ENVIRONMENTAL ASSESSMENT

FOR THE CHILOQUIN DAM FISH PASSAGE PROJECT

Environmental Assessment

Prepared for the Northwest Regional Office of the Bureau of Indian Affairs

on behalf of the United States Department of the Interior

April 27, 2005

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The Bureau of Indian Affairs (BIA) has developed this Environmental Assessment (EA) for the Chiloquin Dam Fish Passage Project. Chiloquin Dam is located on the Sprague River about 30 miles north of Klamath Falls, Oregon. The dam is a major barrier that restricts the endangered Lost River and shortnose suckers from reaching their historical spawning and rearing grounds in the Sprague River Watershed. The EA will be available for a 30-day public comment period beginning April 27, 2005. Written comments regarding the EA will be accepted at: Bureau of Indian Affairs, 911 NE 11th Avenue, Portland, Oregon, 97232 – Attention, June Boynton, Environmental Protection Specialist. Or you may contact Ms. Boynton at 503-231-6749.

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List of Acronyms and Abbreviations

BIA	Bureau of Indian Affairs
BMP	best management practice
BP	before present
CEQ	Council on Environmental Quality
cfs	cubic feet per second
DO	dissolved oxygen
DSL	Department of State Lands
EA	environmental assessment
EIS	environmental impact statement
EJ	environmental justice
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
fps	feet per second
FWS	U.S. Fish and Wildlife Service
gpm	gallons per minute
hp	horsepower
kW	kilowatt
KWUA	Klamath Water Users Association
mg/L	milligrams per liter
MPID	Modoc Point Irrigation District
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
Reclamation	U.S. Bureau of Reclamation
RM	river mile
SHPO	State Historic Preservation Office
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

1.0 INTRODUCTION

This environmental assessment (EA) evaluates the impacts of alternatives designed to improve fish passage at Chiloquin Dam on the Sprague River in south-central Oregon. Congress provided funding to the Bureau of Indian Affairs (BIA) to study alternatives, including the removal of Chiloquin Dam, that would provide adequate upstream and downstream passage for fish (particularly the endangered shortnose and Lost River suckers) on the Sprague River. In this EA, the removal of Chiloquin Dam is considered to be the proposed action. This EA assesses the potential impacts to the environment of the proposed action and of other alternatives to providing fish passage. It also evaluates the impacts that would occur if no action was taken and the dam was not removed; this alternative is referred to as the No Action Alternative.

Chiloquin Dam is located near the City of Chiloquin in Klamath County, south-central Oregon, approximately 30 miles north of Klamath Falls (Figure 1-1). The dam is at River Mile (RM) 0.87 on the Sprague River, a short distance upstream from its confluence with the Williamson River, approximately 10 miles before entering Upper Klamath Lake.

The dam was built by the United States Indian Service in 1914 as an irrigation diversion dam. Ownership of the dam was transferred to the Modoc Point Irrigation District (MPID) through the Klamath Termination Act of 1954. Congress recognized that there is inadequate fish passage at Chiloquin Dam. Section 10905 of the Farm Security and Rural Investment Act of 2002 (7 USC §§ 7901 et seq.) (P.L. 107-171) authorized the Secretary of the Interior, in collaboration with the MPID, Klamath Tribes, Oregon Department of Fish and Wildlife (ODFW), and other interested parties, to study providing adequate upstream and downstream passage for fish at Chiloquin Dam. The U.S. Bureau of Reclamation (Reclamation) completed the first phase of the Chiloquin Dam Fish Passage Appraisal Study in 2003 (Reclamation 2003). BIA and Reclamation continued to refine these alternatives during phase two in 2004, to complete the study. The action alternatives analyzed in this EA—Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal—are consistent with the alternatives analyzed in phase one of the study. The alternatives identified in phase one of the study that were not analyzed in this EA include a new, smaller diversion dam at an upstream site, an infiltration gallery, and groundwater development. These three alternatives were eliminated because of cultural resource, cost, and sedimentation concerns.

BIA is preparing this EA in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. §§ 4321 et seq.), as amended, and associated implementing regulations. The purpose of the EA is to describe the environmental consequences of removing Chiloquin Dam. The EA will be used to determine whether to prepare a Finding of No Significant Impact (FONSI) or an environmental impact statement (EIS). If the EA shows that the removal would not have a significant impact on the human and natural environment, a FONSI will be prepared. If the EA indicates that the proposed action constitutes a major federal action significantly affecting the quality of the human and/or natural environment, then a Notice of Intent to prepare a draft EIS will be published in the *Federal Register*.

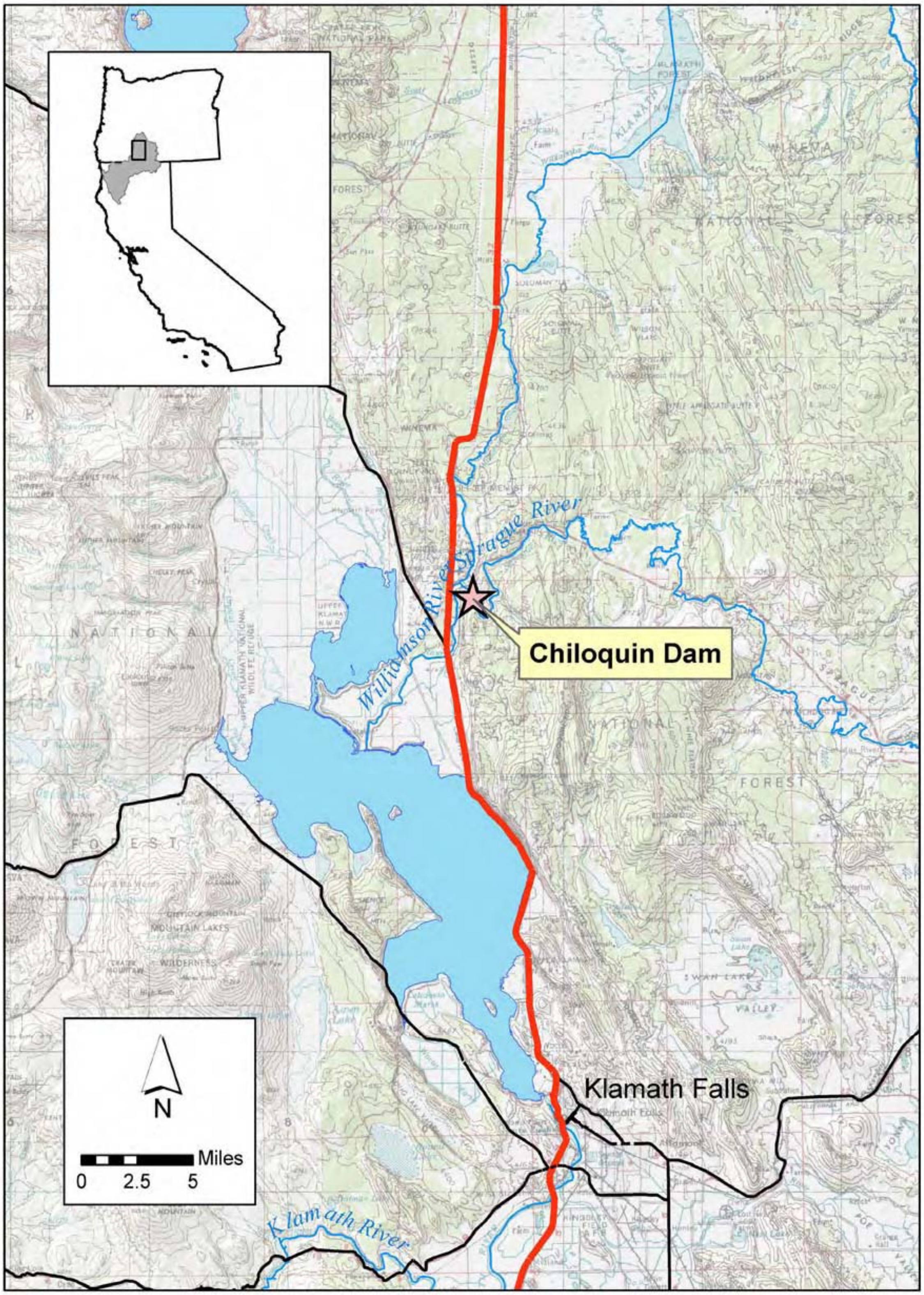


Figure 1-1. Location of Chiloquin Dam on the Sprague River, Oregon

1.1 Purpose and Need for the Project

The purpose of the project is to improve fish passage at Chiloquin Dam on the Sprague River and contribute to recovery of endangered shortnose and Lost River suckers while continuing to deliver water to the MPID.

In October 2003, the National Research Council committee on endangered and threatened fishes in the Klamath Basin recommended the removal of Chiloquin Dam to increase the extent of spawning habitat in the upper Sprague River and expand the range of sucker larvae in Upper Klamath Lake and the conditions under which larvae enter the lake.

The U. S. Congress, BIA, U.S. Fish and Wildlife Service (FWS), ODFW, Klamath Tribes, and local stakeholders recognize Chiloquin Dam is a partial barrier for upstream migration to approximately 80 miles of habitat for the endangered shortnose and Lost River suckers, and other species, upstream from the dam in the Sprague River . The dam is an especially serious impediment during low water periods.

Improved passage would benefit both species of endangered sucker and aid in their recovery, but the extent of benefits would likely depend on the quality and quantity of upstream spawning habitat. BIA believes improved fish passage at Chiloquin Dam will be instrumental in taking full advantage of the benefits of upstream habitat restoration that may occur over time.

2.0 PROPOSED ACTION AND ALTERNATIVES

This section describes the No Action Alternative and three action alternatives for improving fish passage at Chiloquin Dam: the Dam Removal Alternative (the proposed action), the Dam Retention With Fish Passage Improvements Alternative, and the Partial Dam Removal Alternative. The proposed action is to remove Chiloquin Dam and construct pumping facilities on the Williamson and Sprague Rivers to allow for water delivery to the MPID.

2.1 No Action Alternative

Under the No Action Alternative, no efforts would be undertaken to improve fish passage at Chiloquin Dam. The existing dam and structures would continue to be operated and maintained by the MPID. All irrigation district users would continue to use the current diversion point to receive irrigation water.

2.2 Dam Removal Alternative – Proposed Action

Under the Dam Removal Alternative, the entire Chiloquin Dam and all of its associated structures, including the fish ladders, water delivery measures, and the concrete structures, would be removed. This is a gravity diversion dam that supplies irrigation water to the MPID. If the dam is removed MPID would require an alternative method of water delivery to continue to meet irrigation demands and would incur new costs by switching from a gravity diversion source to new pumping plants. In order to carry out the proposed action a fund would be established to cover the increased electrical costs associated with pumping.

As part of this alternative, the existing Williamson River Pumping Plant on Highway 97 would be upgraded or a new pumping plant would be constructed to supply irrigation water to the MPID. Either pumping plant option would require a fish screen at the intake to prevent fish entrainment. A new pumping plant would also require a pipeline to route water into the Main Canal to supply the MPID. MPID's upper Main Canal would be abandoned and would no longer be available to deliver water to the two MPID water users located between Chiloquin Dam and a new downstream pumping plant site. Both of the affected water users—Mr. and Mrs. Glen Kircher and the Lonesome Duck Resort (Mr. and Mrs. Steve Hilbert)—would require new water delivery systems. For ease of discussion in this document, the Lonesome Duck property has been divided into "upper," "middle" and "lower" sections. The lower section, formerly owned by Jeld Wen, would remain unchanged. The upper and middle sections would require new methods of routing water, and the turnouts for each would be modified.

2.2.1 Construction and Related Activities at the Dam Site

In order to remove the dam the reservoir may be drawn down below the dam crest elevation by releasing maximum quantities of water through the canal headworks and left sluiceway, which have a combined discharge capacity of over 200 cfs. If necessary, the MPID canal could be breached near existing concrete blocks to return the flow to the river channel below the dam site. The existing corrugated metal culvert would be removed from the canal to increase the discharge capacity. Some of the estimated 122 existing concrete blocks (each weighing over 3,000 pounds) along the MPID canal could be repositioned within the river channel to help divert the streamflow downstream of the demolition site, or additional concrete blocks or other barriers could be used. The concrete blocks used to divert flow will be returned to their original positions. Sandbags could be placed on the dam crest to provide further protection against overtopping if necessary.

The initial streamflow diversion described above would permit the removal of the right abutment fish ladder and the downstream portion of the center fish ladder in the dry area created with a cofferdam. A 100-foot-long temporary cofferdam, consisting of steel H-piles driven into the reservoir sediments and river alluvium as deep as possible, with timber planks installed between the H-piles, could be used to remove water from the reservoir on the right half of the dam. This dry area would allow for removal of the right sluiceway and at least 50 linear feet of the dam down to the original bedrock surface. A controlled breach of the temporary cofferdam by selective removal of the timber planks, using a crane, would establish the streamflow through the dam breach and draw the reservoir level down below the existing sediment level at the dam. This would allow the removal of the left abutment structures consisting of the canal headworks and wingwalls, and the left sluiceway and fish ladder. The timber support towers and footbridge remnants would also be removed. Finally, the remaining portions of the dam and center fish ladder would be removed. A second temporary cofferdam, also consisting of steel H-piles and timber planks, could be installed to allow for water removal of the center portion of the dam. Clean rockfill could be placed in the reservoir for equipment access and to supplement the temporary cofferdams as needed. The left abutment area would be reshaped to more natural looking contours.

Demolition of the concrete appurtenant structures could utilize a backhoe with a hydraulic hoe-ram and/or a bucket with hydraulic thumb. Demolition of the mass concrete dam could use conventional drill and blast methods, provided the use of explosives is approved for the site. The timber support towers could be pulled down for demolition. Removal of the dam and appurtenant structures would result in over 850 cy of concrete debris (including reinforcing bars), 3,000 pounds of structural steel (rail steel and I-beams), approximately 12,000 pounds of mechanical items, over 6 tons of timber, and 110 linear feet of chain link fencing. Waste concrete would be buried within the MPID canal within 1,000 feet downstream of the dam site. Approximately 2,000 cubic yards of embankment materials would be removed from the left abutment and would be available for use as canal backfill. Other waste materials would be removed from the site.

Demolition activities at the dam site would involve the operation of heavy construction equipment and power generators, and could occur during evening hours. These activities would generate noise, and after-hours work would require the use of artificial lighting. Excavated materials from the right abutment may be hauled in end-dump trucks downstream and across the Kircher’s bridge for disposal within the MPID canal on the left abutment. Construction access roads would likely be established on both sides of the river channel.

Most of the direct construction activity would occur west of the dam. Because the Main Canal would be approved as a disposal site for concrete and steel rubble from dam removal, access to the east side of the dam would be limited, and contractor staging areas would be located on the west side. Some, and possibly most, of the concrete removal would occur downstream of the dam. Heavy equipment would need access along the shallow river bed, and temporary roadways may be constructed.

A fenced staging area would enclose an office trailer and equipment storage area; this area would likely cover one-third of an acre. Possible staging area locations include (1) an area west of the dam on U.S. Forest Service (USFS) property; (2) an area near or adjacent to the Main Canal, on the Kircher property; and (3) an area southwest of the high school football field, on Klamath County School and Klamath County property. A temporary stockpile site would also be required to transfer cofferdam and road materials from larger trucks to smaller trucks. The stockpile site would require about three-fourths of an acre. The only stockpile site identified to date is the site southwest of the high school football field.

The dam would be removed beginning in July 2006, with removal completed in January 2007.

2.2.2 Upper Canal Abandonment

At completion of dam removal MPID would abandon and transfer easement rights for the upper canal to the owners of the land upon which the canal is located. The abandoned canal may be left undisturbed or could be backfilled subject to the landowner's wishes.

The entire length of canal running through the Kircher property, with the exception of the irrigated portion, may be used to dispose of materials from the demolished Chiloquin Dam, backfilled, and reseeded. About 1000 feet of canal length would be needed for material disposal. The section of canal located on irrigated farm land would be backfilled with topsoil and reseeded and not used for material disposal. A fence would be constructed to contain animals that were formerly restrained by the canal.

The canal located on USFS land and Hilbert land may be left undisturbed, or backfilled in part or completely based on agreements between MPID and the landowners. Landowners may wish to maintain access currently provided by the canal bank. If the canal is backfilled, the existing banks will be used as fill.

2.2.3 Water Delivery Options

The Chiloquin Dam was originally constructed to create a point of diversion for the Modoc Point Project by the United States Indian Service. Currently, the Dam provides a point of diversion for the MPID Main Canal. The MPID Main Canal begins at Chiloquin Dam in Section 3 (section in this context refers to the Township and Range system of land surveying), and runs roughly parallel to the Sprague and Williamson Rivers to the northeast corner of the main MPID lands in Section 21. Water is delivered down the Main Canal by gravity. In addition to water delivered to the MPID lands in and south of Section 21, there are three points along the canal where MPID delivers water by gravity to small parcels between the Dam and the main MPID lands. Removal of the Dam will eliminate the MPID point of diversion and gravity operation of the canal. MPID and displaced water users along and below the canal must convert from the current gravity delivery system to an alternate pumping system at new downstream points of diversion. The change from the Dam point of diversion to the new points of diversion will be enabled by the Oregon Water Resources Department's documentation in the records of the Klamath Basin Adjudication. The MPID point of delivery at the Dam will be changed to the following four new points of diversion: a pumping plant on the Williamson River, two small pumping stations on the Williamson River for the Lonesome Duck Resort property, and a small pump station on the Sprague River to serve the Kircher property.

The water delivery options considered under the Dam Removal Alternative would be to upgrade the existing Highway 97 pumping plant on the Williamson River or to construct a new pumping plant at one of two nearby locations on the river. A new pumping plant would also require a pipeline to route water into the Main Canal to supply the MPID. Under each of the pumping plant options, BIA would construct a state-of-the-art fish screen on the pump intake to reduce entrainment of endangered shortnose and Lost River suckers and native fish resources, consistent with current federal and state fish screen criteria.

Figure 2-1 shows the barn-like design for a new pumping plant structure. Figure 2-2 shows locations of the three pumping plant options. Figure 2-3 shows the locations of all facilities required for the proposed pumping plant, including access roads, pipelines, and staging areas.

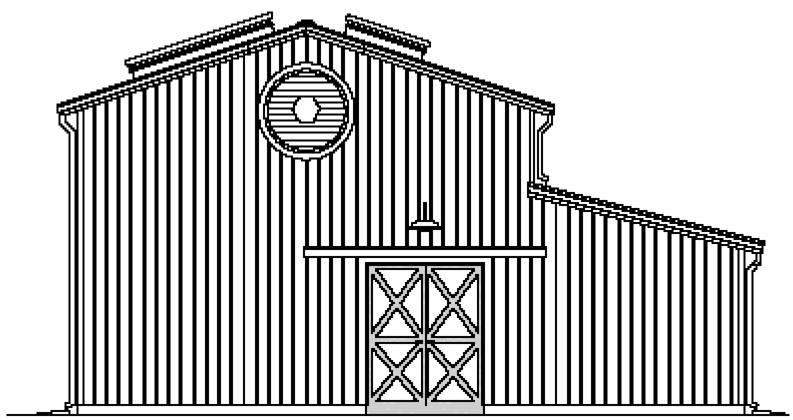


Figure 2-1. Elevation of Proposed Pumping Plant Structure

Construction or upgrade of a pumping plant would likely begin in August 2005 and could take up to 1 year to complete.

2.2.3.1 Existing Pumping Plant Station on the Williamson River

The existing pumping plant was constructed in 1957 on the Williamson River, approximately 100 yards downstream of the Highway 97 Bridge in south-central Oregon near the town of Chiloquin. It was constructed primarily to provide supplementary water deliveries to MPID. The plant contains two Fairbanks-Morse propeller pumps with a 40-cubic-foot-per-second (cfs) per-pump capacity to deliver 80 cfs of water to the MPID Main Canal. While the pumps have been previously tested, the pumping plant has never been used and the intake does not have fish screens to prevent entrainment.

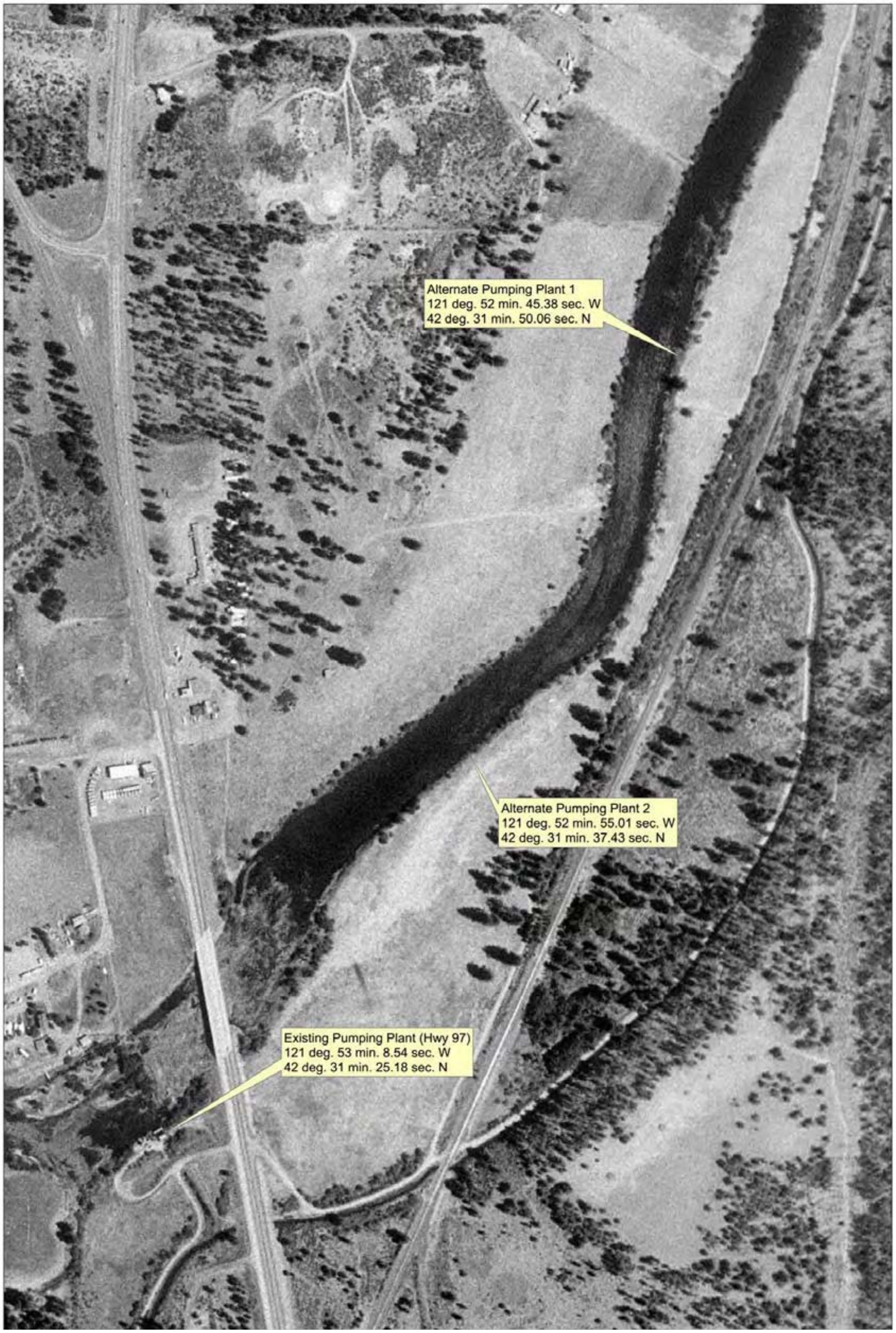


Figure 2-2. Alternative Pumping Plant Locations

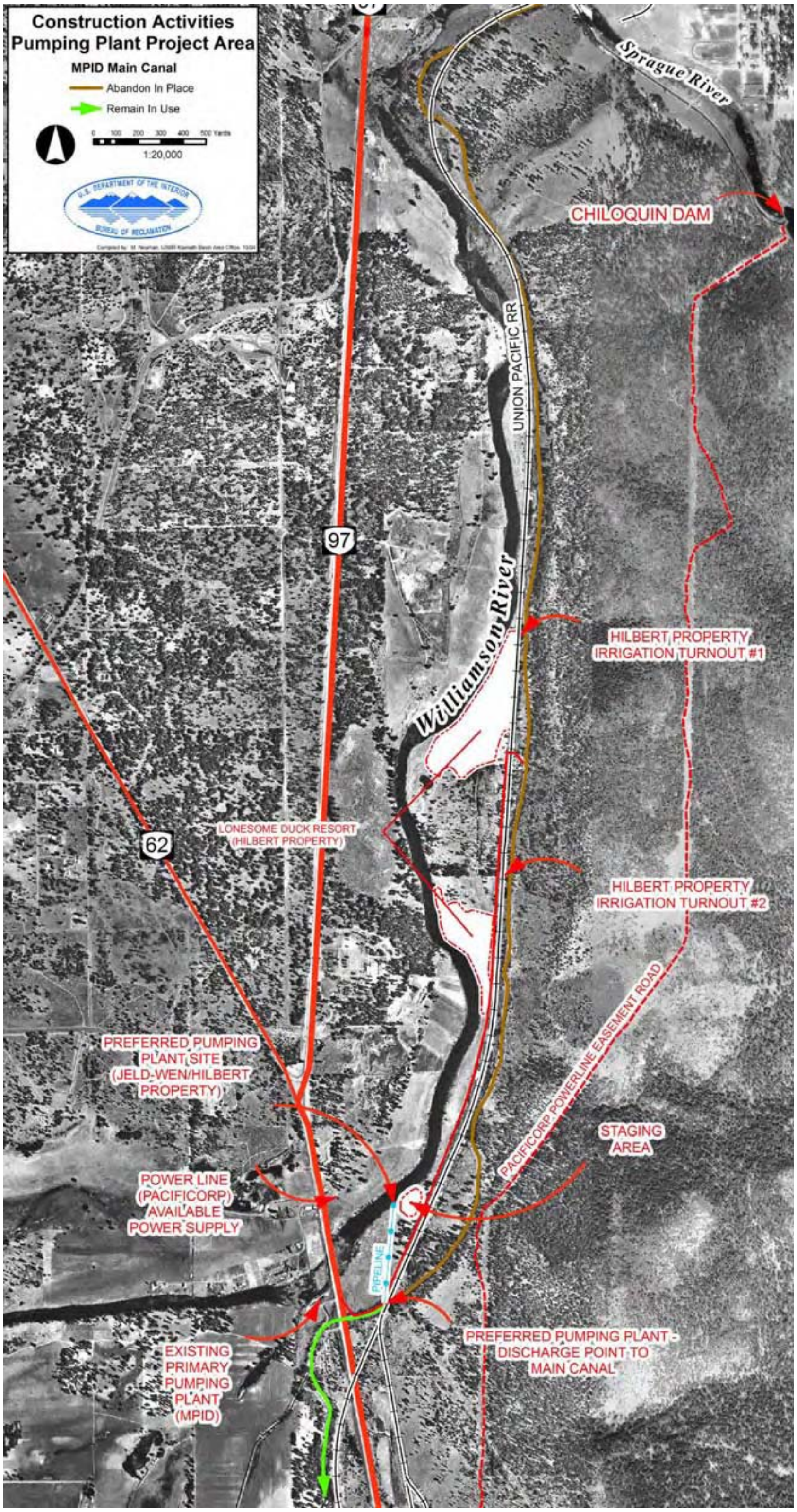


Figure 2-3. Facilities Required for the Proposed Pumping Plant Options

If fish screens could successfully be installed at the existing pumping plant, it could be operated and maintained. If the plant became operational, the two upstream water users – Kircher and Lonesome Duck – would receive water from pumping stations as described in Sections 2.2.3.3 and 2.2.3.4.

2.2.3.2 Proposed New Pumping Plant and Pump Configuration (PP 2)

The proposed pumping plant would be located approximately one-quarter of a mile upstream from the Highway 97 Bridge over the Williamson River. The work site for the alternate pumping plant and the access road would be located totally within the Lonesome Duck Resort property. The pumping plant would be a multi-unit arrangement utilizing three axial flow pumps with electric motors. The pumping plant substructure would be a deep concrete sump attached to a fish screen structure. The pumping plant superstructure would be a steel structure resembling a barn. The building would muffle equipment noise and would protect the interior components from dust, wind, and weather. The pumping plant would include about 1,400 linear feet of 42-inch-diameter discharge pipe; this pipe would be buried to an average depth that would provide 3 feet of earth cover over the top of the pipe.

The overall site dimensions of the pumping plant and fish screen area would be approximately 130 feet wide by 250 feet long. An all-weather gravel surfaced road would be constructed to provide access to the pumping plant from the main access road; this roadway would be about 14 feet wide by 430 feet long. The plant is designed to be capable of meeting its demands throughout a range of expected possible river stages. The flow velocity in the fish screen structure reservoir would be low, and most suspended particles in the water would settle out before entering the pumping plant sump. The pumping plant sump would be capable of being dewatered for cleaning and maintenance.

The plant equipment would be arranged to allow for safety clearances and access for maintenance and repair. Hatches on the superstructure would allow MPID to access the pump units and motors using a mobile crane. The hydraulic design of the sump pump and intake would, to the maximum extent possible, direct water to the pumps in a uniform, steady, single phase. Splitter walls would isolate each pump.

The new pumping plant would consist of three vertical turbine below-deck discharge pumps. The rated head (minimum) flow for the individual pumps would be two units each at 35 cfs and one unit at 2 cfs.

The two 35-cfs pumps would be utilized during the irrigation season. One of these pumps would be equipped with a variable-speed motor in order to better meet lower diversion demands more efficiently. The 2-cfs proposed pump would be designed to operate alone during the winter months, to provide for winter flow requirements in the MPID Main Canal.

Water would be delivered from the Williamson River to the pumping plant through a fish screen structure. The fish screens would meet current federal and state criteria and would protect juvenile, sub-adult, and adult species of sucker, redband trout, and other native species from the effects of impingement and entrainment. The fish screens are designed to have an approach velocity of 0.2 feet per second (fps) perpendicular to the face of the screens over the gross area of the screen face. The velocity component parallel to the face of the screens would be at least twice the perpendicular component.

The fish screens are designed to provide the level of protection described above to a maximum pumping flow of 70 cfs. The screen panels would consist of profile wire bars of stainless steel, with a mesh-size opening of 1.75 millimeters. The screens would be completely submerged under all flow conditions. To achieve full-time submergence while minimizing structure excavation, the screens would be oriented at 30 degrees from the horizontal. The screens would be cleaned using an air-burst system located beneath the screens; this system could be operated manually, remotely with timers, or whenever head loss was detected across the screen face. Debris dislodged by the air burst would be carried away by the streamflow. If the head loss became so great that the structural integrity of the screens was threatened (i.e., total blockage of the screens), pumps would automatically shut down to equalize the head across the screens and permit cleaning. Adjustable baffles behind the face of the screens would equalize the velocity distribution through the screens.

Concrete retaining walls would be constructed at each end of the fish screen structure to direct approaching streamflow nearly parallel to the screens. Directing flow in this manner would help divert fish back into the main stream flow away from the screens and riverbank. The retaining walls would be visible above water level. Below water level, riprap will be present.

The primary route to the site is from Highway 97. The only access road from Highway 97 to the work sites and the rest of the property is the Lonesome Duck Resort access road. This road is narrow but has adequate room and surface conditions to serve as an access and haul road for all work items needed at this site. This road leads up to within 430 feet of the proposed pumping plant site. For the remainder of the distance, the contractor would need to prepare a roadway across an existing grass field; this would be converted into a permanent roadway at the completion of construction.

Construction of the pumping plant will require that a cofferdam be placed in the Williamson River for up to one year. As discussed in section 7.2, BIA will be required to obtain an in-river work extension from the ODFW to allow construction to occur beyond the normal in-river work period. The normal in-river work period for the Williamson and Sprague Rivers is July through September.

2.2.3.3 Possible Alternate Pumping Plant on Upper Lonesome Duck Resort Property (PP 1)

An option was considered to locate a new alternate pumping plant on the Williamson River approximately one-half mile upstream of the Highway 97 Bridge. This proposed site is located on the Lonesome Duck property on a relatively straight reach of the Williamson River. The new pumping plant and discharge pipe would be constructed to deliver up to 70 cfs during the summer irrigation season and 2 cfs during the winter stock watering period. The discharge pipeline would be an about 400 linear-foot, 54-inch pressurized pipe that would pass directly under the Union Pacific railroad track and right-of-way, parallel to the Main Canal. Union Pacific would have to issue a permit to allow the pipeline to be constructed by boring under the tracks. BIA also investigated the option to convey the pipeline through existing culverts in the railroad embankment; however, Union Pacific indicated this would not be permitted due to concerns about drainage and runoff from hillsides adjacent to the railroad line.

Design and construction of the pumping plant and the need for an access road at this alternative site would be similar to the proposed pumping plant configuration.

2.2.3.4 Preferred Pumping Plant Site Selection

A comparative analysis of the proposed pumping plant sites was performed to determine the effects of operations at alternative pumping plant locations on endangered suckers. The primary purpose of the analysis was to determine entrainment risks at the alternate pumping plant locations and to determine the best site to minimize risks to endangered suckers during their annual out-migration from the Sprague River back to Upper Klamath Lake.

Suckers drift down the Sprague and Williamson Rivers after emerging from spawning beds at a very small size (10-20 millimeters); therefore, this early life history stage is potentially subjected to the greatest risk of entrainment even when appropriately designed fish screens are in place. Fish screens for the proposed pumping plant are being designed to meet Federal and State anadromous fish criteria to protect juvenile fish greater than 30 mm in size. It is accepted that anadromous fish screen criteria provides adequate protection for all life stages of sucker except the smallest larval size. Consequently, larval suckers 10-22 mm in size could be entrained through fish screen mesh openings; therefore, if hydraulic characteristics at a particular site increase the amount of time that larval suckers may be exposed to the screen surface, then entrainment could occur when a fish screen is present on the pumping plant intake system.

Larval suckers have limited swimming motility; after egg emergence, they drift with the stream flow out of tributaries into Upper Klamath Lake during spring and early summer. Larval sucker drift generally occurs from April through mid-July (Buettner and Scoppettone 1990, as cited in Reclamation 2003; Klamath Tribes 1996, as cited in FWS 2002; Cooperman and Markle 2003, as cited in Reclamation 2003). Larval drift peaks in the Sprague and Williamson Rivers from May to mid-June. Larval drift occurs mainly at night and larvae move to the margins of the river during the high (studied in April 2004) and low (studied in July 2004) flow periods at Pumping Plant 1 (PP 1) and at the existing pumping plant site to address the hydraulics and velocity fields (i.e., direction of flow in relation to the channel morphology) of the river and to help assess the relative entrainment risks of pumping (Reclamation 2004a; see Appendix A). USGS Western Fisheries Research Center (Klamath Falls Field Station) assessed the spatial distribution of larval drift across the river cross-section and diel patterns of larval drift at two pumping plant sites (the existing site and PP 1) in spring 2004 (USGS 2004; see Appendix B).

Reclamation's hydrographic survey data (Appendix A) showed different flow and velocity characteristics at the existing pumping plant compared to the two optional upstream alternate pumping plant sites (PP 1 and PP 2). During high flow conditions, two problems were identified.

First, scour holes upstream of the existing pumping plant site direct flow toward the pumping plant and depth-averaged velocity vectors are directed toward the trashracks on the intake.

Second, USGS preliminary survey results (Appendix B) indicate that a high percentage of sucker larvae drifted at night and early morning hours near the surface at mid-channel for both the existing and proposed PP 1. However, during night-time hours, catches of larval suckers in nets sampling near the river bottom at the existing pump site were approximately 2 to 4 times greater than in comparable nets at the proposed upstream PP 1. This trend was most noticeable in the river-section station on the west side of the channel closest to the intake at the existing Highway 97 pumping plant. Furthermore, the existing pump site had overall higher catches than the proposed PP 1 presumably because of hydraulic conditions or because additional larvae may recruit to the drift between sites. During the early morning hours, larval sucker drift appears to have a prolonged duration at the existing pump site in contrast to the proposed alternative pump site, where a shift was observed to higher catches in net sampling near the river bottom and toward the east channel of the river farthest from the pump intake location.

Velocity vectors have a very uniform magnitude (laminar characteristic) throughout the PP 1 reach and there is little difference in magnitude or direction in surface and depth-averaged velocities. During low flow conditions, the PP 2 site had similar velocity magnitudes near the left bank as compared to those collected at the upstream site (PP 1). Reclamation concluded that based upon the similarity of low-flow hydraulics and geomorphology of the two alternate pumping plant sites (PPs 1 and 2), it is reasonable to expect that the two sites would have similar hydraulic properties during high flow conditions on the Williamson River.

USGS conclusions, based on data from the PP 1 site, regarding larval drift using the surface and mid-channel during the night can be extrapolated to the slightly downstream PP 2 site, as well. Hydraulic properties at PP 1 and PP 2 locations are virtually identical; therefore, larval drift patterns can be expected to be very similar in terms of spatial and diel patterns. On this basis, PP 2 was selected as the preferred pumping plant location because (1) fish entrainment risks appear to be minimized compared to the existing pumping plant site, (2) the discharge pipeline could be routed to the Main Canal without having to bore under the Union Pacific railroad line, and (3) this site was most cost-effective based upon engineering considerations and potentially lengthy permitting issues if boring under the railroad was the only viable option.

2.2.4 Irrigation Delivery Pumping Stations and Systems for Affected Water Users

The abandonment of MPID's upper Main Canal would result in the loss of the ability to deliver irrigation water to three parcels of land. All three parcels would require new water delivery systems. One parcel is the Kircher property; the other parcels are part of the Lonesome Duck Resort. As mentioned previously, the Lonesome Duck property has been divided into upper, middle and lower sections. The lower section would remain unchanged. The upper and middle sections would require new methods of routing water, and the turnouts for each would be modified.

2.2.4.1 Kircher Property

The proposed pumping and distribution system for the Kircher property (Figure 2-4) would deliver irrigation water to the property after the upper Main Canal was abandoned. The irrigable land at the main site is about 12.4 acres and is about one-half mile downstream from the dam. The system would consist mainly of a frame-mounted, prefabricated, self-contained, small horsepower (hp) pumping station, with a distribution pipeline running generally southeast

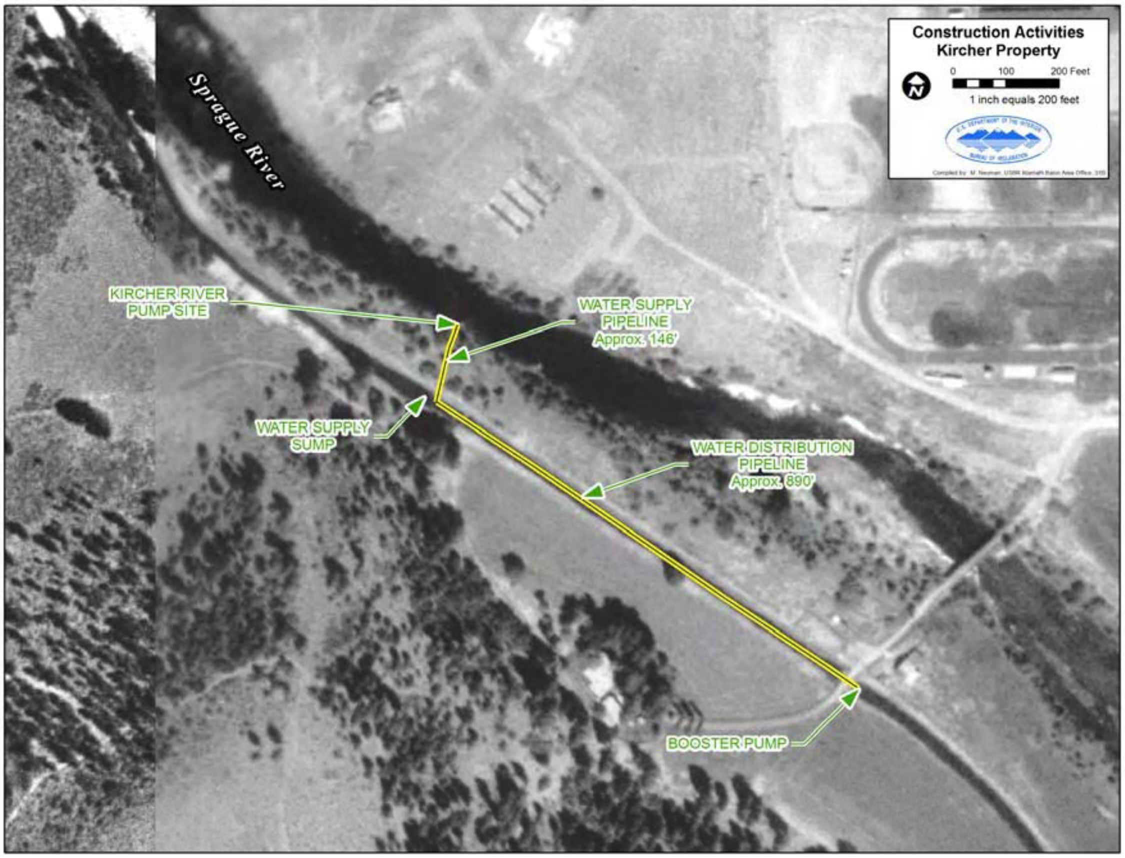


Figure 2-4. Pumping Station and Water Distribution System, Kircher Property

through the existing Main Canal. The new concrete intake sump would have an approved fish screen at the entrance that would be placed in the Sprague River. The pumping station would be capable of delivering about 400 gallons per minute (gpm) to the discharge sump.

The proposed pumping station, with the associated controls, piping, concrete sump, and screened intake, would be placed adjacent to the river at the westernmost end of the mainland site, next to the existing canal fish screen outfall structure. The pump intake would be fitted with a prefabricated, self-cleaning, cylindrical fish screen; the screen size would meet state and federal regulatory requirements.

The ODFW currently operates and maintains a roller drum fish screen in the Main Canal at the location of the proposed Kircher property pump station. The fish screen components in the Main Canal would be removed and the fish screen concrete box would be retrofitted to serve as a discharge sump for the pumping station. To serve the Kircher property, a pipeline would be installed in the existing canal and would run approximately 890 feet upstream (easterly) to the existing booster pump, located adjacent to the main access road to the Kircher property. This pipeline would be placed in the existing canal, along with the pumping station power supply line, before the canal was backfilled. Power would be supplied from the existing powerline next to the main access road.

Installation of a water delivery streamside pump would require a temporary access route, about 18 feet wide by 200 feet long. This route would extend from the river's edge and through the Kircher property.

2.2.4.2 Lonesome Duck Resort

The preferred approach for providing irrigation water to the Lonesome Duck Resort would be basically the same as the system for the Kircher property. However, in this case, two small-capacity riverside pumping stations would be installed on the Williamson River to deliver irrigation water to the resort's upper and middle pasture lands, respectively (see Figure 2-5). The proposed pumping stations, with the associated controls, piping, concrete sump, and screened intake, would be placed adjacent to the river The pumps' intakes would be fitted with a prefabricated, self-cleaning, cylindrical fish screen; the screen size would meet state and federal criteria.

The pumping station and water distribution system proposed for both sites (upper and middle pasture areas) would consist mainly of two frame-mounted prefabricated, self-contained, small pumping stations, with a distribution pipeline running to the existing Turnouts 1 and 2. The new concrete intake sump would have an approved fish screen at the entrance that would be placed in the Williamson River. The pumping station would be capable of delivering about 700 gpm at both sites. The pumping station will require a pipeline. The location of the pipeline will be negotiated with the landowner and may be buried in a trench or could run on the ground surface from the pumping stations to Turnout 1 (130 feet) and Turnout 2 (880 feet).

Installation of small-capacity pumping stations would require a temporary access route about 18 feet wide. This route would run from the river to Turnouts 1 and 2. The upper site would require about an additional 2,000 feet of light-duty access in order to transport equipment and materials around the upper pasture. No additional construction staging area would be needed for this work.

The power required to operate a pumping station at either the upper or middle site would be about 2.5 kilowatts (kW) single-phase. For the middle site, power to operate a pumping station is currently available nearby. The upper site would require that a powerline be extended from the opposite side of the river, about 800 feet away. The powerline could either be suspended overhead or extended under the river through directional boring. The powerline extension work would be conducted by PacifiCorp.

2.3 Dam Retention With Fish Passage Improvements Alternative

The Dam Retention With Fish Passage Improvements Alternative involves replacing the existing fish screen with a new, upgraded fish screen structure in the MPID Main Canal. In addition, either two new fish ladders at Chiloquin Dam or a natural rapids structure below Chiloquin Dam would be constructed.

The natural rapids structure would involve constructing a new 750-foot river channel downstream of the dam made of riprap. This would be constructed in a manner to allow fish to migrate past the dam, while still maintaining the gravity diversion at the dam. This type of

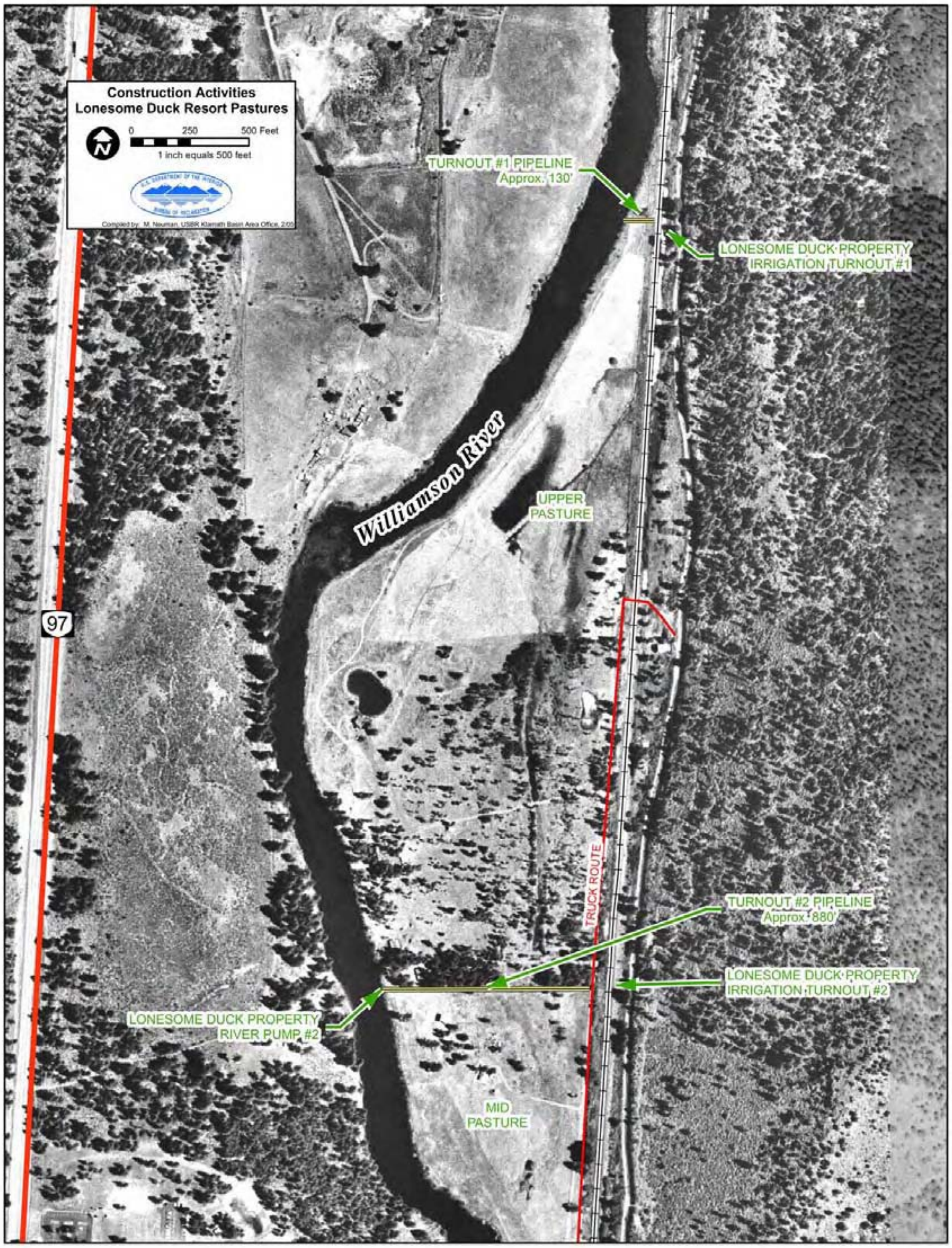


Figure 2-5. Pumping Station and Water Distribution System, Concept 2, Lonesome Duck Property

natural riffle design has not been proven with the shortnose and Lost River suckers found in the Chiloquin area, but would be similar to a design developed to allow the passage of a similar species, the razorback sucker, past diversion dams of a similar size (Reclamation 2003).

The new upgraded fish screen structure that would be placed in the Main Canal would be conceptually identical to the screen for the pumping plants described in Section 2.2. In this case, the fish screen would be a vertical flat plate designed for a maximum diversion flow of 60 cfs, based on a minimum water depth at the screen face of 2.5 feet. The screens would be designed to operate at a canal water depth of 5 feet, which is the approximate height of the canal bank. At this height, the screens would not become plugged and be overtopped, so fish would not pass the screen structure. A bypass system would also be constructed; it would consist of an 18-inch pipe leading back to the Sprague River. It is assumed that the pipe would be placed in the water at a point where the water depth and velocity would deter predators. The pipe would be designed for a velocity of approximately 5 fps (Reclamation 2003).

