish and Giant Garter Snake.
- Best Management Practices were incorporated into project plan to minimize impacts to Waters of the U.S. caused by soil erosion.
- All vehicle movement to/from construction site will be on existing roads to minimize impacts to Waters of the U.S.

Project alternatives considered in planning process

DWR, Northern District (DWR ND), was funded by DWR's Fish Passage Improvement Program (FPIP) to provide preliminary engineering designs and cost estimates for fish passage alternatives at Weir No. 2 in the EBC of the Sutter Bypass. Several stakeholder meetings were held with representatives of Ducks Unlimited, water districts, and local, State, and federal agencies to discuss the alternatives of the project. The stakeholder group considered many alternatives to improve fish passage, including those listed below. The alternatives were evaluated on numerous factors including fish passage, operation and maintenance, location and condition of existing facilities, stream characteristics, stream hydrology, site geology, biological criteria, owner liability, and economics. Eight alternatives were narrowed down to one after consultation with the fish passage stakeholder group. The selected alternative for Weir No. 2 was investigated, and the results are summarized in the preliminary engineering report.

The initial alternatives considered for Weir No. 2 are listed below. The alternative carried through preliminary design is underlined.

- Alternative 1 – No action.
- Alternative 2 – Remove Weir No. 2.
- Alternative 3 – Replace Weir No. 2 with a new weir and fish passage structure at the existing location (right bank or left bank fishway, or both banks).
- Alternative 4 – Replace Weir No. 2 with a new weir and fish passage structure at the existing location (right bank fishway), and tie the fish ladder into the Sutter

National Wildlife Refuge (SNWR) diversion canal entrance. This would only be necessary if a fish screen became required for the SNWR diversion and the SNWR diversion point and proposed fish screen were moved down to Weir No. 2 to improve sweeping velocities past the screen.

- Alternative 5 – Replace Weir No. 2 with a new weir and right bank fish passage structure at the SNWR diversion site about 800 feet upstream of the existing structure. This would only be necessary if a fish screen became required for the SNWR diversion. The fish ladder would be tied to new fish screen facilities to improve sweeping velocities past the screen.
 - Alternative 6 – Remove the existing fish ladder and replace it (in the existing right bank location) with a state-of-the-art fish ladder, possibly including an auxiliary water system. The existing weir structure would be kept.
 - Alternative 7 – Remove the existing fish ladder and replace it (in the existing right bank location) with a state-of-the-art fish ladder, possibly including an auxiliary water system. Plus, tie into the SNWR diversion as described above. The existing weir structure would be kept.
 - Alternative 8 – Remove the existing fish ladder and replace it (at the left bank to improve access) with a state-of-the-art fish ladder, possibly including an auxiliary water system. The existing weir structure would be kept.
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- Alternative 1 was abandoned because it does not meet the goals of this restoration project.
 - Alternative 2 was abandoned because of the dependence by numerous diverters upstream on the elevated water surface maintained by the Weir No. 2 structure. Without maintaining the current water surface, the SNWR gravity diversion would not be able to function and other diverters using pumps would be required to move pumps or pump from a lower elevation.
 - Alternative 3 is the option carried through preliminary design. Sub-alternatives were investigated for different diversion structure options and fish ladders.
 - Alternative 4 was abandoned because of the uncertainty of whether a new fish screen structure is required for the SNWR diversion. The group did not want to commit to building a new fish ladder with the intent of tying into a new fish screening facility that may not be built in the future.
 - Alternative 5 was abandoned because of the uncertainty of whether a new fish screen structure is required for the SNWR diversion. The group did not wish to move the weir structure upstream without tying into a new fish screen structure that may not be built in the future.
 - Alternative 6 was abandoned once the deteriorating condition of the existing weir structure was confirmed. A major overhaul or rebuild of the weir structure is necessary and gives flexibility for placing a new fish ladder. The group also decided that an auxiliary water system was not desired due to the added operation and maintenance. The group believes that a new fish ladder with a well-placed entrance would provide good attraction to the new fish ladder.
 - Alternative 7 was abandoned once the deteriorating condition of the existing weir structure was confirmed. A major overhaul or rebuild of the weir structure is necessary and gives flexibility for placing a new fish ladder. The group also decided that an auxiliary water system was not desired due to the added operation and maintenance. The group believes that a new fish ladder with a well-placed entrance would provide good attraction to the new fish ladder. In

addition, the group did not want to commit to building a new fish ladder with the intent of tying into a new fish screening facility that may not be built in the future.

- Alternative 8 was abandoned once the deteriorating condition of the existing weir structure was confirmed. A major overhaul or rebuild of the weir structure is necessary and gives flexibility for placing a new fish ladder. The group also decided that an auxiliary water system was not desired due to the added operation and maintenance. The group believes that a new fish ladder with a well-placed entrance would provide good attraction to the new fish ladder.

Willow Slough Weir

During the project planning several changes were made and measures were incorporated into the construction plan to avoid or minimize impacts to wetlands and endangered species.