2.4 Partial Dam Removal Alternative

The Partial Dam Removal Alternative consists of two options: (1) installing a series of three steel radial gates with hoists, or (2) installing a single Obermeyer crest gate with inflatable bladders. Each option assumes a gate impoundment height of 8 feet and a total crest length of 150 feet. This gated or adjustable crest would allow the reservoir level to be lowered during critical migration periods, from March 1 through June 1. To address the 1-month time period during which both fish migration and irrigation diversion releases could be required (May 1 through June 1), the existing fish ladder would be upgraded to meet federal and state fish passage standards. The fish screen in the Main Canal would also be replaced with a new, upgraded screen as described for the Dam Retention with Fish Passage Improvements Alternative (Section 2.3).

2.5 Comparison of Alternatives

Table 2-1 compares the primary features of the three action alternatives, including their approximate preliminary appraisal cost estimates from phase one of the study (Reclamation 2003).

Preliminary March 2003 cost estimates of the project alternatives were used to evaluate alternatives and screen costs. During development at the appraisal level (phase one), the design effort was consistent across all alternatives. As the project developed, the preferred alternative designs were further refined as more design information was obtained. Additional feasibility level design updated estimates of the preferred plan. As a result, the current cost estimate for the preferred plan substantially increased. The refined and updated field cost estimate associated with the preferred alternative, dam removal, is approximately $7,200,000.

The increase in the current cost estimate for dam removal has raised concerns regarding the validity of the cost estimates from the appraisal level screening process. The original appraisal-level cost screening process remains valid for the purpose of comparing alternatives. In reviewing the alternative fish ladder options, it is believed a commensurate level of design on the other alternatives would have resulted in similar cost increases. This judgment is based upon comparison of costs associated with fish ladder construction at other sites. Although the absolute value of the estimate has been further refined for the proposed action, the results of the initial screening process allows for a relative comparison of all the alternatives.

Table 2-1. Primary Features of the Action Alternatives

FEATURE	DAM REMOVAL		DAM RETENTION W/FISH PASSAGE IMPROVEMENTS		PARTIAL DAM REMOVAL	
	HWY 97 PUMP	NEW PUMP	NATURAL RAPIDS	TWO LADDERS	RADIAL GATES	CREST GATES
Water Delivery System	Upgrade existing pumping plant; supply water for two displaced MPID users	Construct new pumping plant; supply water for two displaced MPID users	Existing gravity diversion	Existing gravity diversion	Existing gravity diversion	Existing gravity diversion
Extent of Dam Removal	Complete	Complete	None	None	Partial	Partial
Sediment Management	Natural dispersal	Natural dispersal	Disposition in reservoir	Disposition in reservoir	Some natural disposition	Some natural disposition
Fish Screens	Pumping plants	Pumping plants	In Main Canal	In Main Canal	In Main Canal	In Main Canal
Fish Passage	Free-flowing river	Free-flowing river	Two ladders	Natural rapids structure	Radial gate; new east abutment fish ladder	Crest gate; new east abutment fish ladder
Capital Construction Costs	$1,770,000	$2,150,000	$2,030,000	$2,760,000	$2,830,000	$7,480,000
Pumping Costs, Annual	$50,000	$50,000	$0	$0	$0	$0

3.0 AFFECTED ENVIRONMENT

Chiloquin Dam (Figure 3-1) is located on the Sprague River near the City of Chiloquin in Klamath County, south-central Oregon, approximately 30 miles north of Klamath Falls. This section describes the affected environment in the Chiloquin Dam area.

Figure 3-1. Chiloquin Dam

3.1 Land Use

Land in the Upper Klamath Lake drainage is predominantly forest (69.5 percent) and shrubland/grassland (13.7 percent). Agriculture, including farming and grazing, comprises 5.5 percent of the land use types (Reclamation 2003). Chiloquin Dam is located on the Sprague River, a tributary of the Williamson River, which in turn flows into Upper Klamath Lake, the dominant water feature in the Upper Klamath Basin (Reclamation 2003).

The Sprague River is a source of recreation, including swimming and fishing. Klamath tribal members and others in the community of Chiloquin use the reservoir behind Chiloquin Dam for swimming and fishing, although BIA staff have observed that this area is used much less than other swimming areas on the Williamson River near the center of Chiloquin. During the summer, the area immediately upstream and downstream of the Williamson River Bridge in Chiloquin appears to be used nearly daily for swimming. Other areas that are used for swimming include the Sprague River below the Kirchers' bridge, and an area adjacent to the railroad bridge on the Sprague River above the confluence of the Williamson (approximately one-quarter of a mile and three-quarters of a mile below Chiloquin Dam, respectively).

Although some fishing occurs in the reservoir, the majority of fishing in the Chiloquin area appears to occur downstream of Chiloquin Dam. Popular spots include an area immediately below the dam and the pools between Kircher's bridge and the railroad bridge on the Sprague River (personal communication Joe Hobbs, Klamath Tribal Vice-Chair, 2004). Numerous pools between the confluence of the Sprague and Williamson Rivers and the Highway 97 Bridge are fished daily. Klamath County Park provides a public launch point for drift boats, kayaks, canoes, and rafts in Chiloquin on the Williamson River approximately one-quarter of a mile below the confluence of the Sprague River. Native trout weighing up to 10 to 15 pounds are caught in this reach.

Land ownership types within 500 meters of the project area are shown in Figure 3-2.

3.2 Water Quality: Geomorphology, Hydrology, and Sediment Transport

The drainage area of the watershed upstream of the Williamson River gauge is approximately 3,000 square miles, with 53 percent (1,580 square miles) of that area upstream of the Sprague River gauge. Thus, the Sprague River contributes about half of the surface water flow into the lower Williamson River and Upper Klamath Lake. The 1.5-year flood is estimated to be 1,370 cfs for the Sprague River and 2,040 cfs for the Williamson River downstream of the confluence with the Sprague River. Based on a study performed by USGS, the 100-year flood flow is 12,800 cfs for the period from 1921 through 1987. A December 1964 flood peaked at 14,000 cfs (Reclamation 2003). Stream flow generally ranges between 100 and 400 cfs during the July through November period, and mean annual discharge at Chiloquin Dam is estimated to be 588 cfs (Reclamation 2003).

Chiloquin Dam is located at RM 0.87 on the Sprague River. Near the upper end of the reservoir behind the dam, the Sprague River exits a bedrock canyon that extends another 10 miles upstream. The river channel through the bedrock canyon is steep, with a coarse channel-bed consisting of cobble and boulder.

The Sprague River from approximately RM 12.0 downstream to the confluence with the Williamson River is steep (approximately 0.0018 [slope values are dimensionless, with larger numbers representing steeper slopes]), with a relatively high sediment transport capacity. Downstream from this confluence, the Williamson River maintains a relatively steep slope of approximately 0.001 for 2 miles (i.e., from RM 11.0 to RM 9.0 on the Williamson River). The lowest reach of the Williamson River (RM 0.0 to RM 9.0) has a much lower slope of approximately 0.00004 (Reclamation 2003).

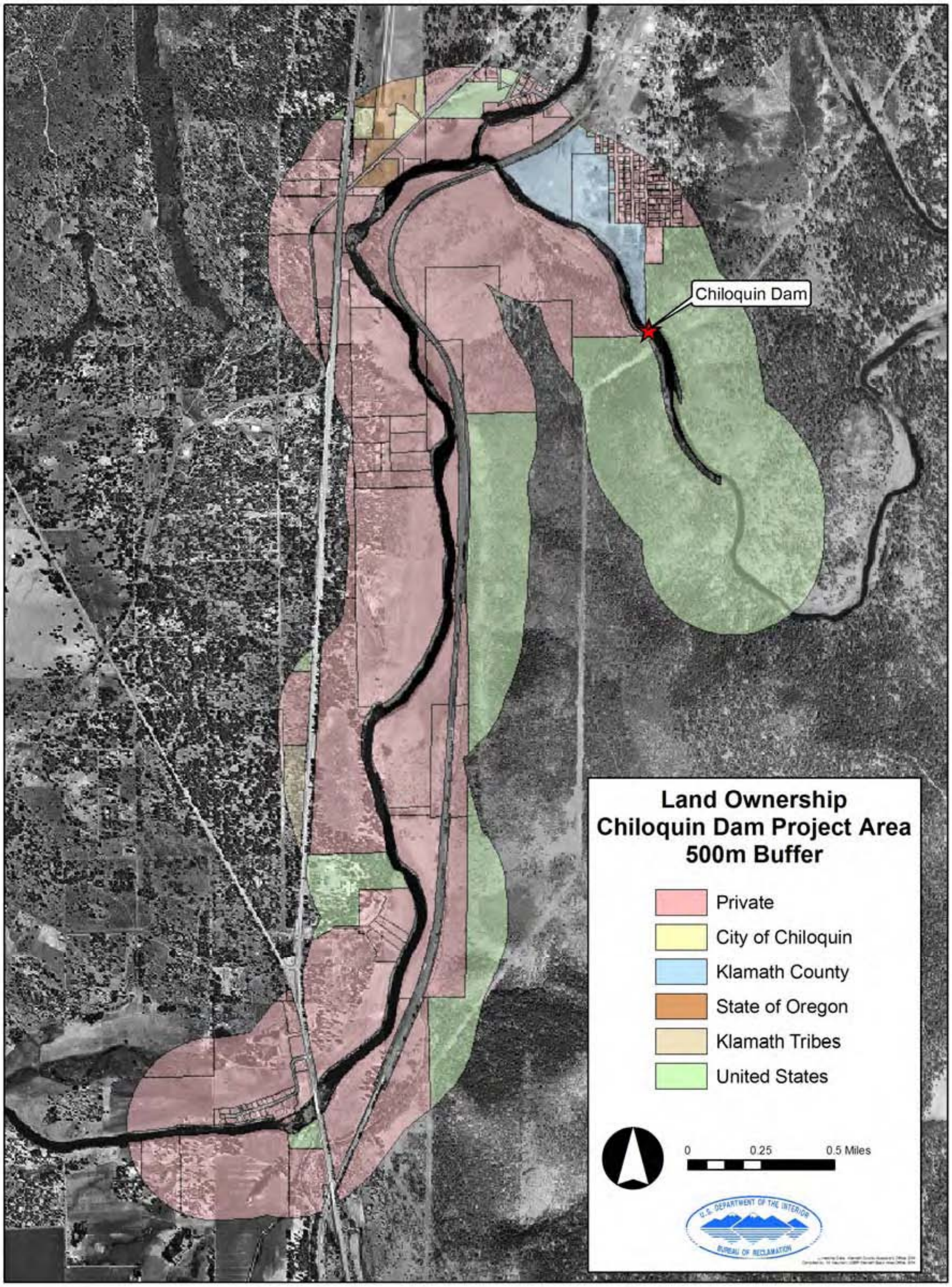


Figure 3-2. Land Ownership for the Chiloquin Dam Project Area

The reservoir behind the dam (Figure 3-3) extends upstream approximately 3,600 feet and contains a pool volume of approximately 60 acre-feet. Its sediment trap efficiency has been estimated to be near zero. The dam is operated as a run-of-the-river project, which does not have any capacity for attenuating flood flows. These characteristics suggest that newly introduced sediments of sand size and smaller are currently transported through the reservoir to the downstream river channels. In other words, the reservoir holds about as much sediment as it can, and newly arriving sediment is transported through the reservoir and on downstream.

Figure 3-3. Chiloquin Dam Reservoir

Sediments have accumulated in the reservoir, with the greatest amount of deposition occurring from the dam structure to a point upstream 1,600 feet. A segment of the reservoir extending from the dam upstream 900 feet has an average sediment depth of 5 feet, while the segment from 900 to 1,600 feet upstream has an average depth of 2 feet. Conservative estimates of the sediment volume in this 1,600-foot segment are 45,000 cubic yards (61,000 tons). Sediment accumulation along the reservoir margins and side channels are estimated to be an additional 45,000 cubic yards (61,000 tons). Cut logs and other woody debris are widely scattered throughout the reservoir sediment.

Sediment samples initially collected from the bed upstream from Chiloquin Dam were collected and analyzed for contaminants (Reclamation 2003, Attachment 6). Because contaminants are usually found in the fine fraction (silt and clay), the samples may have been biased toward smaller size fractions than what is actually in the reservoir. In order to more accurately quantify the size distribution of reservoir sediments, an additional 20 sediment samples were collected from the main channel area of the reservoir pool upstream from Chiloquin Dam in December 2004 (Reclamation 2004b).

The 20 sediment samples collected had median particle diameters ranging from silt (less than 0.0625 millimeter) to very coarse sand (1 to 2 millimeters). Considering that reservoir sediment deposits are generally between 2 and 5 feet thick, the samples collected from the surface are considered to be representative of the deeper reservoir sediment deposits.

All 20 bed material samples from the reservoir were averaged to create a composite particle size distribution. The composite sediment gradation was used to estimate sediment transport rates and reservoir sediment mass by size fraction. The mass of sediment behind Chiloquin Dam likely to be transported downstream was previously estimated to be between 49,000 and 61,000 tons. When the reservoir sediment is classified according to the composite size gradation, the amount of sediment in each size class can be estimated. Table 3-1 shows the mass of reservoir sediment in each size fraction. Between 19,000 and 24,000 tons of the reservoir sediment is estimated to be finer than sand (silt or clay size) and is expected to be transported downstream rapidly as part of the wash load. Approximately 5 tons of the reservoir sediment is coarser than sand (gravel size). The upper estimate of 61,000 total tons of reservoir sediment was used for all calculations in a subsequent sediment transport analysis (Reclamation 2005).

Table 3-1. Tons of Reservoir Sediment in the Active Channel by Size Fraction Based on Upper and Lower Volume Estimates

SIZE FRACTION	PERCENT IN SIZE CLASS	TONS OF RESERVOIR SEDIMENT, LOWER LIMIT (49,000 TONS)	TONS OF RESERVOIR SEDIMENT, UPPER LIMIT (61,000 TONS)
Fines (<0.0625 mm)	39.42	19,318	24,049
Very Fine Sand (0.0625 to 0.125 mm)	8.85	4,339	5,402
Fine Sand (0.125 to 0.25 mm)	9.98	4,890	6,088
Medium Sand (0.25 to 0.5 mm)	12.50	6,127	7,628
Coarse Sand (0.5 to 1.0 mm)	11.91	5,836	7,265
Very Coarse Sand (1.0 to 2.0 mm)	8.63	4,229	5,264
Very Fine Gravel (2.0 to 4.0 mm)	4.84	2,374	2,955
Fine Gravel (4.0 to 8.0 mm)	2.62	1,284	1,598
Medium Gravel (8 to 16 mm)	1.05	514	640
Coarse Gravel (16 to 32 mm)	0.18	88	110

Source: Reclamation 2005

Because the Sprague River watershed is a rural area lacking urban and industrial activities, it is believed to have few anthropogenic influences that would contaminate sediments entering the Chiloquin Dam reservoir. Naturally occurring constituents from the surrounding soil likely pose the greatest threat of contamination to sediments entering the reservoir. Analyses of the sediments that have accumulated in the Chiloquin Dam reservoir indicated that tests for all metals were below screening level criteria; tests for all chemicals analyzed were also below screening levels, although some results (organic compounds) were inconclusive due to laboratory reporting limits. Based on physical, chemical, and land use data, the sediments in Chiloquin Reservoir have been classified as suitable for unconfined aquatic disposal (Reclamation 2003, Attachment 6).

3.3 Ecology

The Sprague River is a tributary of the Williamson River, which in turn flows into Upper Klamath Lake, the dominant water feature in the Upper Klamath Basin (Reclamation 2003). Upper Klamath Lake is a high-desert lake in south-central Oregon located approximately 30 miles from the California state line. The Cascade Mountains are to the west and north of the lake. To the east and south is arid sagebrush steppe (NANFA 2004). The confluence of the Williamson and Sprague Rivers is about 10 miles above the lake; these two rivers are Upper Klamath Lake's greatest water source, contributing almost half of the lake's total annual water supply (NANFA 2004).

Upland habitat surrounding Chiloquin Dam consists mainly of ponderosa pine, big sage, and bitterbrush. The riparian zone near Chiloquin Dam is limited due to the Sprague River’s steep banks (Reclamation 2003). Willows, rushes, sedges, and grasses are scattered along the river’s banks. Cottonwoods and aspens are located in the banks below the dam.

Aquatic resources within the vicinity of Chiloquin Dam are associated with the Sprague River watershed. The current condition in the Sprague River watershed follows about 150 years of agricultural development and logging. Historical land use practices have altered the stream morphology and hydrology and decreased the amount of riparian vegetation in the drainage. The watershed’s degraded habitat condition is being addressed through a cooperative partnership among federal, state, county, local, and tribal governments.

The MPID currently diverts water from the Sprague River through the gravity flow headgates at Chiloquin Dam. Irrigation deliveries up to 60 cfs are normally made to the MPID canal from May 1 through September 30 of each year. The shortnose and Lost River suckers are known to spawn in the Sprague River system between March 1 and June 1 (Reclamation 2003). Currently, the dam has one functional fish ladder (Reclamation 2003). In 2000, USGS implemented a routine sampling program at this fish ladder to monitor the fish species composition, timing, and relative abundance during spawning runs. Data from these efforts and the routine capture of suckers in all cells of the ladder suggest that some fish are able to successfully negotiate the existing fish ladder. However, the efficiency of the ladder to pass fish at lower flows and the extent to which fish are able to find, enter, and negotiate the ladder are still largely unknown (USGS 2004).

Measured values in the Sprague River for water temperature, dissolved oxygen (DO), and pH do not always meet water quality standards set by the Oregon Department of Environmental Quality (ODEQ) (Reclamation 2003). Several segments of the river have elevated water temperatures that can reach the mid-70 °F range in the summer. These temperatures are reportedly elevated because near-stream vegetation has been disturbed, altered, or removed, which has reduced stream shading (Reclamation 2003). Previous sampling efforts have found low DO levels in the Sprague River during the summer. Excessive temperatures, slow velocities, and excessive algal growth contribute to these generally low levels of DO (Reclamation 2003). In addition, from RM 50 to the river's mouth, the state pH standard (6.5 to 9.0) has been exceeded during the warmest part of the summer day.

Three fish species and the bald eagle (*Haliaeetus leucocephalus*) have historically occurred or currently occur near the Chiloquin Dam site and are listed as federally threatened or endangered (Reclamation 2003, FWS 2004, ODFW 2004). These species are discussed in Section 3.4, under the Threatened and Endangered Species section. In addition, thirteen species have been identified by the USFS (Region 6) as species of interest that occur or may occur within the Sprague River watershed near the project area. The USFS maintains a complete list of sensitive species that occur in Region 6. This region includes all of Oregon and Washington. The Chiloquin Ranger District provided a modified list of Region 6 Sensitive Species that may occur or have the potential to occur (habitat present) in the project area. The complete list of Region 6 Sensitive Species can be obtained by contacting the Chiloquin Ranger District at (541) 783-4001. The species identified by the USFS the Klamath largescale sucker (*Catostomus snyderi),* interior redband trout (*Oncorhynchus mykiss newberrii*), several lamprey species *(Lampetra* spp.), American peregrine falcon (*Falco peregrinus anatum*), bufflehead (*Bucephala albeola*), northwestern pond turtle (*Clemmys marmorata marmorata*), Pacific fringe-tailed bat *(Myotis thysanodes vepertinus*), Pacific pallid bat (*Antrozous pallidus pacificus)* and Klamath pebblesnail (*Fluminicola N. Sp. 1*). Table 3-2 lists these species and their status.

3.3.1 Klamath Largescale Sucker

Listing Status. In the late 1980s, the FWS considered the Klamath largescale sucker to be a candidate species for listing under the ESA (Reclamation 2003). It is currently not a federal- or state-protected species, but is listed as a USFS Region 6 Sensitive Species (Sanborn 2005b). In the mid-1980s, Klamath largescale sucker populations were estimated to be as low as 7,000 individuals (Reclamation 2003). The population of Klamath largescale suckers has not been recently monitored. In response to the many factors adversely affecting suckers, the State of Oregon took management action to terminate the recreational harvest of suckers in the 1980s in an effort to benefit Upper Klamath Lake sucker populations. Because the status of this species has been of concern to the Chiloquin Dam collaborator's group, this species is included in this section.

Habitat Preference. The Klamath largescale sucker consists of two populations; one follows the general life pattern of rearing in the lake and spawning in rivers, but the other rears and spawns in river systems and spends its entire life cycle in riverine habitat. There is little information available on the river life history.

Table 3-2. Northwest Forest Plan (Region 6) Sensitive Species Near the Project Site

COMMON NAME	SCIENTIFIC NAME	STATE STATUS[a,b]	USFS REGION 6 SENSITIVE SPECIES[d,e]
Klamath largescale sucker	*Catostomus snyderi*	Note C	SS
Interior redband trout	*Oncorhynchus mykiss newberrii*	SOC	SS
Pit-Klamath Brook lamprey	*Lampetra lethophaga*	SOC	SS
Modoc Brook lamprey	*Lampetra folletti*	SOC	
Klamath River lamprey	*Lampetra similes*	SOC	SS
Miller Lake lamprey	*Lampetra minima*	SOC	
Undescribed Upper Klamath lamprey	N/A	SOC	
Klamath pebblesnail	*Fluminicola n. sp. 1*		SS
American peregrine falcon	*Falco peregrinus anatum*	E	SS
Bufflehead	*Bucephala albeola*		SS
Northwestern pond turtle	*Clemmys marmorata marmorata*		SS
Pacific fringe-tailed bat	*Myotis thysanodes vespertinus*		SS
Pacific pallid bat	*Antrozous pallidus pacificus*		SS

a. E = endangered; T = threatened
b. SOC = species of concern
c. Considered for federal listing in the late 1980s. The status of this species has been raised as a concern by the Chiloquin Dam collaborator's group; thus, it is included in this section.
d. SS – Region 6 Sensitive Species
e. Region 6 Sensitive Species identified by the USFS as being present or having habitat present in the project area

Sources: Reclamation 2003, ODFW 2004, USFS List of Region 6 Sensitive Species

The Klamath largescale sucker occurs mainly above Klamath Falls. Spawning usually occurs on gravel substrates from late March to mid-April, though it sometimes occurs earlier in streams fed by warm springs. In Upper Klamath Lake, spawning migrations occur in March, with a peak at the end of March. The Klamath largescale sucker is likely vulnerable to disturbance on the spawning grounds. It feeds primarily on benthic organisms and may grow up to 2 feet in length.

Historic and Current Range (Spawning and Rearing). The reported range includes Upper Klamath Lake, the Clear Lake/Lost River system, the entire Sprague River, the lower 12 miles of the Sycan River, the lower Williamson River, and the upper Williamson River above Klamath Marsh. They are probably not abundant wherever they are found. They currently occur in waters that have been highly modified by dams, diversions, pollution, and introduced predators.

Although they occur in the Klamath River below Klamath Falls, they are mostly found above the Link River Dam.

Known Occurrences in the Project Area. The Upper Klamath Lake population that spawns above Chiloquin Dam is currently believed to be relatively stable based on fish ladder monitoring data over the last quarter of a century (Buettner 2003, as cited in Reclamation 2003). Researchers have documented successful passage of the fish ladder by radio-tagged Klamath largescale suckers in 1983 and 1984 (Reclamation 2003).

3.3.2 Interior Redband Trout

Listing Status. Redband trout are part of an indigenous complex of trout that are found throughout the Upper Klamath River Basin. The ODFW reports that this trout complex is included in the department's Klamath Lake gene conservation group of the Oregon Basin redband trout complex, which is listed as a state-protected species (Reclamation 2003). The USFS also recognizes redband trout as a Region 6 Sensitive Species.

Life History. Redband trout that rear in Upper Klamath Lake and the Klamath River migrate to tributaries to spawn. Redband trout reach maturity at age 3+ and typically spawn in the spring, but summer and fall spawning stocks also occur in tributaries with natural spring inflows. They all spawn in good-quality flowing water, with appropriate depth and velocity, over a gravel substrate in which fish dig redds (nests) and deposit their eggs. After hatching and emerging from the gravel, migratory (adfluvial) redband trout may stay in their natal streams for more than a year before they migrate down to Upper Klamath Lake or the Klamath River, where they reach maturity.

Known Occurrences in the Project Area. Redband trout spawning and the status of the population are not well documented in the Sprague River system. Spawning generally occurs during the spring, based upon the redband trout's springtime passage over Chiloquin Dam. There is also a fall run of redband trout that migrates up the Sprague River to spawn (Reclamation 2003).

3.3.3 Upper Klamath Basin Lamprey

Listing Status. The Upper Klamath River Basin is known to have a high diversity of lamprey species (*Lampetra* spp.), with four named species and one undescribed form that is also limited to the Klamath River Basin. These species are all unique to the Klamath Basin and are considered species of concern by ODWR (Reclamation 2003). In addition the Pit-Klamath Brook lamprey and the Klamath River lamprey are USFS Region 6 Sensitive Species.

There are two nonparasitic forms with the common name Pit-Klamath Brook lamprey (*L. lethophaga* and *L. folletti*) and three parasitic forms commonly referred to as Klamath River lamprey (*L. similis*), the Miller Lake lamprey (*L. minima*), and the undescribed form that occupies Upper Klamath Lake and migrates up the Sprague River (Logan and Markle 1993, as cited in Reclamation 2003; Lorion et al. 2000; Reid 2003, as cited in Reclamation 2003). The undescribed Upper Klamath Lake lamprey has historically been referred to as a land-locked Pacific lamprey (*L. tridentata*); however, it has been shown to be morphologically and genetically distinct from the coastal species and is more closely related to other Klamath River basin lampreys (Lorion et al. 2000). The Miller Lake lamprey was believed to have been exterminated by chemical treatment of Miller Lake in 1958, but several populations of *L. mimima* have been recently discovered, and the species distribution has expanded to include the Williamson and Sprague River drainages (Lorion et al. 2000, as cited in Reclamation 2003).

Known Occurrences in the Project Area. Lamprey species that move upstream from Upper Klamath Lake to spawn have limited swimming and no jumping ability; they rely on their suction-cup mouths to attach to objects and facilitate their movement through high-velocity areas. The extent to which the existing Chiloquin Dam fish ladder, with a pool-weir design, may restrict this upstream spawning migration in the Sprague River system is not known. Since 2000, USGS has been sampling the Chiloquin Dam fish ladder for suckers from February to late May. During this time, USGS has observed lampreys using the ladder. Most lampreys were found in the lower cells of the fish ladder and were occasionally seen in upper cells (USGS 2001).

3.3.4 American Peregrine Falcon

Listing status/life history. The American peregrine falcon is listed by OWDR as endangered (ODWR 2004) and is listed by the USFS as a Region 6 Sensitive Species. These birds nest on cliffs averaging 230 feet high, within 1 mile of a riparian area. The nests are on ledges at 40 to 80 percent of cliff height, with view of the surrounding area. Primary prey are birds including bluejays, flickers, meadowlarks, pigeons, starlings, shorebirds, waterfowl, and other readily available species (Pagel, 2004).

Known Occurrences in the Project Area. Nesting habitat is present in the rimrock ½ mile above the proposed pumping plant.

3.3.5 Bufflehead

Listing status/life history. The bufflehead is listed by the USFS as a Region 6 Sensitive Species that may occur near the project site. The bufflehead is a cavity nester, using either natural or woodpecker-excavated (especially flicker) cavities. Nests are usually found within 650 feet of water. Their diet consists of aquatic insects and seeds from aquatic vegetation in freshwater or brackish water habitats, crustaceans, snails and other mollusks. In the winter, fish are also an important component of the diet (Ehrlich et al., 1988).

Known Occurrence in the Project Area. Bufflehead are known to occur throughout the Sprague River watershed.

3.3.6 Northwestern Pond Turtle

Listing Status/life history. The northwestern pond turtle is listed by the USFS as a Region 6 Sensitive Species that may occur near the project site. This turtle is one of only two native turtles occurring in Oregon. During warm weather, it is found in slow-moving bodies of water with rocky or muddy bottoms and aquatic vegetation. It often utilizes rocks or logs extending into the water for basking. Eggs are laid in summer in sandy uplands, ¼ mile or more from the water. Forested upland areas are used as hibernating habitat from approximately October through April, where they dig holes into the duff or conceal themselves under logs and debris for protection and thermo-regulatory purposes (Holland, 1994).

Known Occurrence in the Project Area. The northwestern pond turtle has been observed in the Sprague River near the town of Chiloquin.

3.3.7 Pacific Fringe-Tailed Bat

Listing status/life history. The Pacific fringe-tailed bat is listed by the USFS as a Region 6 Sensitive Species that may occur near the project site. These bats utilize large diameter snags and live trees with deep furrowed bark, old buildings, tree hollows and creviced rock outcrops (Western Bat Group Workshop, 1998). They forage over meadows, small water bodies and streams.

Known Occurrence in the Project Area. Habitat used by these bats may occur near the project area.

3.3.8 Pacific Pallid Bat

Listing status/life history. The Pacific pallid bat is listed by the USFS as a Region 6 Sensitive Species that may occur near the project site. It is associated with ponderosa pine in southern Oregon (Cross, 1995). It utilizes large diameter snags and live trees with deep furrowed bark, old buildings, tree hollows and creviced rock outcrops (Western Bat Group Workshop, 1998). This bat forages over meadows, small water bodies and streams.

Known Occurrence in the Project Area. Habitat used by these bats may occur near the project area.

3.3.9 Klamath Pebblesnail

Listing status. The Klamath pebblesnail is listed by the USFS as a Region 6 Sensitive Species that may occur near the project site.

Known Occurrence in the Project Area. There was an historical site mapped for this mollusk in the Williamson River, but is likely to be wrong (described as the East Fork of the Sprague River). It is found at several sites in Upper Klamath Lake, at springs around the lake margin, and in the Link River. In the 1990s, sites above and below Chiloquin Dam in the Williamson and Sprague Rivers were sampled for aquatic mollusks and this species was not found.

3.4 Threatened and Endangered Species and Critical Habitats

Three fish species and the bald eagle (*Haliaeetus leucocephalus*) have historically occurred or currently occur near the Chiloquin Dam site and are listed as federal and/or state threatened and endangered (Reclamation 2003, FWS 2004, ODFW 2004). The identified species are the shortnose sucker (*Chasmistes brevirostris)*, Lost River sucker (*Deltistes luxatus)*, bull trout *(Salvelinus confluentus)* and bald eagle. Table 3-3 lists the federally listed species that have been identified as occurring, either historically or currently, near Chiloquin Dam or in the Sprague River watershed. In a letter dated October 14, 2004, BIA requested that the U.S. Fish and Wildlife Service (FWS) provide a list of species of concern that may be potentially impacted by the removal of Chiloquin Dam or the construction of a new pumping plant.

Table 3-3. Federally Listed Threatened or Endangered Species that Occur or May Occur Within the Sprague River Watershed Near the Project Site

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS[a]
Shortnose sucker	*Chasmistes brevirostris*	E
Lost River sucker	*Deltistes luxatus*	E
Bull trout	*Salvelinus confluentus*	T
Bald eagle	*Haliaeetus leucocephalus*	T

a. E = endangered; T = threatened

3.4.1 Shortnose Sucker and Lost River Sucker

Listing Status. The shortnose sucker and Lost River sucker were listed as federally endangered under the Endangered Species Act (ESA) on July 18, 1988 (FWS 1988). These species are also listed as endangered by the State of Oregon and as Region 6 Sensitive Species by the USFS (ODFW 2004, Sanborn 2005b). These large, long-lived suckers are endemic to the Upper Klamath Basin of Oregon and California and historically, within their range, were abundant and widespread (FWS 1993).

The conversion of natural lake areas to agricultural use, damming of rivers, draining of marshes, instream flow diversions, water quality problems in Upper Klamath Lake and its tributaries, loss of riparian vegetation, livestock grazing, water manipulation, and exotic species competition are factors that may have contributed to the population decline for these species (FWS 1988).

Critical Habitat. On December 1, 1994, the FWS published a proposed rule designating critical habitat for Lost River and shortnose suckers (59 FR 61744) (FWS 1994). The proposed critical habitat encompasses the majority of the Sprague River, both upstream and downstream of the dam. Three types of habitat were proposed as critical habitat: (1) lakes, reservoirs, and streams within current or historic range of the suckers; (2) lands within the 100-year floodplain, as identified on Federal Emergency Management Agency (FEMA) maps, adjacent to the critical aquatic habitats; and (3) riparian zones within 300 feet of stream habitats but not identified on FEMA maps. Critical habitat identifies areas that may require special management or protection. It alerts federal agencies, states and the public, and other entities about the importance of an area for the conservation of a listed species.

Spawning Areas. Lost River sucker reach sexual maturity between the ages of 6 and 14 years. From early February through May, they begin their runs up tributary streams in order to spawn. Females release their eggs in riffles (stretches of stream that flow swiftly over rubble bottoms), depositing 44,000 to 231,000 eggs each. After hatching, larvae drift downstream.

Shortnose sucker reach sexual maturity at age 6 or 7. They begin their spawning runs in March, migrating up tributary rivers to spawn. Females broadcast tens of thousands of eggs in stretches of riffles and smooth runs of water, over gravel- or rubble-covered stream bottoms. Some suckers in both species spawn along the shores of lakes and springs (CDPR 2004).

The Williamson and Sprague Rivers are the primary spawning areas for populations of suckers in the Upper Klamath Basin. One of the principal reasons for listing the sucker in 1988 was the recognition that Chiloquin Dam blocked sucker spawning runs. FWS (1988) estimates that Chiloquin Dam eliminated 95 percent of the historical spawning runs. Prior to listing, the Williamson River/Sprague River spawning population was estimated to be as low as 2,650 shortnose sucker and 11,860 Lost River sucker (Reclamation 2003).

In the late 1980s, several studies examined the spawning distribution of Lost River and shortnose suckers in the Williamson and Sprague Rivers below Chiloquin Dam. These studies found both sucker species spawning in several riffles below the dam to approximately RM 6.0 on the Williamson River (Bienz and Ziller, 1987; Coleman et al. 1989).

Rearing Habitat. After larvae (young-of-year) adfluvial sucker stocks hatch from eggs and emerge from the gravel nest sites, they emigrate from the river by means of passive drift to Upper Klamath Lake. Larval outmigration from the Williamson River to Upper Klamath Lake can begin in May and is generally completed by the end of July. In Upper Klamath Lake, larvae are known to occupy primarily nearshore shallow water habitat (less than 20 inches deep) (Reclamation 2003). They are generally found in higher densities associated with emergent aquatic vegetation or some form of submerged structure, such as logs or large rocks (Klamath Tribes 1996, as cited in FWS 2002). Potential larval habitat has been quantified adjacent to the mouth of the Williamson River. It is believed that larvae emigrating from the Williamson River move east then south along the shoreline. Because of the large numbers of spawning adult suckers in the Williamson River, the area around the mouth of the Williamson is believed to be crucial nursery habitat for sucker larvae (FWS 2005).

Juvenile Habitat. Young-of-year juvenile suckers (i.e., 1 to 4 inches total length) generally occupy Upper Klamath Lake nearshore shallow water habitats less than about 3.5 feet deep, and mostly less than 20 inches deep (FWS 2002). Juveniles are often found in unvegetated habitats, primarily over rocky substrates, including rock, gravel, and gravel/sand mix. Scientific investigations recently have provided evidence that juveniles also use emergent vegetation along the near shoreline areas (FWS 2002).

Adult Habitat. Fish distribution studies have found adult shortnose and Lost River suckers in a wide variety of habitats throughout the Klamath River basin.

Tolerance to Degraded Water Quality. Reclamation (2003) reports that adult suckers experience signs of temperature-induced stress and temperature-induced mortality at a high-stress temperature of 28 °C (82 °F). Suckers' low-stress threshold, at which behaviour is altered, occurs when water temperatures reach 25 °C (77 °F). In addition, the DO low-stress and high-stress threshold criteria for suckers are 4 milligrams per liter (mg/L) and 6 mg/L (Loftus 2001, as cited in Reclamation 2003). Suckers exhibit low- and high-stress thresholds for pH at 9.0 and 9.75 (Reclamation 2003).

Known Occurrences in the Project Area. Chiloquin Dam has one functional fish ladder. Although some suckers use the fish ladder, the greatest portion of their population spawns in downstream reaches (Reclamation 2003). Downstream spawning habitat on the Sprague and

Williamson Rivers is mostly armored cobbles, which provides a poor-quality spawning substrate (KWUA 2001). Lost River suckers and shortnose suckers largely spawn within a 4.3-mile reach of the Williamson River from RM 4.3 to the confluence of the Sprague River and within a 1-mile reach of the Sprague River from its mouth to immediately below Chiloquin Dam (Reclamation 2003). Various researchers have observed that suckers do spawn upstream of Chiloquin Dam, indicating that passage through the ladder is at least partially successful for certain sizes and species of fish. Perkins et al. (2000) indicated Lost River suckers have an early run (first 3 weeks of April) and are known to spawn in the upper Sprague River. Dunsmoor observed Lost River suckers spawning in the upper Sprague River during March 1995 (Perkins et al. 2000, as cited in Reclamation 2003).

Lost River suckers greater than 22 inches were typically not captured in the Chiloquin Dam ladder in 1996. This may indicate that large Lost River suckers may have difficulty ascending the ladder, a general aversion to the ladder, or a preference for spawning in areas downstream of the ladder (Perkins 1996, as cited in Reclamation 2003). Similarly, shortnose suckers were not able to migrate through the ladder to spawn upstream in 1987 and 1988 (Buettner and Scoppettone 1990, as cited in Reclamation 2003).

A total of 2,549 adult suckers were captured at the fish ladder in 2002, of which 1,406 (55.2 percent) were Lost River suckers, 784 (30.8 percent) were Klamath largescale suckers, and 318 (12.5 percent) were shortnose suckers. Additionally, 41 suckers (1.6 percent) were captured that displayed intermediate characteristics of two species, usually Lost River sucker and Klamath largescale suckers. Timing of sucker movements through the ladder varied among species. In March, catches in the ladder consisted primarily of Klamath largescale suckers, but by mid-April switched to mostly Lost River suckers. The number of suckers captured in the ladder declined during the second week in May, and no suckers were captured after May 15 (USGS 2002).

3.4.2 Bull Trout

Bull trout were listed by the FWS as threatened on June 10, 1998 (63 FR 31647-31674). Bull trout critical habitat was designated in the Klamath River Basin in September 2004. Historically, bull trout inhabited the lower Sycan River, remaining today only in a few headwater tributaries above the Sycan Marsh. They also currently occupy a number of small headwater tributaries of the Sprague River. Today, bull trout are absent from the lower Sprague and Williamson Rivers and have not been found in the project area.

3.4.3 Bald Eagle

Listing Status. Bald eagles in the lower 48 states were first protected in 1940 by the Bald Eagle Protection Act, then were federally listed as endangered in 1967. In 1995, the bald eagle was reclassified as threatened in all of the lower 48 states. The bald eagle was proposed for delisting on July 6, 1999; a decision on whether to delist the bald eagle is pending (64 FR 36453). No critical habitat has been designated for the bald eagle.

Historical Status and Current Trends. The bald eagle is the only eagle unique to North America. It ranges from central Alaska and Canada south to northern Mexico. The majority of nesting bald eagles in Oregon occur in the following areas: Columbia River below Portland, the Oregon coast and Coast Range, the High Cascades, Klamath Basin, and the upper Willamette River

Basin. A nesting survey found 401 breeding pairs in Oregon and 40 on the Washington side of the Columbia River in 2002. Population goals in 8 of 10 recovery zones in Oregon have been met or exceeded. Wintering bald eagles are found throughout the state, but concentrations occur in areas with dependable food supplies such as Klamath and Harney Basins and along the Snake and Columbia Rivers (ODFW 2004).

Breeding and Wintering Habitat. Bald eagle nest site selection varies widely from deciduous, coniferous, and mixed forest stands. Nest trees are usually large-diameter trees characterized by open branching and stout limbs. Nests are in dominant or codominant trees often located near a break in the forest such as a burn, clearcut, field edge (including agricultural fields), or water. The majority of nest sites are within one-half mile of a body of water such as coastal shorelines, bays, rivers, lakes, farm ponds, or dammed up rivers (beaver dams, log jams, etc.) and have an unobstructed view of the water. Bald eagle habitat occurs primarily in undeveloped areas with little human activity.

Winter foraging areas are usually located near open water on rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant, or in areas with little or no water (rangelands, barren land, tundra, suburban areas, etc.) where other prey species (rabbit, rodents, deer, carrion) are abundant. Communal roost sites contain large trees (standing snags and utility poles have also been used) with stout lower horizontal branches for perching. Up to100 bald eagles may use these roost sites at night and during the day, especially during inclement weather. Perch trees used during the day possess the same characteristics as roost trees but are located closer to foraging areas (ODFW 2004).

Occurrence in Project Area. Chiloquin Dam is within a 1-mile buffer zone of a nest known as the Modoc Rim active nest site (# 439). The proposed pumping plant locations are within a one-half mile buffer zone of the Lobert Draw nest site (# 938). Bald eagle winter roosting sites are not known to occur within the project area.

3.5 Wetlands

Wetlands occur in areas between terrestrial and aquatic systems and "are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Federal Interagency Committee for Wetland Delineation 1989). Approximately 2.5 acres of National Wetlands Inventory wetlands, classified as semi-permanently and seasonally flooded, occur approximately 1,000 feet upstream of Chiloquin Dam, and approximately 6 acres of seasonally flooded wetlands occur about 1,600 feet downstream (Figure 3-4).

The existing reservoir has a narrow band (3 to 20 feet) of wetland plants along the margin, as well as a couple of small islands of less than one-half acre. It is speculated that the narrowness of this wetland fringe is due to the relatively stable water levels and the fairly steep banks of the reservoir. Typical shrubs along the reservoir margin are Douglas spirea and willow (sp.). Other wetland plants such as common horsetail (*Equisetum arvense*), cattail (*Typha* sp.), bulrush (*Scirpus* sp.), Baltic rush (*Juncus balticus*), and spike rush (*Eleocharis* sp.) were observed on a brief visit to the dam site in August 2004.

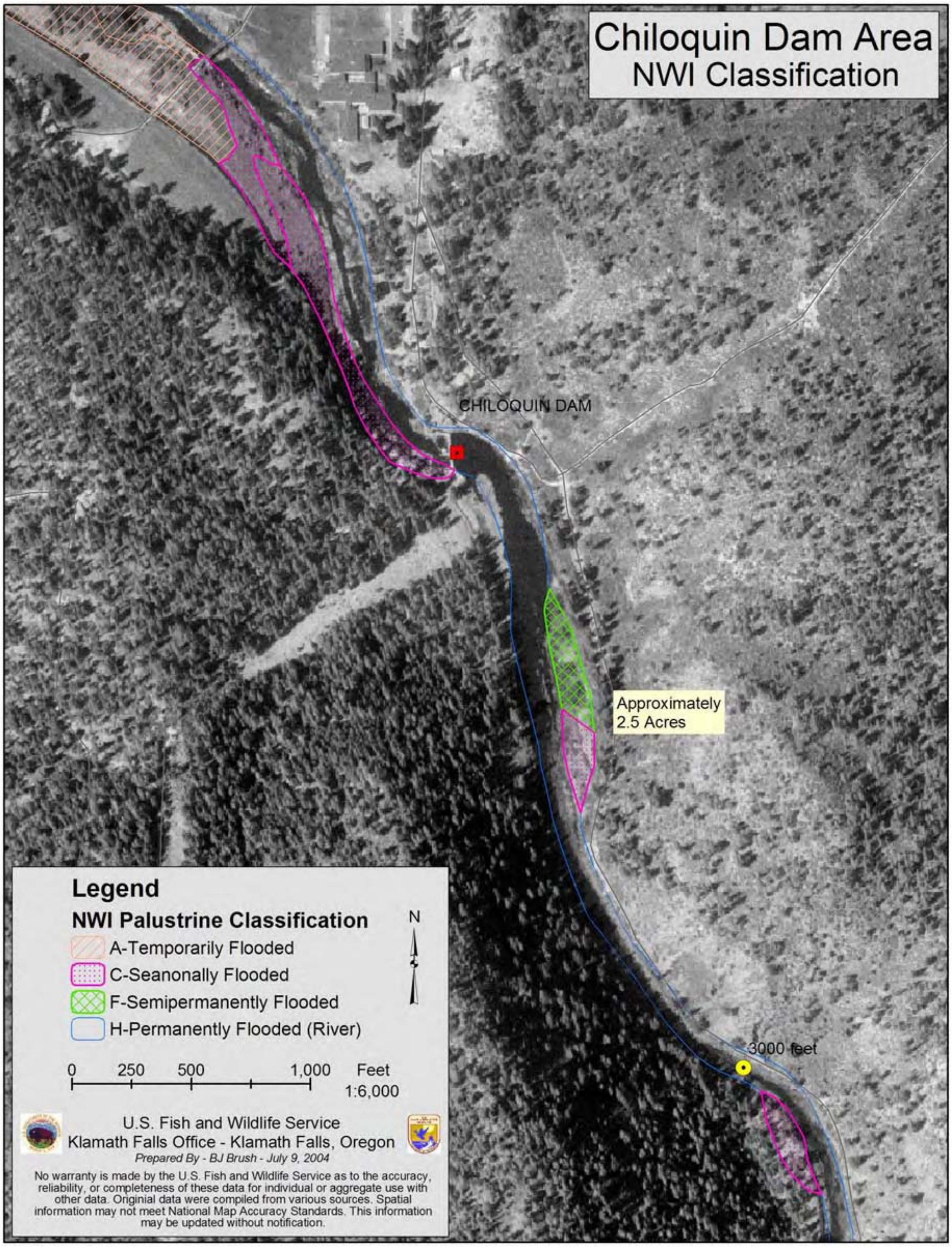


Figure 3-4. Occurrence of Wetlands near Chiloquin Dam

3.6 Archaeological and Historic Resources

An archaeological summary of the Klamath Basin (Kritzer 2003) indicates that the area was populated at least 10,000 years ago (before present [BP]), as evidenced by cultural material in association with fossilized bison and ox bone. From around 5,000 BP on, the subsistence pattern becomes increasingly focused on riverine, lake, and marsh resources. By 2,000 BP, house pit villages appear.

Based on Ruby and Brown (1992), contact with the Klamaths was first made by Hudson Bay fur trappers in 1826. At contact, the Klamaths were settled around and exploiting the available lake, marsh, and river resources while also hunting and gathering in the surrounding areas. Their territory centered around Chiloquin, Oregon, and the Sprague and Williamson Rivers, was central to one of their major settlement areas. Reflecting their long use of this land, a large number of sacred, cultural, and resource exploitation areas and a variety of site types associated with settlement are located throughout their aboriginal territory.

Euro-American settlement of the Klamath Basin began in the 1850s. In 1864, the Klamath and other Indians entered into a treaty with the United States. This resulted in the creation of the Klamath Indian Reservation.

In 1914, Chiloquin Dam was built by the U.S. Indian Service as part of the Klamath Indian Irrigation Project. The purpose of the dam was to encourage farming by Indians. However, the flooding of the area disrupted traditional fishing, gathering, and other resource uses of the area. The dam and resultant reservoir caused the Klamath fishers to modify their fishing practices. The First Sucker Ceremony shifted to below the dam, and commercial harvest of fish began occurring at the dam's central fish ladder.

In 1954, the Klamath Tribes were terminated by an Act of Congress. Chiloquin Dam was then transferred from federal to MPID ownership. In 1986, the Klamath Tribes were restored by another Act of Congress, which returned their federally recognized status.

A review of previous work and an archaeological reconnaissance of the area of potential effects indicate that a number of archaeological and historic sites are known to exist in or near the project area (Kritzer 2003). A cultural "reconnaissance" (Deur 2003) provides an overview of Klamath tribal member use of the project area and dam site.

Chiloquin Dam and related features are currently being studied by Reclamation (Welch, 2005). Additional surveys and tribal consultation will be done as required under the National Historic Preservation Act (NHPA). As required under NHPA, consultation with the Oregon State Historic Preservation Office (SHPO) and Klamath Tribes regarding historic properties is ongoing and will be concluded by the time the NEPA process is completed.

3.7 Indian Trust Resources

The United States government has a unique legal and political relationship with American Indian tribal governments. The basis for this relationship is derived from the Constitution of the United States and is more fully set out in such documents as treaties, federal statutes, and executive orders. Court decisions have analogized this relationship, in some cases, to one with a private trustee or fiduciary, with the United States as the trustee, the respective Indian tribe as the beneficiary, and the land or other property held by the United States as the corpus or body of the trust. This role of the United States government is commonly referred to as the Indian trust responsibility.

Secretarial Order 3215 defines Indian trust assets as "lands, natural resources, money, or other assets held by the Federal government in trust or that are restricted against alienation for Indian tribes and individual Indians." On October 14, 1864, the Klamath Indians, the Modoc Indians, and the Yahooskin Band of Snake Paiute Indians signed a treaty with the United States agreeing to forgo claims to their larger aboriginal territory in exchange for a smaller land base, certain hunting, fishing, and gathering rights, and financial support over a period of at least 20 years. Congress terminated the Klamath Indian Reservation in 1954, but left the tribes' hunting, fishing, and gathering rights and supporting water rights intact. The 1864 treaty provides for fishing rights and has been interpreted to extend to the interaction of fish and water. The tribes' water rights include the right to certain conditions of water quality and flow to support all life stages of fish. Although these rights have not been quantified, managing fish passage over Chiloquin Dam appears to be one way of conserving and protecting the Klamath Tribes Indian trust assets.

3.8 Air Quality

Currently, the proposed activities associated with Chiloquin Dam removal do not represent a major source of air pollution. Direct on-site construction activities include air pollution associated with equipment operation and power generators. At this time, blasting is under review and consideration as a means of demolition.

3.9 Socioeconomics

As of the 2000 Census, 716 people resided in Chiloquin, Oregon. Minority groups make up 59 percent of the population. Native Americans are the single largest minority group, representing just over half of the town's population. Approximately 5 percent of the population identify themselves as Hispanic or Latino (all races). The median household income is $20,687, and low-income individuals represent 31 percent of the population.

Klamath County contains a population of 63,775. Minority groups make up 16 percent of the population. Hispanics and Latinos are the single largest minority group, representing 8 percent of the population. Approximately 4 percent of the population identify themselves as Native American. The median household income is $31,537, and low-income individuals represent 17 percent of the population.

3.10 Public Health and Safety

Chiloquin Dam and its associated structures pose a potential health and safety concern to the general public. The dam is old, and many of the associated structures no longer function. The structures include a canal headworks structure on the west abutment, a sluiceway and abandoned concrete fish ladder adjacent to the canal headworks on the west abutment, a heavily deteriorated concrete fish ladder near the center of the dam, a functioning concrete fish ladder at the east abutment of the dam, and a nonfunctioning sluiceway adjacent to the east abutment fish ladder. The area near the east abutment has been fenced off numerous times and posted for hazards. There are often gatherings in this location for socializing, swimming, and fishing.

3.11 Aesthetics

Chiloquin Dam is situated in an area where the land is predominantly forested (see Figures 3-1 and 3-3). The dam is a concrete gravity structure with an embankment section provided on the west abutment. It has a maximum structural height of 21 feet and a total length of more than 220 feet. The dam's existing features, listed in Section 3.10, consist of a variety of functioning and nonfunctioning dilapidated concrete structures that can be seen from certain vantage points along the shore of the Sprague River. Immediately downstream from the dam, the Sprague River runs along cleared land on one side, including an old mill site with dilapidated structures. The opposite side of the river includes the MPID canal, which has undergone extensive erosion and has been shorn up with large concrete blocks (Figure 3-5).

Figure 3-5. Concrete Blocks Along the Existing MPID Canal near Chiloquin Dam

The proposed pumping plant site is near the Highway 97 Bridge on a straight reach of the Williamson River. The site is located on a mildly sloping grassy field near railroad lines, an access road, and a powerline. Figures 3-6 and 3-7 show views of the vicinity, including the Highway 97 Bridge.

3.12 Noise

Currently, the proposed project area at Chiloquin Dam does not represent a substantial source of operational noise. Direct on-site construction activities would include ongoing noise from equipment operation and power generators. At this time, blasting is under review and consideration as a means of demolition.

Figure 3-6. Vicinity of the Proposed Pumping Plant

Figure 3-7. View of the Highway 97 Bridge

3.13 Traffic

Typical traffic to Chiloquin Dam is currently light, with access provided over deeply rutted, unimproved roads. The primary access and haul route to the dam site is from State Highway 97, traveling east on Chiloquin Road for about 1 mile to the City of Chiloquin, then south for about 0.8 miles through the city area along Second Street, which is the designated truck route. The east side of the dam can be accessed by continuing south about 1 mile, past the Chiloquin School District zone, and then east for 0.1 miles to the Sprague River and the dam. The road to the east side of the dam, which travels north and south adjacent to the east side of the high school, appears to be a continuation of Fourth Street. This road is used as a school bus circle route for the high school, and the asphalt paving appears to be suitable for moderate-duty use. It appears that this section of roadway could need resurfacing if it were used to haul heavy loads.

The west side of the dam can be reached by turning west at the high school, continuing for one block, then turning south and continuing about 0.1 miles to the access road over the Kircher-owned bridge; this is the only bridge that crosses the Sprague River in this vicinity, and it has a 25-ton load rating. Access to the west side of the dam continues south over the bridge to the Kircher property, then turns east at the Main Canal (owned by MPID) and continues east along the Main Canal for about 0.4 miles to the dam; this would be the preferred haul route. An alternate access route, which is curvy and narrow, runs parallel to the canal road about 600 feet to the east.

Alternate routes to both sides of the dam include PacifiCorp's powerline easement roadway, which travels north and south over mountainous terrain, and non-maintained USFS logging roads that travel east from the dam on both sides. The alternate routes are poorly maintained and are not recommended for haul routes, but they could serve as possible routes to provide access for heavy equipment. The PacifiCorp powerline roadway can be accessed at the Jeld-Wen Timber Products Plant, located about 4 miles southwest of Highway 97; this route could provide access to the west side of Chiloquin Dam. The same powerline roadway can also be accessed about 1.1 miles northeast from the Sprague River access road. The PacifiCorp powerline roadway is not suitable for standard highway truck and trailer traffic. With occasional tree trimming and road blading, the roadway could be used as an access route to mobilize some pieces of heavy equipment to the work site. However, this route would not be favorable or recommended as a haul route due to the steep terrain and slow travel speed. The numerous USFS logging roads in this vicinity were not reviewed at length due to their inconsistency. The USFS's preference at this time is to restrict development of these roads.

The primary route to the Lonesome Duck and Jeld-Wen sites is from Highway 97. The Lonesome Duck Resort access road from Highway 97 leads to both of the potential work sites. The access road is narrow but has adequate room and surface conditions to serve as an access and haul road for the potential sites. Current traffic on the road is minimal, consisting of lodgers and workers at the Lonesome Duck resort and some anglers who access the Williamson River through private property. Figure 2-3 shows existing roads and the surrounding environment of the alternative pumping plant locations.

Access to the existing pumping plant is provided by a road leading about 100 yards from Highway 97. The only traffic on this access road is destined for the pumping plant and the tribal land surrounding it. Current traffic is minimal, consisting mostly of anglers.

Key roads, construction areas, and construction areas for potential dam modification work are shown in Figure 3-8.

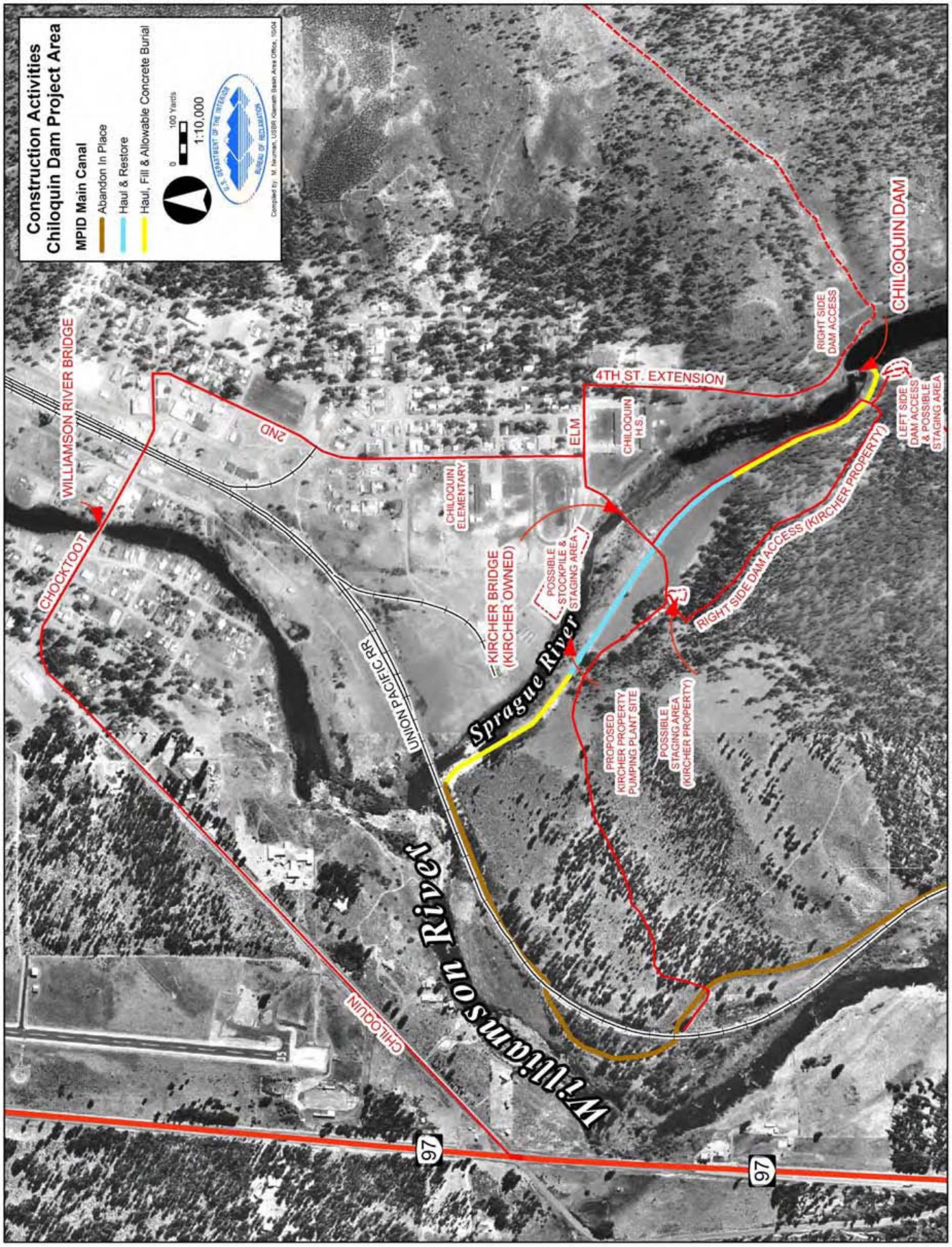


Figure 3-8. Construction Activities, Chiloquin Dam Project Area

4.0 ENVIRONMENTAL EFFECTS

This section describes the environmental effects associated with the alternatives analyzed in the proposed action area at Chiloquin Dam.

4.1 Land Use

For decades, the land surrounding Chiloquin Dam has not experienced extensive changes in land use.

4.1.1 No Action Alternative

Recreational uses of the reservoir and surrounding area would continue to include swimming and other activities associated with the reservoir.

4.1.2 Dam Removal Alternative

Under the Dam Removal Alternative, some farmers would lose access to water currently provided by MPID withdrawn from the Sprague River at Chiloquin Dam. Water would be made available to these farmers with small pumps drawing water directly from the Sprague and Williamson Rivers; therefore, irrigated farming land use would not be affected by any of the alternatives analyzed.

MPID's Main Canal is a non-lined earthen canal that has a certain amount of seepage as do most earthen canals. The abandonment of the section of Main Canal between Chiloquin Dam and the new pumping station will reduce the amount of water from canal seepage loss. The ability of the canal to capture runoff and seep into the surrounding land will vary based upon the underlying landowners' desire to backfill, partially backfill, or leave the canal open to catch available runoff as it currently does. BIA will work with MPID and landowners to determine those areas of the canal that would remain open to capture runoff.

Some lands that are at a lower elevation along the abandoned canal may currently receive seepage associated with conveying irrigation water. Eliminating seepage loss is one method of conserving water. These lands would no longer receive seepage associated with conveying irrigation water if the canal is abandoned. Leaving the canal open would continue to allow runoff seepage to occur.

Land from the abandoned canal will become available for other uses. In portions surrounded by irrigated agricultural uses, topsoil will be used to convert the canal to agricultural land.

The reservoir would no longer exist, eliminating its use for swimming. However, many swimming areas exist in the vicinity of Chiloquin, and opportunities to swim elsewhere would not be diminished.

Land along the shore of the reservoir would gain some amount of area under the Dam Removal Alternative. The shoreline would change from lake-front to river-front property.

4.1.3 Dam Retention With Fish Passage Improvements Alternative

Impacts to land use would be similar to the impacts under the No Action Alternative.

4.1.4 Partial Dam Removal Alternative

Impacts to land use would be similar to impacts under the Dam Removal Alternative. Reservoir levels would fluctuate on an annual basis. The reservoir would be full in summer months during the irrigation season (May through September) when swimming is most popular.

4.2 Water Quality: Geomorphology, Hydrology, and Sediment Transport

The key potential impact to water quality resulting from the action alternatives would be potential sedimentation of the Sprague and Williamson Rivers below Chiloquin Dam. As indicated in Section 3.2, toxicity studies show that the sediment is not contaminated with hazardous substances. Based on physical, chemical, and land use data, the sediments in Chiloquin Reservoir have been classified as suitable for unconfined aquatic disposal (Reclamation 2003, Attachment 6).

4.2.1 No Action Alternative

The No Action Alternative would maintain the existing channel and reservoir morphology. Suspended sediment (wash load) would continue to be transported downstream of the dam, while bedload would continue to be cut off from downstream transport and accumulate in the reservoir. MPID would continue to take delivery of water as in the past, through the Main Canal.

4.2.2 Dam Removal Alternative

The Dam Removal Alternative would result in sediment transport downstream through the Sprague and Williamson Rivers. Sediment transport and deposition was analyzed in a series of studies contained in Reclamation 2003 (Attachments 5 and 6) and Reclamation 2005.

The sediment analysis and modeling in the 2005 Reclamation study are based on several conservative assumptions:

- The mean daily river flows of the Williamson River, below the confluence with the Sprague River, and the Sprague River for the entire period of record were used (86 and 84 years, respectively). The peak river flows that occur during floods were not used, but they can greatly increase the sediment transport capacity of the river.
- The upper estimate of the reservoir sediment mass (61,000 tons) was used rather than the lower estimate (49,000 tons) or a mid-point estimate. In addition, the assumption was made that the entire 61,000 tons of sediment would be transported from the reservoir by March 15 in the first year following dam removal, rather than assuming that in low water years less sediment would leave the reservoir.
- Results from the Yang sediment transport equation (Yang 1973, as cited in Reclamation 2005) were used rather than the results from the Engelund and Hansen equation (Engelund and Hansen 1972, as cited in Reclamation 2005). The Yang transport equation provides more conservative findings in that it results in longer transport periods.

The HEC-RAS model (U.S. Army Corps of Engineers) was used to predict the river hydraulic conditions and sediment transport rates over a range of river flows for the analyses completed in 2003. This model was also used in 2005 to analyze sediment deposition in riffles.

The pool reach upstream from the Highway 97 Bridge was modeled with 15 surveyed cross sections and the results from this modeled reach are the basis for the predictions in Tables 4-1 and 4-2. In addition, two shorter reaches containing spawning riffles were modeled:

- On the Williamson River between the Highway 97 Bridge and the Sprague River confluence, and

- On the Sprague River downstream from Chiloquin Dam.

Sediment transport capacity depends on flow rate, and the highest rates of sediment transport coincide with peak runoff. Years with low runoff and lower peak flows transport less sediment downstream. The timing of the peak flows is also important to the removal of sediment. Historic hydrographs that were able to transport the reservoir sediment downstream prior to March 15 were also years that had early peak flows.

Following dam removal, the river channel upstream of the structure would likely begin incising rather rapidly (days to weeks) through the aggraded sediments. Because of the steep slope of the Sprague River (upstream and downstream of the dam) and non-cohesive sediments in the reservoir, the river would incise and widen until arriving at a quasi-equilibrium channel within a relatively short period of time (several years, depending on the magnitude and frequency of effective discharges).

Transport of sediment currently stored behind Chiloquin Dam is highly dependent on future flow hydrology. Sediment in the silt- and clay-sized fractions would likely be rapidly transported through this reach as wash load without depositing on the riverbed. Based on historic hydrologic data, a majority of the reservoir sediment (90 percent) would likely be transported downstream in the first year. By the end of the second year, only trace amounts of sand would likely be left upstream from the Highway 97 Bridge (Williamson RM 7.0). The gravel in the reservoir would take longer to transport downstream and would require much higher flows than sand to initiate transport.

The sediment transport study (Reclamation 2003) for the removal of Chiloquin Dam estimated that the majority of reservoir sediment would pass through the Sprague River within 6 months of dam removal. Additional modeling was done to estimate transport times from the confluence of the Sprague River and the Williamson River to the Highway 97 Bridge.

The pumping plant reach (upstream from the Highway 97 Bridge), however, does not have large enough transport capacity to transport the entire mass by March 15 in all water years. The full mass of sediment can only be transported through the pumping plant reach in a single season during high water years. However, all of the clay, silt, and very fine sand and portions of the coarser sand (70 percent of the total) are expected to be transported through the pumping plant reach by March 15 of the first year following dam removal. The analyses also show that most of the sediment (90 percent) delivered to the pumping plant reach would likely be transported downstream within the first year after dam removal. Finally, the analyses indicate that the sediment transport capacity of the Highway 97 riffle is larger than that of the pumping plant reach as a whole, and that the sediment that moved through the pumping plant reach would be quickly transported through the Highway 97 riffle into the lower Williamson River.

Riffle areas are important habitat for Lost River and shortnose suckers. Several riffles are located below Chiloquin Dam all the way to the Highway 97 Bridge. Based on cross-sectional data collected at two riffle areas (see Figure 4-1) the model results provide a quantitative estimate of the sediment transport rates through the riffles and the pumping plant reach. Additional cross-sectional data could help refine the model results, but the conclusions of this study would not change substantially. Riffles tend to be the reaches with the highest sediment transport capacity and are therefore, the least likely to experience sediment deposition. The model results of the two riffle reaches confirm this expectation. Analysis results indicate that all of the clay, silt, and sand can be transported through the two modeled riffle reaches in the period following dam removal (October 1 to March 15). Based on these calculations, the riffle areas between Chiloquin Dam and Highway 97 would not be expected to experience sediment deposition following dam removal.

Due to the timing of runoff, when the time period is extended from March 15 to April 30, the percentage of historic years with the capacity to transport all the sediment in a size fraction increases dramatically. Table 4-1 indicates the probability of sediment transport past the Highway 97 Bridge (Williamson RM 7.0) over a 3-year period based on different size classes.

Table 4-1. Probability of Reservoir Sediment Being Transported Past the Highway 97 Bridge for Each Size Fraction over Time, Assuming Chiloquin Dam is Removed in October

DATE	PROBABILITY OF SEDIMENT TRANSPORT (PERCENT)					
	CLAY AND SILT	VFS	FS	MS	CS	VCS
15-Mar, Year 1	100	100	59	37	27	21
30-Apr, Year 1	100	100	92	71	65	55
30-Sep, Year 1	100	100	95	84	74	67
15-Mar, Year 2	100	100	100	100	86	66
30-Apr, Year 2	100	100	100	100	99	93
30-Sep, Year 2	100	100	100	100	100	97
15-Mar, Year 3	100	100	100	100	100	100

Source: Reclamation 2005

By March 15 of the first year all of the silt clay and very fine sand should be transported downstream, and approximately 59, 37, 27, and 21 percent of the fine sand, medium sand, coarse sand, and very coarse sand respectively will also be transported downstream. By the end of April in the first year the amount of sediment transported downstream increases to 92, 71, 65, and 55 percent for fine sand, medium sand, coarse sand, and very coarse sand respectively. After one year the amount of sediment transported downstream increases to 95, 84, 74, and 67 percent for fine sand, medium sand, coarse sand, and very coarse sand respectively.

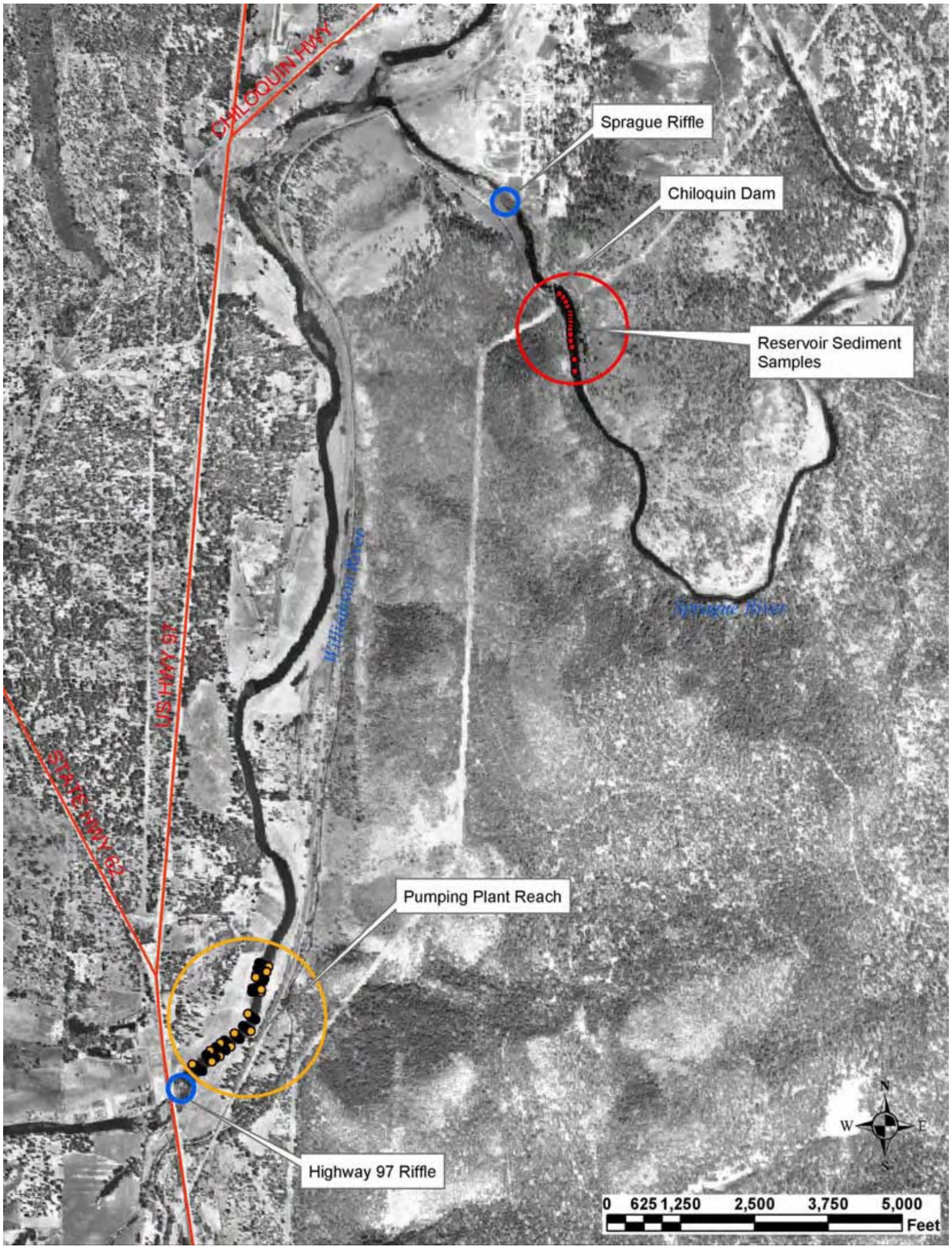


Figure 4-1. Location of the Highway 97 Riffle, Pumping Plant Reach, Sprague Riffle, and Reservoir Sediment Samples

Table 4-2 shows the mass of sediment in tons that would remain in the river channel upstream from the Highway 97 Bridge over time under the Dam Removal Alternative.

Table 4-2. Mass of Sediment (Tons) Remaining in the River Channel Upstream from the Highway 97 Bridge Over Time, Assuming Chiloquin Dam is Removed in October[a]

DATE	CLAY AND SILT	VFS	FS	MS	CS	VCS	TOTAL CLAY/SILT/SAND
01-Oct, Year 0	24,100	5,410	6,090	7,630	7,270	5,270	55,700
15-Mar, Year 1	0	0	2,500	4,810	5,310	4,160	16,800
30-Apr, Year 1	0	0	490	2,220	2,550	2,370	7,620
30-Sep, Year 1	0	0	310	1,220	1,890	1,740	5,160
15-Mar, Year 2	0	0	0	0	270	600	860
30-Apr, Year 2	0	0	0	0	20	130	140
30-Sep, Year 2	0	0	0	0	0	60	60
15-Mar, Year 3	0	0	0	0	0	0	0

a. Based on probability values from Table 4-1

Source: Reclamation 2005

As the slope of the lower Williamson River decreased, so would the sediment transport capacity. Transport of sand-sized sediment from RM 7.0 to 4.5 would likely take several years to a decade, while transport from RM 4.5 to Upper Klamath Lake would take decades. It is expected that most of the sediment released during dam removal would be stored in the lower Williamson River, which has a history of being extensively dredged.

Reclamation (2003) estimated if the total sediment volume behind the dam were spread out over the entire lower 4 miles of the Williamson River, sediment would deposit to a depth of approximately 4 inches. Sediment actually will move as a wave from the dam to this lower river reach (0-4 miles), and some of the mass will be deposited (for varying periods of time) in other stretches of the Sprague and Williamson Rivers. Sediment will deposit in intermediate stages until a dynamic equilibrium is reached. The lower Williamson River is actually a dredged, over-widened channel that is sediment-starved, so the sediment may provide a benefit to this portion of the river (Mark Buettner, personal communication April 7, 2005).

Modeling showed that if a hypothetical initial wave of sediment equal to the entire mass assumed to mobilize from the Chiloquin Dam reservoir, distributes between RM 3.76 and 3.21, it would not exceed 3 feet of deposition. Transport capacities between RM 3.76 and 3.21 are relatively high so any deposition will only be temporary. Farther downstream, transport capacity at RM 2.5 is relatively low and reservoir sediment will accumulate in this area until the transport capacity is high enough to move sediment to lower river cross-sections.

At lower flows the water surface elevation at RM 3.76 is the same as the Upper Klamath Lake water surface elevation, so, the minimum depth of flow would not fall below 7 feet. Therefore, there will be no effect on navigation or fish passage on the lowest portion of the Williamson River even with temporary sediment deposition. The water surface elevation between RM 3.76 and 3.21 is predicted to increase approximately 2 inches when sediment is deposited during high flow (16,000 cfs). At flows ranging from 300-10,000 cfs, there is no measurable change in water surface elevation as a result of sediment deposition in the lower Williamson River. Therefore, no impacts to flooding potential would be expected from the deposition of sediments in the lower Williamson River from the removal of Chiloquin Dam.

Because the sediments in Chiloquin Reservoir have been classified as suitable for unconfined aquatic disposal, the transport and deposition of these sediments downstream would likely have no adverse impact on the sediment composition of the lower Williamson River.

In addition to the initial release of sediment, construction activities at the dam may result in temporary increases in turbidity throughout the demolition process.

This alternative includes construction of a pumping plant to deliver water to the MPID and three small pumping stations to deliver water to affected landowners that will no longer have access to water from the MPID canal. The installation of the small pumping stations will have minimal impact on water quality, mainly consisting of a temporary increase in turbidity over a short period of time. The entire installation of each pumping station is expected to take about a month.

The construction of the main pumping plant will require the installation of a cofferdam in the Williamson River approximately 50 feet offshore of the plant site, for a length of about 380 feet. The dam would be approximately 10 to 15 feet high and would be constructed of sheet metal pilings. The dam may be in place up to one year. After installation of the dam, fish caught behind the dam would be trapped and released back into the river. This portion of the river is approximately 200 feet wide. The free-flowing portion of the river would be about 150 feet. Therefore, the dam would not infringe on fish migratory routes and would not substantially change the velocity of water moving through this area. Larval drift in this area tends toward the opposite shore, so the dam should not impact larval drift. The cofferdam is not located near any riffles that make up the most important spawning habitat for the endangered shortnosed and Lost River suckers. Installation of the cofferdam will temporarily increase turbidity. Once in place, the cofferdam will help to contain ongoing increased turbidity due to construction.

4.2.3 Dam Retention With Fish Passage Improvements Alternative

This alternative would maintain the existing channel and reservoir morphology upstream of Chiloquin Dam. Suspended sediment (wash load) would continue to be transported downstream of the dam, while bedload would continue to be cut off from downstream transport.

Construction of the natural rapids structure would change the channel morphology in the vicinity of the dam. The material used for channel construction would likely be similar in size to the existing cobble and boulder deposits in that area. Any channel morphology changes resulting from construction of the rapids would be limited to within approximately 800 feet of the dam.

Construction activities at the dam may result in temporary increases in turbidity throughout the construction process.

4.2.4 Partial Dam Removal Alternative

Because this alternative involves removal of nearly the entire existing dam structure, the effects on acute sediment supply and transport would likely be similar to those identified under the Dam Removal Alternative. Annual operation of the spillway gates would result in the erosion and transport of a small volume of sediment to the downstream river channels. Upstream of the new spillway structures, the channel would not reach equilibrium because the area would be cyclically inundated and dewatered, potentially leading to erosion of reservoir banks. Localized channel bed scour at the new hydraulic structures would be expected.

4.3 Ecology

The impacts associated with the proposed action and the alternatives are related to construction activities and sedimentation following dam removal. These activities may affect wetlands, threatened and endangered species and other species identified by the Chiloquin collaborator's group as occurring near the project site. Threatened and endangered species are discussed in Section 4.4 and wetlands are discussed in Section 4.5.

4.3.1 No Action Alternative

Under the No Action Alternative, fish passage at Chiloquin Dam would not improve. The undersized fish screen would continue to be subject to overtopping, and it would not be replaced to meet current fish screen standards. There would be no additional impacts on aquatic or terrestrial species.

4.3.2 Dam Removal Alternative

The Dam Removal Alternative involves removing the dam and all associated structures. As part of this alternative, the existing Williamson River pumping plant on Highway 97 would need to be upgraded or a new pumping station would be required to supply irrigation water to the MPID. Either pumping plant option would require a fish screen at the intake to prevent fish entrainment. Fish screens would be designed to meet current federal and state criteria and would protect larval, juvenile, sub-adult, and adult species of sucker, redband trout, and lamprey from the effects of impingement and entrainment.

Dam removal activities and the construction of a pumping plant and associated pipeline would result in minimal, short-term negative impacts in upland areas. Short-term impacts would include increased pedestrian and truck traffic and temporary road construction. These impacts could be mitigated by encouraging the use of established roadways and paths and following the best management practices (BMPs) (see Appendix C).

Under the Dam Removal Alternative, the reservoir above Chiloquin Dam would be dewatered. The reservoir behind the dam extends upstream approximately 3,600 feet. The reservoir is 1 to 2.5 times wider and 1.7 to 4.4 times deeper than the unimpounded river. Dam removal would result in dewatering the reservoir and exposing two narrow strips of land on either side of a newly established river channel.

Following dam removal, the river channel upstream of the structure would likely begin incising rather rapidly (days to weeks) through the aggraded sediments. Because of the steep slope of the Sprague River (upstream and downstream of the dam) and non-cohesive sediments in the reservoir, the river would proceed through the progressive processes of degradation, widening, and aggradation until arriving at a quasi-equilibrium channel within a relatively short period of time (several years, depending on the magnitude and frequency of effective discharges) (Reclamation 2003).

Revegetation of the narrow, newly exposed sediment beds would be delayed until 1 year after dam removal to allow for natural vegetative recruitment. A vegetation management plan would be developed in consultation with the Klamath Tribes and the USFS to revegetate those areas that did not naturally fill in. During the second summer following dam removal, the vegetation plan would be implemented.

Construction areas on the Williamson River immediately adjacent to the pump station would be replanted with riparian vegetation. Vegetated areas disturbed by dam removal, pipeline construction, and canal abandonment would be reseeded using standard land reclamation practices in consultation with the appropriate landowners.

BMPs would be followed to minimize impacts to the water quality, the streambed, and any spawning habitat during construction. The dam site would be restored to near pre-dam conditions, including backfilling and regrading the MPID Main Canal to the point where the new pumping plant's pipeline would deposit water back into the canal for irrigation distribution. Unvegetated soil at the construction site that could erode would be restored using seeded topsoil (Reclamation 2003). BMPs would be followed to minimize impacts to terrestrial and aquatic resources from construction and related activities.

Construction activities related to dam removal would affect water quality because of short-term increases in downstream sedimentation as the sediment behind the dam was released. These activities could also result in increased turbidity, causing a temporary reduction in primary productivity due to reduced light penetration and smothering of benthic organisms, including periphyton and aquatic macrophytes. After construction, primary productivity would likely increase to previous levels, and macrophyte recolonization would occur (UK Marine SAC 2004, American Rivers 2002, Cornell University 2004). A sediment toxicity assessment was performed on the deposited sediment behind the dam. Data from the assessment showed that organics and heavy metals were not at levels that would adversely affect fish and wildlife species (Reclamation 2003, Attachment 6).

Supersaturation could occur in the water downstream of the dam if it were drawn down too quickly. This could result in gas-bubble disease in fish downstream of the site (Bednarek 2001). This impact could be mitigated by slowly drawing down the reservoir prior to dam removal. Negligible or no impacts are anticipated.

The USFS maintains a complete list of Region 6 Sensitive Species. The Chiloquin Ranger District has provided a modified list of Region 6 Species to include only those identified as likely present in the Klamath Basin, that may or occur within the specific project area, as indicated in Table 4-3. Species and habitat attributes are described in Section 3.3. Effects determinations have been made for those sensitive species that may be impacted by dam removal.

Table 4-3. USFS Region 6 Sensitive Species Known to Occur or Potentially Occur in the Project Area

SPECIES	SPECIES AND/OR HABITAT PRESENT	EFFECTS DETERMINATION
Klamath largescale sucker (*Catostomus snyderi*)	Yes	MIIH
Interior redband trout (*Oncorhynchus mykiss newberrii)*	Yes	MIIH
Pit-Klamath Brook lamprey (*Lampetra lethophaga*)	Yes	MIIH
Klamath River lamprey (*Lampetra similes*)	Yes	MIIH
American peregrine falcon *(Falco peregrinus anatum*)	Yes	MIIH
Bufflehead *(Bucephala albeola*)	Yes	MIIH
Northwestern pond turtle *(Clemmys marmorata marmorata*)	Yes	MIIH
Pacific fringe-tailed bat *(Myotis thysanodes vespertinus*)	Yes	MIIH
Pacific pallid bat *(Antrozous pallidus pacificus*)	Yes	MIIH
Klamath pebblesnail (*Fluminicola n. sp. L*)	Yes	MIIH; potential for habitat to be impacted by sediment released from behind the dam

Effects Determination Code for Region 6 Sensitive Species
MIIH = The project may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species.

This alternative includes the abandonment and backfilling of portions of the MPID canal. In some locations on the Sprague River, the canal forms a barrier to cattle reaching the river. In places where the canal is backfilled and no longer blocks cattle access to riparian habitat, a fence will be installed to provide a barrier.

4.3.3 Dam Retention With Fish Passage Improvements Alternative

Under the Dam Retention With Fish Passage Improvements Alternative, a new fish screen structure in the MPID Main Canal and either two new fish ladders at Chiloquin Dam or a natural rapids structure would be constructed. Replacing the existing fish screen structure with a new upgraded screen would minimize fish entrainment. A new fish ladder would likely improve fish passage for multiple species. However, fish passage improvements could still delay the movement of upstream migrating fish (Reclamation 2003). Migration delays could reduce spawning success by altering physiological processes that are cued to the time a particular fish moves upstream to spawn. Some fish that did not readily find the fish ladder entrance or were not strongly inclined to move up through the ladder could also drop downstream to spawn in what is generally considered lower quality habitat (Reclamation 2003).

The dam's presence increases the risk to upstream or downstream migrating fish moving through the ladder or dropping over the dam. Fish are also more vulnerable to poaching and predation. If logs or debris blocked one of the ladder cells, fish migration would be blocked until the debris was removed. This effect could be mitigated with regular ladder maintenance. If large numbers of fish moved into a ladder, there would be an additional risk of suffocation, as has been documented in fish ladders at other lakes (Reclamation 2003). This effect could be mitigated by regularly monitoring the fish ladders.

The natural rapids option could provide an alternative to fish ladders although they are unproven for the species in the vicinity of Chiloquin Dam. The natural rapids structure may allow fish to migrate past the dam while still maintaining the gravity diversion at the dam. This structure would not restrict the size of the channel and would provide a relatively long distance to navigate the stream. However, construction of the natural rapids would require more in-water construction below the dam than the other alternatives and would likely cover existing riffle areas below the dam.

Activities associated with construction structures to improve fish passage would result in minimal, short-term negative impacts in upland areas. Short-term impacts would include increased pedestrian and truck traffic and temporary road construction. These impacts could be mitigated by encouraging the use of established roadways and paths and following the BMPs (see Appendix C).

4.3.4 Partial Dam Removal Alternative

The Partial Dam Removal Alternative would allow for unobstructed migration during the majority of the year. During this time, the beneficial impacts would likely be the same as those associated with complete removal of the dam. However, under this alternative, fish passage would not be available for two of five months during the spawning season, which may cause some unexpected delays in migration as fish encounter the ladder. The potential impacts associated with the potential upgraded fish ladder are considered to be the same as the impacts associated with the upgraded fish ladder described in the section above for the Dam Retention Alternative With Fish Passage Improvement.

Dam removal activities would result in minimal, short-term negative impacts in upland areas. Short-term impacts would result from increased pedestrian and truck traffic and temporary road construction. These impacts could be mitigated by encouraging the use of established roadways and paths and following the BMPs (BMPs) (see Appendix C).

4.4 Threatened and Endangered Species and Critical Habitats

Effects of the action refers to the direct and indirect effects of an action on the species or 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 (CFR 50 402.02). In determining the effects of the action, the project has been broken down into construction components, and the impacts to listed species are analyzed for each component.

4.4.1 No Action Alternative

Under the No Action Alternative, fish passage at Chiloquin Dam would not improve and there would be no construction activities. The undersized fish screen would continue to be subject to overtopping, and it would not be replaced to meet current fish screen standards. Fish passage would continue to be restricted. There would be no additional impacts on threatened or endangered species.

4.4.2 Dam Removal Alternative

Table 4-4 shows the construction components and a determination of whether or not they will likely result in adverse affects to listed species.

Table 4-5 shows how construction timeframes and seasonal restrictions for threatened and endangered species compare.

4.4.2.1 Bald Eagle

When describing how a proposed project may affect bald eagles, consideration must be given to actions that might disrupt breeding activities, alter suitable habitat, and/or impact the prey base (FWS 1986). Construction activities may create noise levels that have the potential to startle eagles from their nests, abandon nests completely, avoid normal routines and habitats, or increase the likelihood of chick predation. The effects of these disturbances increase in magnitude during the nesting season, since eggs and/or chicks may be present. Adults that startle from the nest may crush or knock eggs or chicks out of the nest or may remain absent from the nest for too long – either of these behaviors can affect the reproductive success of the nest for that year.

In the Klamath basin, bald eagle breeding occurs from January 1 to August 15. Two bald eagle nests are found in the project area. The one closest to the dam is known as the Modoc Rim nest (#439) and is located over one mile away. The second nest, known as the Lobert Draw nest (#938), is between ¼ and ½ mile from the Lonesome Duck pumping station and is within line-of-sight of the station.

Effects of Dam Removal

Activities that can adversely affect bald eagles as a result of dam removal consist of access, staging and hauling, dewatering the reservoir, in-water work, removing and installing the cofferdam, breaching the dam, and disposal of the concrete.

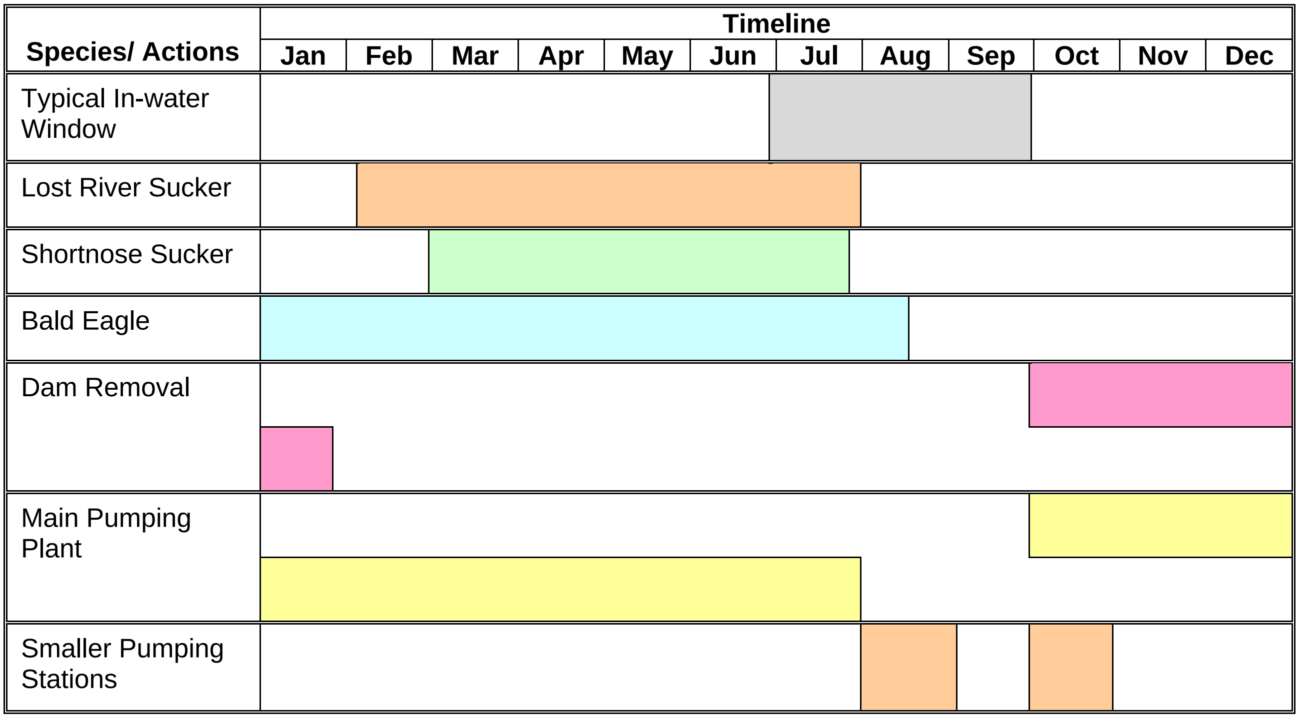
Table 4-4. Construction Activities and Determinations of Potential Adverse Affects to Listed Species

PROPOSED ACTION	ADVERSE EFFECTS TO LISTED OR PROPOSED SPECIES AND CRITICAL HABITAT				
	LOST RIVER AND SHORTNOSE SUCKERS	BALD EAGLE	BULL TROUT	BULL TROUT CRITICAL HABITAT	SUCKER PROPOSED CRITICAL HABITAT
Dam Demolition					
Access/staging/hauling	Yes	Yes	No	No	Yes
Dewatering reservoir	Yes	Yes	No	No	Yes
In-water work	Yes	Yes	No	No	Yes
Cofferdam (remove/install)	Yes	Yes	No	No	Yes
Breach dam	Yes	Yes	No	No	Yes
Concrete disposal	Yes	Yes	No	No	Yes
Kircher Pump Station					
Access to Sprague River	No	No	No	No	No
Install river pump/discharge pipe	Yes	No	No	No	Yes
Install new fish screen	No	No	No	No	No
Sandbag cofferdam	Yes	No	No	No	Yes
Lonesome Duck Pump Stations					
Access to Williamson River	No	No	No	No	No
Install river pump/discharge pipe	Yes	No	No	No	Yes
Install new fish screen	No	No	No	No	No
Sandbag cofferdam	Yes	No	No	No	Yes
Main Pump Plant/Fish Screen					
Access/staging/hauling	Yes	Yes	No	No	Yes
Cofferdam (remove/install)	Yes	Yes	No	No	Yes
In-water work	Yes	Yes	No	No	Yes
Construction	Yes	Yes	No	No	Yes
Plant	Yes	Yes	No	No	Yes
Fish screen	No	Yes	No	No	No
Main discharge pipe	Yes	Yes	No	No	Yes
Temporary operation of plant	Yes	No	No	No	Yes
Canal Abandonment	Yes	Yes	No	No	Yes
Power to Pumping Station	No	No	No	No	No
Long-term Operation and Maintenance	No	No	No	No	No
Fish Screen	Yes	No	No	No	No
Overhead Powerlines	No	Yes	No	No	No

Noise-generating activities associated with dam demolition that may impact the bald eagle include blasting, rock drilling, hauling concrete, and use of heavy equipment. Increased foot and vehicle traffic also has the potential to impact this species.

Typical noise emissions from construction equipment such as trucks, front-end loaders, bulldozers, excavators and other heavy equipment that may be used during demolition range from 70-85 dBA at a 50-foot distance (Parsons 2003).

Table 4-5. Construction Timeframes and Seasonal Restrictions for Threatened and Endangered Species



Noise decreases by 6 dBA every time the distance from the source is doubled. This effect is influenced by topography (e.g., water carries sounds better than ground or tree cover). Without taking topography into account, a noise level of 95 dBA at the construction site would result in 63 dBA, approximately ½ mile from the source. A study conducted in 1987, evaluated the disturbance effects of noise on eagles (Botteroff 1987). The study determined that acceptable noise levels for bald eagles were not to exceed 65 dBA or 10 dBA above ambient peak levels within 0.5 miles of any construction area.

The eagle nest closest to the dam is known as the Modoc Rim nest (#439) and is located over one mile away. The loudest pieces of equipment would have a combined noise level of 95 dBA at a 50-foot reference distance. This is a conservative noise estimate since all pieces of equipment rarely operate all at once. Based on topography and distance, noise levels at the Modoc Rim nest would be well below 65 dBA. To further minimize noise impacts to this nest, work is scheduled for fall and early winter, which will avoid the particularly sensitive portion of the eagle nesting season (January 1 to August 15).

The Bald Eagle Recovery Plan (FWS 1986) prohibits construction-related activities within 1320 feet of nests and roosts during periods of eagle use. However, if eagles have good line-of-sight from the nest to the construction activity, the restrictions apply up to 2640 feet. The Modoc Rim nest site is outside either of these restrictive boundaries.

Blasting can produce short-term noise levels between 100 and 120 dBA, depending on the methods used to muffle the sound. However, because no blasting will occur during the sensitive eagle breeding period, no adverse effect to bald eagles is anticipated.

Eagles winter in the Klamath Basin from early October to March 15, but are not known to roost in the project area. However, if roosting eagles are located, the restrictions listed above (1320 feet and 2640 feet, depending on line-of-site conditions) would be applied.

No nest trees or roosting habitat will be removed during dam demolition, so these types of habitat will not be adversely affected.

The primary prey base for the eagle (waterfowl) may be temporarily impacted when the dam is removed, as the reservoir behind the dam is currently providing habitat for water birds that the eagles may prey upon. Once the water leaves the reservoir and the edges of the reservoir dry up, there will be less open-water habitat for ducks and other waterfowl to use. However, it is expected in the long term, that the edges of the reservoir will flood seasonally and create fringe wetlands that will be valuable as a source of food and refuge for waterfowl. Hence, as the river system reverts back to its pre-dam status, the numbers of waterfowl may increase.

Critical habitat has not been designated for the bald eagle; therefore, none will be impacted as a result of this project.

Effects of Installing the Kircher Pump Station

Construction activities associated with installing the Kircher pumping station that may impact the bald eagle include building and removing the cofferdam, installation of a river pump and discharge pipe, and accessing, staging and hauling materials to and from the site.

The proposed location of the Kircher pumping station is within a mile of the Modoc Rim nest (#439), but is not within line-of-sight. Combining all the noise levels together would generate a conservative estimate of 95 dBA at a 50-foot reference distance. Decreasing the noise level by 6 dBA for every doubling of distance, noise levels at the Modoc Rim nest would be well below 65 dBA. The types of equipment used, the noise generated, and the duration of the noise would be substantially less than those at the dam. There would be no blasting, no in-water work, and the small pumping station would be built in a fraction of the time needed to demolish the dam. The nest is not within line-of-sight, so the Recovery Plan restrictions would not apply. No new overhead powerlines will be needed, as power already exists at this site.

Wintering eagles are not known to roost near the proposed Kircher pumping station site, so will not be adversely affected. Construction of the Kircher pump will occur during the fall, outside both the nesting and winter roosting season for eagles.

No snags, nest trees, or roosting sites suitable for eagle use will be destroyed at the pumping station site. The primary prey base for the eagle (waterfowl) may be temporarily displaced from the river near the station during construction, but the effects would be short-lived, and there are plenty of alternative locations for waterfowl to congregate.

Critical habitat is not an issue for bald eagles, as none has been designated.

Effects of Installing the Pump Stations on the Upper and Middle Lonesome Duck Properties

Construction activities which may impact the bald eagle associated with construction of two water delivery pumping stations for the Upper and Middle Lonesome Duck property include building and removing a cofferdam, installation of two river pumps and discharge pipe, and accessing, staging and hauling materials to and from the site.

As with the Kircher pumping station, equipment and personnel needed to build the Lonesome Duck pumps is far less than what is required to tear out the dam. Noise levels would reach about 95 dBA, if all the equipment operated at once. A more reasonable noise estimate is 70 to 85 dBA, since simultaneous use of equipment is unlikely. By using the distance formula for noise, a noise level of 95 dBA at the construction site would result in 70 dBA, ¼ mile away and 63 dBA, ½ mile away. The Lobert Draw nest (# 938) is between ¼ and ½ mile from the site. Based on the topography and distance from the site, noise levels at the Lobert Draw nest are just under the acceptable 65 dBA threshold.

In addition, the eagles appear to be habituated to the current level of noise associated with Highway 97 and the railroad, approximately 3180 feet and 1963 feet from the nest, respectively. The eagles at this nest site have been using the area actively since 1977, and have produced an average of 2 young each year. Background noise associated with traffic on highways and freight rail cars has been estimated to be 70 dBA (USDOT 1998). The eagles, therefore, are likely habituated to existing noise levels that are very similar to those that will be generated during construction of the pumping stations.

Construction of the Lonesome Duck pumping stations will occur during late summer, and will therefore, fall outside the eagle nesting season.

Power to the Upper Lonesome Duck property will be supplied from an existing source to new power poles that will be erected on either side of the river. The new poles may increase the likelihood of death or injury by electrocution if eagles were to land on top of the poles. To mitigate this potential adverse affect, raptor-friendly poles will be installed. These poles are designed to prevent electrocution due to the spacing of wire and wood struts along the top. There is also a possibility that eagles may collide with the new powerline spanning the river at this location. Although the likelihood of a wire collision is low, to mitigate the potential, colored balls, similar to those used at airports for high visibility will be attached to the wire. Based on the implementation of these mitigations, no adverse affects are anticipated from supplying power to the Upper Lonesome Duck pumping station. The Middle Lonesome Duck pumping station already has a source of power and no additional power will be supplied for the middle site.