Avoidance of Impacts to Waters of the United States and to Federally listed species

Several project alternatives were considered to avoid impacts (see below)

- Size of construction area was reduced to minimize dewatered area and avoid impacts to streambed
- A temporary vehicle crossing required over Willow Slough was initially proposed to be a berm of ca. 4,000 cubic yards of imported fill material placed in Willow Slough, with culverts to allow flows and fish to pass. The design of the bridge was changed to a vehicle bridge that will rest on the streambanks with only one central piling support, avoiding impacts to Waters of the U.S. and to fish passage.
- Planned removal of mature riparian trees was eliminated to avoid impacts to riparian forest.
- Proposed staging areas were modified after consultation with U.S Army Corps of Engineers (Brian Vierria, Sacramento District) to exclude an intermittent stream channel tributary to Willow Slough Weir and avoid disturbance impacts to Waters of the U.S.

Minimization of Impacts to Waters of the United States and to Federally listed species

- The originally proposed plan to block fish passage temporarily during construction was abandoned, and a temporary fish ladder was designed and will be constructed around the Willow Slough Weir construction site.
- A proposed fish exclusion screen at the downstream entrance to Willow Slough was eliminated due to potential effects on Waters of the U.S. and on listed fish species.
- The boundaries of staging areas were modified to minimize impacts to Giant Garter Snake habitat by moving them farther from aquatic habitats.
- Project scheduling was altered to restrict construction to periods that would avoid impacts to Giant Garter Snake by restricting all activity to Giant Garter Snake active season.
- Best Management Practices were incorporated into project plan to minimize impacts to Waters of the U.S. caused by soil erosion

- All vehicle movement to/from construction site will be on existing roads to minimize impacts to Waters of the U.S.

Project alternatives considered in planning process

DWR, Northern District (DWR ND), conducted a preliminary engineering investigation in cooperation with stakeholders and agency representatives. Stakeholder meetings were held with representatives from the U.S. Fish and Wildlife Service, the Department of Fish and Game (DFG), the National Marine Fisheries Service (NOAA Fisheries), Ducks Unlimited, the U.S. Bureau of Reclamation, Sutter County, Sutter Extension Water District, and DWR to discuss the alternative project designs. The stakeholder group considered many alternatives to reduce fish losses. The alternatives were evaluated based on numerous factors including fish passage, operations and maintenance, location and condition of existing facilities, stream characteristics, stream hydrology, biological criteria, owner liability, and economics. After consulting with the stakeholder group, six alternatives were narrowed down to one. The preferred alternative was investigated and the results are summarized in this report.

Six alternatives were considered in this study and are listed below. Alternative 3 was fully investigated as the preferred alternative.

- Alternative 1 – Remove the existing Denil fish ladder, two 60-inch diameter CMP culverts, and one 60-inch diameter concrete culvert. Construct a new fish ladder and flashboard dam weir structure.
 - Alternative 2 – Remove the existing Denil fish ladder, two 60-inch diameter CMP culverts, and one 60-inch diameter concrete culvert. Construct a new fish ladder and automated spillway gate structure.
 - Alternative 3 – Remove the existing Denil fish ladder, two 60-inch diameter CMP culverts, and one 60-inch diameter concrete culvert. Construct a new fish ladder and four 60-inch diameter CMP culverts.
 - Alternative 4 – Remove the existing Denil fish ladder, two 60-inch diameter CMP culverts, and one 60-inch diameter concrete culvert. Construct a new fish ladder and two 60-inch diameter CMP culverts and three 5-foot flashboard weirs.
 - Alternative 5 – Modify the existing Denil fish ladder, add two 60-inch diameter CMP culverts with headgates, and remove the existing 60-inch diameter concrete culvert. Alternative 6 – Do nothing.
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- Alternative 1 was eliminated because the flashboard dam weir structure would take more staff time to operate than current operations thus leading to more expense in the long run. Presently, the daily adjustments performed at Willow Slough Weir to maintain the EBC at the correct water surface elevation can be performed by one person. Safety issues and vandalism was also a concern because the location is readily accessible by the public.
 - Alternative 2 was eliminated because the automated spillway gate structure and foundation would be very costly. Willow Slough is completely inundated when the Sutter Bypass is flooded, therefore the control building which houses the machinery necessary to operate the gates would need to be built across the EBC on top of the levee. The control building would also be prone to vandalism.

- Alternative 3 is the alternative that was carried through the preliminary design process. This alternative was chosen for several reasons; culverts can easily be operated and maintained, culverts are economical, and during flood events culverts are less susceptible to damage than other structures. Both the Pool and Chute fish ladder and Full Ice Harbor fish ladder were considered feasible for this project site.
- Alternative 4 was eliminated because operation and maintenance costs associated with the flashboard weirs were considered too high. Vandalism and safety issues were also of concern.
- Alternative 5 was rejected quickly by DFG and NOAA Fisheries because the existing Denil fish ladder doesn't meet current fish passage criteria. The existing ladder is approximately 73 feet long and the current criteria for a Denil fish ladder states that for every 30 feet of run a resting pool is needed. The high maintenance associated with the existing fish ladder was also a concern.
- Alternative 6 was eliminated because it does not meet the goals of this restoration project.