No nests, snags, or roost sites will be removed during construction of the pumping stations. As with the Kircher pumping station, waterfowl (preferred eagle prey) near the Lonesome Duck property may be displaced from the immediate vicinity during construction, but the disturbance is temporary in nature and there are ample alternate areas of the river for ducks to utilize.

Effects of Construction of the Main Pumping Plant

Impacts to the bald eagle associated with constructing the main pumping plant located on the Lonesome Duck Property, include construction of the plant, installation of the fish screen, construction of the main discharge pipe and installation, installation and removal of a cofferdam, and accessing, staging and hauling materials to and from the site. The proposed pumping plant is within the ½-mile buffer for the Lobert Draw nest site.

More equipment and workers will be needed to install the main pumping plant as compared to the much smaller pumping stations on private property. Noise levels would reach about 95 dBA if all the equipment operated at once, but assuming that the equipment operates intermittently, a more reasonable noise estimate is 70 to 85 dBA. By using the noise formula, a noise level of 95 dBA at the construction site would result in 70 dBA, ¼ mile away and 63 dBA, ½ mile away. Based on the topography and distance from the site, noise levels at the Lobert Draw nest are just under the acceptable 65-dBA threshold.

In addition, the eagles appear to be habituated to the current level of noise associated with Highway 97 and the railroad, approximately 3180 feet and 1963 feet from the nest, respectively. The eagles at this nest site have been using the area actively since 1977, and have produced an average of 2 young each year. Background noise associated with traffic on highways and freight rail cars has been estimated to be 70 dBA (USDOT 1998). The eagles, therefore, are likely habituated to existing noise levels that are very similar to those that will be generated during construction of the main pumping plant.

No nests, snags, or roost sites will be removed during construction of the pumping plant. As with the smaller pumping stations, waterfowl near the main plant may be temporarily deterred from using the site, but the disturbance is short term, and many other river habitats exist nearby for waterfowl use.

Construction of the main pumping plant will occur during mid-fall through the following mid-summer months, and therefore, will take place during both the eagle nesting season (January 1 to August 15) and eagle winter roosting period (late fall to early spring). However, no adverse affects to nesting eagles are anticipated because the noise thresholds from construction fall within an acceptable range as described above, and the eagles are already habituated to train and vehicle traffic. Wintering eagles are not known to use the pumping plant area, so will not be adversely affected.

Effects of Canal Abandonment

The upper section of the Main Canal (excluding the piece that runs through the Kircher agricultural property) will be backfilled with concrete pieces from the demolished dam, overlaid with soil, and planted with native vegetation. The portion of the canal on the Kircher property that will not be used for concrete disposal, will be filled with soil and revegetated, or left open in accordance with landowner preferences. The Lobert Draw nest (#938) is within ½ mile of this portion of the Main Canal.

These activities will be conducted outside the eagle breeding season of January 1 to August 15 and will not involve blasting or use of equipment that will cross the 65 dBA threshold. Given the calculations provided in the preceding paragraphs regarding decibel changes as related to distance and topography, the noise emitted from canal abandonment activities will have little affect on eagles. The eagles at the Lobert Draw nest are apparently habituated to noise, because the railroad and highway (averaging 70 dBA) are within 1963 and 3180 feet of the nest, and the eagles have continued to fledge young successively each year since 1977. The canal is within line-of-sight of the Lobert Draw nest, and the protective buffers described above will apply if construction occurs within periods of eagle use.

Backfilling the canal will not remove suitable eagle habitat, nor affect critical habitat, as none has been designated. Waterfowl currently using the canal (when the canal supports water) will be forced to find other sources of water. However, other sources of waterfowl habitat are abundant in the Klamath Basin, including other parts of the river in the project area, Upper Klamath Lake, and the National Wildlife Refuges.

Effects of Supplying Power to the Pumping Stations

Powerlines will be carried over the river via the underside of the Highway 97 Bridge and then buried in a trench to reach the main pumping plant. The one exception is the Upper Lonesome Duck pumping station, described earlier, in which the power will be run overhead across the river. BIA will request from the electric utility that colored balls be attached to the wires. for equipment used to install the powerline system will fall within the acceptable 65-dBA range. higher visibility and the power poles will be made raptor-friendly.

No eagle habitat will be removed when the powerline is carried across the Highway 97 Bridge, and none will be destroyed during trench-digging to the main pumping plant, as the ground is mostly open pasture. Power already exists for the Kircher and Middle Lonesome Duck pumping stations, so no further power will be needed. The powerline installation is primarily an upland function, and will not displace waterfowl (a primary component of the eagle's diet).

No critical habitat will be removed as none has been designated.

Effects of Long-term Operations and Maintenance

The Modoc Point Irrigation District will be responsible for long-term operation and maintenance. They expect to conduct any needed maintenance in March before the irrigation season begins, and again in October when the season is over. Maintenance activities may simply require the use of a pickup truck to get personnel to the site, or if repairs are needed, the use of a crane to hoist up the pumps. MPID also anticipates they will conduct weekly inspections to check the fish screens and overall operation of the pumps from April to the end of September. Routine activities will not require in-water work and will not impact waterfowl. If actions arise that may affect listed species, they will be coordinated through the FWS and accomplished to minimize impacts.

The two bald eagle nests within the project vicinity are likely well-habituated to the existing levels of noise (that includes highway traffic and railroad trains) as evidenced by the nesting success of both pairs. No suitable habitat will be removed and no critical habitat for the species has been designated. The vehicles and personnel needed to routinely maintain the project should have little affect on the bald eagle, regardless of when the inspections occur, due to the very low levels of noise and human activity required.

Overall Effect to Eagles from all Construction Components

The project component that is most complex and that will produce the highest level of noise (dam removal) will occur outside the nesting and winter roosting periods for eagles. Actions to construct the pumping stations on private property are much smaller in level of impact and scope and will also occur outside these sensitive periods. Although construction of the main pumping plant will overlap into both nesting and wintering timeframes, the eagles closest to this site are well-habituated to current levels of highway and railway noise. In addition, the noise generated from construction will be no louder than what currently exists. No habitat suitable for eagle use will be removed and the prey base will remain largely unaffected. The new powerline over the river will be made raptor-friendly. Overall, the project is not anticipated to have an adverse affect to bald eagles.

4.4.2.2 Lost River and Shortnose Suckers

Listed suckers are typically impacted by actions which may alter migration, affect spawning ability and access, disturb feeding and rearing patterns, prevent escape from predation, elevate risks of physical harm or injury, result in entrainment, cause avoidance behavior, and affect water quality. Several, all, or none of these affects may result, depending on the type of action proposed.

Lost River and Shortnose Sucker Proposed Critical Habitat

Critical habitat has been proposed for both species of suckers, beginning at Upper Klamath Lake and extending up the Sprague and Williamson Rivers about 60 miles to the town of Beatty, Oregon, near the confluence of the Sycan River. Project activities occur near and within both rivers, and therefore, the project occurs within proposed critical habitat for Lost River and shortnose suckers.

Critical habitat is comprised of essential features that will aid in the conservation of the species and areas within critical habitat may require special management or protection. These features are known as Primary Constituent Elements (PCEs) and in general, include: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally, (5) habitats that are protected from disturbance or are representative of the historical geographical and ecological distribution of a species (50 CFR 424.12).

The draft *Lost River and Shortnose Suckers Proposed Critical Habitat Biological Support Document (FWS 1993)* has tailored these features to specifically address the needs of the suckers. Critical habitat for suckers may provide one or all of the following: an adequate supply of good-quality water to support the life stages of the species; habitat that historically or currently can provide refuge from predators or stress; areas to feed, spawn, or rear; or corridors that link these areas. The PCEs determined to be of most value to the Lost River and shortnose suckers include:

Water: An amount of water of sufficient quality delivered to target areas in the watershed that will support the various life stages of the suckers, including wetland-related habitats that will maintain and enhance populations.

Physical Habitat: Areas that are currently or were historically used by suckers to successfully escape stress and predation, spawn, rear, and feed, including areas that link these types of habitat, and seasonally used areas.

Biological Environment: Adequate availability of food for all life stages, sufficient refuge from predators, a balance of native and introduced stocks, and habitats healthy enough to minimize competition and parasitism.

Six Critical Habitat Units (CHUs) have been proposed in the Klamath Basin. The project is located in CHU #5 – The Williamson and Sprague Rivers. CHU #5 is important because it includes most of the spawning habitat of the sucker populations in Upper Klamath Lake.

Effects of Dam Removal

Lost River and shortnose suckers at all life stages are susceptible to the impacts of construction activities associated with dam demolition, including dewatering the reservoir behind the dam, building and removing the cofferdam, demolished concrete disposal, and in-water work associated with any of these actions.

Juvenile and adult suckers may be directly harmed, killed, or displaced during in-water activities by temporary increases in turbidity or being crushed as equipment moves through the water or compacts the gravel on the river bottom. Fish may also avoid the area to escape heavy machinery and vibrational noise. To help mitigate these effects, most in-water work will occur during the late summer, fall, and early winter months when the lowest numbers of fish are present (i.e., little or no migration or spawning are occurring, and no larvae are present).

Blasting may be used to breach the dam and break the concrete into chunks small enough to be hauled away. Blasting may cause underwater pressure waves and vibrations that can kill nearby fish or interfere with fish movement and cause behavioral and physical stress.

Hauling concrete from the water is likely to bury bottom-dwelling organisms and create short-term turbidity increases. Turbidity causes both avoidance behavior and, with severe and frequent exposure, may reduce survival and growth rates (Scannell 1988). However, plumes of sediment can also provide cover and refuge from predators (Gregory and Levings 1988). The plume generated would cause the greatest level of impact at its source, and would dissipate as the plume is carried away downstream.

Accessing, staging, and hauling materials to and from the site is not likely to impact the endangered suckers, as these activities will not be conducted within the water. To further minimize any potential impacts, a Spill Prevention Plan will be implemented to ensure that chemicals, gasoline, or other toxins and debris do not enter the water. For in-water demolition, equipment may introduce contaminants (fuel, lubricants, hudraulic fluids) that can alter the pH of the water and create toxic conditions for many aquatic species of animals and plants. To help mitigate these effects, all necessary in-water work would be conducted following BMPs. In addition, any construction activities that would require vehicles to enter the Sprague River would be scheduled to avoid impacts to fish spawning areas located immediately below the fish ladder entrance on the right abutment of the dam.

Cofferdam construction may result in the destruction of riparian vegetation, including mid-size willow trees that occur intermittently along the banks of the project. Overhanging riparian vegetation provides shelter and shade for suckers, and helps cool the water during the summer months, thereby, improving water quality. Removal of any streambank vegetation may be offset by the wetland gains above the reservoir once the water is released and the wetlands begin to develop along the fringe.

Lowering the water behind the dam may lead to entrainment of fish. During initial dewatering of the reservoir and after installation of the cofferdam, any stranded fish behind the dam would be trapped and released back into the river. A salvage plan will be developed for stranding that may occur throughout any component of the project. The cofferdam would not infringe on fish migratory routes and would not substantially change the velocity of water moving through this area. Larval drift will be over by the time the cofferdam is in place (and larval tend to drift toward the opposite shore, anyway), so the cofferdam should not impact the drifting of larvae. The cofferdam is not located near any riffles that make up the most important spawning habitat for the suckers.

Sedimentation downstream following dam removal would not likely impact riffles which are considered prime spawning areas directly below the Chiloquin Dam to RM 7.0 on the Williamson River. The Reclamation (2005) sediment transport study on riffles found that sediment transport rates for the riffle downstream from Chiloquin Dam and the riffle upstream of the Highway 97 Bridge (Williamson RM 7.0) are high enough to transport the entire mass of sand-sized reservoir sediment downstream by the first March 15 following dam removal.

Even though sediment transport rates through the riffles are high enough to remove the entire mass of sediment quickly, the actual time to transport the sediment through the whole reach will depend on transport rates through the reaches between the riffles. These areas between the riffles are areas likely to be used by drifting larval suckers. Short-term impacts, lasting from 1 to 3 years following dam removal, to larval habitat may occur directly below the dam to RM 7.0 of the Williamson River.

A longer-term impact would be expected on any spawning and larval habitat that occurs between RM 7.0 and RM 4.5 on the Williamson River. Transport of sand-sized sediments in this stretch would likely take several years to a decade (Reclamation 2003). However, the majority of the sucker spawning habitat occurs between RM 7.0 of the Williamson River and the Chiloquin Dam (Bienz and Ziller, 1987; Coleman et al 1989). A decades-long impact may occur between RM 0 (Upper Klamath Lake) and RM 4.0 on the Williamson River (Reclamation 2003) and it is expected that most of the sediment released during dam removal would be stored in the lower Williamson River (Reclamation 2003). Transport of sediment in this stretch of the river may take decades. However, the lower Williamson River is actually a dredged, over-widened channel that is sediment-starved, so the sediment may provide a benefit to this portion of the river (Mark Buettner, personal communication, April 7, 2005).

Sediment released from behind the dam can adversely affect suckers and other aquatic species if chemicals and metals have accumulated in sufficient quantities so that water quality becomes impaired, degraded, and undesirable for aquatic life when sediment is transported downstream.

The reservoir's storage capacity has been reduced as sediment has accumulated, and depending on upstream land uses, there is potential for the sediment trapped behind the reservoir to have become contaminated over time. To address these potential sediment toxicity effects, Reclamation assessed the toxicity characteristics of the sediment behind Chiloquin Dam in Phase I of the fish passage study (Reclamation 2003, Attachment 6).

Reclamation used a coring device to collect sediment samples at 13 locations in the reservoir during October 2002 (Reclamation 2003). The first sample was collected the farthest from the dam (4,500 feet); subsequent samples were collected on transects moving progressively downstream toward the dam. The number of samples collected was based upon a USACE Sampling Analysis Plan. Reclamation then followed the sediment toxicity evaluation process developed in the joint agency dredging and aquatic disposal guidance manual - *Dredged Material Evaluation Framework, Lower Columbia River Management Area* (USACE et. al., 1998 as reported in Reclamation 2003). The protocol outlined in this manual calls for a ranking scheme or tiered classification criteria as the most cost-effective means to evaluate the potential environmental impact from dredging operations.

Reclamation followed Tier I and Tier II protocols to (1) examine past land use activities upstream of Chiloquin Dam in order to identify potential sources of contamination to sediment, focusing on the number, type, and proximity to chemical sources (existing and historical) and (2) analyze the chemical concentration of sediment samples to determine if they are acceptable for unconfined aquatic disposal. Chemical evaluation tests were conducted for the presence of metals, hydrocarbons, phthalates, phenols, extractable organics, and pesticides. Based upon these tests and following acceptable protocols, Reclamation found the following:

- Water that flows into Chiloquin reservoir originates in a watershed with few anthropogenic influences.

- No chemicals measured in the sediment samples exceeded screening level criteria, but laboratory reporting limits for some organic compounds were insufficient relative to their screening level criteria. Based solely on the chemical assessments alone, Chiloquin Reservoir sediment was not classified as suitable for unconfined aquatic disposal because of reporting limit problems.

- Land use information on the Sprague River watershed justifies removing several classes of organic compounds from the standard list of chemicals of concern, including those compounds with inadequate reporting limits.

- Based upon all available information on the Chiloquin Reservoir sediment, physical data, chemical data, and land use assessments, the sediment was classified suitable for unconfined aquatic disposal.

The results of these toxicity tests indicate that adverse affects to the aquatic ecosystem is expected to be extremely low if sediment were allowed to be released naturally following dam removal. Due to the uncertainty associated with laboratory reporting limits on some organic compounds, it would be necessary to collect additional sediment samples and conduct further chemical tests, with reporting limits sufficient to evaluate their potential impact without question. However, Reclamation's protocols and testing procedure for this sediment study has been reviewed and approved by Oregon Department of Environmental Quality, the state agency responsible for issuing Water Quality Certifications in the USACE's Section 404 Clean Water Act permitting process.

Dam removal would eliminate a substantial barrier to fish migration that prevents or impedes the Lost River and shortnose suckers from reaching potential spawning areas in the upper reaches of the Sprague River watershed. Dam removal should return the river to a more natural flow, increasing available spawning and foraging habitat for suckers and resulting in a beneficial long-term impact.

Effects to proposed critical habitat for the suckers includes short-term adverse effects and long-term beneficial effects. In the short term, dam removal may alter critical habitat in and around the project area by altering the physical habitat. However, in the long run, dam removal would eliminate a substantial barrier to fish migration that prevents or impedes the endangered Lost River and shortnose suckers from reaching potential spawning areas in the upper reaches of the Sprague River watershed. Approximately 80 miles of habitat upstream from the dam will be available, not only to the suckers, but to many other aquatic species as well (lampreys, sculpins, native fish). This habitat will provide access to new wetlands, increase amounts of cover to escape stress and predation, create new and increased opportunities to spawn, rear, and feed, and potentially lower levels of competition and parasitism. Dam removal should facilitate pre-dam conditions and provide substantial benefit (at least in terms of migration and access to historical spawning grounds) to listed suckers.

Effects of the Kircher Pump Station

Activities that may impact the Lost River and shortnose suckers associated with construction of the Kircher pumping station include installation and removal of a sandbag cofferdam, installation of a river pump and discharge pipe, and installation of a new fish screen. A small cofferdam would be installed composed of various-sized sandbags. In-stream work is not expected to require any vehicles to actually work in the river itself. Instead, the cofferdam material will be placed using a back-hoe tractor, or an excavator, which would operate from the bank above the water line. Silt fencing and other safeguards would be in place, and the work would be accomplished in accordance with state and federal permitting requirements to maintain water quality standards.

Possible impacts to suckers include short-term increases in turbidity associated with installation and removal of the cofferdam, avoidance of the area during construction, and a low possibility of stranding behind the dam. Fish stranded behind the dam will be trapped and returned to the Sprague River, using the salvage plan to be developed. The cofferdam will not be located near any riffles that make up the most important spawning habitat for suckers. Impacts to suckers may be minimized by scheduling work to avoid critical migration, spawning, and larval drift periods, when possible.

Construction of the Kircher pumping station may temporarily impact water quality as sediment is released from placement and removal of the cofferdams. However, equipment used for cofferdam work will operate from the bank, and will not physically enter the water. No streamside trees will be removed. The physical nature of the streambed may change slightly as the cofferdam is installed and removed, but overall, the nature of proposed critical habitat in this area will remain largely unaltered.

Effects of Installing the Pump Stations on the Upper and Middle Lonesome Duck Properties

Activities that may impact the Lost River and shortnose suckers associated with the Upper and Middle Lonesome Duck pumping stations include installation and removal of sandbag cofferdams, installation of a river pump and discharge pipe, and installation of a new fish screen. Although the sandbag cofferdams would employ BMPs and be installed to meet state water quality standards, suckers may be impacted by short-term increases in turbidity associated with installation and removal. In addition, suckers may become stranded behind the cofferdam. Suckers entrained behind the dam will be trapped and returned to the Williamson River, using the salvage plan to be developed. In-water work will be conducted from the riverbank, and will not involve vehicles actually driving through the water or along the riverbed. The cofferdams will not be located near riffles that make up the most important spawning habitat for the suckers. Work would be scheduled, where possible, to avoid sensitive spawning, migration, and larval drift periods.

Construction of the Lonesome Duck pumping stations may temporarily impact water quality as sediment is released from placement and removal of the cofferdams. However, equipment used for cofferdam work will operate from the bank, and will not physically enter the water. No streamside trees will be removed. The physical nature of the streambed may change slightly as the cofferdam is installed and removed, but overall, the nature of the proposed critical habitat in this area will remain largely unaltered.

Effects of Construction of the Main Pumping Plant

Impacts to the endangered suckers associated with constructing the main pumping plant on the Lonesome Duck Property include construction of the plant, installation of the fish screen, construction of the main discharge pipe and installation and removal of a cofferdam.

Activities to access, stage, and haul materials to and from the site are not likely to impact the endangered suckers, as these activities will not be conducted within the water. However, to further minimize any potential impacts, a Spill Prevention Plan will be implemented to ensure that chemicals, gasoline, or other toxins and debris do not enter the water. All necessary in-water work would be conducted following BMPs. A portion of this work would be conducted outside the critical migrating, spawning, larval emergence, and drift timeframes, but other portions would be conducted within these sensitive time periods.

Suckers may be harmed, killed, or stressed as approximately 560 cubic yards of crushed rock from the riverbed is removed (associated with the cofferdam) following project completion. To help mitigate direct harm or fish avoidance of the area, the temporary cofferdam would be placed in a manner that would not be eroded by expected flows, near-normal flows would be maintained to minimize flooding, and the cofferdam would not exceed 55% of the river's width.

During initial dewatering and after installation of the cofferdam, any stranded fish behind the dam would be trapped and released back into the river (using the salvage plan to be developed). The cofferdam would not infringe on fish migratory routes and would not substantially change the velocity of water moving through this area. The cofferdam is not located near any riffles that make up the most important spawning habitat for suckers.

Construction of the cofferdam and the main pumping plant may result in the destruction of riparian vegetation along the riverbanks. Roughly 30 to 40 percent of the embankment shoreline has clusters of mid-sized willows. Shading of the water, which helps regulate temperature and protect water quality, and overhanging protective fish cover would be lost.

Depending on the construction method used, composition of the bottom, and wind and current conditions during construction, fill material placed in the water and suspended in the water column would temporarily increase the turbidity of the water. Material would once again be suspended in the water column upon removal of the cofferdam. Plume size would be greatest at its source and would dissipate rather quickly downstream. Suckers may suffer from a short-term decrease in water quality and may also modify their behavior to avoid the plume.

During construction and use of the cofferdam small amounts of oil and grease may be discharged into the watercourse from construction equipment. Because the cofferdam is temporary in nature, the frequency and concentration of these discharges are not expected to have more than minimal impacts on overall water quality.

Impacts to endangered suckers associated with construction of the main pumping plant, fish screen, and discharge pipe will avoid critical migration, spawning and larval drift periods when possible. However, some construction during these sensitive times is unavoidable and will occur. BMPs would be followed to minimize impacts to water quality, the streambed, and spawning habitat during construction. All work would be conducted in accordance with state and federal permitting requirements.

One element of constructing the main pumping plant is to temporarily test-operate the plant before the canal discharge structure is built. This will be a short test to make sure the pumps and controls work properly. For the test, a temporary discharge pipe will be installed, which will recirculate the water immediately back to the pump intake instead of discharging into the Main Canal. This will provide some assurance to MPID that the pump actually works before the dam is removed. This “test” should have little or no impact on the suckers as it is very short-lived in nature and does not involve in-water work.

Construction of the main pumping plant will temporarily impact water quality as sediment is released from in-water work and streamside willows are removed. The physical nature of the streambed may change as the cofferdam is installed and removed. Overall, the nature of proposed critical habitat near the main pumping plant will be altered slightly.

Effects of Canal Abandonment

As the canal is drained and prepared for rehabilitation, it is likely that fish may become trapped in residual pools of water. Before work is done anywhere along the canal, stranded fish will be salvaged (using the overall salvage plan to be developed). Monitoring will be conducted to identify areas where fish are entrained and the fish will be physically relocated to safety. Once stranded fish are removed from the canal, the remaining canal abandonment activities (placing concrete, backfilling with soil, replanting) are not expected to impact suckers, since the water will be gone and the canal will be reverted to upland habitat.

The Main Canal up to the point of its fish screen provides habitat in which suckers may feed, rear, and migrate. This habitat will be lost once the canal is abandoned. However, considering the long-term benefits of providing access to miles of critical habitat upstream from the dam that is of higher quality because it is located directly in the river and allows for potential spawning, the loss of the canal is of little or no impact to overall critical habitat importance.

Effects of Supplying Power to the Pumping Stations

Powerline activities are not expected to create turbidity and will not involve using equipment within the river itself. Erosion control practices would be implemented during trench-digging to ensure that sediment would not be carried to the river during a sudden storm event. Therefore, supplying power to the project will have little to no effect on Lost River and shortnose suckers.

Supplying power to the project should not impact the elements considered important for sucker critical habitat, i.e., no in-water work is scheduled and the physical and biological properties of the water and streambed will not be impacted.

Effects of Long-term Operations and Maintenance

Long-term operation of the new Williamson River Pumping Plant will result in the potential for sucker larvae to be entrained into the pump intake system during their downstream migration period back to Upper Klamath Lake. The long-term operation of the pumping stations installed on the Hilbert and Kircher properties pose a much smaller entrainment risk due to their being very low capacity river pumps as compared to the main pumping plant site. These pump systems are designed with state-of-the-art fish screens that meet Federal and State criteria to protect juvenile fish > 30 mm in size. Since larval suckers drifting down the Sprague and Williamson Rivers are at a 10-20 mm size range, they can be entrained through the 1.75 mm mesh openings on the main pumping plant vertical screens and to a lesser extent through the mesh openings on the pan screens installed on the smaller river pumps.

The new fish screens will be a substantial improvement over the current baseline condition. ODFW has operated a roller drum fish screen and bypass system in the Main Canal about a ¼ mile downstream of the Kircher Bridge that crosses the Sprague River since the 1960's. ODFW's screen is designed for 0.4 approach velocity and has no sweeping flow by virtue of being in the Main Canal. BIA's fish screen design criteria (0.2 ft/second approach velocity, 1.75 mm wedge wire, minimum sweeping flow of twice the approach velocity) is more conservative (i.e., offers greater protection) than the current ODFW fish screen in place and is similar to interim sucker criteria the U.S. Fish and Wildlife Service (FWS), ODFW, and California Department of Fish and Game has already adopted for the Upper Klamath Basin. Moreover, the Service has already approved BIA's proposed fish screen criteria for the main pumping plant and has indicated that these criteria will significantly reduce entrainment of fish including some reduction in entrainment of larval suckers (FWS, 2004b). Due to the favorable hydrological conditions that led to the selection of the main pumping plant location on Lonesome Duck property (see Appendices A and B), larval entrainment is expected to be substantially less than the current baseline and entrainment risks are expected to be minimized due to positive sweeping flows and the probability that a fish's exposure time on the screen surface is low.

Pickup-size vehicles that visit the project routinely for maintenance are expected to stay completely out of the river, will not cause sediment loading, and will not create disturbances that will deter fish from using the area. If more intensive efforts are needed to conduct repairs and heavier equipment is used, there is the possibility that water quality may be impacted. However, BMPs will be used to offset any impacts and reinitiation of consultation will be sought with the U.S. FWS, in the unlikely event that impacts from repairs are considered beyond those described in this document. Overall, the operation and maintenance activities will have little or no impact to the Lost River and shortnose suckers.

Routine activities to maintain the project should not impact the elements considered important for sucker critical habitat. Habitat features will considerably improve once the project is completed, as new wetland areas will sprout up along the fringes of the reservoir, and 80 miles of new habitat for spawning, rearing, feeding, and escape from predation will be opened up for the suckers to utilize. Maintaining the pumping stations should not require in-water work and will not impact the physical or biological properties of the water or streambed.

Overall Effect to Lost River and Shortnose Suckers from all Construction Components

Removing the dam and constructing the main pumping plant and smaller pumping stations involves in-water work that may physically injure, kill, trap, or harass suckers and may involve working in several areas of the river at once. In-water work may also increase turbidity, which may cause avoidance behavior or reduce survival rates. Dam demolition may create vibrational disturbances. Although much of the work will be conducted outside of sensitive spawning and larval drift periods, due to the two-year phasing of construction and the need to keep some structures in place for months at a time, construction of the main pumping plant will occur when adults are spawning or larval are drifting. Because the loss of at least one fish is likely to occur, and one component of construction will take place during spawning and drift periods, the project overall, is likely to have an adverse affect to the Lost River and shortnose suckers.

Overall Effect to Proposed Sucker Critical Habitat from all Construction Components

Water, physical habitat, and biological environment features considered important to sucker critical habitat will be altered slightly while the project is under construction, but will improve and increase once the dam is removed. Given that the critical habitat is still in the proposed stage (where the threshold for adverse affects is higher) and that the long-term benefits to critical habitat upstream from the dam are substantial, the project overall, is not likely to adversely modify or destroy this habitat.

4.4.2.3 Bull Trout and Bull Trout Designated Critical Habitat

On June 10, 1998, the Service listed the Klamath River population segment of the bull trout and the Columbia River population segment as threatened (FWS 1998). In 2002, the Service released the draft recovery plan (FWS 2002b). The Service is currently doing a 5-year review for the bull trout which will determine if the current listing status is warranted. Following completion of the 5-year review the recovery plan will be finalized. The final rule designating critical habitat for the bull trout took effect on November 5, 2004 (FWS 2004). Agency Lake was designated as a critical habitat unit for the bull trout to allow for connectivity between populations.

No bull trout are currently found in the project area and therefore, they should not be affected by the project. Bull trout critical habitat will also not be affected because it is not within the area that would be impacted by the project.

4.4.2.4 Effect Determinations

Bald Eagle

The proposed project will result in a "*may affect, not likely to adversely affect*" determination for the bald eagle based on: (1) the primary prey base for the eagle (waterfowl) may be temporarily displaced in the short term due to loss of open-water habitat in the reservoir, but may increase over the long term, as the reservoir fringes become important wetland habitat; (2) snags and/or live trees large enough for nesting or roosting will not be removed as a result of the project; (3) the project lies outside the ¼-mile buffer zone of the two eagle nests closest to the project; (4) noise associated with the project could disrupt breeding; however, the potentially noisiest type of construction (dam removal, that may include blasting) will occur outside the eagle nesting season of January 1 to August 15; and (5) the closest breeding pair of eagles have habituated to the current level of noise (which includes passage of a train) as they have successfully reared young since 1977. This effect determination requires the action agency to conduct informal consultation with the U.S. FWS.

Lost River and Shortnose Suckers

The proposed project will result in a *"may affect, likely to adversely affect"* determination for both the Lost River and shortnose suckers based on the following: (1) heavy equipment needed to construct and remove the cofferdam and to breach Chiloquin Dam is likely to smother, trap, injure, or kill one or more fish during construction; (2) although monitoring will minimize any harm, dewatering of the canal is also likely to entrain or kill one or more fish; (3) despite mitigation measures that will be implemented to protect the suckers and the overall long-term benefit of the project, it is impossible to ensure that not one sucker of either species will be harmed or killed during the course of this project. This effect determination requires the action agency to conduct formal consultation with the U.S. FWS.

Lost River and Shortnose Sucker Proposed Critical Habitat

The proposed project is not likely to result in the *"destruction or adverse modification"* of proposed sucker critical habitat. Several of the Primary Constituent Elements important to the integrity of critical habitat will be briefly impacted as a result of the project. These elements include short-term losses in habitat near and below the dam that provide refuge from stress and predators, and a potential decrease in water quality as sediments are released from behind the dam and during in-water construction. However, in the long-term, the project is expected to have a beneficial effect on critical habitat. Again referring to the Primary Constituent Elements, 80 miles of habitat upstream from the dam that is currently difficult or impossible for many aquatic species to access, will be opened up once the dam is breached. Although only a portion of this 80-mile stretch is considered "suitable" for sucker spawning, most of this stretch will at least provide refuge from predators and stress, areas for fish of all ages to feed and rear. This effect call requires that informal conferencing be initiated with the U.S. FWS.

Bull Trout and Bull Trout Designated Critical Habitat

The proposed project will have *"no effect"* to either bull trout or designated bull trout critical habitat, because neither exists in the project area. No coordination with the U.S. FWS for this species and its habitat is necessary.

4.4.3 Dam Retention with Fish Passage Improvements Alternative

Construction activites at the dam site would be similar to the Dam Removal Alternative. However, construction of the natural rapids would require more in-water construction below the dam than the other alternatives and would likely cover existing riffle areas below the dam. The dam's presence increases the risk to upstream or downstream migrating fish moving through the ladder or dropping over the dam. Fish are also more vulnerable to poaching and predation. Improved fish ladders may still slow fish migration and migration delays could reduce spawning success. The natural rapids option could provide an acceptable alternative to fish ladders although they are unproven for the species in the vicinity of Chiloquin Dam.

4.4.4 Partial Dam Removal Alternative

Construction activites at the dam site would be similar to the Dam Removal Alternative. The Partial Dam Removal Alternative would allow for unobstructed migration during the majority of the year. During this time, the beneficial impacts would likely be the same as those associated with complete removal of the dam. However, under this alternative, fish passage would not be available for two of five months during the spawning season, which may cause some unexpected delays in migration as fish encounter the ladder. The potential impacts associated with the potential upgraded fish ladder are considered to be the same as the impacts associated with the upgraded fish ladder described in the section above for the Dam Retention Alternative with Fish Passage Improvement.

4.5 Wetlands

4.5.1 No Action Alternative

There would be no impacts to existing wetlands under the No Action Alternative.

4.5.2 Dam Removal Alternative

Sediment deposition downstream of the removed dam could bury existing vegetation. However, the return to a natural flow regime could benefit native plants and communities over time (Poff et al. 1997). The transport of sediment downstream would provide an opportunity for channel change and the creation of new surfaces suitable for reproduction of riparian pioneer species (Shafroth et al. 2002). Channel change could result in dewatering of wetlands upstream and downstream of Chiloquin Dam. In addition, riparian and wetland species of concern that could be impacted by dam removal have not been identified.

Seeds of some emergent wetland species buried by sediment and submerged in water would be uncovered if the dam were removed. It has been estimated that these seeds can remain viable for between 45 and 400 years (Shafroth et al. 2002). Following dam removal, seed banks that have been buried would be expected to play an important role in primary succession on newly exposed sediments upstream of the dam. Dam removal could also increase the efficiency of long-distance transport of seeds by water, which could enhance riparian restoration efforts (Shafroth et al. 2002).

Upstream of the dam and along the margins of the current reservoir, some vegetation could be disturbed or destroyed as the river dynamics changed from reservoir to free-flowing river. Initially, vegetation would not likely be in equilibrium with the new distributions of hydroperiods. There could be a transition phase during which extensive bare areas could be colonized or mud plants uncovered as water stages declined with the draining of the reservoir. If there were a high risk of non-native vegetation establishment in these areas, a managed approach to vegetation established could be warranted.

Access to the downstream side of Chiloquin Dam may disrupt vegetation that may include wetland plants such as common horsetail (*Equisetum arvense*), cattail (*Typha* sp.), bulrush (*Scirpus* sp.), Baltic rush (*Juncus balticus*), and spike rush (*Eleocharis* sp.) were observed on a brief visit to the dam site in August 2004.

4.5.3 Dam Retention with Fish Passage Improvements Alternative

Access to the downstream side of Chiloquin Dam and construction of fish passage improvements may disrupt vegetation that may include wetland plants such as common horsetail (*Equisetum arvense*), cattail (*Typha* sp.), bulrush (*Scirpus* sp.), Baltic rush (*Juncus balticus*), and spike rush (*Eleocharis* sp.) were observed on a brief visit to the dam site in August 2004.

4.5.4 Partial Dam Removal Alternative

Impacts to wetlands would be similar to the impacts under the Dam Removal Alternative. However, cyclical water level fluctuation may increase the difficulty of revegetation.

4.6 Archaeological and Historic Resources

The BIA is currently consulting with the Klamath Tribes, Reclamation, and the Oregon SHPO on site eligibility and appropriate avoidance of or mitigation measures for archaeological and historic resources under all the action alternatives. A preliminary determination has been made that the dam itself is not eligible for inclusion on the National Register of Historic Places (NRHP). As such, the project would have no effect on historic properties, subject to SHPO concurrence. If other cultural resources were found within the project area and determined to be eligible, they would be avoided or mitigated in accordance with the NHPA.

4.6.1 No Action Alternative

Natural processes, such as erosion, would continue to affect sites in the area, although there would be no project impacts to any site eligible for or included on the NRHP under the No Action Alternative.

4.6.2 Dam Removal Alternative

Under this alternative, there would be a pumping plant, buried pipelines, a powerline, access roads, staging areas, and other construction sites and activities. An archaeological survey of the known pipeline routes led to a redesign to avoid a cultural resource. Surveys for other parts of the project did not locate any cultural resources. Additional archaeological surveys would be required for any unsurveyed areas prior to land-disturbing activities. Further, under Section 106 of the NHPA, an archaeological survey of the dewatered basin would also be required to determine if any inundated sites had been exposed.

4.6.3 Dam Retention With Fish Passage Improvements Alternative

The Dam Retention With Fish Passage Improvements Alternative would have no effect on historic properties, subject to SHPO concurrence. If other cultural resources were found within the project area and determined to be eligible, they would be avoided or mitigated in accordance with the NHPA. Construction of natural rapids downstream of the dam site may cover up riffle areas that are known spawning areas for the shortnose and Lost River sucker. These areas have been the site of The First Sucker Ceremony.

4.6.4 Partial Dam Removal Alternative

The Partial Dam Removal Alternative would have no effect on historic properties, subject to SHPO concurrence. If other cultural resources were found within the project area and determined to be eligible, they would be avoided or mitigated in accordance with the NHPA.

4.7 Indian Trust Resources

4.7.1 No Action Alternative

The No Action Alternative would leave Chiloquin Dam in place, and fish passage would not be improved. The Klamath Tribes treaty rights (including the right to certain conditions of water quality and flow to support all life stages of fish) could continue to be impaired.

4.7.2 Dam Removal, Dam Retention with Fish Passage Improvements, and Partial Dam Removal Alternatives

The Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal Alternatives would have a beneficial impact to fish passage on the Sprague River. The Klamath Tribes' treaty rights include the right to certain conditions of water quality and flow to support all life stages of fish. Improving fish passage appears to be one way to aid in conservation and protection of the Klamath Tribes trust assets.

The traditional fishing location just below the dam may be altered. The BIA has worked with the Klamath Tribes, the City of Chiloquin, and Klamath County, and others to identify, improve, and provide access to a potential fishing site near the Chiloquin Dam.

Improving fish passage at Chiloquin Dam furthers the Secretary of the Interior's discharge of the trust responsibility by protecting and enhancing the treaty-based fishing rights of the Klamath Tribes. The preferred alternative would aid in the recovery of Lost River and short-nosed suckers, both of which play a major role in the tribes' culture and subsistence.

Removal of the dam would allow unrestricted spawning access for suckers and other fish species to approximately 80 miles of habitat and represents an important first step in improving the likelihood of sucker recovery and restoration of tribal fisheries. The preferred alternative would result in increased flows of approximately 60 cfs in the Sprague River from the current location of Chiloquin Dam, beyond the confluence of the Williamson River downstream approximately 5 miles. The increased flows would result in increasing available habitat within this reach, which flows adjacent to the Klamath Tribal headquarters and City of Chiloquin. A substantial amount of fishing and recreational use occurs in this reach by both Indian and non-Indian anglers.

4.8 Air Quality

4.8.1 No Action Alternative

There would be no air quality impacts associated with the No Action Alternative.

4.8.2 Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal Alternatives

Construction activities related to the Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal Alternatives would temporarily emit minor amounts of traffic- and construction-related pollutants. Construction-related sources of particulates would include the use of unimproved haul roads and activities associated with excavating, loading and dumping, hoe-ramming, and blasting. Dust generated by construction traffic could require some mitigation by periodically spraying water for dust abatement. BMPs would be followed to minimize impacts to air quality.

4.9 Socioeconomics

The scopes of any of the construction projects associated with the Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal Alternatives are such that they would have only a small impact on the local economy and the community. Temporary secondary benefits from spending by construction workers would mostly benefit the economy of the Chiloquin area and Klamath County. Potential long-term benefits from improved fish passage would also likely benefit the people in the area of the City of Chiloquin.

4.9.1 No Action Alternative

Under the No Action Alternative, the MPID would continue to receive its water allocation through the gravity diversion of streamflow into its Main Canal. Any liability and safety issues associated with the dam, its structures, and the canal would continue to be borne by the MPID. The canal is reported (Reclamation 2003) to be highly susceptible to seepage and washouts, especially the first 500-foot reach near the headworks structure. This reach of the canal is constructed in erosive, porous soils and is adjacent to the river.

4.9.2 Dam Removal Alternative

The MPID would receive irrigation water via a pumping plant farther downstream on the Williamson River. Two users above the pumping plant would receive water via small pumps drawing water from the river. The MPID would be freed from any safety or liability issues associated with the dam, its structures, or the nearby relatively unstable portion of its canal, as these structures would be removed or taken out of service. A fund would be established to cover the increased electrical costs associated with pumping**.** It is estimated that additional power costs would be approximately $50,000 per year, based upon the assumption that MPID will be faced with a 10 fold increase in power rates in the future. **T**herefore, there would not be any economic impacts to irrigators.

4.9.3 Dam Retention With Fish Passage Improvements Alternative

Irrigation water would continue to flow through the MPID's diversion canal. The availability of irrigation water during low river flows would be a concern under the natural rapids option.

4.9.4 Partial Dam Removal Alternative

Irrigation water would continue to flow through the MPID's diversion canal during irrigation season.

4.10 Public Health and Safety

4.10.1 No Action Alternative

The No Action Alternative would leave Chiloquin Dam and associated structures in place. The structures would continue to be a health and safety risk to the public.

4.10.2 Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal Alternatives

During dam removal and construction activities, including construction of the pumping plant, applicable construction safety standards would be enforced. All structures would either be removed from the dam site or buried to help ensure public safety and to avoid any potential liability issues.

4.11 Environmental Justice

In February 1994, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629), directed federal agencies in the Executive Branch to consider environmental justice (EJ) so that their programs would not have "disproportionately high and adverse human health or environmental effects" on minority and low-income populations. The Council on Environmental Quality (CEQ) later provided additional guidance for integrating EJ into the NEPA process in a December 1997 document, *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ 1997).

4.11.1 No Action Alternative

The No Action Alternative would not cause impacts, adverse or otherwise, on the human environment. As a result, there would be no disproportionate negative impacts on minority or low-income populations.

4.11.2 Dam Removal Alternative

Only minor environmental impacts have been identified under the Dam Removal Alternative; therefore, no disproportionately high and adverse human health or environmental effects on minority and low-income populations are anticipated. Beneficial impacts could accrue from improved fish passage, but these potential benefits would require further improvement in habitat restoration upstream from Chiloquin Dam. The community of Chiloquin would likely see a small economic benefit from the temporary presence of construction workers. The size of this workforce and duration of the project would not likely affect local infrastructure. However, secondary purchases made by construction workers could benefit local businesses.

4.11.3 Dam Retention With Fish Passage Improvements Alternative

EJ impacts under this alternative would be similar to the impacts under the Dam Removal Alternative.

4.11.4 Partial Dam Removal Alternative

EJ impacts under this alternative would be similar to the impacts under the Dam Removal Alternative.

4.12 Aesthetics

For all action alternatives, any night operations would be required to comply with specification requirements for light control. Floodlights would be shielded and directed downward to avoid being a nuisance to surrounding areas.

Under these alternatives, logs and other debris that are currently under water could be exposed. There could be a need to mitigate this aesthetic impact in the short term.

4.12.1 No Action Alternative

There would be no aesthetic impacts associated with the No Action Alternative. However, the dam currently appears to be in a state of disrepair. Exposes rebar, broken concrete, and damaged wood structures are all visible.

4.12.2 Dam Removal Alternative

Dam removal would result in partially draining the reservoir to a point where a river channel is established. The reservoir banks will be devoid of vegetation. As pointed out in section 4.3, it is anticipated that the banks would revegetate in one year after dam removal. If the banks do not revegetate in one year, a vegetation plan will be developed to reestablish natural vegetation.

The construction of a new pumping plant associated with the Dam Removal Alternative would have a design and style consistent with existing utility structures in the vicinity. Private landowners whose lands are adjacent to the pumping plant site would make their land available for this project and have reviewed preliminary designs with regard to aesthetic impacts. Figures 4-2 and 4-3 show the land and river views of one possible design for the pumping plant. These figures are useful for gaining a sense of the scale and positioning of the plants, but the actual structure will be designed to resemble a nearby barn, as shown in Figure 2-1.

Figure 4-2. Land View of the Proposed Pumping Plant (Artist's Rendition)

Figure 4-3. River View of the Proposed Pumping Plant (Artist's Rendition)

4.12.3 Dam Retention with Fish Passage Improvements

This alternative includes the possible construction of natural rapids downstream of the dam site. The natural rapids structure would involve constructing a new 750-foot river channel downstream of the dam made of riprap. This structure would substantially change the existing view downstream of the dam, including covering up existing riffle areas. However, the structure would be designed to resemble natural rapids.

4.12.4 Partial Dam Removal

Partial dam removal would result in partially draining the reservoir to a point where a river channel is established. The exposed reservoir banks will be devoid of vegetation. The reservoir will be refilled after construction and then drained on a annual basis to allow for fish passage. It is possible that variable reservoir heights may result in increased erosion of reservoir banks and may inhibit revegetation.

4.13 Noise

4.13.1 No Action Alternative

There would be no noise impacts associated with the No Action Alternative.

4.13.2 Dam Removal, Dam Retention With Fish Passage Improvements, and Partial Dam Removal Alternatives

Noise would be generated by various dam removal and construction activities, including the operation of heavy construction equipment, hauling equipment (dump trucks), drills and jackhammers, air compressors, and controlled blasting for concrete excavation. Noise levels could produce short-term adverse impacts close to the dam site but would likely not be noticeable beyond a distance of 1 mile. Some natural attenuation of noise levels would likely be provided by trees and the existing terrain.

The construction of a new pumping plant associated with the Dam Removal Alternative would produce similar temporary construction noise. However, noise levels would likely be consistent with those of nearby Highway 97 and the railroad tracks, and no special noise abatement procedures should be necessary.

Background noise associated with traffic on highways and freight rail cars has been estimated to be 70 dBA (USDOT 1998. Noise levels during construction could reach about 95 dBA if all the equipment operated at once, but assuming that the equipment operates intermittently, a more reasonable noise estimate is 70 to 85 dBA at a 50-foot distance (Parsons 2003). Noise decreases by 6 dBA every time the distance from the source is doubled. This effect is influenced by topography (e.g., water carries sounds better than ground or tree cover). Without taking topography into account, a noise level of 95 dBA at the construction site would result in 70 dBA, ¼ mile away and 63 dBA. A more typical noise level of 80 dBA at the construction site would result in 65 dBA, ¼ mile away and 48 dBA ½ mile away. Typical noise levels are presented in Table 4-6 for comparison.

Table 4-6. Typical Environmental and Industry Sound Levels

NOISE SOURCE (AT DISTANCE)	A-WEIGHTED SOUND LEVEL IN DECIBELS (DBA)	NOISE ENVIRONMENT	SUBJECTIVE IMPRESSION
Civil Defense Siren (100')	140-130		Pain Threshold
Jet Takeoff (200')	120		Very Loud
Very Loud Music	110	Rock Music Concert	
Pile Driver (50')	100		
Ambulance Siren (100')	90	Boiler Room	
Freight Cars (50')	85		
Pneumatic Drill (50')	80	Printing Press Kitchen with Garbage Disposal Running	Loud
Freeway (100')	70		Moderately Loud
Vacuum Cleaner (100')	60	Data Processing Center Department Store/Office	
Light Traffic (100')	50	Private Business Office	
Large Transformer (200')	40		Quiet
Soft Whisper (5')	30	Quiet Bedroom	
	20	Recording Studio	
	10		Threshold of Hearing

Source: State of California 2002

4.14 Construction and Traffic

All of the alternatives, except the No Action Alternative, would result in temporary increases in traffic for construction activities. During construction, BMPs would be followed to avoid potential effects of operating construction equipment. These practices are described in Appendix C.

4.14.1 No Action Alternative

The No Action Alternative would result in no impacts on traffic.

4.14.2 Dam Removal Alternative

4.14.2.1 Impacts from Dam Removal

In most cases, contractors prefer to work their crews on 40-hour weeks, utilizing 8-10 hours a day, and 4-5 days a week. Under the Dam Removal Alternative, critical time constraints exist due to the short construction schedule and the need to work around severe winter conditions. Though the dam must remain in place through the irrigation season (May through September), preparatory work, including some of the cofferdam installation, could start by August 2006. Winter conditions could delay work, and an early snowmelt could increase stream flows and inundate work areas. For this reason, overtime hours such as double shifts and weekends could be required. Most of the construction activity would likely occur in the early phases for mobilization and stockpiling, which would mainly occur in the first 5 weeks once mobilization began. After this initial phase, work traffic would likely taper off to mainly the contractor's work force, with occasional supply trucks.

If the Dam Removal Alternative were implemented, the current schedule calls for a project timeframe of October – December 2006. Basically, the demobilization phase would include the same equipment and materials brought in at start-up, but demobilization activities would likely be conducted over a broader period of time and would not be as intense as the start-up phase.

With regard to construction-related traffic, some of the initial limitations under consideration include weight limits for roads and bridges, designated truck routes, and special requirements when driving through school zones for the Chiloquin elementary and high school areas. The principal at Chiloquin High School has identified basic concerns for noise, general work traffic, and truck haul traffic within the school vicinity. Of particular concern is work traffic activity during the start and end of the school day and during school-related functions. These hours would be restricted to allow for only light-duty traffic, such as pickup trucks.

Other than the demolished concrete and steel, all other waste material would be handled and hauled to designated waste sites, in accordance with federal, state, and local regulations.

Demobilization of the contractor's equipment would likely be conducted in reverse order from the setup process.

Site restoration would include activities associated with removal of the dam and abandonment of the Main Canal. Basic canal restoration work would entail pushing the canal embankment back into the canal prism, compacting the material in place, and blading the area to produce a smooth surface. Reseeding with certified weed-free native vegetation in coordination with USFS forest management plans would be performed as required. Topsoil would be used to cover the soils on the Kircher property that are adjacent to irrigated land. Portions of the canal could require minimal abandonment, which would entail occasional breaching of the embankment, at permissible locations, in order to maintain drainage of the canal.

4.14.2.2 Impacts from Construction of a Water Delivery Pumping Station for the Kircher Property

The work at this site would be basic construction work of relatively short duration. Because portions of the structures would be prefabricated, it is anticipated that the on-site work for the pumping plant, sump conversions, distribution pipelines, and canal backfill tasks could be completed in about a month, at 8 to 10 hours per day. Some after-hours work could be required.

Installation of a water delivery streamside pump would involve constructing a temporary access route, about 18 feet wide by 200 feet long, to install the river pumping station and pipeline, which would extend from the river's edge and through the Kircher property. Additional construction routes or areas would not be needed.

Construction equipment would be of moderate size and would likely include a small dozer, a tractor backhoe, and boom truck. Noise and dust impacts would likely be low to moderate. Potential environmental impacts would be associated with the riverside work for the installation of the concrete sump and pump intake unit. This work would likely require a small sandbag cofferdam to facilitate construction and dewater the work site by about 4 feet. The cofferdam would likely contain less than 8 cubic yards of gravel and would be installed in accordance with state and federal permitting requirements to maintain water quality standards.

No additional demobilization concerns beyond the scope of the primary contract are anticipated for work at this site. Restoration work would include retaining the topsoil of the trenched farmland and restoring the river embankment around the pump installation work.

4.14.2.3 Impacts from Construction of the Main Water Delivery Pumping Plant and Smaller Pumping Stations for the Upper and Middle Lonesome Duck Properties

The primary route to the Lonesome Duck Resort property is from Highway 97. The only access road from Highway 97 to the proposed work sites and the rest of the property is the resort access road. This road is narrow but has adequate room and surface conditions to serve as an access and haul road for all work items needed at this site. It leads up to within 430 feet of the proposed pumping plant site. For the remainder of the distance, the contractor would need to prepare a roadway across the existing grass field; this would be converted into a permanent roadway at the completion of construction.

The main pumping plant and fish screens will be built over about a 9 month period. The smaller pumping stations for affected landowners will each require about 1 month to install. Some after-hours work could be required. Construction equipment would likely include a small dozer, a tractor backhoe, and boom truck.

A staging area of about one-quarter of an acre would likely be adequate for the proposed work. An additional short-term stockpile site could be needed to facilitate the construction of the cofferdam; however, no additional ground area would be needed within the overall work site. To minimize weight impacts on the grass field, it is anticipated that the contractor would minimize the amount of rock stockpiled at any one time, rather than stockpiling all of this material on the site at the same time. A ground lining of geo-textile fabric, or similar barrier, would be required to minimize impacts to field topsoil, such as from stockpiling, in areas to remain as field ground after construction. There is more than adequate ground area to provide for a staging and stockpiling area; however, Lonesome Duck Resort would approve final details.

Typical traffic to the worksite would include daily employees' vehicles and mobilization and demobilization of contractors' heavy equipment. Heavy-truck haul would be occasional and would consist of delivering crushed rock (cofferdam) and concrete and removing excavation spoil and crushed rock. Mobilization and demobilization would typically require about two heavy truck loads at the start and end of the job, plus occasional medium-delivery trucks. Heavy trucks involved in this operation could have a gross vehicle weight ranging from 25 to 36 tons.

Heavy truck haul for supplying concrete would typically be eight trucks in one day for each placement phase; this job would consist of about four and one-half placement phases. The amount of excavation spoil to be hauled out would be about 3,100 cubic yards. This would typically be trucked out at the rate of four trucks per hour, 7 hours a day, over 12 working days. At this time, a spoil site has not been designated for excavation material. It is expected that excavation material would be placed at a location that conformed with state and local regulations.

Based on initial site investigations, it appears that the on-site earth material could be suitable for most of the pipe bedding; this would minimize the need to haul in material for this purpose. Sheetpiling is the most likely material for constructing the cofferdam.

Installation of small-capacity pumping stations would require a temporary access route, about 18 feet wide, to run the length from the river to Turnouts 1 and 2. The upper site would require about an additional 2,000 feet of medium-duty access in order to transport equipment and materials around the upper pasture. No additional construction staging area would likely be needed for this work.

The power required to operate a pumping station would be about 2.5 kW single-phase. For the middle site, power to operate a pumping station is currently available nearby. The upper site would require that a powerline be extended from the opposite side of the river, about 800 feet away. The powerline could either be suspended overhead or extended under the river through directional boring. The powerline extension work would be conducted by PacifiCorp.

Construction of the pumping and distribution system would result in construction-related traffic on Highway 97 and along the access road. The primary concern regarding traffic impacts would be safe travel to and from the work site. Highway 97 is primarily open highway, with high-speed traffic, and the access road turnoff is sharp and poorly visible, especially for northbound traffic. Traffic considerations would need to be studied and plans for safe travel implemented. The access road is narrow but would be manageable as long as standard safety precautions were observed.

Direct on-site activities would involve the operation of equipment, including power generators, and would result in ongoing noise. The excavation and placement of the discharge pipe would take about 2 weeks. During that time, the work intensity would be steady, then would likely diminish for the remainder of pumping plant construction. This work could be performed using only a backhoe tractor and a medium-sized boom truck.

Potential environmental impacts would be associated with the riverside work for the installation of a concrete sump and pump intake unit. The proposed sheetpile cofferdam would facilitate construction and dewater the work site. The cofferdam would be installed in accordance with state and federal permitting requirements to maintain water quality standards.

Construction activities, especially the instream placement of the cofferdam and construction of the pumping plant intake and fish screen structures, could adversely affect water quality. Groundwater could be encountered during excavation near the river. In all cases, the excavation contractor would be required to address the control and discharge of dewatering in accordance with federal and state regulatory requirements and permits.

Impacts to air quality would be minor. Construction activities would generate dust, which would likely be controlled using standard dust abatement procedures.

Most of the material to be removed from the work site, such as excavated earth and crushed rock, is considered clean inert material and could potentially be reused for other work on the proposed project or at other nearby locations. All waste materials would be handled in accordance with federal, state, and local regulations and hauled to designated waste sites.

Demobilization of the contractor's equipment would likely be conducted in reverse order from the setup process. The cofferdam and other temporary instream materials would be removed from the riverbed in accordance with state and federal permitting requirements.

Site restoration would involve reconditioning disturbed sites such as the access road, the old canal, and the river bank. The ground would be restored by backfilling with soil and topsoil, contouring, and reseeding using certified weed-free native vegetation in coordination with USFS forest management plans.

Although the existing access road is basically adequate to handle the proposed construction activities, some impacts would be expected. Restoration of the access road would include blade work and a moderate application of surface gravel to some portions of the roadway. Sites where temporary roads were constructed would also be restored.

The amount of power required to operate the proposed alternate pumping plant is estimated to be 200 kW. No power is available at the alternate pumping plant site. The closest powerline is across the Williamson River, approximately 1,000 feet away. The power supply and line to the pumping plant would be installed by PacifiCorp under a separate construction contract, presumably by extending a line over the river.

4.14.3 Dam Retention With Fish Passage Improvements Alternative

Construction traffic impacts at Chiloquin Dam under this alternative would be similar to the impacts under the Dam Removal Alternative. This alternative does not include the addition of a pumping plant or pumping stations, so traffic would be limited to the dam site. Construction activities for the fish ladder or natural rapids below the dam would be much greater than the No Action and Dam Removal Alternatives.

4.14.4 Partial Dam Removal Alternative

Construction traffic impacts at Chiloquin Dam under this alternative would be similar to the impacts under the Dam Removal Alternative. This alternative does not include the addition of a pumping plant or pumping stations, so traffic would be limited to the dam site. The addition of a fish ladder would include greater construction activities below the dam in comparison to the No Action and Dam Removal Alternatives.

4.15 Construction Disposal (Burial) of Removed Dam Concrete

Other than routine construction debris, concrete removed from the dam site would be the major waste type requiring disposal.

4.15.1 No Action Alternative

No construction concrete disposal would be required under the No Action Alternative.

4.15.2 Dam Removal Alternative

Removal of the dam and appurtenant structures would result in over 850 cubic yards of concrete debris (including reinforcing bars), 3,000 pounds of structural steel (rail steel and I-beams), approximately 12,000 pounds of mechanical items, over 6 tons of timber, and 110 linear feet of chain link fencing. Waste concrete and steel would be buried within the MPID canal within 1,000 feet downstream of the dam site. Approximately 2,000 cubic yards of embankment materials would be removed from the left abutment and would be available for use as canal backfill. Other waste materials would be removed from the site.

The contractor would prepare the concrete for disposal by breaking it into approximate 2-foot chunks. Any steel rebar projecting beyond 6 inches would be bent relatively flush with the concrete or cut off. The concrete would be hauled away and placed in the canal from one-half to two-thirds of the canal prism height; the concrete would then be covered with about 2 feet of compacted earth. Based on measurements taken of the upper reach of the Main Canal, typical canal prism depths are about 4.5 feet and have an overall cross-sectional volume of about 3 cubic yards per linear foot, leaving about 2 cubic yards per linear foot available for concrete and steel burial.

Construction road activities would be accomplished to avoid impacts to fish spawning areas located immediately below the fish ladder entrance on the east abutment. Disposal of concrete in the canal would require concurrence from the ODEQ. Early consultation with the ODEQ suggests it would allow the disposal of this material.

4.15.3 Dam Retention With Fish Passage Improvements Alternative

Minor amounts of concrete would need to be disposed of under this alternative. Disposal methods would be similar to the methods used under the Dam Removal Alternative.

4.15.4 Partial Dam Removal Alternative

Less concrete waste would be generated under this alternative, but disposal impacts would be similar to the impacts under the Dam Removal Alternative.

5.0 SUMMARY

Chiloquin Dam is located near the City of Chiloquin in Klamath County, south-central Oregon, approximately 30 miles north of Klamath Falls (Figure 1-1). The dam is at River Mile (RM) 0.87 on the Sprague River, a short distance upstream from its confluence with the Williamson River, approximately 10 miles before entering Upper Klamath Lake.

This environmental assessment (EA) evaluates the impacts of alternatives designed to improve fish passage at Chiloquin Dam on the Sprague River in south-central Oregon. Congress provided funding to the Bureau of Indian Affairs (BIA) to study alternatives, including the removal of Chiloquin Dam, that would provide adequate upstream and downstream passage for fish (particularly the endangered shortnose and Lost River sucker) on the Sprague River.

BIA is preparing this EA in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. §§ 4321 et seq.), as amended, and associated implementing regulations. The purpose of the EA is to describe the environmental consequences of removing Chiloquin Dam. The EA will be used to determine whether to prepare a Finding of No Significant Impact (FONSI) or an environmental impact statement (EIS). If the EA shows that the removal would not have a significant impact on the human and natural environment, a FONSI will be prepared. If the EA indicates that the proposed action constitutes a major federal action significantly affecting the quality of the human and/or natural environment, then a Notice of Intent to prepare a draft EIS will be published in the *Federal Register*.

This EA investigated a no action alternative and three action alternatives for improving fish passage at Chiloquin Dam: the Dam Removal Alternative (the proposed action), the Dam Retention With Fish Passage Improvements Alternative, and the Partial Dam Removal Alternative.

5.1 Summary of Alternatives

The No Action Alternative would leave the existing Chiloquin Dam in place along with the existing MPID Main Canal.

The proposed action is to remove Chiloquin Dam, abandon a portion of the MPID Main Canal, and construct pumping facilities on the Sprague and Williamson Rivers to allow for water delivery to the MPID and two landowners who would no longer be able to receive deliveries from the MPID Main Canal. A fund would be established At completion of dam removal MPID would abandon and transfer easement rights for the upper canal to the owners of the land upon which the canal is located. The abandoned canal may be left undisturbed or could be backfilled subject to the landowner’s wishes. About 1000 feet of canal length would be needed for material disposal from the demolished Chiloquin Dam.

The Dam Retention With Fish Passage Improvements Alternative involves replacing the existing fish screen with a new, upgraded fish screen structure in the MPID Main Canal. In addition, either two new fish ladders at Chiloquin Dam or a natural rapids structure below Chiloquin Dam would be constructed. The fish screen in the Main Canal would also be replaced with a new, upgraded screen as described for the Dam Retention With Fish Passage Improvements Alternative (refer to Section 2.3). No new water delivery structures would be required under this alternative.

The Partial Dam Removal Alternative consists of two options: (1) installing a series of three steel radial gates with hoists, or (2) installing a single Obermeyer crest gate with inflatable bladders. Each option assumes a gate impoundment height of 8 feet and a total crest length of 150 feet. This gated or adjustable crest would allow the reservoir level to be lowered during critical migration periods, from March 1 through June 1. To address the one-month time period during which both fish migration and irrigation diversion releases could be required (May 1 through June 1), the existing fish ladder would be upgraded to meet federal and state fish passage standards. The fish screen in the Main Canal would also be replaced with a new, upgraded screen as described for the Dam Retention With Fish Passage Improvements Alternative (refer to Section 2.3). No new water delivery structures would be required under this alternative.

5.2 Summary of Potential Effects

All of the alternatives except the No Action Alternative would result in temporary construction impacts. These impacts would include temporary increases in noise, truck traffic, and water turbidity, and the disturbance or removal of small areas of vegetation. Work schedules and work site locations would be managed in such a way as to minimize impacts to terrestrial, aquatic, and cultural resources and to minimize noise and other construction-related impacts that could affect neighbors. BMPs would be followed to minimize impacts. Construction noise would likely blend with existing noise from nearby Highway 97 and the Union Pacific railroad, and because of the site's rural setting, noise would tend to attenuate before reaching nearby receptors. In addition, traffic associated with pumping plant construction in the vicinity of the highway and the railroad would be carefully managed to ensure safe operations to and from Highway 97 and near school grounds.

Construction impacts at the dam site and the pumping plant sites could result in the taking of endangered species. Taking of endangered species will be addressed in a consultation process with the FWS. Limited numbers of animals or fish may be injured, killed, or disturbed. For example, construction noise may occur during the eagle nesting season, construction equipment in the river may run over fish, or fish may become stranded behind cofferdams or in the canal. Stranded fish will be salvaged.

No Action Alternative

The No Action Alternative would likely result in the greatest impacts to public safety, given the deteriorating condition of the dam and already exposed rebar and jagged concrete. There would be no new impacts to environmental resources under this alternative. However, ongoing impacts would include partial blockage of upstream migration for endangered shortnose and Lost River suckers.

Dam Removal Alternative

The Dam Removal Alternative would likely have the greatest beneficial impacts for the endangered shortnose and Lost River suckers. Currently, 80 miles of upstream habitat for these endangered suckers is partially blocked by the dam. Removing the dam would increase access to this upstream habitat, which in turn could improve fisheries populations. Currently, substantial habitat improvement is needed upstream of the dam. Therefore, for this benefit to be fully realized, increased access must be coupled with habitat improvement upstream of the dam.

Sediment transport and deposition through the Williamson and Sprague Rivers would be a key concern under the Dam Removal Alternative. Hydrological modeling of the Sprague and Williamson Rivers has demonstrated that the sediment associated with dam removal would not be likely to impact riffle areas that make up the most sensitive spawning habitat areas. Further, based on hydrologic record, it is highly likely that most sediment would be transported entirely out of the critical stretches of the rivers in the first year.

After dam removal, a new river channel would emerge where the reservoir is currently located. This channel would likely change the configuration of wetlands around the reservoir and possibly downstream from the dam. However, no net change in the quantity of wetlands would be expected. Further wetland delineation is expected as part of consultation with the USACE.

Dam removal would reduce the health and safety risk to the public by removing the current structures that pose a risk.

Aesthetic impacts under the Dam Removal Alternative would include restoration of the reservoir to a free-flowing river and introduction of the newly constructed pumping plant to the landscape. The reservoir would be returned to a natural stretch of river that many would find equally appealing. Loss of the dam in its current dilapidated condition would be a beneficial aesthetic impact. Construction of the pumping plant would result in a new structure near the Highway 97 Bridge over the Williamson River, but the structure would generally blend with the surrounding infrastructure of the bridge, outbuildings, and railroad. The pumping plant structure would be built to resemble nearby barns.

Because additional land would be required for construction of the pumping plant under this alternative, it is possible that archaeological resources would be discovered. However, all work areas would be surveyed to avoid potential impacts. The BIA is currently consulting with the Klamath Tribes, Reclamation, and Oregon SHPO regarding the proposed action. If cultural resources were found within the project area under this alternative, they would be avoided or the impacts mitigated in accordance with the NHPA.

Dam Retention With Fish Passage Improvements Alternative

The Dam Retention With Fish Passage Improvements Alternative would result in impacts similar to those under the Dam Removal Alternative; however, no pumping plant or pumping stations would be required. However, the creation of a new natural rapids fish ladder would extend below the dam about 700 feet. This new feature would incorporate natural appearing rapids. A culturally important habitat area for endangered sucker would be impacted at the downstream base of the dam. A more conventional fish ladder is also an option under this alternative. A conventional fish ladder could cause delays in fish migration and may lead to species hybridization.

Partial Dam Removal Alternative

The Partial Dam Removal Alternative would result in impacts similar to those under the Dam Removal Alternative; however, no pumping plant or pumping stations would be required. Sediment transport during construction would be similar to those under the Dam Removal Alternative; however, cyclical reservoir heights included in ongoing annual dam operation may result in increased erosion of reservoir banks and periodic downstream releases of sediment. Fish ladders would be relied on for two out of the five months Lost River sucker spawning and two out of three months of shortnose sucker spawning time. Fish ladder impacts would be similar to those for the Dam Retention With Fish Passage Improvements Alternative.

Table 5-1 briefly summarizes and compares the environmental consequences of the alternatives analyzed in this EA.

Table 5-1. Comparison of Potential Environmental Consequences of the Alternatives

POTENTIALLY AFFECTED RESOURCE	NO ACTION	DAM REMOVAL	DAM RETENTION WITH FISH PASSAGE IMPROVEMENTS	PARTIAL DAM REMOVAL
Land Use	No impact	Reservoir bank conversion to river bank. Loss of swimming in reservoir. Portion of irrigation canal would be converted to agriculture.	No impacts	Reservoir bank conversion to river bank.
Water Quality: Geomorphology and Sediment	No impact	Sediment from reservoir would transport to the lower Williamson River and eventually into Klamath Lake. Riffle areas should not be affected. Most sediment transported past the Highway 97 Bridge in first year.	Sediment transport – less than dam removal	Sediment transport similar to dam removal at construction – possible increased erosion along reservoir banks – ongoing, periodic sediment releases annually.
Ecology and T&E[a] Species	Continued adverse impacts to suckers due to partial blockage of upstream habitat	Likely beneficial impact to suckers from improved access to upstream habitat. Temporary impacts to T&E[a] species during construction.	Likely beneficial impact to suckers from improved access to upstream habitat, but passage unproven for affected species. Natural rapids may result in habitat loss downstream of dam. A conventional fish ladder may slow migration. Temporary impacts to T&E species during construction.	Likely beneficial Impact to suckers from improved access to upstream habitat – but fish passage limited to fish ladder two months of irrigation season. Temporary impacts to T&E[a] species during construction.
Wetlands	No Impact	Change in wetlands configuration along new riverbank	No impact	Change in wetlands configuration along new riverbank – changing reservoir levels may affect establishment of new vegetation
Archaeological and Historic Resources	No impact	No adverse impact	Culturally important fishing site reduced downstream of dam.	No adverse impact
Air Quality	No impact	Temporary construction impacts at dam and pumping plant sites	Temporary construction impacts at dam	Temporary construction impacts at dam
Socioeconomics	No impact	Minor benefits	Minor benefits	Minor benefits
Public Health & Safety	Continued adverse impacts to public	Beneficial impact to public	Beneficial impact to public	Beneficial impact to public
Environmental Justice	No impact	No impact	No impact	No impact
Aesthetics	Aesthetic values associated with reservoir maintained	Naturally flowing river and new pumping plants	No adverse impact	Naturally flowing river when gates are open. Reservoir flooded during irrigation season. Potentially non vegetated banks visible in winter, spring and fall
Noise	No impact	Temporary construction noise at dam and pumping plants	Temporary construction noise at dam	Temporary construction noise at dam
Traffic	No Impact	Temporary increase in construction traffic at dam and pumping plant sites	Temporary increase in construction traffic at dam	Temporary increase in construction traffic at dam

a. Threatened and Endangered

6.0 LIST OF PREPARERS

Table 6-1 lists the individuals who contributed to the preparation of this EA.

Table 6-1. List of Preparers

NAME	AFFILIATION	LOCATION	FUNCTION OR EXPERTISE
Baechler, Michael	Battelle	Portland, Oregon	Project Manager for Battelle
Boynton, June	BIA	Portland, Oregon	Environmental Protection Specialist and Contracting Officers Technical Representative
Brandt, Charles	Battelle	Richland, Washington	Regional Expert
Elliot, Douglas	Battelle	Portland, Oregon	Socioeconomics, Environmental Justice
Eschbach, Tara	Battelle	Corvallis, Oregon	Deputy Project Manager, Archaeological and Historic Resources, Cultural Resources, Aesthetics, Noise
Hanrahan, Tim	Battelle	Richland, Washington	Sediment and Geomorphology
James, Chuck	BIA	Portland, Oregon	Archaeologist
Korson, Chuck	Reclamation	Klamath Falls, Oregon	Fish Passage Manager
Neitzel, Duane	Battelle	Richland, Washington	Peer Review Ecology
Orban, Rebecca	Battelle	Albuquerque, New Mexico	Administrative Support
Padgett, Desiree	Battelle	Dillon, Colorado	Technical Editor, preliminary draft
Ross, Christine	Battelle	Richland, Washington	Graphics and Desktop Publishing Support
Tedrick, Doug	BIA	Washington, D.C.	Project Manager
Scott, Michael	Battelle	Richland, Washington	Peer Review Socioeconomics, Environmental Justice
Stegen, Amanda	Battelle	Richland, Washington	Ecology, Threatened and Endangered Species, Air Quality
Swartz, Lucinda Low	Battelle	Kensington, Maryland	Program Management, Quality Assurance
Swisher, Kristi	Reclamation	Klamath Falls, Oregon	NEPA Officer and endangered species

7.0 CONSULTATION AND COORDINATION WITH THE PUBLIC AND OTHERS

7.1 Public Scoping Process

BIA held a public scoping meeting on June 16, 2004, at the Klamath Tribes Administration Building in Chiloquin, Oregon. The BIA announced this meeting eight times in the local *Herald and News* newspaper and also issued a local press release. The notice ran in the newspaper on June 1, 4, 6, 8, 11, 13, 14, and 15, 2004. Through this notice, BIA invited federal, state, and local government agencies, local organizations, and individuals to participate in the scoping process by providing oral comments at the scheduled public meeting and/or by submitting written suggestions and comments no later than July 16, 2004.

Approximately 30 members of the public attended the public scoping meeting on June 16. The meeting began with BIA and Reclamation staff members providing background information on the project and a brief presentation on the NEPA process. Following the BIA's prepared statements, the meeting was opened for public questions and comments.

Seven attendees provided either oral comments or written statements at the public scoping meeting. Two comment letters were received by fax: one on July 12 and one on July 15, 2004. Copies of the comments submitted during the scoping meeting are available at the BIA office in Portland, Oregon, and at Reclamation's Klamath Falls office. The scoping meeting was recorded; a compact disk of that recording is available through the BIA Portland office.

7.2 Collaborative Process

In 2002, Reclamation organized a collaborative group of stakeholders with interest in the Chiloquin Dam Fish Passage Study. The group is still active today and continues to meet as needed. The stakeholders provide information and receive feedback in an open process. In addition, information related to the Fish Passage Study is provided to the group, and stakeholders are asked to provide their perspective, comments, reactions, and concerns. The stakeholders consist of the following federal, state, tribal, local, and private entities:

- BIA
- Blue Flame (nonprofit organization)
- City of Chiloquin
- FWS
- Jeld-Wen (Klamath Falls, Oregon, corporation)
- Glenn and Bonnie Kircher
- Klamath County
- Klamath County School District

- Klamath River Inter-Tribal Fish and Water Commission
- Klamath Tribes
- Klamath County Guides Association
- Klamath Watershed Council – Sprague River Working Group
- KWUA
- Lonesome Duck Resort, Steve and Debbie Hilbert
- MPID
- ODEQ
- ODFW
- Oregon Department of Water Resources
- Reclamation
- USFS, Chiloquin Ranger District
- USGS

7.3 U.S. Fish and Wildlife Service

Consultation with the FWS for listed species is scheduled to begin in the spring of 2005 and would likely be completed by summer of the same year.

7.4 U.S. Army Corps of Engineers and Department of State Lands

Permits from the Department of State Lands (DSL) and USACE would be required for impacts to wetlands and waters of the United States. A wetland delineation may be conducted according to guidance outlined in the USACE's 1987 wetland manual. Applications would be submitted to both DSL and the USACE once this NEPA document is finalized. The permits would likely be issued within 120 days of acceptance. Although no impacts to wetlands are anticipated, appropriate mitigation would be implemented if deemed necessary by the regulatory agencies.

7.5 U.S. Forest Service

A special use permit will be required from the USFS for use of federal lands within the Fremont-Winema National Forests for access to the Chiloquin Dam, and for staging deconstruction or construction activities at the dam and the MPID canal.

The USFS has reviewed this EA to evaluate the proposed actions potential consistency with the Northwest Forest Plan Aquatic Conservation Strategy (USFS 2005). The USFS developed the Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands.

The USFS found that the alternatives within the EA comply with the Aquatic Conservation Strategy, and rated the alternatives has shown in Table 7-1. Complying with the Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain an existing condition or implement actions to restore conditions. The terms in the table are described as follows:

- Maintain: keep everything at status quo or at baseline conditions,
- Improve: make slight improvements over baseline, and
- Restore: return system to near-natural or pre-dam conditions

Table 7-1. USFS Comparison and Consistency of Alternatives to the Aquatic Conservation Strategy Objectives

ACS OBJECTIVES	NO ACTION	DAM REMOVAL	DAM RETENTION FISH PASSAGE IMP.	PARTIAL DAM REMOVAL
1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities uniquely adapted.	Maintain	Restore	Improve	Improve
2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.	Maintain	Restore	Improve	Improve
3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Maintain	Restore	Maintain	Maintain

Table 7-1. USFS Comparison and Consistency of Alternatives to the Aquatic Conservation Strategy Objectives (cont.)

ACS OBJECTIVES	NO ACTION	DAM REMOVAL	DAM RETENTION FISH PASSAGE IMP.	PARTIAL DAM REMOVAL
4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Maintain	Restore	Maintain	Maintain
5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport	Maintain	Restore	Maintain	Improve
6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	Maintain	Restore	Maintain	Improve
7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevations in meadows and wetlands.	Maintain	Restore	Maintain	Improve
8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	Maintain	Restore	Maintain	Improve
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.	Maintain	Restore	Maintain	Improve

7.6 Oregon State Historic Preservation Officer

Concurrence with the Oregon SHPO is being sought for impacts to cultural resources and would be in hand before the project was constructed.

7.7 Oregon Department of Environmental Quality

The ODEQ would be consulted before debris from the removal or modification of Chiloquin Dam was used as fill in the abandoned portions of the MPID canal.

7.8 Oregon Department of Fish and Wildlife

The ODFW would be consulted if construction schedules required a variance to in-water work timing guidelines. The variance process helps to ensure that the in-water work would not pose unreasonable risk to aquatic resources.

7.9 Other State and Local Government Agencies and Landowners, Including Union Pacific Railroad

Other state and local government agencies will be consulted to ensure that BIA actions are implemented in a safe and responsible manner. One agency that will be consulted is the Oregon Department of Transportation to make them aware of construction traffic and traffic patterns on Highway 97. Local property owners affected by the project will continue to be consulted to ensure that project activities do not adversely impact them. These property owners include the Klamath County School District, Klamath County, the Union Pacific Railroad, and other private landowners.

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APPENDIX A

DATA REPORT: HYDROGRAPHIC SURVEY MEASUREMENTS COLLECTED AT THREE PROPOSED PUMPING PLANT SITES ON THE WILLIAMSON RIVER NEAR CHILOQUIN, OREGON

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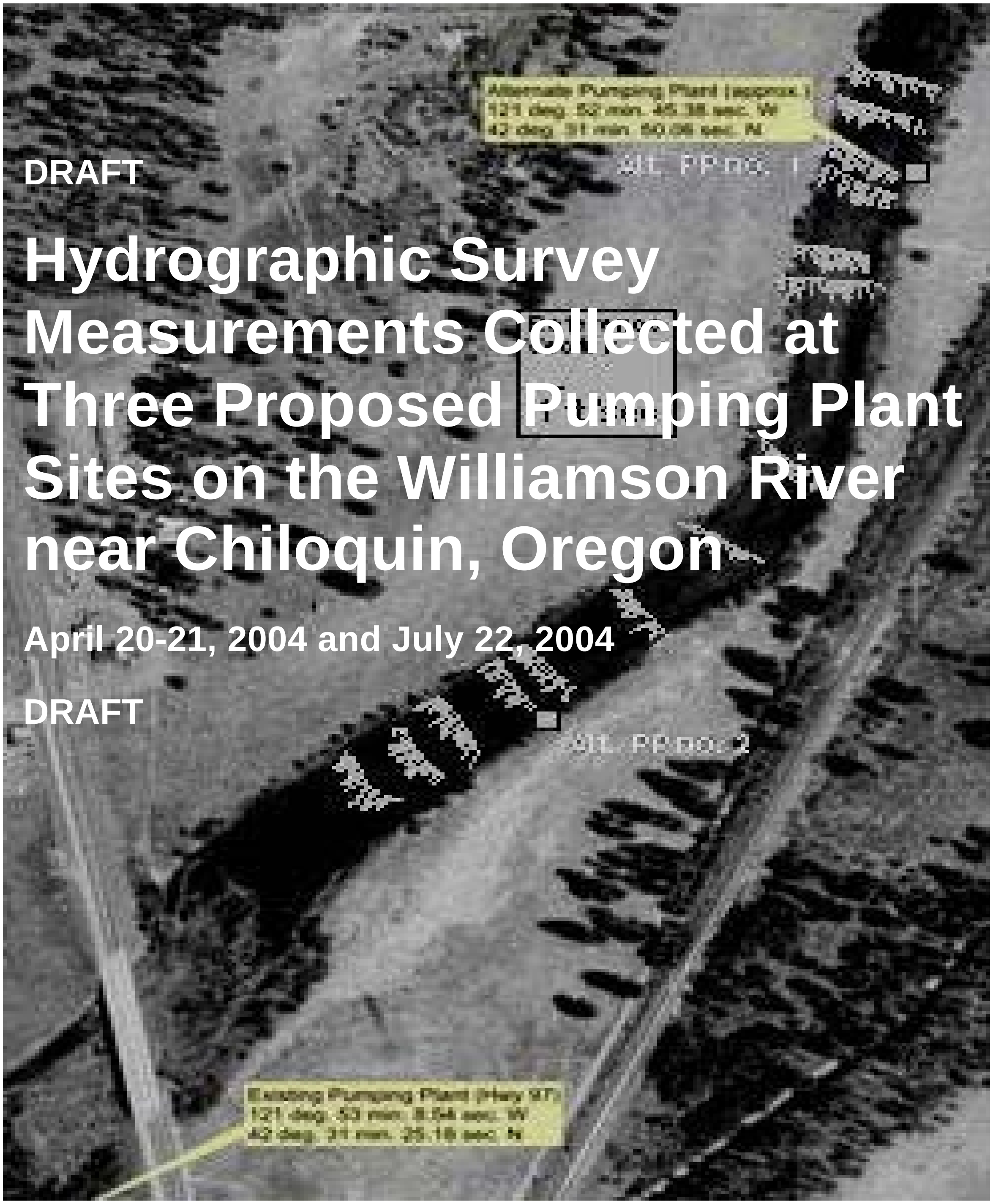
RECLAMATION

Managing Water in the West



DRAFT

Hydrographic Survey Measurements Collected at Three Proposed Pumping Plant Sites on the Williamson River near Chiloquin, Oregon

April 20-21, 2004 and July 22, 2004

DRAFT

U.S. Department of the Interior
Bureau of Reclamation **July 30, 2004**

Data Report

Hydrographic Survey Measurements Collected at Three Proposed Pumping Plant Sites on the Williamson River near Chiloquin, Oregon, April 20-21, 2004 and July 22, 2004

by Tracy B. Vermeyen P.E., Hydraulic Engineer,
Bureau of Reclamation
Water Resources Research Laboratory, Denver, Colorado.

Introduction: The Bureau of Reclamation (Reclamation) recently completed a study to investigate the feasibility of improving fish passage at Chiloquin Dam on the Sprague River, Oregon. The study, conducted in collaboration with many stakeholders, evaluated several alternatives, including dam removal. During the study process, Reclamation completed appraisal level investigations on geology, sediment transport, sediment geochemistry, dam stability, engineering, and hydrology. Collaborators, after reviewing these technical investigations, reached consensus to support the dam removal alternative as best accomplishing the objective to improve upstream and downstream fish passage.

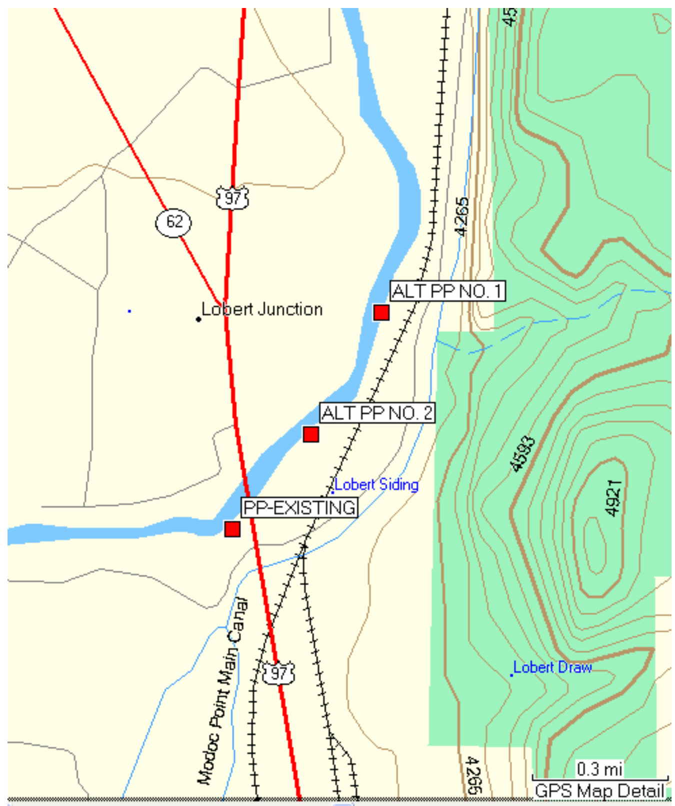


Figure 1. Location map of the proposed pumping plant locations on the Williamson River, near Chiloquin, Oregon.

Reclamation is now working with Bureau of Indian Affairs in Phase II of the study to further investigate the opportunity to remove Chiloquin Dam. In order to do so, Modoc Point Irrigation District (MPID), the owner of the dam, will need an alternate method of receiving irrigation water since gravity diversion will no longer be viable if the dam is removed. Reclamation is currently evaluating three alternate pumping plant sites on the Williamson River which would provide MPID with an option to pump water for irrigation purposes. The three pumping plant options are: 1) to use an existing pumping plant which has never been used, 2) construct a new pumping plant at a site located 0.6 miles upstream from the existing pumping plant, or 3) construct a new pumping plant at a site located 0.3 miles upstream from the existing pumping plant (see figure 1). Under the pumping option, a fish screen would need to be integrated into the pump intake system to comply with the Federal requirement to minimize the entrainment of endangered Lost River and shortnose suckers. Reclamation's evaluation specifically addresses two questions: 1) where is the best potential pumping site for locating a fish screen structure, and 2) what are the relative biological risks of pumping given the variable channel morphology and hydraulic conditions existing at the three potential pumping plant sites?

Reclamation's Technical Service Center (TSC) conducted hydrographic surveys on April 20-21, 2004 and July 22, 2004 to collect hydraulic data needed to compare the hydraulic and biological suitability of each proposed pumping plant site on the Williamson River. An acoustic Doppler current profiler (ADCP) was used to perform the hydrographic surveys in conjunction with a topographic surveys conducted by Klamath Basin Area Office (KBAO) personnel. ADCP data were collected to support the site selection for a replacement pumping plant associated with the decommissioning of Chiloquin Dam on the Sprague River. The purpose of these surveys was to document the velocity fields, river discharge, and bathymetry for a river reach encompassing the existing pumping plant site during high and low flow conditions. Likewise, similar hydrographic surveys were made at two alternate pumping plant sites.

Hydrographic Instrumentation and Software: A RD Instruments 1200 kHz Zedhed ADCP was used for this project. A Garmin GPSMap76 receiver (with WAAS differential correction) was used to collect supplemental horizontal position data during the hydrographic survey. GPS was used to store positions at the start and end of ADCP transects. A 200 kHz digital echosounder was used to collect water depths concurrently with ADCP data. A laptop computer was used for data collection. A software package called WinRiver (v1.05) was used to collect ADCP, Garmin GPS data, and echo sounder data. A U.S. Army Corps of Engineers program called CORPSCON was used to convert the Garmin GPS position data (latitude and longitude) to northings and eastings in the Oregon State plane coordinate system (Oregon Zone - South 3602). The CORPSCON setup information used in the coordinate transformation was as follows:

SOFTWARE: Corpscon for Windows 5.11.08
Horizontal Datum: State Plane, NAD83
Horizontal Zone: Oregon South – 3602
Horizontal Units: U.S. Survey Feet
Vertical Datum: NAVD88
Vertical Units: U.S. Survey Feet

Boat: KBAO provided a 12-ft drift boat with a 10-HP outboard motor to carry the personnel and equipment during the hydrographic survey. A boat operator and hydraulic engineer were on the boat during the hydrographic surveys.

Surveying: For the high flow survey conducted on April 20-21, 2004, KBAO provided a total station survey instrument to collect survey points at the start of each ADCP transect. A few days earlier, KBAO surveyors established cross sections in the vicinity of the proposed pumping plant sites. For the alternate pumping plant site no. 1, KBAO surveyors surveyed 5 cross sections upstream and downstream from the proposed site. The spacing between cross sections was 50 ft. A 500-ft-long river reach was included in this hydrographic survey. At the existing pumping plant site, 4 cross sections were established upstream and downstream of the plant. The spacing between cross sections was 50 ft. A 400-ft-long river reach was included in the hydrographic survey at the existing pumping plant site.

During the April 2004 hydrographic surveys, a KBAO surveyor used a total station to survey the starting position and water surface elevation for each ADCP transect using a prism attached to the ADCP mount. This method of establishing the starting and ending position for each transect worked well at alternate pumping plant site no. 1. At the existing pumping plant site, rapid currents and shallow depths created large offsets in the ADCP computed positions because bottoming tracking data were periodically interrupted. Consequently, GPS data were used for establishing the position of ADCP velocity and depth data. CORPSCON software was used to convert the GPS latitude/longitude data into Oregon State plane coordinates (Oregon Zone -South 3602). The KBAO surveyor collected all total station survey points in the Oregon Zone - South 3602 zone.

Alternate pumping plant site no.2 was identified as a viable site in June 2004 and a bathymetric survey was performed by KBAO surveyors on June 30, 2004. KBAO Surveyors were not involved with the hydrographic surveys made on July 22, 2004.

Williamson River Conditions: On April 20, 2004, the Williamson River gage below the confluence with the Sprague River (USGS Gage 11502500) recorded an average flow and stage of 1163 ft^3/sec and 4.37 ft, respectively (see figure 2). On April 21, 2004, the Williamson River gage recorded an average flow and stage of 1160 ft^3/sec and 4.36 ft, respectively. On July 22, 2004, the Williamson River gage recorded an average flow and stage of 387 ft^3/sec and 3.20 ft, respectively. Note: *Data provided by the USGS in Oregon -- including stream discharge and water levels from water-quality monitors--are considered preliminary and have not received final approval.*

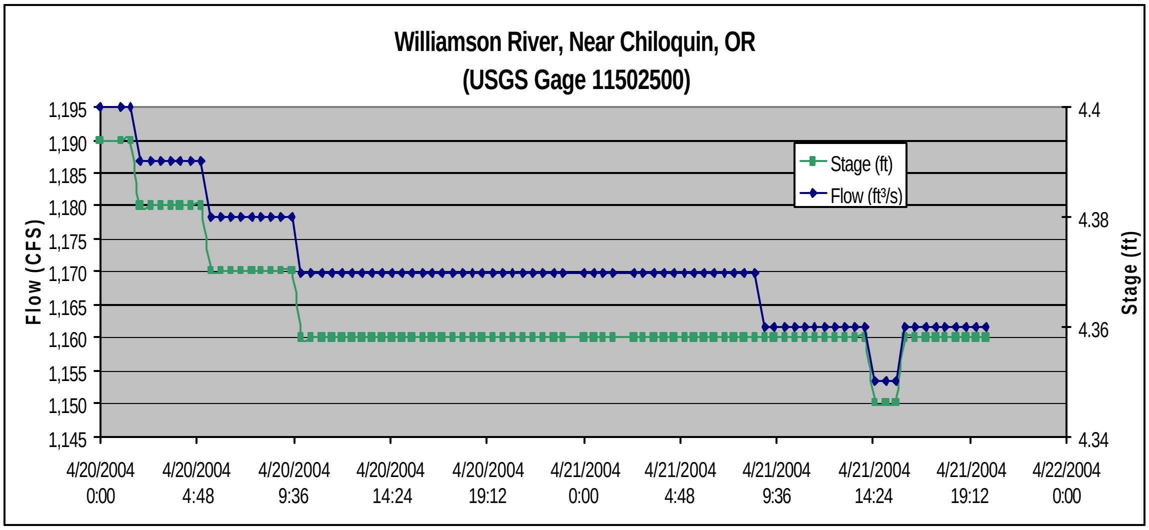


Figure 2. Williamson River flow and stage data for April 20-21, 2004. The gage is located at latitude 42° 33' 54" and longitude 121° 52' 42" and is approximately 2.6 miles upstream from alternate pumping plant site no. 1. From USGS website http://waterdata.usgs.gov/or/nwis/uv/?site_no=11502500 .

ADCP Transects: At alternate pumping plant site No. 1, ADCP and hydrographic survey data were collected between surveyed cross sections that were spaced 50-ft upstream and downstream from the two pumping plant locations. Water surface elevations and ADCP starting and ending locations were surveyed using a total station. At the existing pumping plant site, ADCP transects could not be made along river cross sections because of the swift currents and very shallow depths. As a result, ADCP data were collected in the deeper water near the existing pumping plant and along the left bank (looking downstream). At alternate pumping plant site No. 2, ADCP data were collected at survey stations provided by KBAO surveyors that were spaced 200-ft apart. ADCP transects were collected at stations: 0+00, 2+00, 4+00, 5+00, 6+00, 7+00, 8+00, 10+00, 12+00, and 14+00. Station 7+00 was selected by the pumping plant designer as the preferred site, so ADCP data collection was concentrated around that location.

Data Quality: To insure that good quality data a compass calibration was performed prior to collecting ADCP data. Likewise, repeatable hydraulic measurements for the same cross section were used to verify the transect data quality. Comparing ADCP data to independent discharge measurements is another method used to estimate data quality. Close agreement between independent discharge measurements (e.g. USGS gage readings) signifies that the ADCP data accuracy is reasonable. Typically, ADCP discharge measurements have a reported uncertainty of ±3 to 5 percent.

Data Processing: All ADCP data presented in this report were extracted from ADCP data files using several quality assurance criteria. On April 20, 2004, ADCP data were processed to generate cross sectional velocity profiles at nine cross sections (U5, U3, U2, U1, PP0, D1, D2, D3, D4) at alternate pumping plant site no. 1. Velocity profile positions were computed using survey data collected with the total station. The positional accuracy of the velocity profiles measured in the vicinity of the alternate pumping plant is probably on the order of ±2 ft. Likewise, bed elevations at the velocity profile locations are probably on the order of ±1.0 ft. ADCP data at cross sections U4 and D5 were not presented because of problems encountered during data collection.

For the existing pumping plant site, ADCP data were more difficult to process because the ADCP lost bottom-tracking in areas with rapid flows and/or shallow depths. As a result, velocity profile positions had to be estimated using GPS data instead of total station points. Consequently, the positional accuracy of the velocity profiles measured in the vicinity of the existing pumping plant is probably on the order of ±15 ft. Another complicating factor was that GPS data were only intermittently available in the ADCP data files because the communication between the GPS and the WinRiver software was intermittent. The bed elevation at velocity profile locations was difficult to estimate because transects were made longitudinally. Consequently, elevations were computed by subtracting the measured depth from the water surface elevation measured at cross section U2 (El. 4145.3 ft). The water surface elevation at cross section U2 was selected because it was the maximum elevation measured by the total station. An estimate of the error in bed elevation measurements at this site is ±1.7 ft. To aid in data visualization, measured velocities were interpolated onto a rectangular grid for data presentation in this report. The resulting data set provides a good representation of the velocity field close to the existing pumping plant, but has the same limitations in the positional accuracy and elevations as the raw velocity profile data.

On July 22, 2004, ADCP data were processed to generate cross sectional velocity profiles at sixteen cross sections (U4, U2, PP0, D1, D2, D5, and Stations 0+00, 2+00, 4+00, 5+00, 6+00, 7+00, 8+00, 10+00, 12+00, and 14+00) at alternate pumping plant sites no. 1 and no. 2, respectively. Station 0+00 was the most downstream ADCP transect and was located near the Highway 97 Bridge over the Williamson River. For the low flow conditions, cross sections 0+00 and 2+00 were too shallow to collect ADCP velocities. Velocity profile positions were computed using GPS data. The positional accuracy of the velocity profiles measured in the vicinity of the alternate pumping plant is probably on the order of ±10 ft. Bed elevations at the velocity profile locations were not computed because there were no water surface elevations available.

Results from April 20-21, 2004 Hydrographic Surveys: On April 20, 2004, the ADCP was used to measure river discharges at 9 transects near the alternate pumping plant site no. 1. The average ADCP measured discharge was 1287 ft^3/sec with a standard error (standard deviation of the mean) of ±19 ft^3/sec. The USGS gage reported an average flow of about 1160 ft^3/sec. The discrepancy between the USGS and the ADCP average discharge readings was +12.2 percent. The reason for this discrepancy is unknown, but may be related to a shift in the rating at the gaging station. Based on experience on other rivers, ADCP discharge measurements typically agree within ±5 percent of a USGS gage readings. In order to determine the source of this discrepancy the USGS would have to be contacted to discuss their gage accuracy.

Table 1 contains a summary of the hydrographic data collected in the vicinity of the alternate pumping plant site no. 1. The average reach properties for the nine transects listed in table 1 are as follows:

- Channel width was 163 ft, channel depth was 5.0 ft
- Cross sectional area was 825 ft^2
- Depth-averaged channel velocity was 1.6 ft/sec

Figure 3 shows the ADCP velocity vectors plotted on an aerial photograph of the alternate pumping plant no. 1 location.

Figures 4 and 5 show the bathymetric contours and depth-averaged velocity vectors, respectively, for alternate pumping plant site no. 1. The bathymetric data shows an area of scour on the right bank beginning at cross section U3 and extending upstream to U5. At the pumping plant cross section, the average depth and channel velocity were 5.0 ft and 1.7 ft/sec, respectively.

Table 1. Hydraulic data for Williamson River cross sections collected near alternate pumping plant site no. 1 for high flows - April 20, 2004.

Transect	River Flow (ft^3/sec)	Average Channel Velocity (ft/sec)	Cross-Sectional Area (ft^2)	Average Depth (ft)	Width (ft)
U5	1307	1.3	1036	6.2	168
U3	1261	1.5	872	5.6	155
U2	1310	1.5	906	5.2	175
U1	1248	1.5	832	5.0	167
PP0	1408	1.7	838	5.0	169
D1	1216	1.6	750	4.7	158
D2	1308	1.7	765	4.7	163
D3	1252	1.8	694	4.6	150
D4	1272	1.8	729	4.4	164

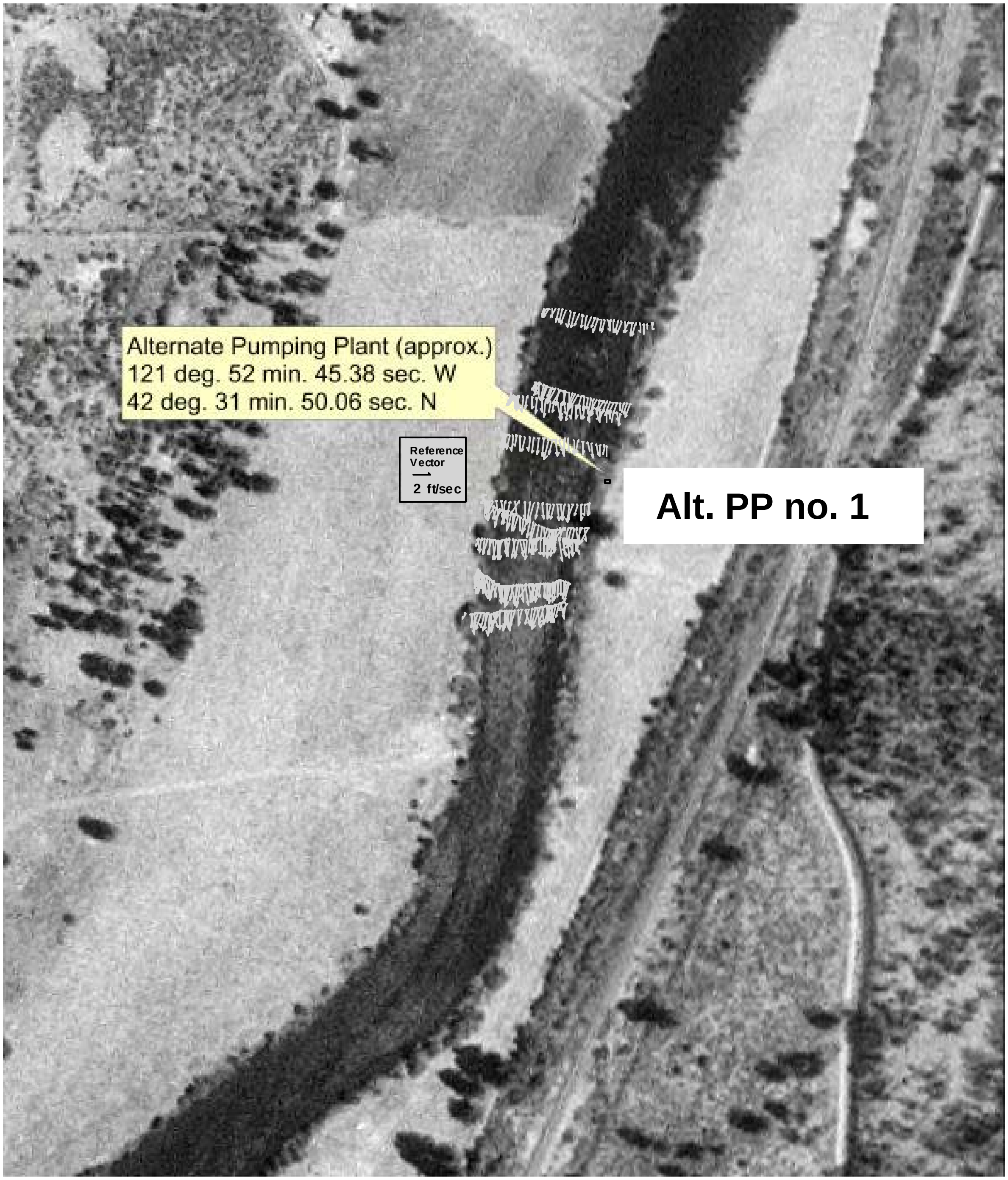


Figure 3. ADCP velocity vectors plotted on an aerial photograph of alternate pumping plant site no. 1.

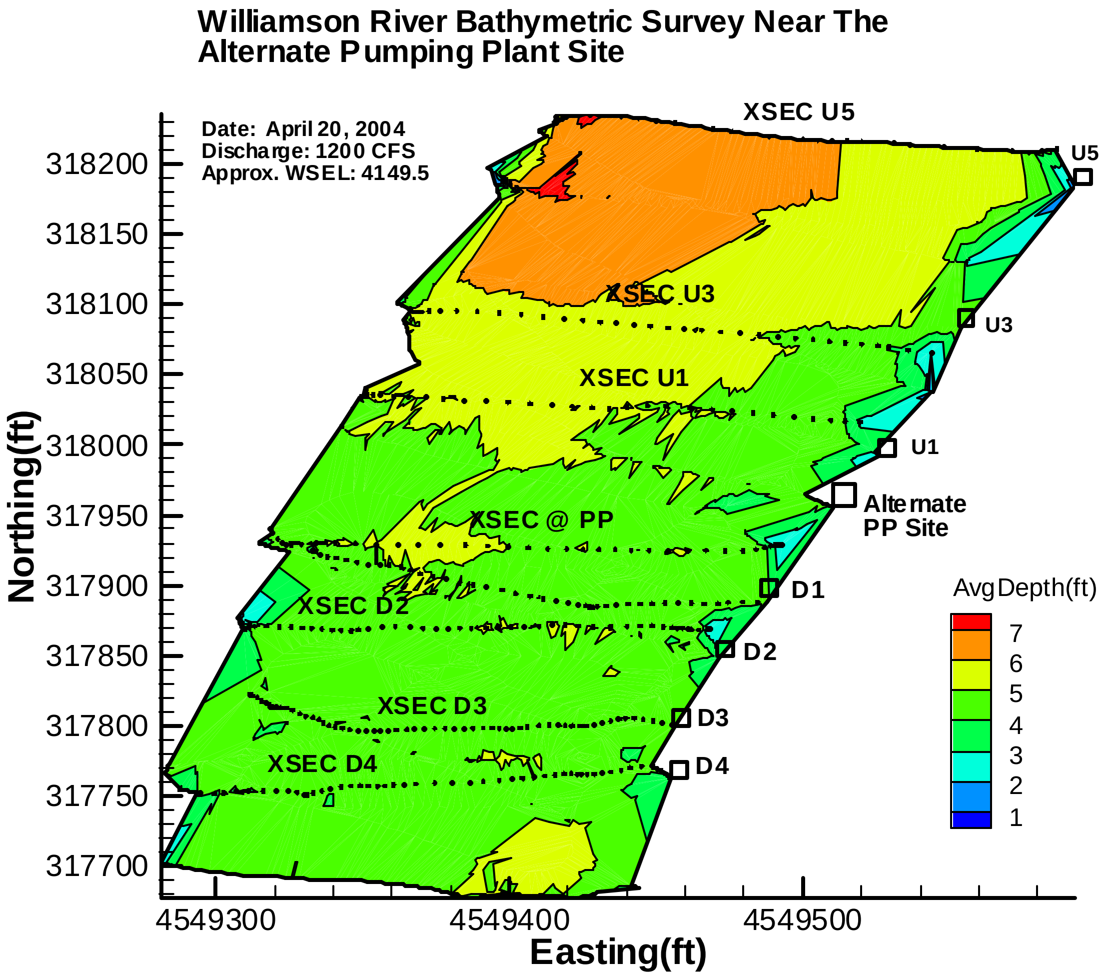


Figure 4. Plot of ADCP transect paths and water depth contours at alternate pumping plant no. 1 site. The boxes along the left bank are the survey stake locations which defined the river cross sections.

Figure 5 shows that velocity vectors have a very uniform magnitude throughout the study reach. In contrast, the velocity directions are somewhat variable. These localized variations in velocity direction are normal in rivers with a rocky bottom. A comparison of near surface and depth-averaged velocities showed no significant difference in velocity magnitude or direction. This result was expected because of the shallow depths in this river reach.

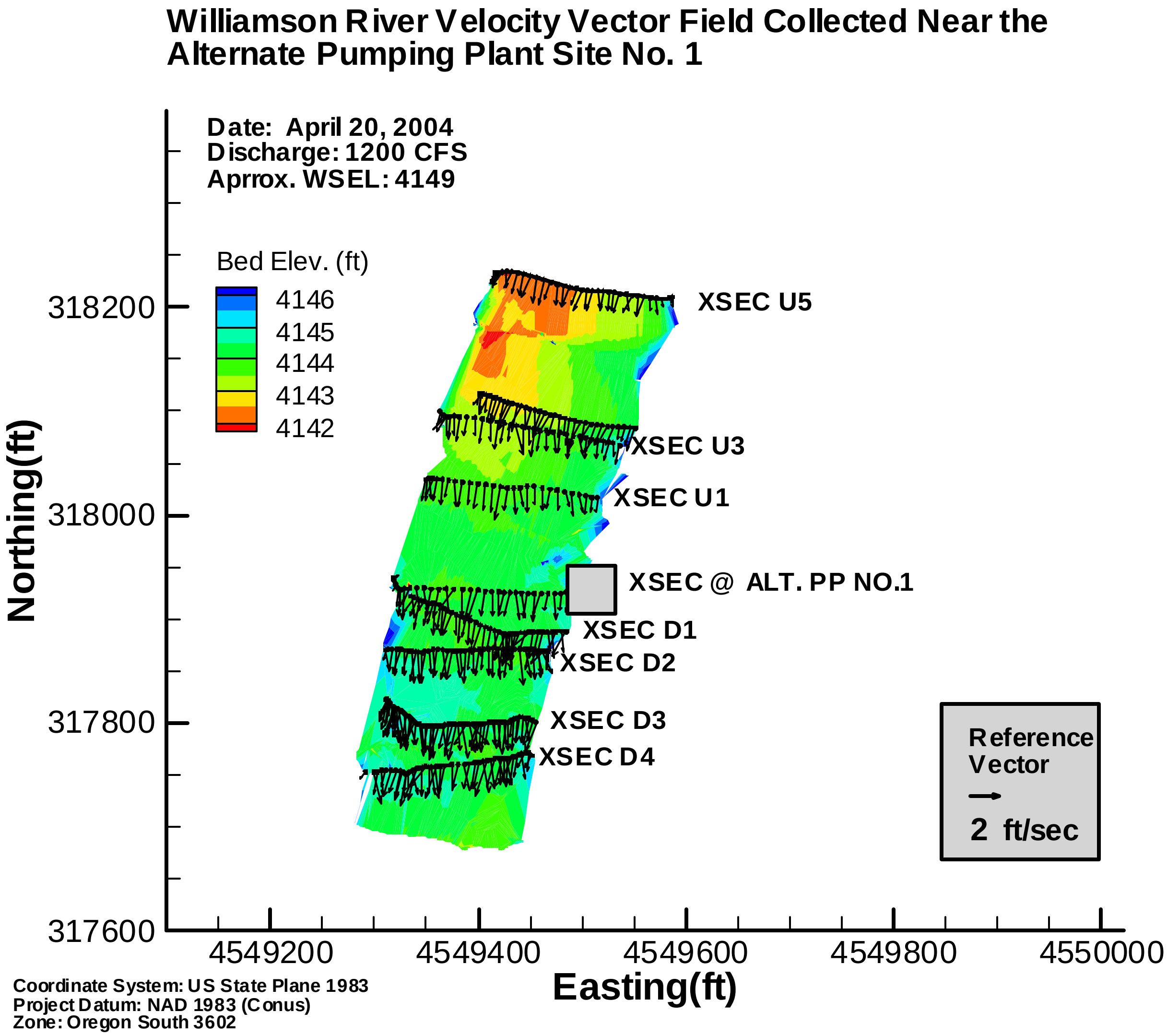


Figure 5. Plot of depth-averaged velocity vectors and river bed elevation contours at alternate pumping plant site no. 1. The velocity vectors show a uniform velocity distribution, in both magnitude and direction, throughout the study reach. Note: Localized variations in velocity direction are typical of rivers with a rocky bottom.

Figure 6 shows the bathymetric contours and ADCP measurement locations near the existing pumping plant site. Figure 6 illustrates the irregular paths taken by the boat during data collection. Bathymetric data shows several areas of local scour just below the riffle entering the study reach (near cross section U2). At the pumping plant cross section, the average depth and velocity were 11.5 ft and 1.6 ft/sec, respectively. With the exception of average depths and depth-averaged velocities shown in table 2, river conditions did not allow the measurement of average hydrographic data for the cross sections in this study reach. Note: Data in table 2 were estimated using interpolated values.

Table 2. Average depths and velocities for river cross sections near the existing pumping plant

Cross Section	Estimated Average Depth (ft)	Estimated Average Velocity(ft/sec)
U2	9.4	1.9
U1	11.4	1.7
EXISTING PP	11.5	1.6
D1	6.1	1.9
D2	3.8	2.7
D3	2.0	n/a

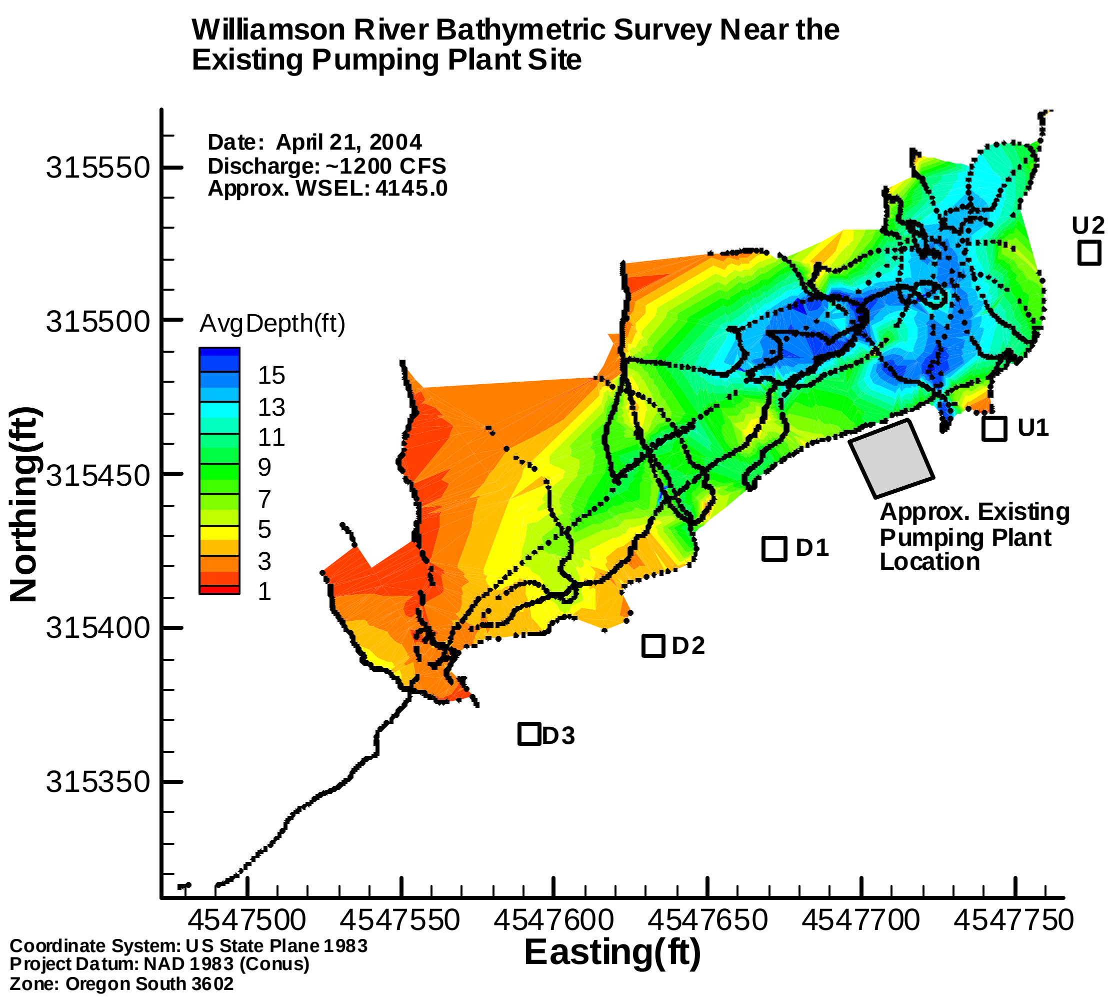


Figure 6. Plot of ADCP transects and water depth contours at the existing pumping plant site. The box icons along the left bank are survey stake positions which defined the measurement cross sections.

Figure 7 shows the bed elevation contours overlaid by depth-averaged velocity vectors. Data used to create the plot in figure 7 were extracted from the ADCP data shown in figure 6. The ADCP data were interpolated using a Kriging algorithm to generate the cross sectional velocity vectors shown in the plot. Interpolated data are smoothed because eight nearby data points were used to compute velocities at 20 to 30 evenly spaced points along each cross section. Figure 7 illustrates how the scour holes upstream from the existing pumping plant direct the flow toward the pumping plant. An eddy zone upstream from the pumping plant is also shown in figure 7.

Figure 8 shows a comparison of depth-averaged and near surface velocity vectors at the existing pumping plant site. Near surface velocities were computed as the average of ADCP velocities measured at 2.6 and 3.5 ft below the water surface.

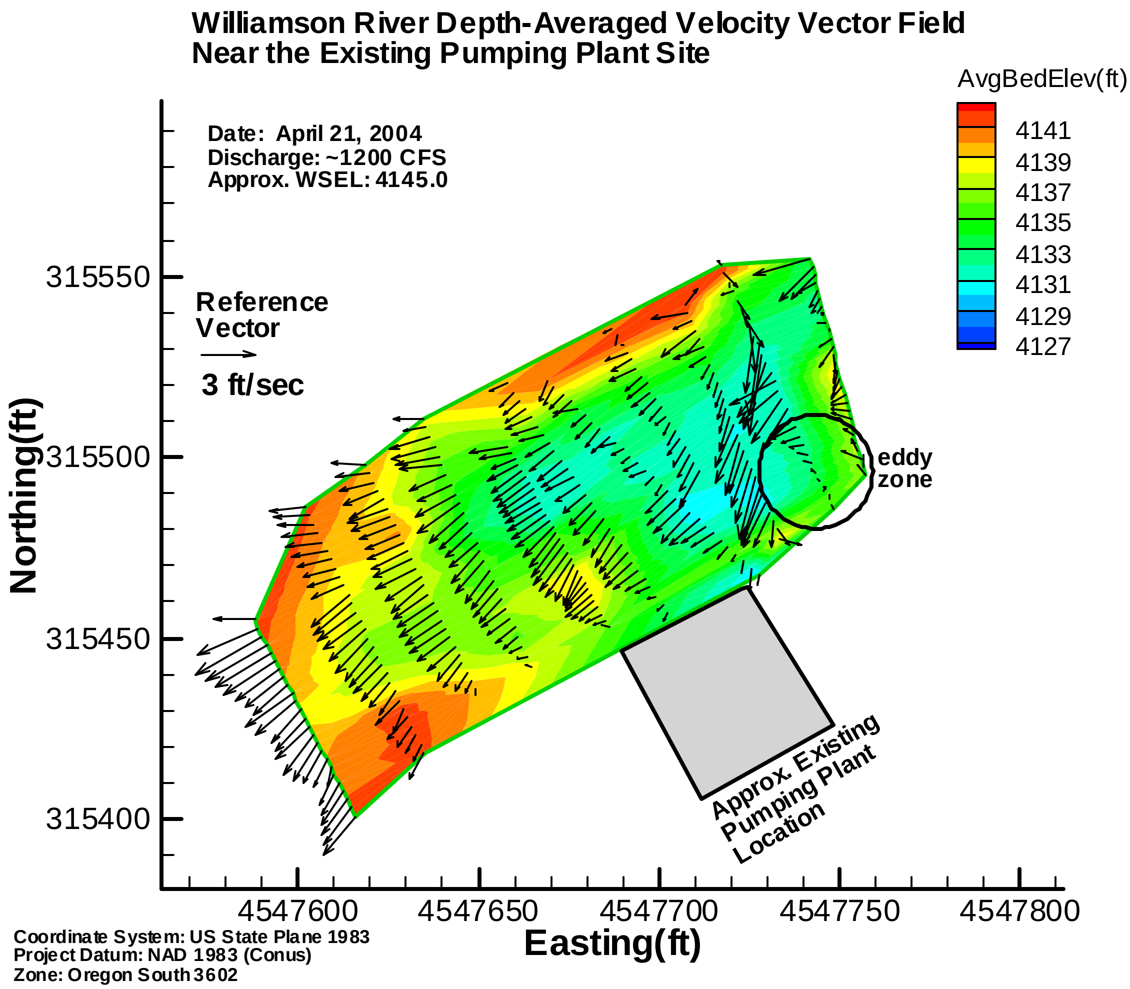


Figure 7. Plot of bed elevation contours and velocity vectors measured near the existing pumping plant site. Note: ADCP velocity data were used to interpolate the cross sectional velocity vectors used for this plot.

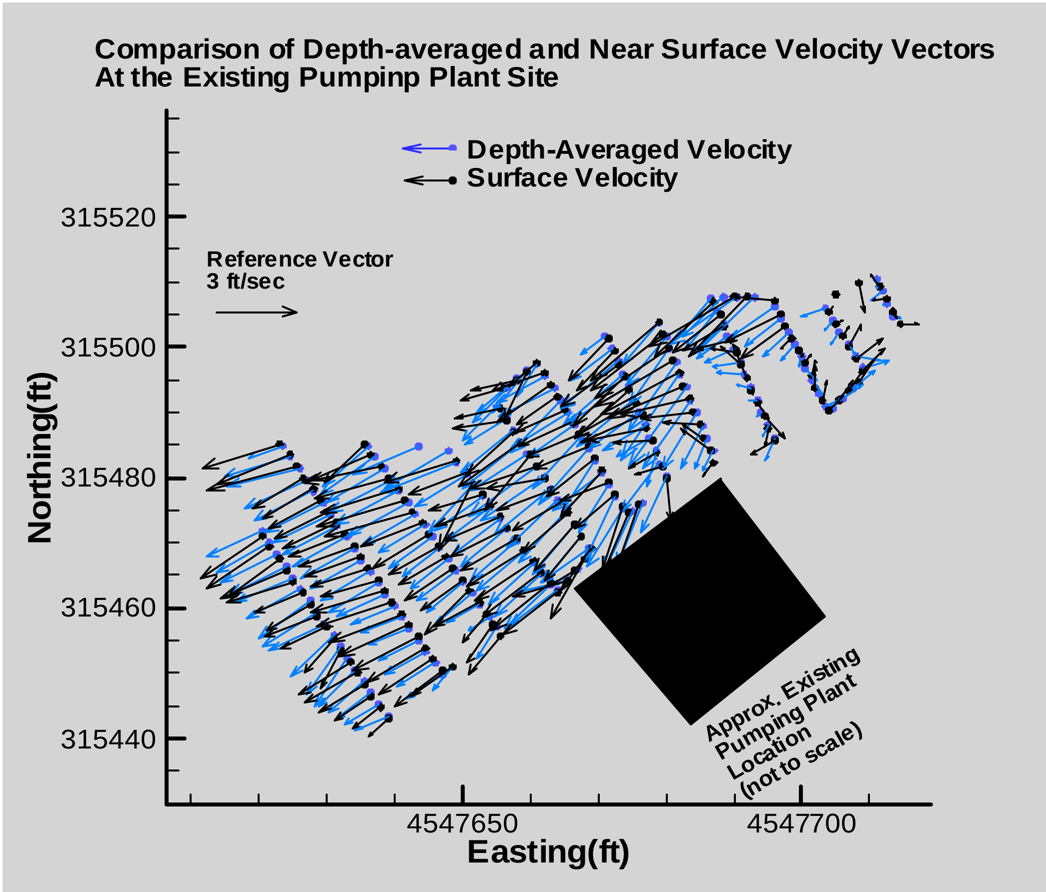


Figure 8. Comparison plot of depth-averaged and surface velocity vectors. The only location where surface velocity vectors differ significantly was just upstream of the existing pumping plant - where surface velocity vectors are directed toward the middle of the channel, and depth-averaged velocity vectors are directed toward the existing pumping plant trashracks.

Results from July 22, 2004 Hydrographic Surveys: On July 22, 2004, an ADCP was used to measure river discharges at 16 transects near alternate pumping plant sites no. 1 and no. 2. Figure 9 shows ADCP transect locations and velocity vectors on an aerial photo of the Williamson River. The average ADCP-measured discharge was 414 ft^3/sec with a standard error (standard deviation of the mean) equal to ±8 ft^3/sec. The USGS gage reported an average flow equal to 387 ft^3/sec. The discrepancy between the USGS and the ADCP average discharge readings was 7.1 percent. Again, the reason for this discrepancy is unknown, but may be related to a shift in the rating at the gaging station. Table 3 contains a summary of the hydraulic data collected in the vicinity of alternate pumping plant site no. 1. The average reach properties for the six transects listed in table 3 are as follows:

- Channel width was 163 ft, channel depth was 3.7 ft
- Cross sectional area was 599 ft^2
- Depth-averaged channel velocity was 0.69 ft/sec

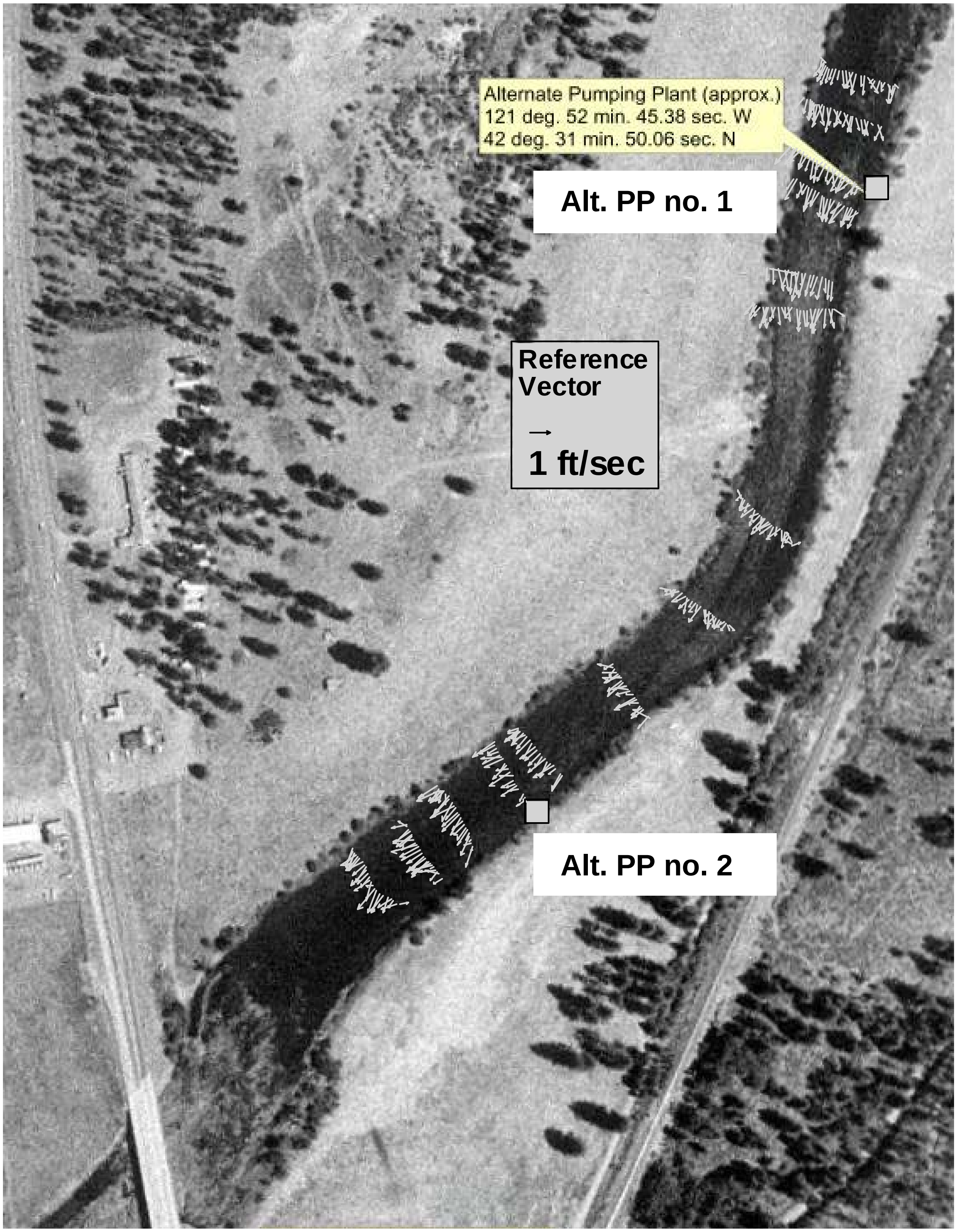


Figure 9. Aerial photograph with depth-averaged velocity vectors collected at two alternate pumping plant sites on July 22, 2004. The location of the ADCP velocity data and the alternate pumping plant site no. 2 should be considered approximate because they are based on GPS measured positions.

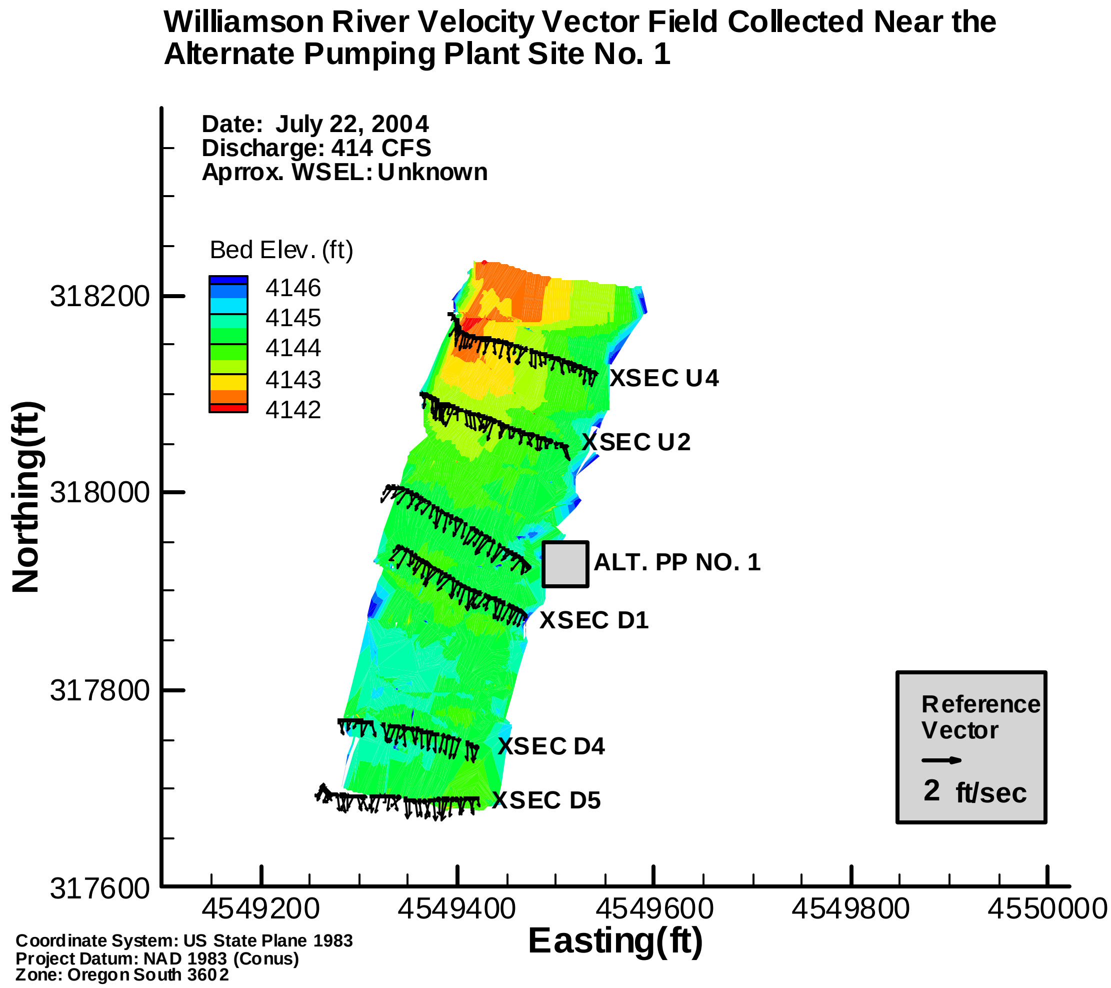


Figure 10. Plot of near-surface velocity vectors and water depth contours at alternate pumping plant site no. 1. The velocity vectors show uniform velocity magnitudes, while local variations in flow direction occur throughout the study reach.

Table 3. Hydraulic data for Williamson River cross sections collected near the alternate pumping plant site no. 1 for low flow conditions (July 22, 2004).

Transect	Flow (ft^3/sec)	Mean Channel Velocity (ft/sec)	Cross-Sectional Area (ft^2)	Average Depth (ft)	Width (ft)
U4	431	0.53	810	4.7	174
U2	411	0.62	659	4.0	165
PP0	414	0.73	571	3.3	171
D1	415	0.78	534	3.5	152
D4	415	0.84	492	3.2	154
D5	400	0.76	527	3.3	159

Figure 10 shows the bathymetric contours and near-surface velocity vectors for alternate pumping plant site no. 1. The bathymetric data show in Figure 10 is the same as was presented in figure 3 (surveyed in April 2004). The near-surface velocity vectors were plotted on top of the bed elevation contours. The location of each velocity vector is within the GPS positional accuracy of about ± 10 ft. At the alternate pumping plant no. 1 site, the average depth and channel velocity were 3.3 ft and 0.73 ft/sec, respectively. Hydraulic data for the other transects (cross sections) are summarized in table 4.

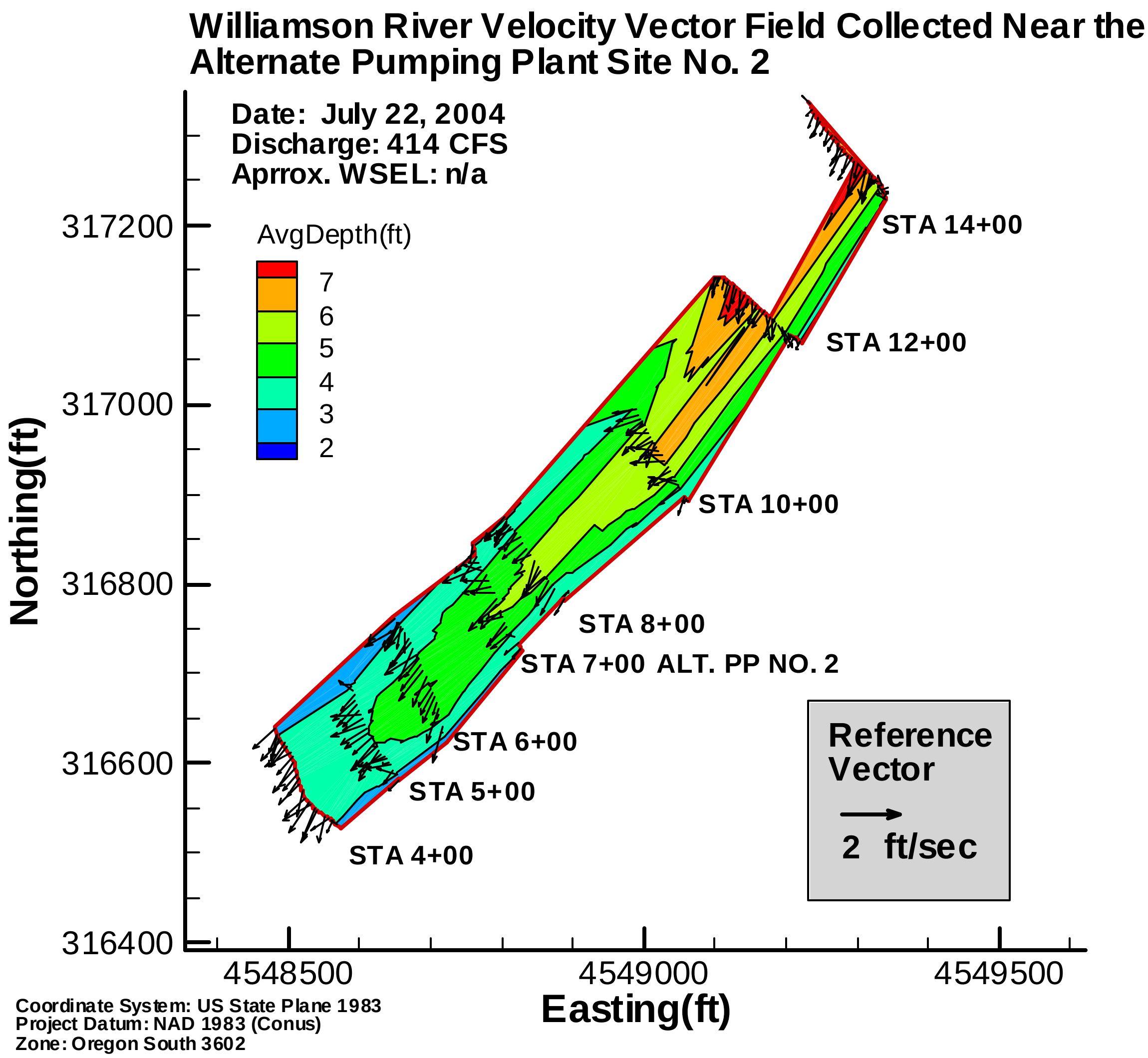


Figure 11. Plot of near-surface velocity vectors and water depth contours at alternate pumping plant site no. 2. The velocity vectors show uniform velocity magnitudes, while local variations in flow direction occur throughout the study reach.

Table 4. Hydraulic data for Williamson River cross sections collected near the alternate pumping plant site no. 2 for low flow conditions (July 22, 2004). Stations 0+00 and 2+00 were too shallow to collect ADCP velocity data.

Transect	Flow (ft^3/sec)	Average Channel Velocity (ft/sec)	Cross-Sectional Area (ft^2)	Average Depth (ft)	Width (ft)
STA 14+00	447	0.45	988	6.3	157
STA 12+00	399	0.45	884	6.2	142
STA 10+00	402	0.59	687	4.9	140
STA 8+00	425	0.74	576	4.2	137
STA 7+00	410	0.66	621	3.9	159
STA 6+00	436	0.66	660	3.9	169
STA 5+00	421	0.74	570	3.5	165
STA 4+00	375	0.77	489	3.3	149
STA 2+00	n/a	n/a	n/a	n/a	189
STA 0+00	n/a	n/a	486	2.5	191

The average reach properties for the ten transects listed in table 4 are as follows:

- Channel width was 153 ft, channel depth was 4.3 ft
- Cross sectional area was 654 ft^2
- Depth-averaged channel velocity was 0.63 ft/sec

Figure 11 shows the ADCP velocity vectors and water depth contours for alternate pumping plant site no. 2. The location of each velocity vector is within the GPS positional accuracy of ± 10 ft. At the pumping plant no. 2 cross section (STA 7+00), the average depth and channel velocity were 3.9 ft and 0.66 ft/sec, respectively. On figure 11, the velocity vectors have a very uniform magnitude throughout the study reach. Conversely, the velocity directions are somewhat variable. These localized variations in velocity direction are normal for rivers with a rocky bottom. A comparison of near surface and depth-averaged velocities was not possible because the shallow depths resulted in only near-surface velocity measurements. Hydraulic data for the other transects (cross sections) collected at alternate pumping plant no. 2 are summarized in table 4.

Figure 12 shows a comparison of near-surface ADCP velocities collected at cross sections through alternate pumping plants sites no. 1 and no. 2. The velocity vector plots show that velocity magnitudes are very similar, except at the left bank near site no. 2 that had lower velocities. For example, near-surface velocities with 20 ft of the left bank for sites no. 1 and no. 2 were 0.64 and 0.44 ft/sec, respectively. Likewise, the average water depths within 20 ft of the left bank for sites no. 1 and no. 2 were 3.1 and 2.9 ft, respectively. Based on the similarity of the low-flow hydraulics and geomorphology of the two alternate pumping plant sites, it is reasonable to expect the two sites would have similar hydraulic properties for high-flow conditions.

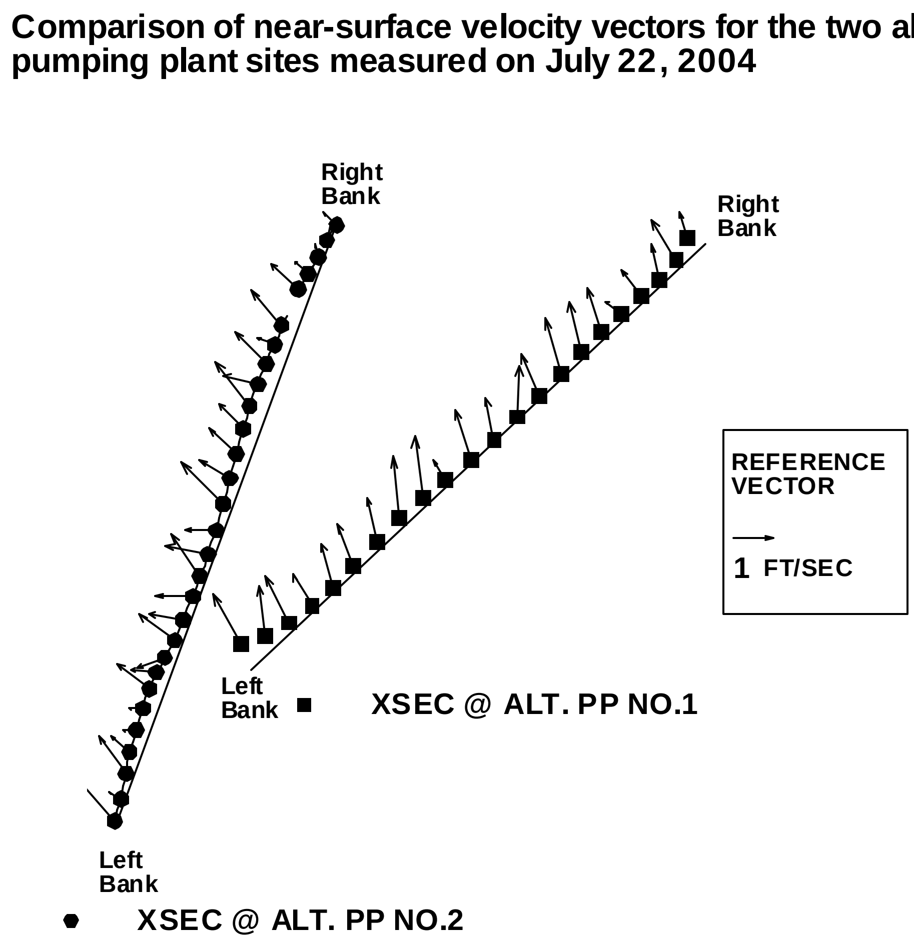


Figure 12. Plot of near-surface velocity vectors for both alternate pumping plant sites. Velocities at alternate pumping plant no. 2 are lower than at alternate pumping plant no. 1 because the cross sectional area is greater. Also, velocities near the left bank are lower at alternate pumping plant no. 2.

Surface Velocity Measurements, July 22, 2004: Low flow conditions and shallow depths wre not conducive to making surface velocity measurements with an ADCP. Consequently, surface velocities were measured using a Sontek Flowtracker mounted on a wading rod. The Flowtracker is a hand-held acoustic Doppler velocimeter that collects 2-dimensional velocity measurements. The 2-D velocities are oriented in a horizontal (x,y) plane, where Vx is in the streamwise direction and Vy is in the crossstream direction. After ADCP measurements were made at alternate pumping plant site no. 2, the Flowtracker and GPS were used to collect surface velocities at two points near the left bank at several stations near the proposed pumping plant site. A GPS receiver was used to locate the survey stations and velocities were measured an estimated 10 and 25 ft from the left bank, except at stations 12+00, 13+00, and 14+00 which were too deep to wade beyond 10 ft from shore. The Flowtracker surface velocity data are presented in Table 5, where negative y-velocities are directed toward the left bank and negative x-velocities are directed upstream. A comparison of ADCP near-surface velocities and Flowtracker velocities showed close agreement throughout the river reach. For example, at Sta 7+00 the average ADCP and Flowtracker velocities measured between 10 and 25 ft from the left bank were 0.44 and 0.47 ft/sec, respectively. Similarly, at Sta 8+00 the average ADCP and Flowtracker velocities measured between 10 and 25 ft from the left bank were 0.76 and 0.67 ft/sec, respectively.

Table 5. Surface velocity data for Williamson River cross sections collected along the left bank at alternate pumping plant site no. 2 (July 22, 2004).

Time	Station #	Dist. From Left Bank (ft)	Water Depth (ft)	Measurement Depth (ft)	Vx (ft/s)	Vy (ft/s)
15:15	4+00	10	2.1	2.0	0.31	-0.10
15:15	4+00	25	2.5	2.4	0.52	-0.05
15:19	5+00	10	2.9	2.8	0.45	0.05
15:21	5+00	25	3.6	3.5	0.47	-0.05
15:24	6+00	10	2.8	2.7	0.54	-0.04
15:26	6+00	25	3.4	3.3	0.63	0.00
15:28	7+00	10	2.8	2.7	0.37	0.06
15:30	7+00	25	3.5	3.4	0.56	0.04
15:33	8+00	10	3.1	3.0	0.61	0.04
15:34	8+00	25	3.3	3.2	0.72	0.01
15:36	9+00	10	3.0	2.9	0.47	0.05
15:38	9+00	25	3.6	3.5	0.55	-0.13
15:41	10+00	10	2.8	2.7	0.55	0.01
15:42	10+00	25	3.4	3.3	0.58	-0.14
15:45	11+00	10	3.0	2.9	0.42	0.00
15:46	11+00	25	3.5	3.4	0.46	-0.04
15:50	12+00	10	3.9	3.8	0.06	0.03
15:53	13+00	10	3.0	2.9	-0.02	0.02
15:56	14+00	10	3.7	3.6	-0.10	0.00

Note: Negative Vy velocities are directed toward the left bank (when looking downstream).

Table 6 contains estimated surface velocity data for Williamson River cross sections collected along the left bank at alternate pumping plant site no. 2 for flow conditions on April 20, 2004. The surface velocities were estimated by multiplying velocities in table 5 by the average ratio of average channel velocities collected at alternate pumping plant no. 1 in April and July 2004. The average ratio was computed using data from cross sections U2, PP0, D1, and D4 and was equal to 2.24. These velocity estimates do assume a similar stage versus cross sectional area relationship for both river reaches, which is reasonable considering the close proximity of the two alternate pumping plant sites. These estimates of surface velocity are needed to determine fish screen exposure times for larval fish times during periods of high flow.

Table 6. *Estimated* surface velocity data for Williamson River cross sections collected along the left bank at alternate pumping plant site no. 2 for high flow conditions on April 20, 2004.

Time	Station # (ft)	Dist. From Left Bank (ft)	Water Depth (ft)	Measurement Depth (ft)	Estimated Vx (ft/s)	Estimated Vy (ft/s)
	4+00	10			0.70	-0.23
	4+00	25			1.16	-0.10
	5+00	10			1.01	0.11
	5+00	25			1.05	-0.12
	6+00	10			1.20	-0.08
	6+00	25			1.41	0.00
	7+00	10			0.84	0.13
	7+00	25			1.26	0.10
	8+00	10			1.37	0.09
	8+00	25			1.62	0.03
	9+00	10			1.06	0.11
	9+00	25			1.23	-0.28
	10+00	10			1.23	0.02
	10+00	25			1.29	-0.32
	11+00	10			0.93	0.00
	11+00	25			1.03	-0.08
	12+00	10			0.13	0.06
	13+00	10			-0.05	0.05
	14+00	10			-0.22	0.01

Note: Negative Vy velocities are directed toward the left bank (when looking downstream).

Miscellaneous Observations

Stream bed conditions at alternate pumping plant sites no. 1 and no. 2 consisted of armored cobbles with fine sediments filling in the interstitial spaces between cobbles. Stream bed conditions at the existing pumping plant were not easily observed because of deep water.

Conclusions

- An acoustic Doppler current profiler was successfully used to perform hydrographic surveys at two proposed pumping plant sites on the Williamson River for a flow of about 1160 ft^3/sec. A second set of data were successfully collected for a flow of about 414 ft^3/sec at alternate pumping plant sites no. 1 and no. 2.

- The ADCP data collected at alternate pumping plant sites no. 1 and no. 2 were of high quality because river flow conditions allowed the boat to be easily maneuvered across the channel.
- The ADCP data collected at the existing pumping plant site were of lesser quality because shallow depths and rapid flow prevented the boat from being maneuvered along a channel cross section. Furthermore, the ADCP periodically lost bottom-tracking data because of shallow depths and/or high water velocities. As a result, surveying data could not be used to compute accurate positions for each velocity profile or depth measurement. To produce a usable data set, GPS positions were used to compute the position of ADCP data.

- Navigational problems at the existing pumping plant site did not affect the quality of the velocities measured by the ADCP, they only affected the accuracy of the position and bed elevation data.

- For high flow conditions, depth-averaged velocities agree closely to near-surface velocities at both sites, except just upstream of the existing pumping plant site, where surface velocities were directed downstream and depth-averaged velocities were directed toward the pumping plant trashracks.

- For low flow conditions, shallow depths did not allow a comparison of depth-averaged velocities and near-surface velocities at alternate pumping plant sites no. 1 and no. 2.

- Comparisons between ADCP near-surface velocities and Flowtracker surface velocities showed very similar velocity magnitudes near the left bank at alternate pumping plant site no. 2.

- Based on the similarity of the low-flow hydraulics and geomorphology of the two alternate pumping plant sites, it is reasonable to expect the two sites would have similar hydraulic properties for high-flow conditions.

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APPENDIX B

DATA SUMMARY: LARVAL SUCKER DRIFT IN THE LOWER WILLIAMSON RIVER, OREGON: EVALUATION OF TWO PROPOSED WATER DIVERSION SITES FOR THE MODOC POINT IRRIGATION DISTRICT

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Larval sucker drift in the Lower Williamson River, Oregon: Evaluation of two proposed water diversion sites for the Modoc Point Irrigation District

July 2004

Data Summary

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Background

The Sprague River Dam, constructed in 1914, is located at river mile (RM) 0.87 on the Sprague River near the town of Chiloquin, Oregon. The dam serves as a diversion point to supply irrigation water for the Modoc Point Irrigation District. The dam has been identified as a potential barrier that inhibits or at times may prevent the upstream movement of Lost River suckers (*Deltistes luxatus*), shortnose suckers (*Chasmistes brevirostris*), redband trout (*Oncorhynchus mykiss*), and other fish species in the Sprague River and Upper Klamath basin (USFWS 2001, NRC 2003). The dam has had a total of three operational fish ladders installed during its history. Each ladder's fish passage efficiency, however, has been questioned. At present, the dam has one functional ladder that has been periodically sampled for the presence of suckers and redband trout since 1975. In 2000, the U.S. Geological Survey (USGS) implemented an intensive routine sampling program at this fish ladder to monitor the fish species composition, timing, and relative abundance during the sucker spawning runs. Data from these efforts and the routine capture of suckers in all cells of the ladder suggest that some fish are able to successfully negotiate the existing fish ladder under some flow conditions. The efficiency of the ladder to pass fish at lower flows and the extent that fish are able to find, enter, and negotiate the ladder, however, is still largely unknown.

Recently, there has been a renewed interest to improve fish passage across the Sprague River Dam. An initial study to examine improved fish passage at the dam was authorized in the 2002 Farm Bill. A technical working group was formed and reached consensus that removing the dam was the recommended fish passage alternative. This recommendation has led to funds being dedicated in the 2005 Federal budget for the removal of the dam. With the removal of the dam, however, it becomes necessary to relocate the Modoc Point Irrigation District's water diversion point. The new point of diversion will likely require a pumping station, which may in turn increase the risk of larval sucker entrainment in the irrigation system. This study was conducted to evaluate larval fish migration past two proposed water pumping sites located downstream from the dam on the lower Williamson River.

Little empirical information exists about larval sucker emigration in the lower Williamson River. Bienz and Ziller (1987) collected information on emigration of larval suckers in the Sprague and Williamson rivers in 1983 and 1984. The authors monitored larval drift at RM 5.9 on the Sprague River and at two sites on the Williamson River (RM 4.9 and RM 13). Their data suggested larval emigration occurred principally during early morning hours (0000 to 0430 hours) with peak emigration occurring in late June and early July. In subsequent years, biologists with the U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, Klamath Tribes, and Oregon State University have collected additional data on larval sucker drift in the lower Williamson River indicating that most larval suckers emigrated through the river system during the nighttime hours with heaviest rates of drift in the thalweg (Buettner and Scoppettone 1990, L. Dunsmoor, pers. comm.; Cooperman and Markle, 2003). The river morphologies in the reaches associated with the proposed pumping sites, however, are not comparable with the river morphologies of where these studies took place, so additional site specific data on larval sucker drift past the proposed water diversion sites was requested.

The primary objective of this research is to evaluate larval fish transport past two proposed water diversion sites on the lower Williamson River selected for a water withdrawal point for the Modoc Point Irrigation District. This information will be used to assist with placement and design of a proposed water pumping station and fish screen on the lower Williamson River at either an existing pump site located immediately below the US 97 crossing or at a ‘proposed alternative pump site’ located upstream of the US 97 crossing (Figure 1).

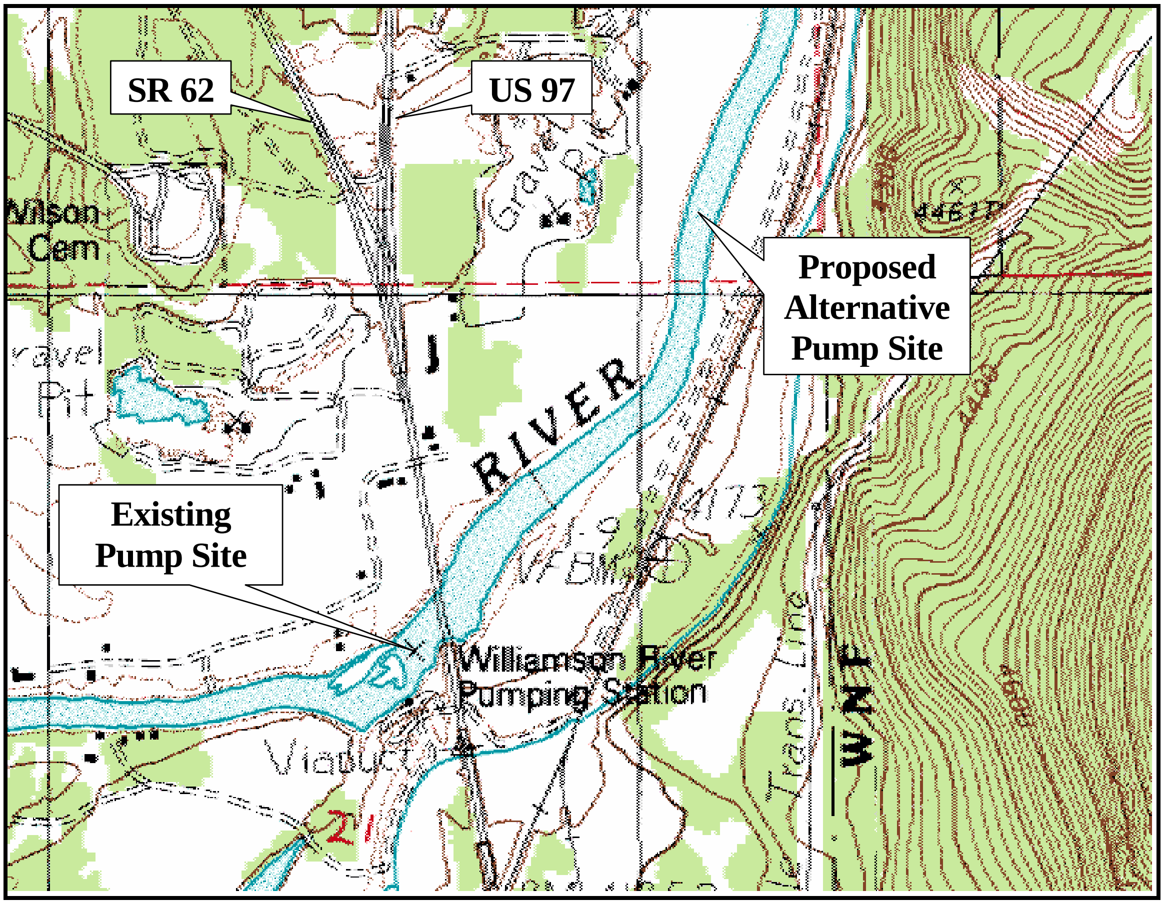

Figure 1. Location of the existing pump site and the proposed alternative pump

Methods

Field sampling was conducted by personnel of the USGS, Klamath Falls Field Station, and the U.S. Bureau of Reclamation, Klamath Basin Area Office, at the existing pump site and the proposed alternative pump site on a weekly basis during the peak larval sucker drift period of 2004 (May 8 through June 4). Sampling was conducted on the descending limb of the hydrograph as recorded at the USGS gage (#11502500) on the Williamson River below the confluence of the Sprague River (Table 1).

Table 1. Average daily stream flow as recorded at the USGS gage (#11502500) on the Williamson River below the confluence of the Sprague River.	
Sample Date	Average Daily Stream Flow
May 8, 2004	905 cfs
May 16, 2004	782 cfs
May 22, 2004	834 cfs
May 29, 2004	672 cfs
June 4, 2004	583 cfs

Five sample stations were established at the proposed alternative pump site and four sample stations were established at the existing pump site on transects of the Williamson River. The five stations at the proposed alternative pump site included one station at mid-channel and two stations to each side of mid-channel, equally dividing the distance from mid-channel to shore (Figure 2). Each station was marked with a buoy and anchor during the sampling period. The four sample stations at the existing pump site were also spaced across the river immediately downstream of the concrete pumping facility at approximately equal intervals. The two mid-channel stations were located at either edge of the presumed thalweg of the river and the two near-shore stations were located to equally bisect the distance between the edge of the thalweg and shore on either side of the river (Figure 3). Each station was marked on a traverse line set to both the north and south riverbanks immediately downstream of the existing pumping facility.

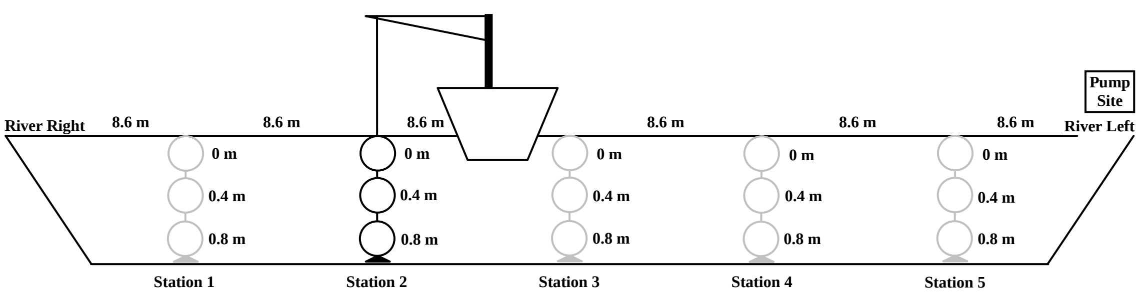

Figure 2. A representational (not to scale) cross-section of the Williamson River and net placement at the proposed alternative pump site.

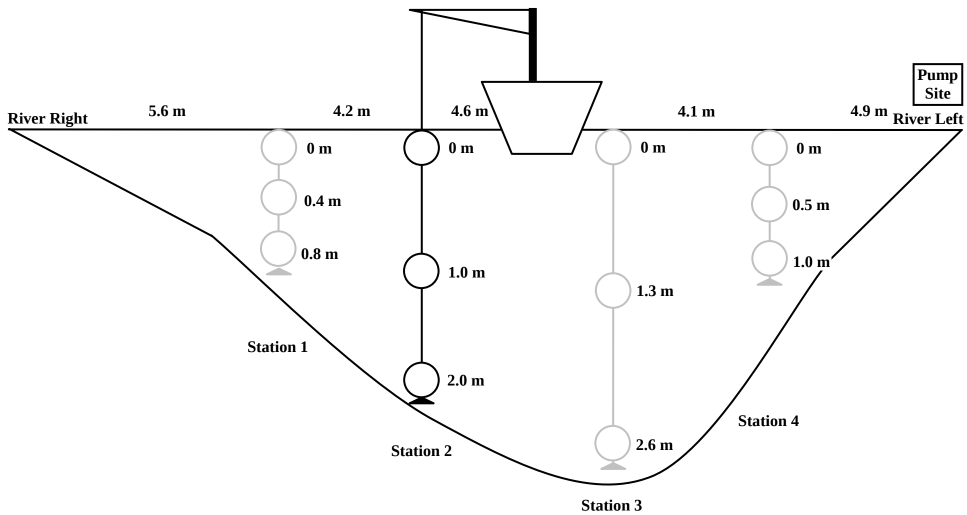

Figure 3. A representational (not to scale) cross-section of the Williamson River and net placement at the existing pump site.

Samples were collected using 2.5 m long drift nets with a 0.3-m-diameter circular opening. The nets were made of 800 µm-mesh Nitex and were fitted with a removable collection cup made with 500 µm-mesh Nitex. A General Oceanics Model 2030R mechanical flow meter was attached in the opening of each net to aid in measuring the volume of water sampled by each net. A 0.3 m PVC hoop was sewn into the mesh of the drift nets used at the existing pump site to reduce the effect of turbulent flows collapsing the net around the flow meter's propeller.

Nets were deployed from a boat with a davit arm that held the drift nets approximately 0.5 m (at the existing pump site) or 1.0 m (at the alternative pump site) away from the side of the boat so drift samples could be collected away from the influence of the boat's drag on the water surface. Boat position was maintained during sampling at the existing pump site by attaching the bow to the traverse line at a station marker and anchoring of the stern. Boat position was maintained at the proposed alternative pump site by attaching the boat bow to an anchored buoy at a river cross-section station and again anchoring of the stern.

Three drift nets were connected in series on a single line from the davit arm to sample three water depths simultaneously (i.e., surface, mid-water column, and near bottom, see Figures 2 and 3). An anchor was attached to the lower-most drift net to keep the series of drift nets perpendicular to the current while they were sampling larval drift. Channel morphology led to relatively uniform sampling depths of nets across the river channel at the proposed alternative pump site (Figure 2). Channel morphology at the existing pump site resulted in the mid-water column nets at the mid-channel stations sampling at depths greater than the bottom nets of the two stations nearest to the riverbanks (Figure 3). We attempted to add additional nets to the mid channel stations at this site but the strength of the river current at these stations resulted in any series of more than three nets being pulled away in the current resulting in them no longer sampling perpendicular in the water column. The drift nets were allowed to sample for approximately 10 min per sample event.

Samples were collected during both daytime and nighttime hours during two, 6-hour shifts for each of the weekly sampling efforts (Table 2). Shifts alternated weekly between a daytime/nighttime sampling regiment and a late evening/early morning sampling regiment. Samples were collected during the daytime/nighttime sampling regiment on May 8 and May 22, and June 4 (at the proposed alternative pump site only) from approximately 0900 to 1500 hours and from 2100 to 0400 hours. Samples were collected continuously during the late evening/early morning sampling regiment on May 15 and May 28 from approximately 1900 to 0700 hours. The mid-water column net was omitted from the sampling at the proposed alternative pump site on the June 4 sample date due to reduced river level.

Table 2. Times the existing pump site and the proposed alternative pump site were sampled for drifting larval suckers.

Sampling Schedules	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	0000
Daytime/ Nighttime	■	■							■	■	■	■	■	■							■	■	■	■
Late evening/ Early morning	■	■	■	■	■	■													■	■	■	■	■	■

Samples were collected across each transect with stations being repeated approximately every 1½ to 2 hours. At least three sets of samples across each transect were collected at each pump site during a shift, resulting in a total of 421 samples being collected at the proposed alternative pump site and 315 samples being collected at the existing pump site.

Samples were fixed in 10% to 15% formalin for 24 to 48 hours. Larval fish samples were then sorted free of debris and stored in 95% ethanol until they could be processed. Processing samples involved separation of larval fish from debris, an initial enumeration of all larval fish, and identification and enumeration of larval fish to the family level. Larval fish samples identified to the family level were subject to at least two quality assurance checks, although most samples passed through three quality assurance checks. Data, which included date, site, station, time, flow meter readings, and counts of larval fish identified to the family level, were placed into electronic files. The electronic files were edited for accuracy of data entry at least once.

Results/Discussion

Analysis of catch per unit effort (CPUE) for larval suckers in the drift (number of individuals per cubic meter of water sampled) averaged across the sample period on an hourly basis showed three distinct drift patterns. These drift patterns were associated with sampling done during daytime, nighttime, and early morning hours. Numbers of samples collected from each river cross-section station at each water column depth was variable for each of the two pump sites (Table 3).

Table 3. Number of times each pump site transect was sampled during the study separated by hours associated with individual drift patterns.						
	Existing Pump Site			Alternative Pump Site		
	Surface	Mid	Bottom	Surface	Mid	Bottom
Daytime (1100-2000)	7	7	7	11	8	11
Nighttime (2200-0300)	17	17	17	17	14	17
Early Morning (0300-0600)	3	3	3	3	3	3

Daytime hours

Sampling during the daytime hours (approximately 0900 to 2000 hours) yielded a relatively small proportion of the total CPUE for each site investigated (Figures 1 and 2). Only 2% of the total CPUE at the alternative pump site and 3% of the total CPUE at the existing pump site was caught during day (Appendix C). The ranges of the daytime catches at both pump sites were relatively evenly distributed throughout the water column and across the river cross-section stations (Appendix D). These low catch rates indicate larval suckers are inactive in the drift and probably holding in low velocity areas during the daytime with individuals occasionally being swept into the active current. Our results are consistent with previous observations of larval sucker drift ecology in the Williamson and Sprague rivers (L. Dunsmoor pers. comm., Cooperman and Markle 2003).

These daytime drift trends are based on seven sampling efforts across the transect at the existing pump site and 11 sampling efforts across the transect at the proposed alternative pump site (Table 3). Only eight samples were collected at the mid net location at the alternative pump site, however, due to reduced river levels at the end of the study.

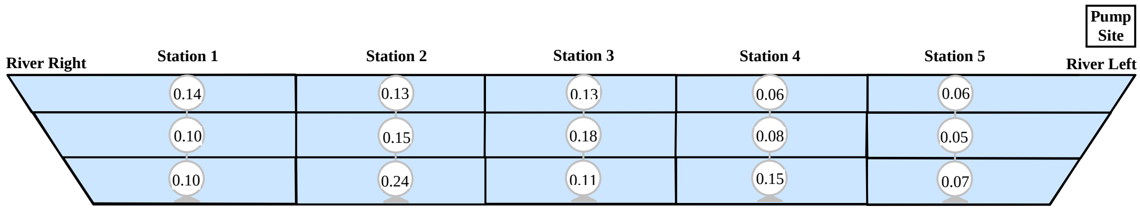

Figure 1. Mean larval sucker density (number of larvae/m^3) at the proposed alternative pump site during daytime sampling (approximately 0900 to 2000 hours).

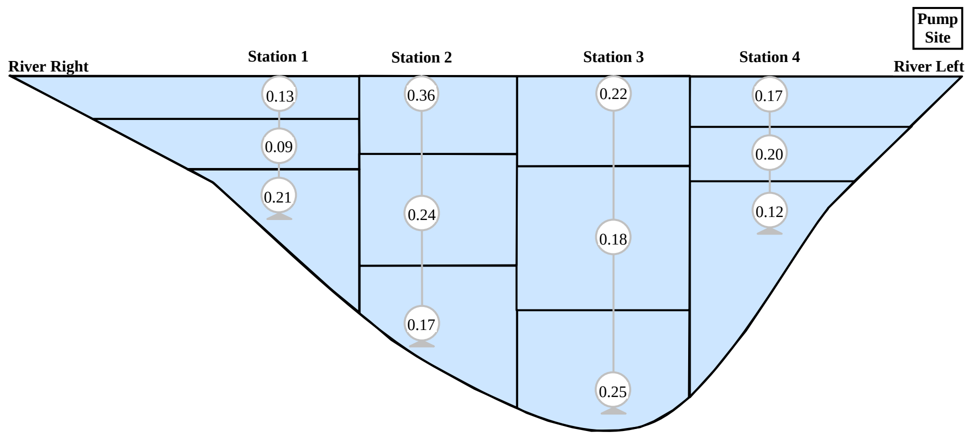

Figure 2. Mean larval sucker density (number of larvae/m^3) at the existing pump site during daytime sampling (approximately 0900 to 2000 hours).

Nighttime hours

Sampling during the nighttime hours (approximately 2100 to 0300 hours) yielded the largest proportion of the total CPUE at each pump site. Nighttime larval drift yielded 64% of the total CPUE at the proposed alternative pump site and 51% of the total CPUE at the existing pump site. Peak larval sucker drift across the river cross-section at both pump sites appeared to coincide with sampling done during the 0200 hours set (Appendix B), with individual peak catches typically occurring between 0000 and 0100 hours at the proposed alternative pump site and between 0000 and approximately 0400 hours at the existing pump site (Table 4). Peak larval sucker drift catches most often occurred at the midchannel stations (Table 4 and Appendix D).

Table 4. Peak larval sucker drift catches at the proposed alternative pump site and the existing pump site.							
Date	Pump Site	Station	Net Position	Time (hours)	Volume Sampled (m^3)	Number of Larvae	Number of Larvae per m^3 sampled
5/08/04	Alternative	3	Mid	0:36:00	8.70	192	22.07
5/22/04	Alternative	4	Surface	0:21:25	6.19	140	22.63
5/22/04	Alternative	3	Surface	0:04:35	5.88	137	23.32
5/08/04	Alternative	2	Mid	0:15:00	8.34	226	27.09
5/08/04	Alternative	2	Surface	0:15:00	8.81	298	33.83
5/29/04	Existing	2	Surface	3:52:06	6.76	136	20.12
5/29/04	Existing	2	Surface	2:42:50	6.60	142	21.53
5/08/04	Existing	3	Mid	0:03:00	11.52	277	24.05
5/15/04	Existing	2	Surface	2:12:30	7.56	185	24.47
5/22/04	Existing	3	Surface	0:29:15	8.78	263	29.95
5/29/04	Existing	3	Surface	4:08:45	8.01	242	30.22
5/29/04	Existing	3	Surface	3:00:00	7.76	268	34.55

Larval suckers appeared to be concentrated in the upper 0.7 m of the water column at both pump site locations during these hours. At the proposed alternative pump site, average and peak catches were generally highest in the surface and mid-column nets at Stations 3 and 2, midchannel and to the river-right of midchannel, respectively (Figure 3 and Appendices C and D). At the existing pump site, average and peak catches were highest at the surface near midchannel (Stations 2 and 3), with higher concentrations on the river-left side of midchannel (towards Station 4, see Figure 4 and Appendices C and D).

More larval suckers also appeared to drift past the river-left side of midchannel at the existing pump site (Station 4) than drifted past the same side of midchannel at the proposed alternative pump site (Station 5) (Appendices C and D). Average densities of larval suckers at the sampling point nearest the existing pump site (Station 4) were also generally higher in the bottom and mid-column nets than in the surface net (Figure 4). This is in contrast to the catches at the comparable sampling points at the proposed alternative pump site (Station 5) that yielded higher catches in the surface net than the bottom and mid-column nets (Figure 3).

These nighttime drift trends are based on 17 sampling efforts across each of these two transects (Table 3). Only 14 samples were collected at the mid net location at the alternative pump site due to reduced river levels at the end of the study.

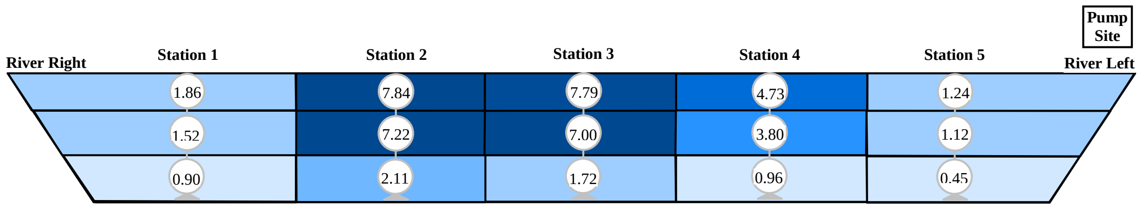

Figure 3. Mean larval sucker density (number of larvae/m^3) at the proposed alternative pump site during nighttime sampling (approximately 2100 to 0300 hours).

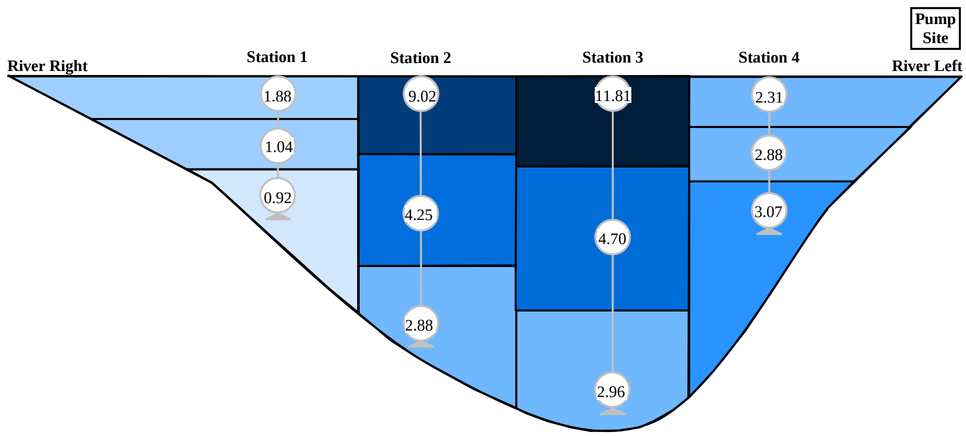

Figure 4. Mean larval sucker density (number of larvae/m^3) at the existing pump site during nighttime sampling (approximately 2100 to 0300 hours).

Early morning hours

Sampling during the early morning hours (approximately 0300 to 0600 hours) yielded the second largest proportion of the total CPUE for both pump sites. Early morning larval drift yielded 36% of the total CPUE at the proposed alternative pump site and 47% of the total CPUE at the existing pump site (Appendix C). Average distribution and density of larval suckers at the existing pump site was similar between early morning hours and nighttime hours (Appendix C). Unlike the nighttime drift, however, there were no peak larval drift catches during these hours at either of the two proposed pumping locations (Appendix D). The larval sucker distribution at the proposed alternative pump site shows a decrease in larval suckers being caught at the surface and an increase for larval suckers being caught towards the river-right shore (towards Station 1) and the nets sampling near the bottom (Figure 5 and Appendices C and D). This trend may represent larval suckers exiting the drift at the proposed alternative pump site during the early morning hours. This pattern was not apparent at the existing pump site, possibly due to the turbulent nature of the river as it passes the existing pump site (Figure 6 and Appendices C and D). These observations may indicate that larval suckers are in the drift for a longer duration at the existing pump site than at the proposed alternative pump site. These early morning drift trends are, however, based on only three sampling efforts across each of these two transects (Table 3).

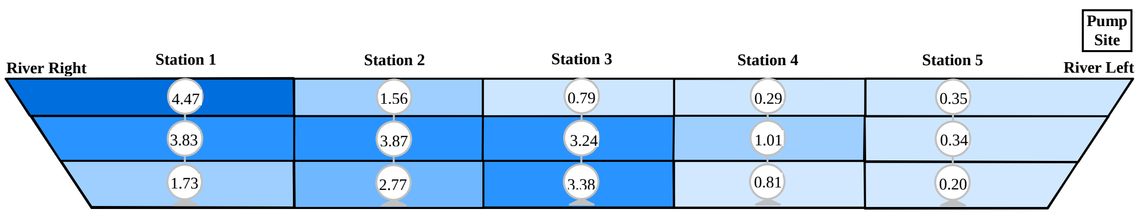

Figure 5. Mean larval sucker density (number of larvae/m^3) at the proposed alternative pump site during early morning sampling (approximately 0300 to 0600 hours).

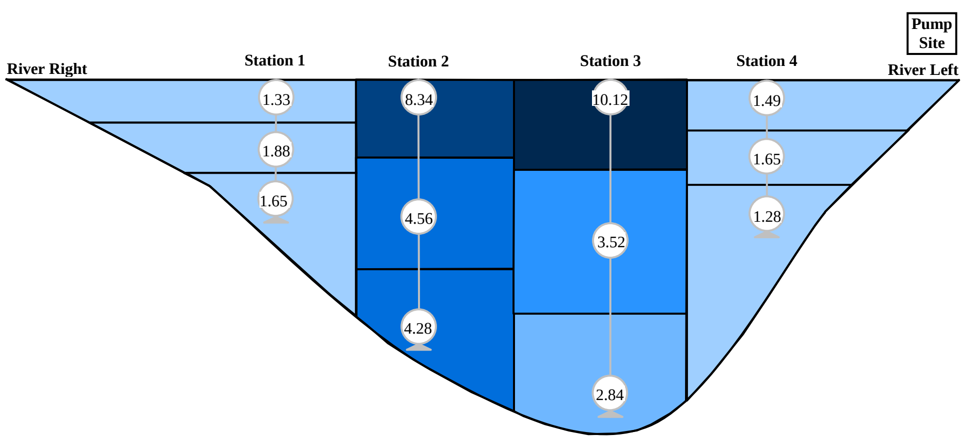

Figure 6. Mean larval sucker density (number of larvae/m^3) at the existing pump site during early morning sampling (approximately 0300 to 0600 hours).

An analysis of the overall average catch rates for each pump site found that the larval sucker catch rate was slightly higher at the existing pump site (2.58 larvae/m^3 per net effort) than the proposed alternative pump site (1.79 larvae/m^3 per net effort). Two plausible hypotheses are: 1.) additional larval suckers may be entering the drift between the proposed alternative pump site and the existing pump site, or; 2.) that hydraulic conditions at the existing pump site, or immediately upstream of this site, are possibly concentrating larval suckers near this site.

Summary

Analysis of larval suckers in the drift as they pass the existing pump site and the proposed alternative pump site indicates that there are several similarities and differences in larval sucker transport past both sites. A total of 62% of the CPUE at the proposed alternative pump site and 43% of the CPUE at the existing pump site were associated with the nighttime drift. Most of the larval drift was associated with the water surface (the top 0.7 m of the water column) and was located at midchannel (Stations 2, 3, and 4 for the proposed alternative pump site and Stations 2 and 3 for the existing pump site).

During daytime hours at both pump sites, there were very few larval suckers in the drift regardless of vertical or horizontal position in the river channel (Figures 1 and 2). During nighttime hours at the proposed alternative pump site, higher larval sucker catches were encountered in the midchannel and to the river-right of midchannel (toward Station 1) than stations to the river-left of midchannel (Figure 3). During nighttime hours at the existing pump site, catches of larval suckers were slightly higher at midchannel and to the river-left of midchannel (toward Station 4) than at stations right of midchannel (Figure 4). During nighttime hours, catches of larval suckers in nets sampling near the river bottom at the existing pump site were approximately 2 to 4 times greater than in comparable nets at the proposed alternative pump site (Figures 3 and 4). This trend was most noticeable in the river cross-section station on the river-left (Station 4) next to the existing intake (Figure 4). These trends generally held true over the five week sampling period (see Appendix A).

The existing pump site also had higher overall catches than the proposed alternative pump site presumably because of hydraulic conditions at the existing pump site or because of additional larval recruitment to the drift between sites. During the early morning hours, larval sucker drift appears to have a prolonged duration at the existing pump site in contrast to the proposed alternative pump site where a shift was observed to higher catches in nets sampling near the river bottom and at towards the river-right shore (Station 1) (Figures 5 and 6).

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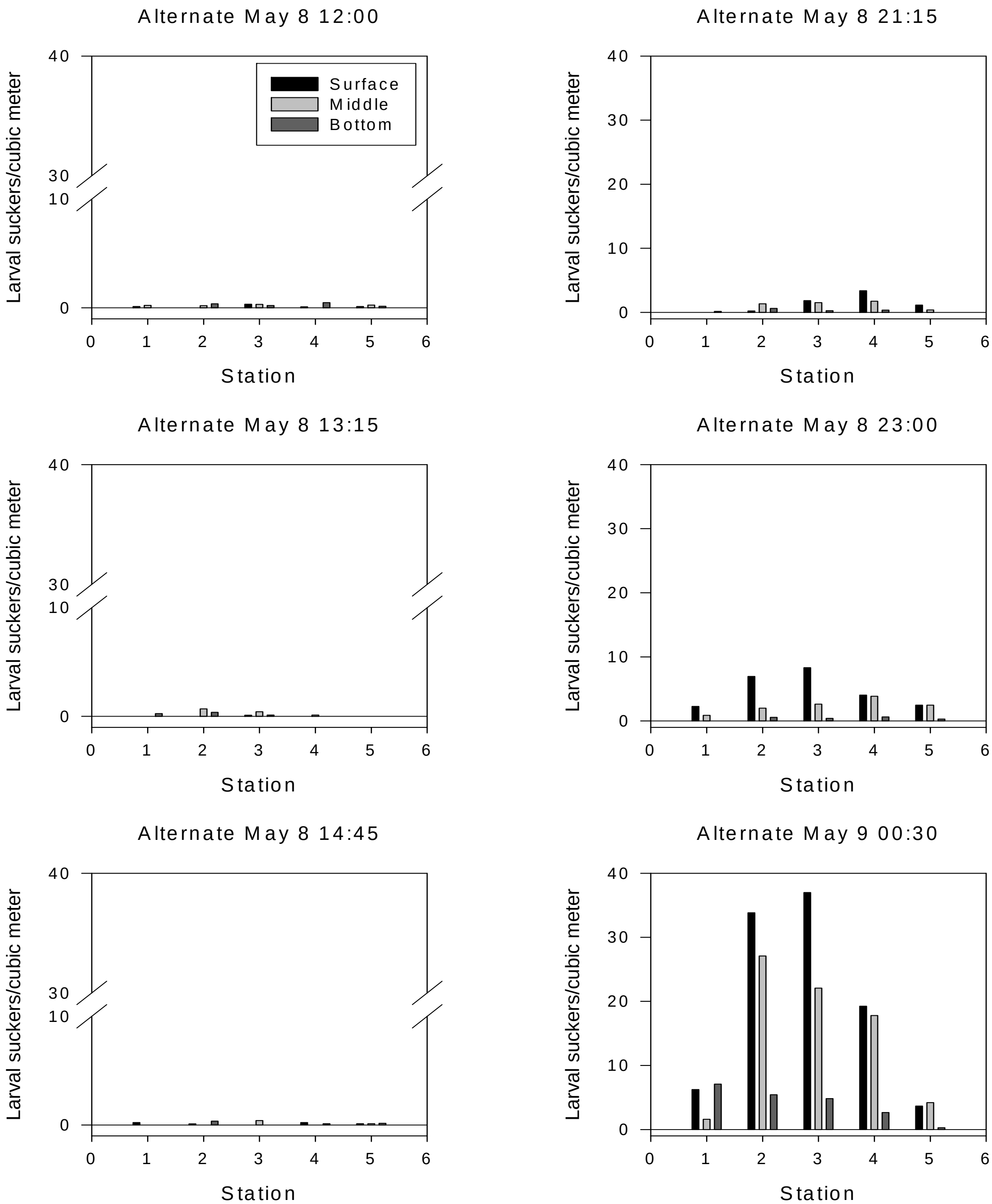
USFWS (U.S. Fish and Wildlife Service). 2001. Biological/Conference opinion regarding the effects of operation of the Bureau of Reclamation's Klamath Project on the endangered Lost River Sucker (*Deltistes luxatus*), endangered Shortnose Sucker (*Chasmistes brevirostris*), threatened Bald Eagle (*Haliaeetus leucocephalus*), and proposed critical habitat for the Lost River/Shortnose suckers. U.S. Fish and Wildlife Service, Klamath Falls Fish and Wildlife Office, Klamath Falls, Oregon.

Appendix A.

Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.



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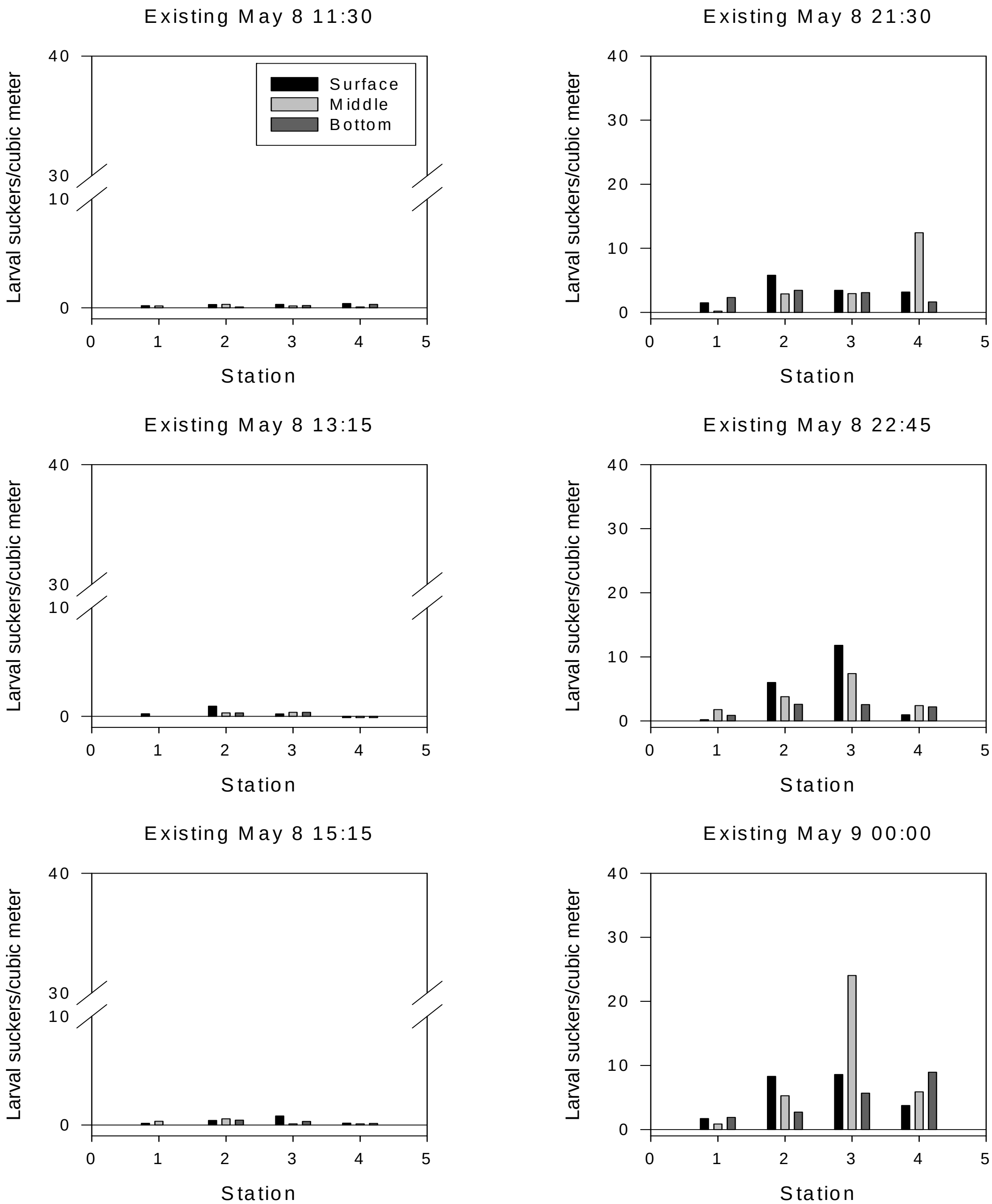
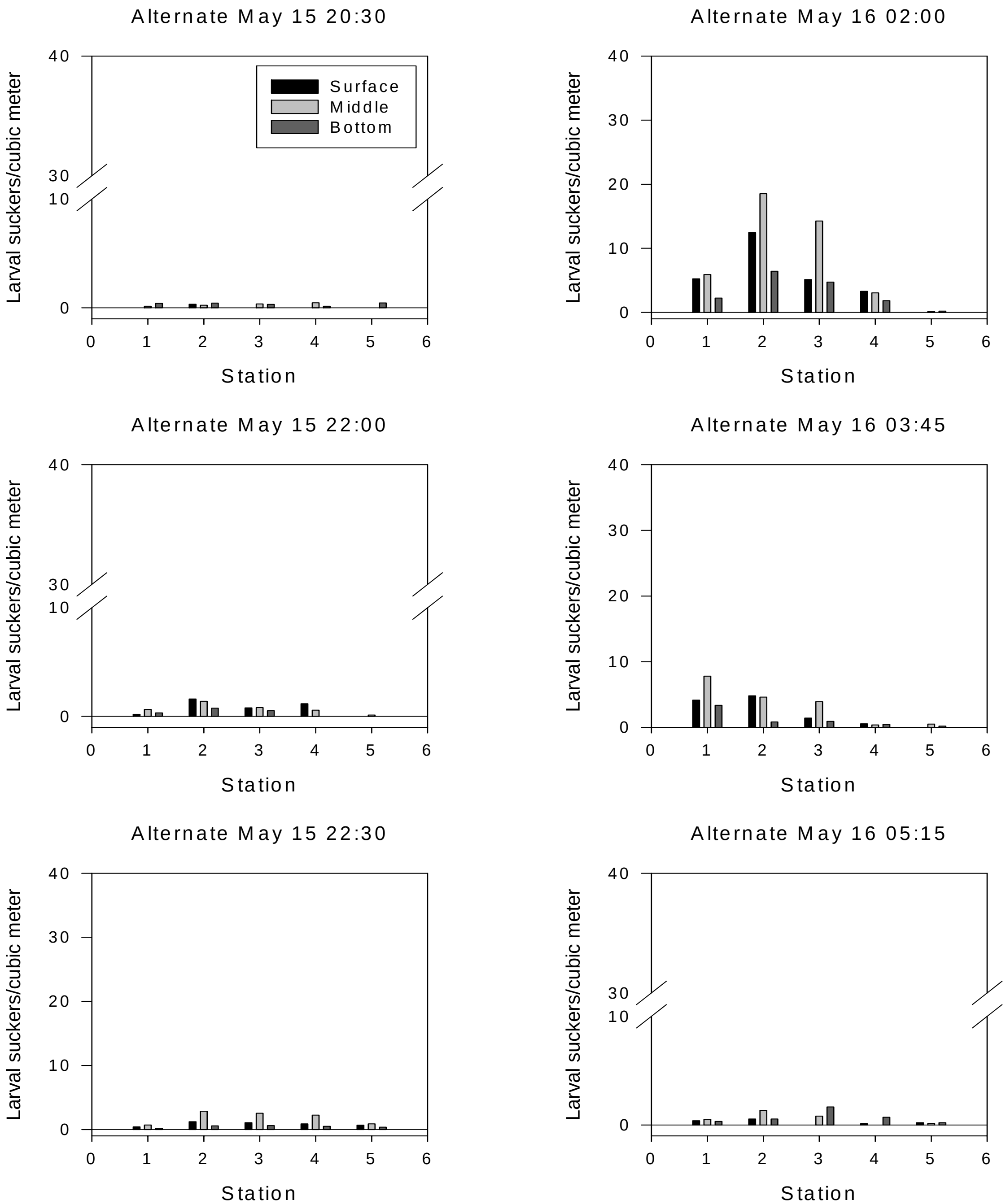
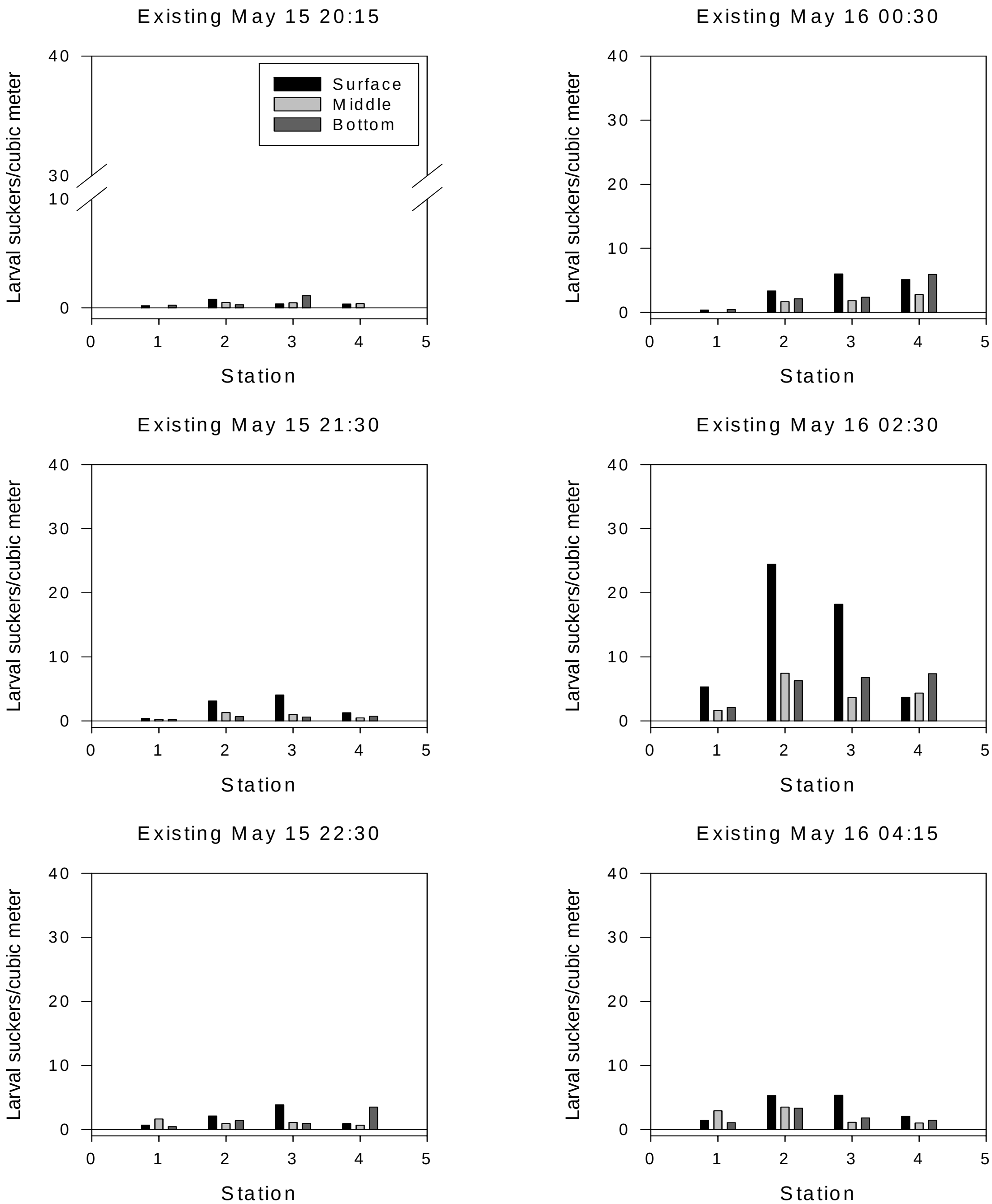


Appendix A (Continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.



Appendix A (continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.



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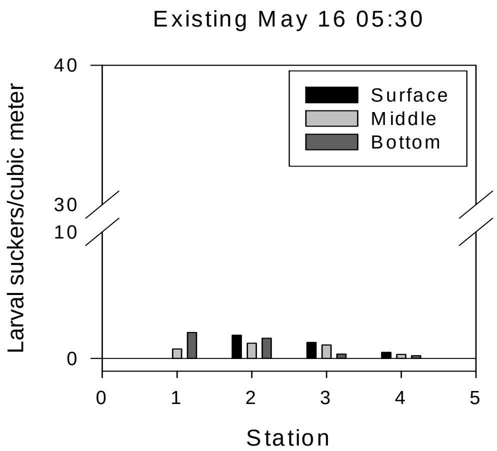
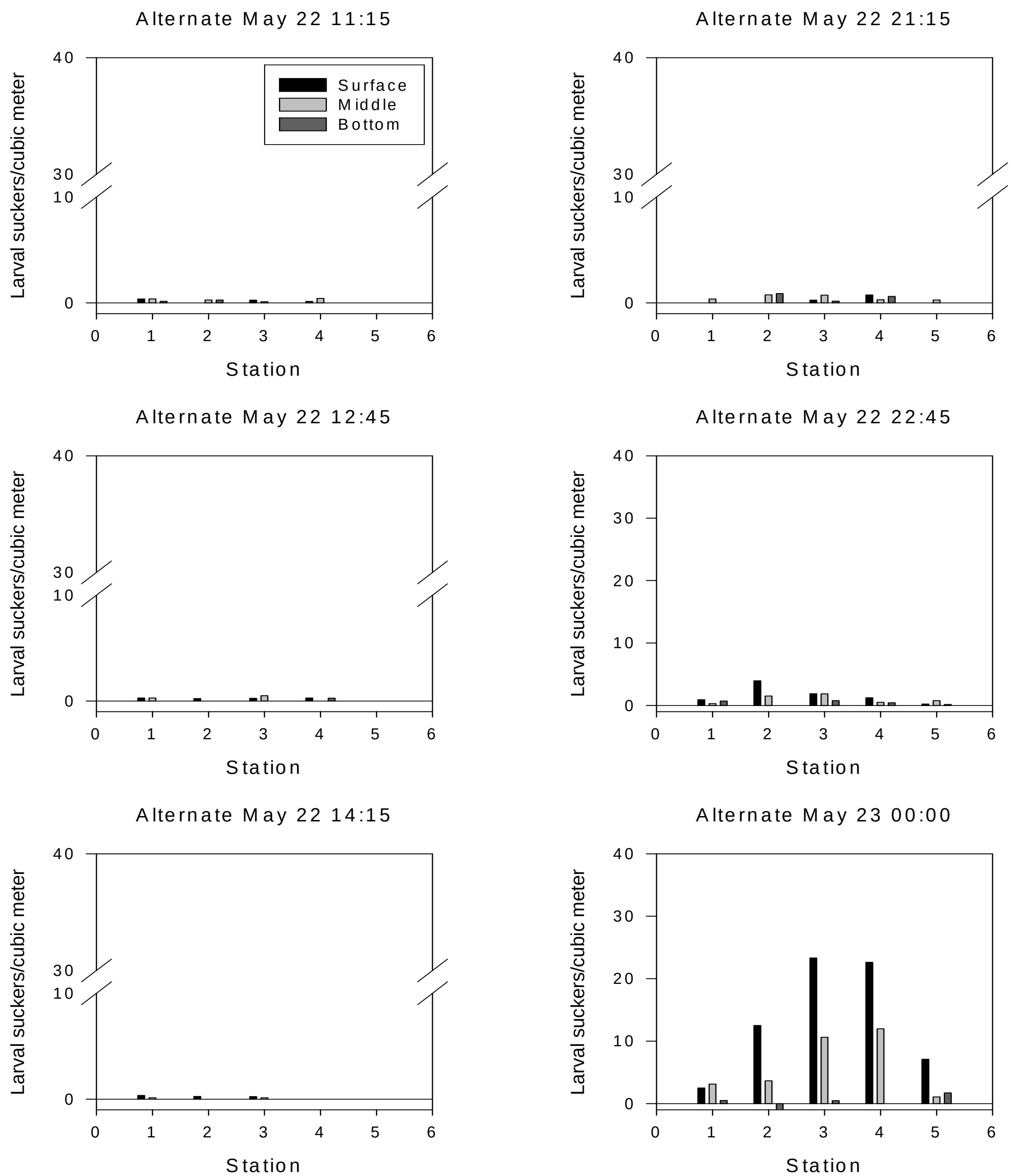
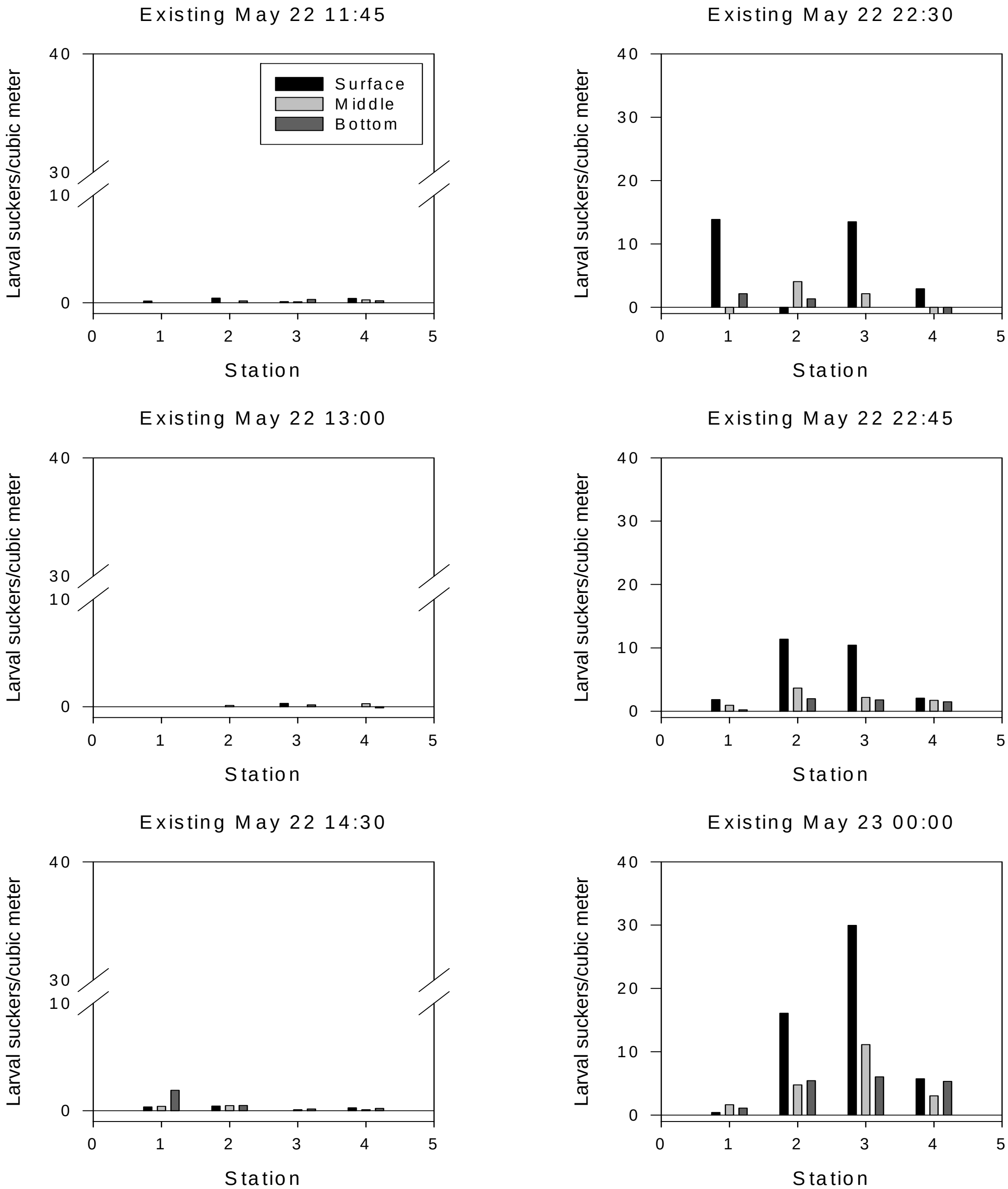


Appendix A (continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.



Appendix A (continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.



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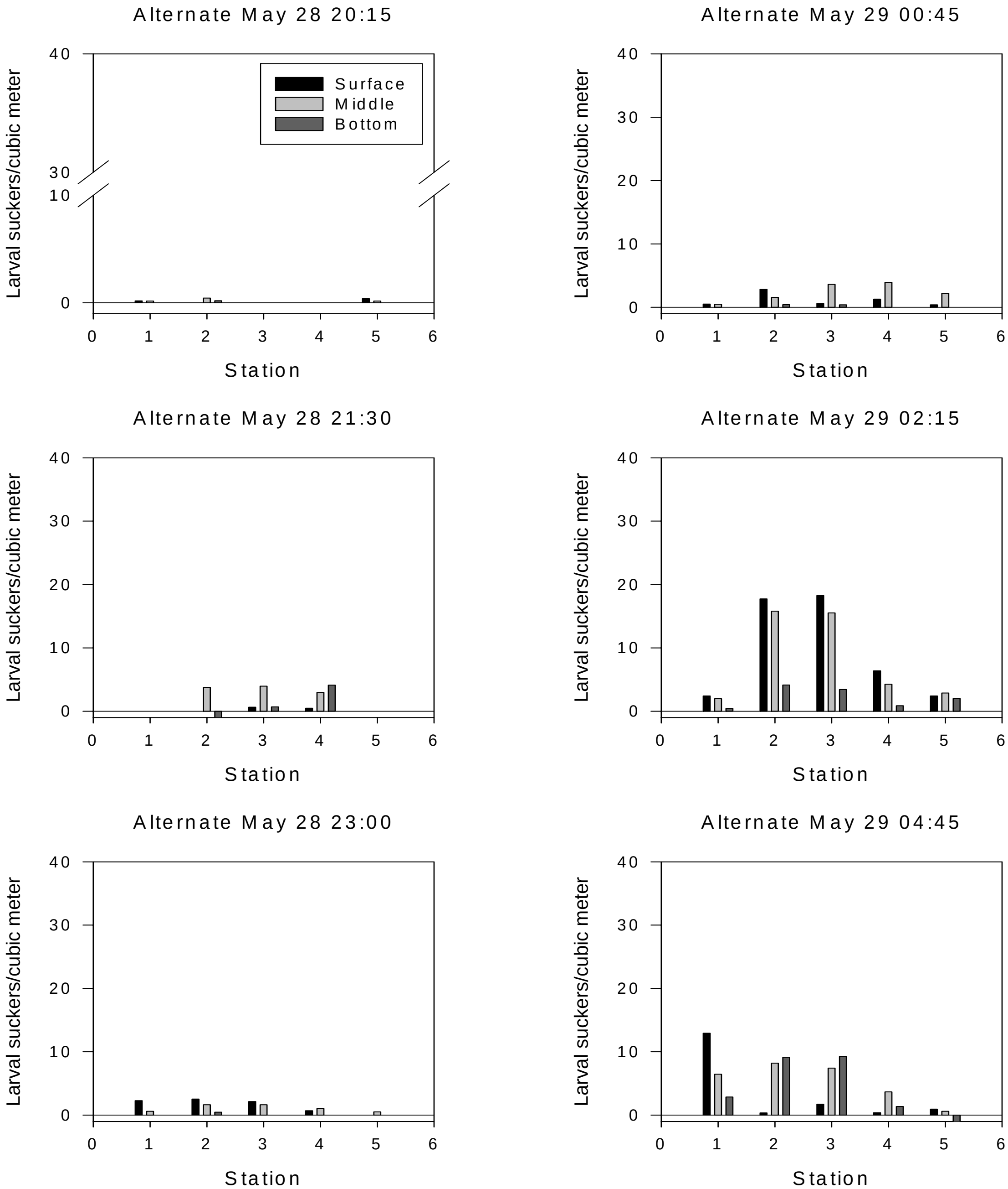

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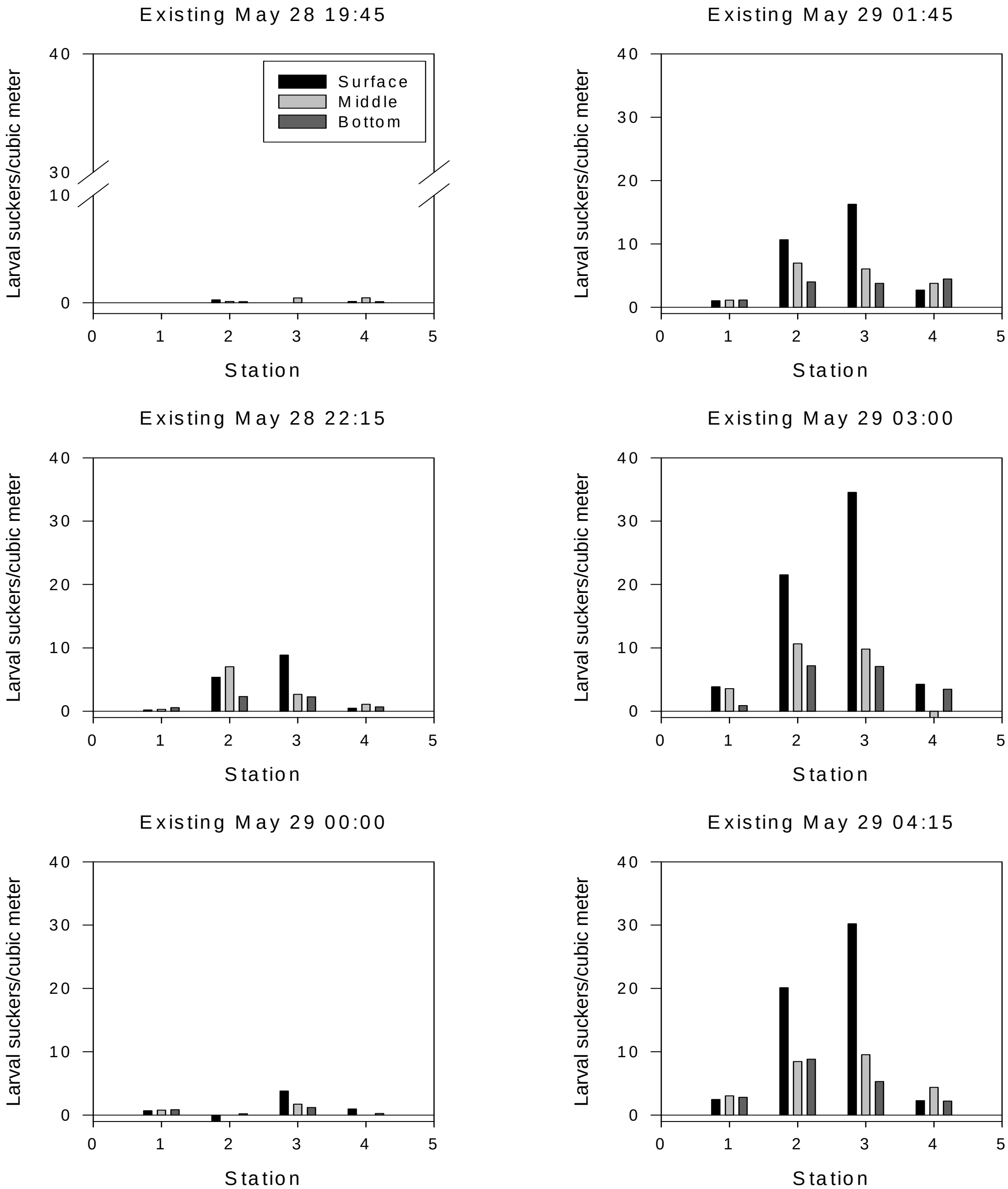
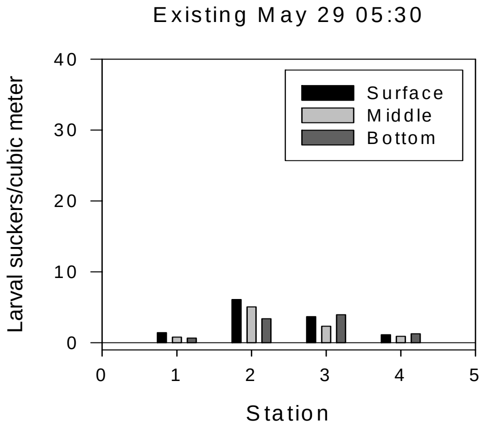
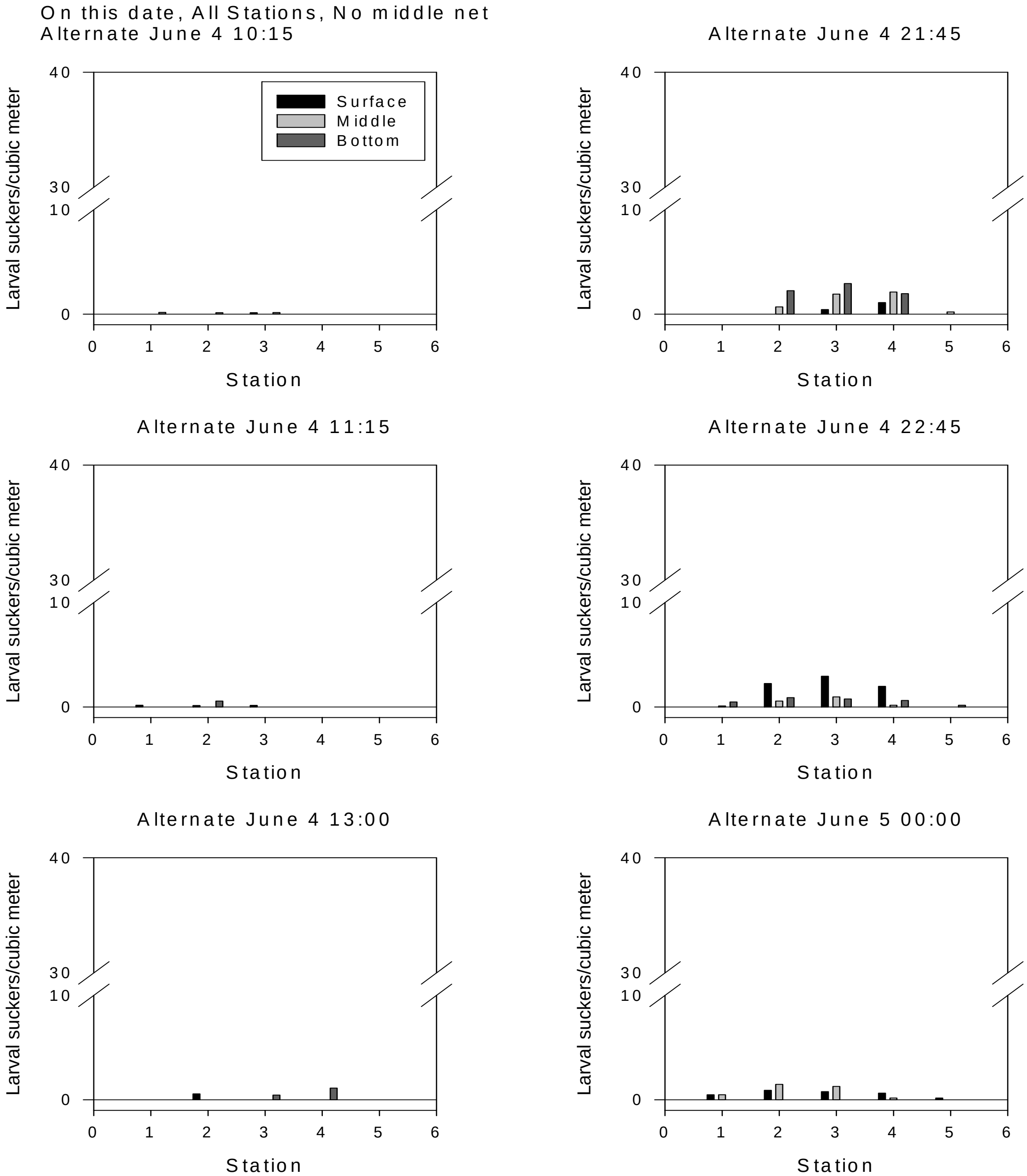


Appendix A (continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.



Appendix A (continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.

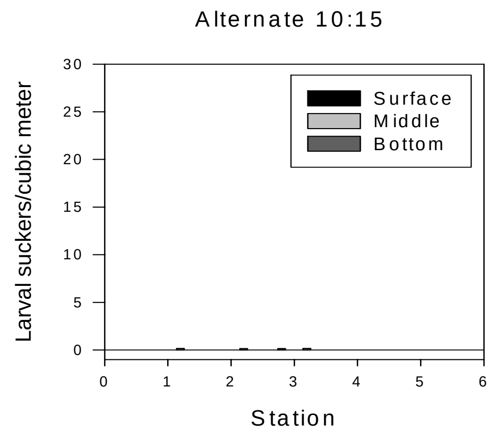


Appendix A (continued). Larval sucker catch per unit effort (number/cubic meter) for drift nets sampling at river cross-section stations as part of an effort to evaluate larval drift past two proposed water diversion sites (Alternate and Existing) in the lower Williamson River, 2004. Times are given in military hours and represent the approximate time that the middle cross-section station was sampled.

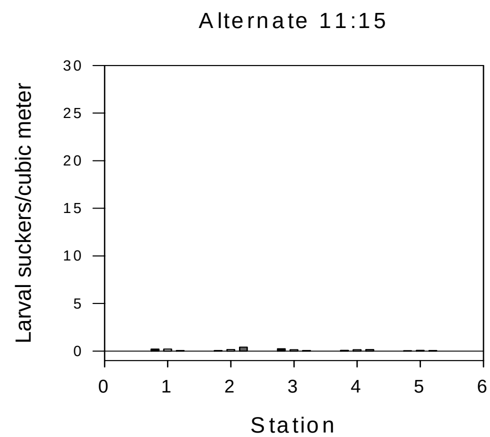
Appendix B.

Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative Pump site and May 8, 15, 22, and 28 at the Existing Pump site. Time given with each graph is representational and presented in military hours.

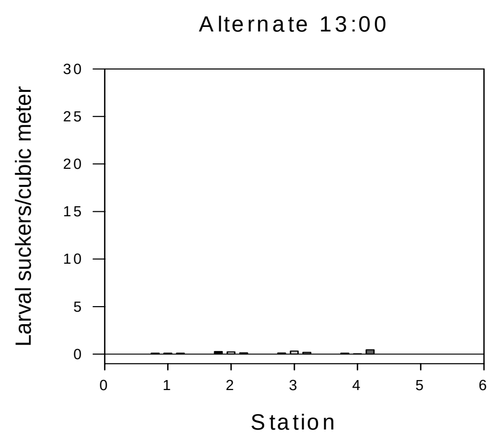
Alternate Pump Site 10:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.00	0.00	0.15	0.00	0.00
Mid	0.00	0.00	0.00	0.00	0.00
Bottom	0.17	0.15	0.16	0.00	0.00



Alternate Pump Site 11:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.22	0.05	0.25	0.08	0.04
Mid	0.21	0.16	0.15	0.14	0.08
Bottom	0.05	0.41	0.07	0.16	0.05

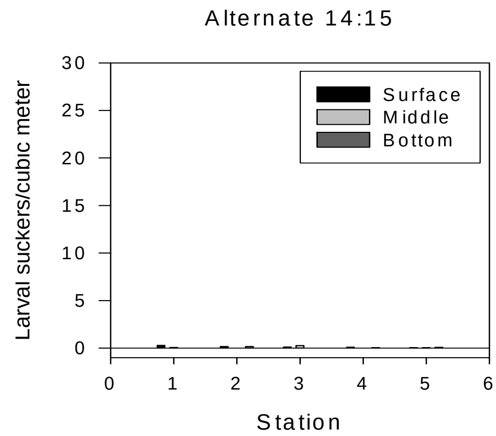


Alternate Pump Site 13:00 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.10	0.27	0.12	0.10	0.00
Mid	0.10	0.23	0.31	0.04	0.00
Bottom	0.09	0.13	0.19	0.46	0.00

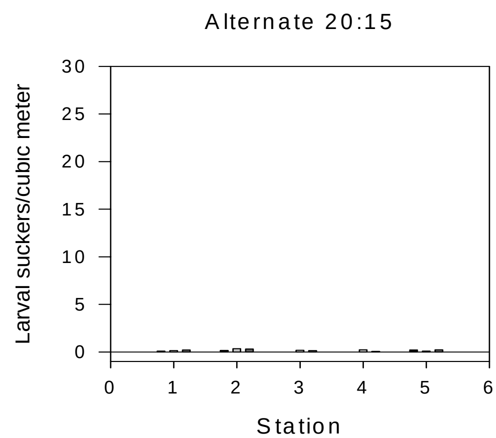


Appendix B. Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

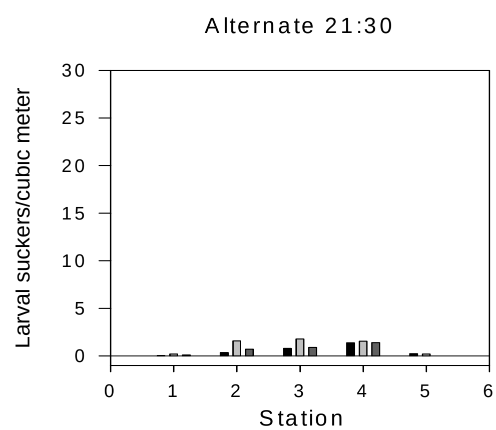
Alternate Pump Site 14:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.29	0.18	0.12	0.11	0.06
Mid	0.07	0.00	0.27	0.00	0.06
Bottom	0.00	0.18	0.00	0.06	0.08



Alternate Pump Site 20:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.10	0.17	0.00	0.00	0.20
Mid	0.15	0.34	0.18	0.23	0.09
Bottom	0.21	0.32	0.15	0.07	0.23

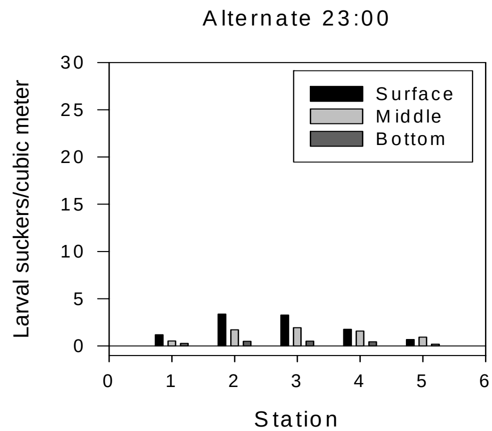


Alternate Pump Site 21:30 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.04	0.36	0.79	1.37	0.23
Mid	0.20	1.59	1.78	1.54	0.20
Bottom	0.09	0.70	0.90	1.41	0.00

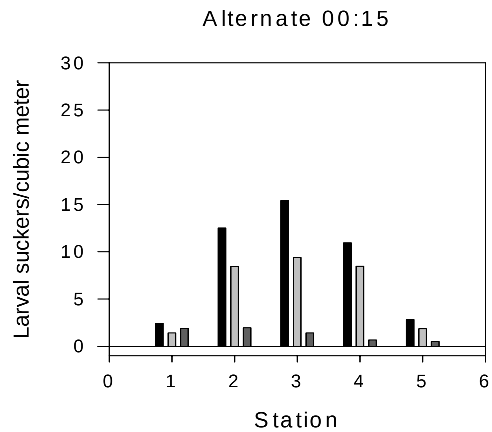


Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

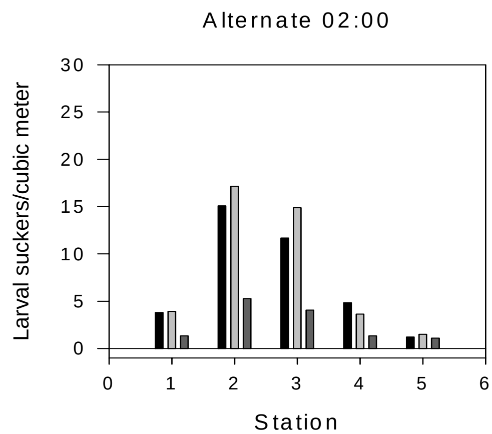
Alternate Pump Site 23:00 Average					
	1	**2**	**3**	**4**	**5**
Surface	1.18	3.38	3.27	1.76	0.67
Mid	0.52	1.71	1.93	1.57	0.93
Bottom	0.28	0.50	0.51	0.44	0.19



Alternate Pump Site 00:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	2.43	12.52	15.42	10.95	2.83
Mid	1.42	8.44	9.39	8.47	1.86
Bottom	1.90	1.95	1.42	0.66	0.49

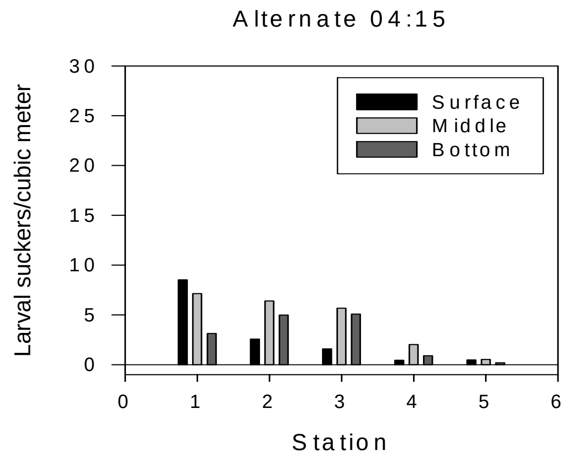


Alternate Pump Site 02:00 Average					
	1	**2**	**3**	**4**	**5**
Surface	3.81	15.09	11.68	4.83	1.21
Mid	3.93	17.15	14.88	3.63	1.50
Bottom	1.33	5.28	4.07	1.33	1.10

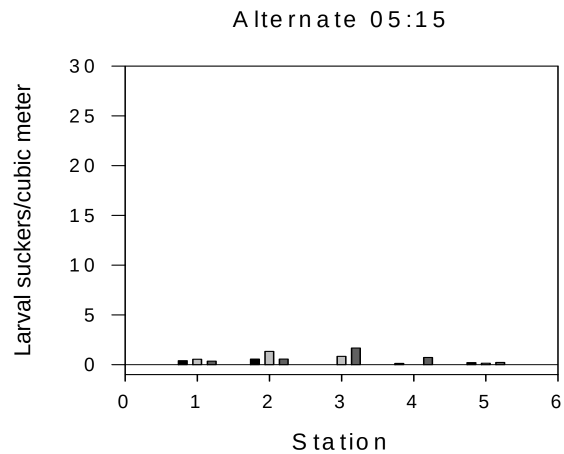


Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

Alternate Pump Site 04:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	8.53	2.57	1.58	0.46	0.48
Mid	7.13	6.40	5.67	2.02	0.54
Bottom	3.12	4.98	5.08	0.90	0.19

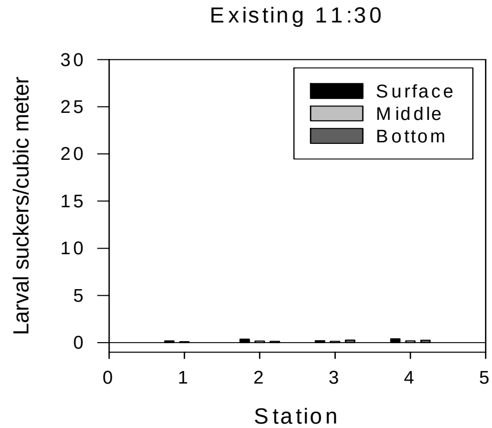


Alternate Pump Site 05:15 Average					
	1	**2**	**3**	**4**	**5**
Surface	0.40	0.55	0.00	0.12	0.21
Mid	0.53	1.34	0.82	0.00	0.14
Bottom	0.34	0.56	1.67	0.71	0.22



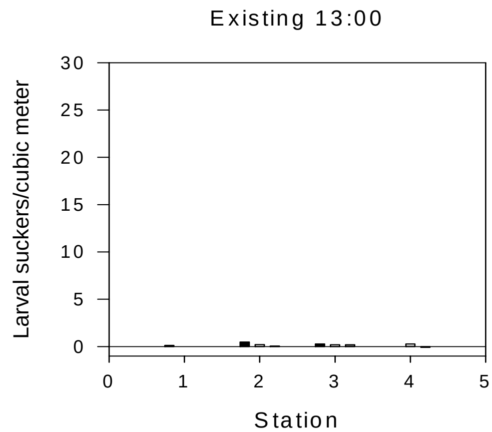
Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

Existing Pump Site 11:30 Average				
	1	**2**	**3**	**4**
Surface	0.19	0.37	0.21	0.41
Mid	0.09	0.16	0.14	0.19
Bottom	0.00	0.14	0.27	0.26

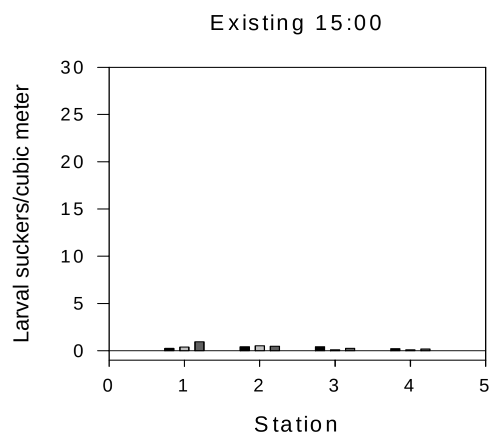


Existing Pump Site 13:00 Average				
	1	**2**	**3**	**4**
Surface	0.12	0.48	0.27	0.00
Mid	0.00	0.22	0.19	0.28
Bottom	0.00	0.05	0.19	--*

*Flow meters for all nets at this point for this time failed to run properly.

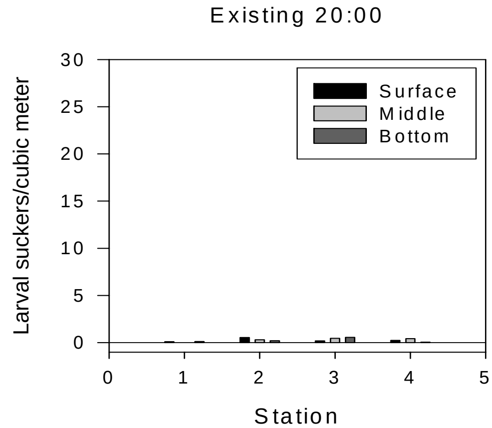


Existing Pump Site 15:00 Average				
	1	**2**	**3**	**4**
Surface	0.25	0.42	0.42	0.22
Mid	0.38	0.52	0.10	0.10
Bottom	0.95	0.47	0.25	0.18

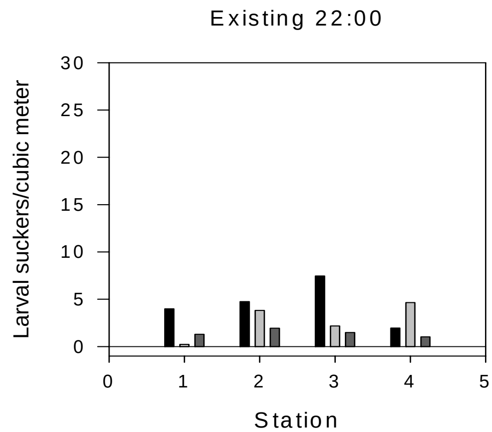


Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

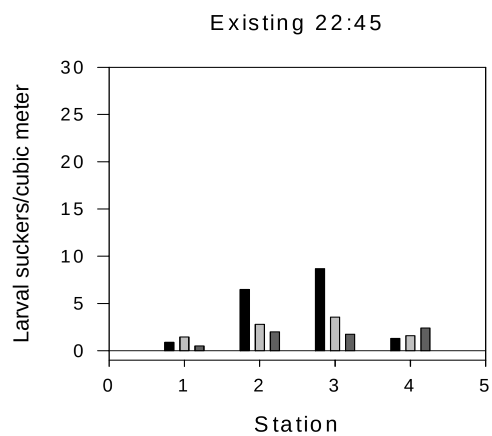
Existing Pump Site 20:00 Average				
	1	**2**	**3**	**4**
Surface	0.09	0.53	0.19	0.24
Mid	0.00	0.30	0.45	0.43
Bottom	0.12	0.20	0.56	0.06



Existing Pump Site 22:00 Average				
	1	**2**	**3**	**4**
Surface	3.99	4.75	7.46	1.96
Mid	0.24	3.81	2.17	4.66
Bottom	1.30	1.94	1.49	1.02

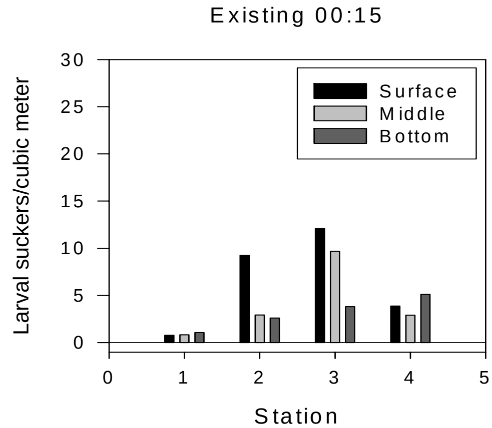


Existing Pump Site 22:45 Average				
	1	**2**	**3**	**4**
Surface	0.89	6.49	8.69	1.31
Mid	1.45	2.79	3.56	1.58
Bottom	0.51	1.99	1.75	2.39

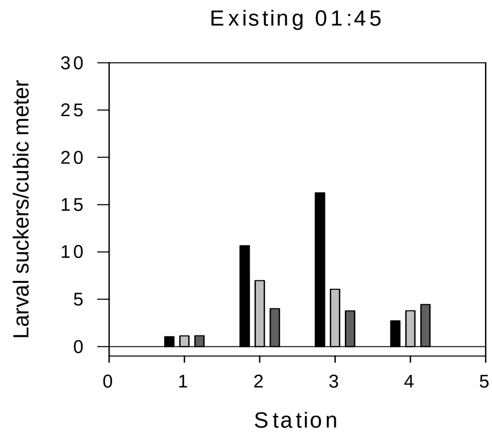


Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

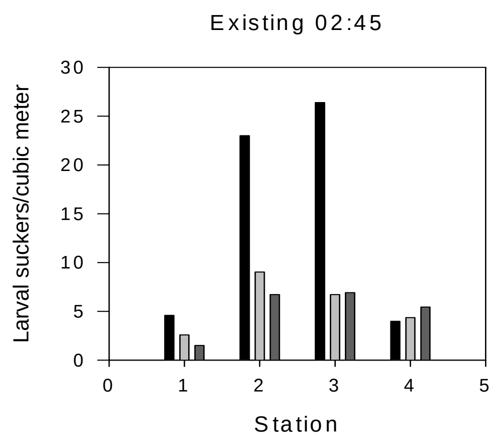
Existing Pump Site 00:15 Average				
	1	**2**	**3**	**4**
Surface	0.79	9.24	12.09	3.89
Mid	0.82	2.93	9.69	2.92
Bottom	1.07	2.62	3.82	5.11



Existing Pump Site 01:45 Average				
	1	**2**	**3**	**4**
Surface	1.04	10.66	16.26	2.71
Mid	1.13	6.97	6.06	3.79
Bottom	1.14	4.01	3.77	4.45

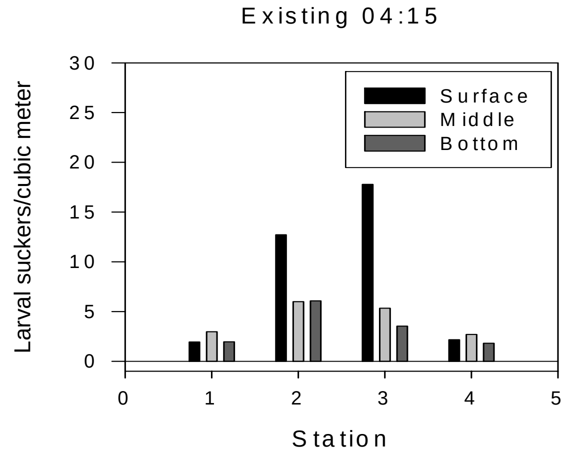


Existing Pump Site 02:45 Average				
	1	**2**	**3**	**4**
Surface	4.58	23.00	26.38	3.98
Mid	2.60	9.03	6.72	4.35
Bottom	1.50	6.72	6.92	5.43

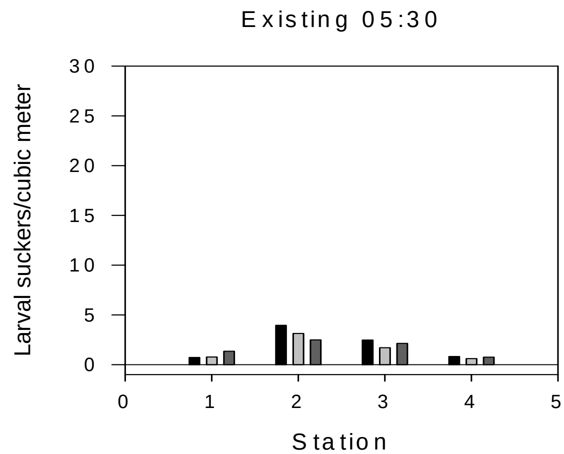


Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Existing site. Time given with each graph is representational and presented in military hours.

Existing Pump Site 04:15 Average				
	1	**2**	**3**	**4**
Surface	1.94	12.71	17.78	2.17
Mid	2.98	5.99	5.34	2.70
Bottom	1.95	6.08	3.54	1.82



Existing Pump Site 05:30 Average				
	1	**2**	**3**	**4**
Surface	0.72	3.96	2.47	0.81
Mid	0.77	3.13	1.70	0.60
Bottom	1.35	2.49	2.14	0.75

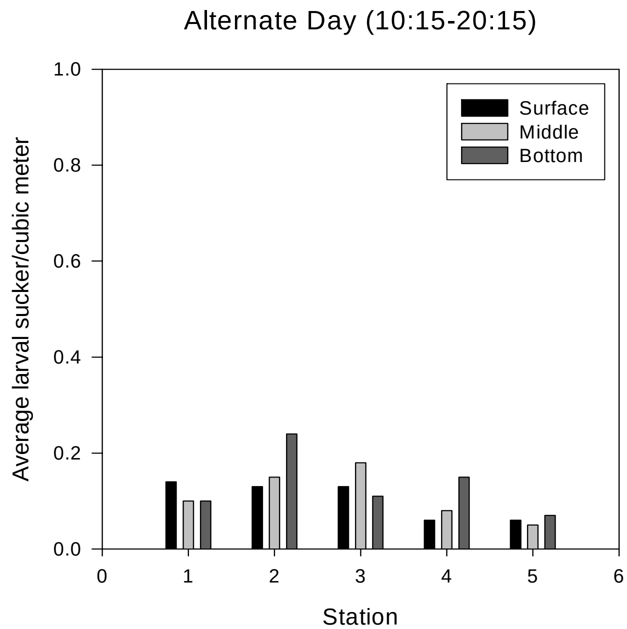


Appendix B (continued). Average catch per unit effort (larval suckers/ cubic meter) for larval suckers captured at two proposed water diversion sites (Alternate and Existing) from the Williamson River in 2004. Averages are calculated from similar hour observations made on May 8, 15, 22, 28, and June 4 at the Alternative site and May 8, 15, 22, and 28 at the Lower site. Time given with each graph is representational and presented in military hours.

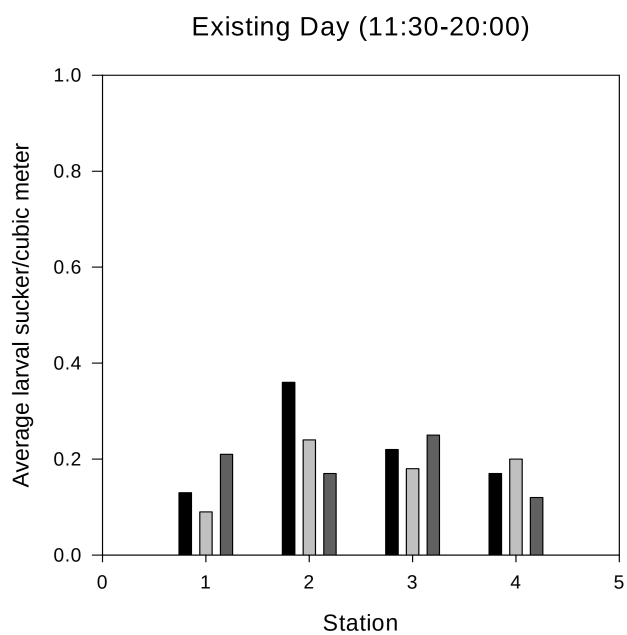
Appendix C.

Average larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.

Alternate Pump Site Daytime Average					
	1	**2**	**3**	**4**	**5**
Surface	0.14	0.13	0.13	0.06	0.06
Mid	0.10	0.15	0.18	0.08	0.05
Bottom	0.10	0.24	0.11	0.15	0.07

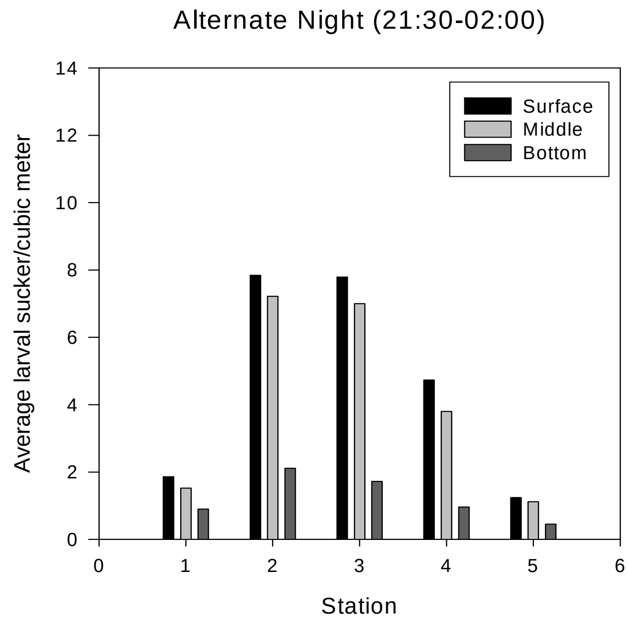


Existing Pump Site Daytime Average				
	1	**2**	**3**	**4**
Surface	0.13	0.36	0.22	0.17
Mid	0.09	0.24	0.18	0.20
Bottom	0.21	0.17	0.25	0.12

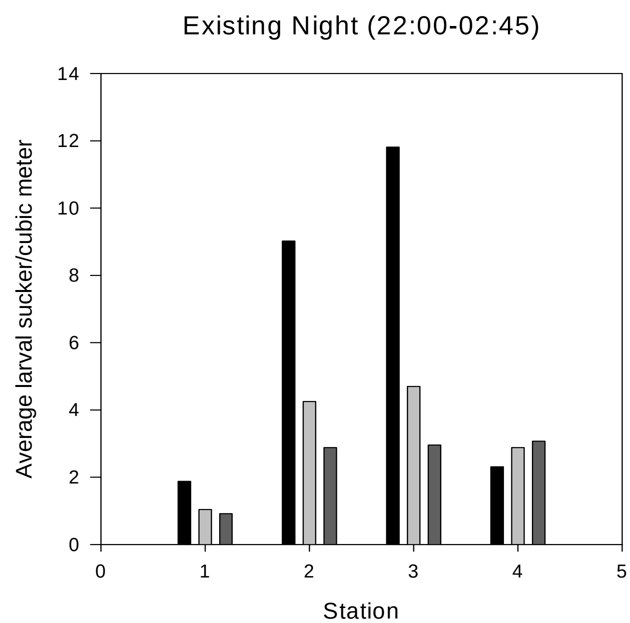


Appendix C. Average larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.

Alternate Pump Site Nighttime Average					
	1	**2**	**3**	**4**	**5**
Surface	1.86	7.84	7.79	4.73	1.24
Mid	1.52	7.22	7.00	3.80	1.12
Bottom	0.90	2.11	1.72	0.96	0.45

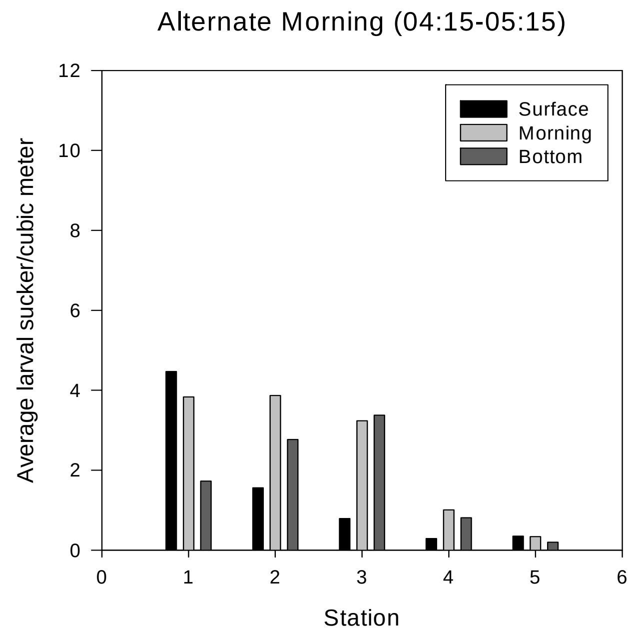


Existing Pump Site Nighttime Average				
	1	**2**	**3**	**4**
Surface	1.88	9.02	11.81	2.31
Mid	1.04	4.25	4.70	2.88
Bottom	0.92	2.88	2.96	3.07

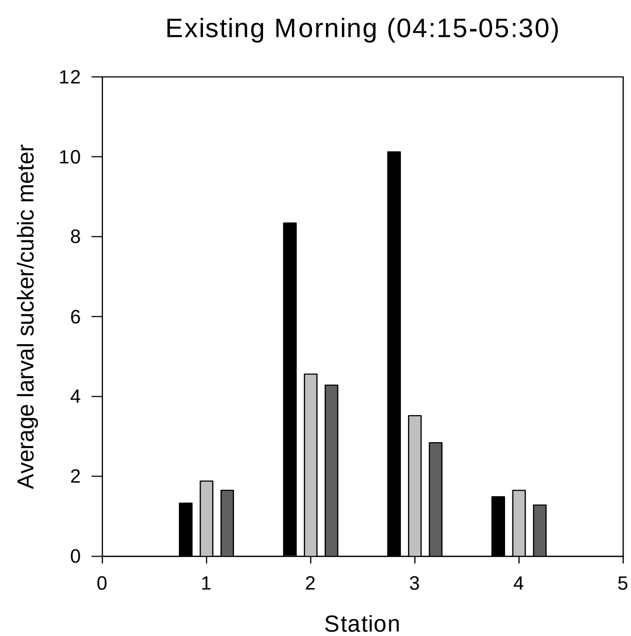


Appendix C (continued). Average larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.

Alternate Pump Site Early Morning Average					
	1	**2**	**3**	**4**	**5**
Surface	4.47	1.56	0.79	0.29	0.35
Mid	3.83	3.87	3.24	1.01	0.34
Bottom	1.73	2.77	3.38	0.81	0.20



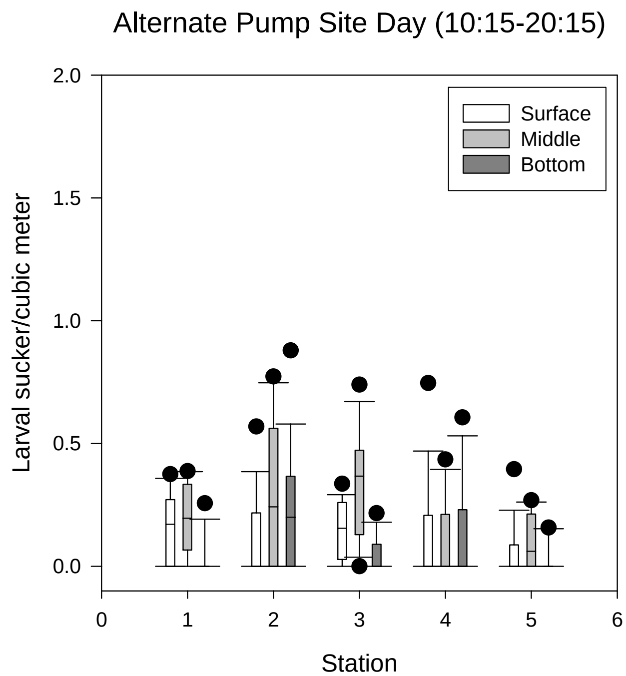
Existing Pump Site Early Morning Average				
	1	**2**	**3**	**4**
Surface	1.33	8.34	10.12	1.49
Mid	1.88	4.56	3.52	1.65
Bottom	1.65	4.28	2.84	1.28

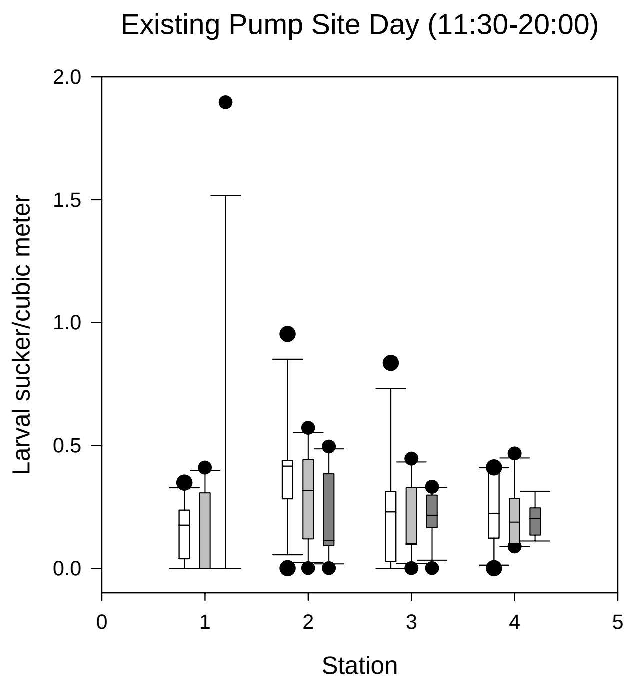


Appendix C (continued). Average larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.

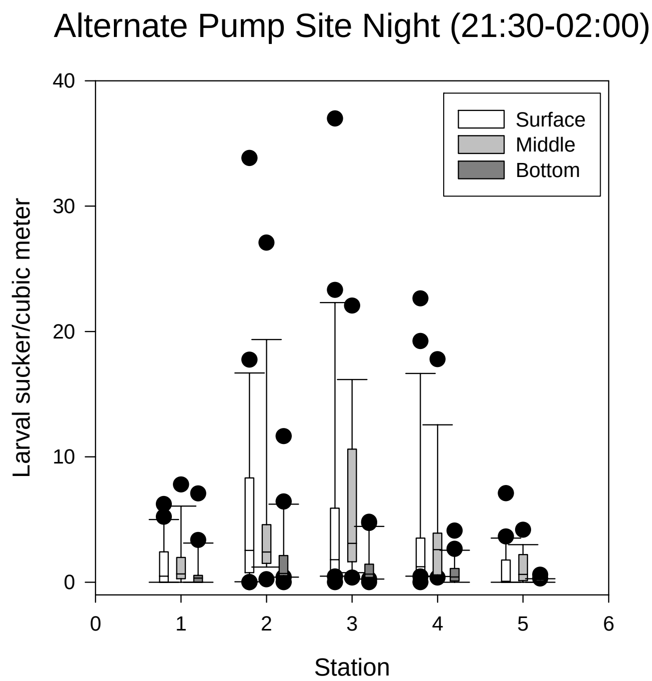
Appendix D.

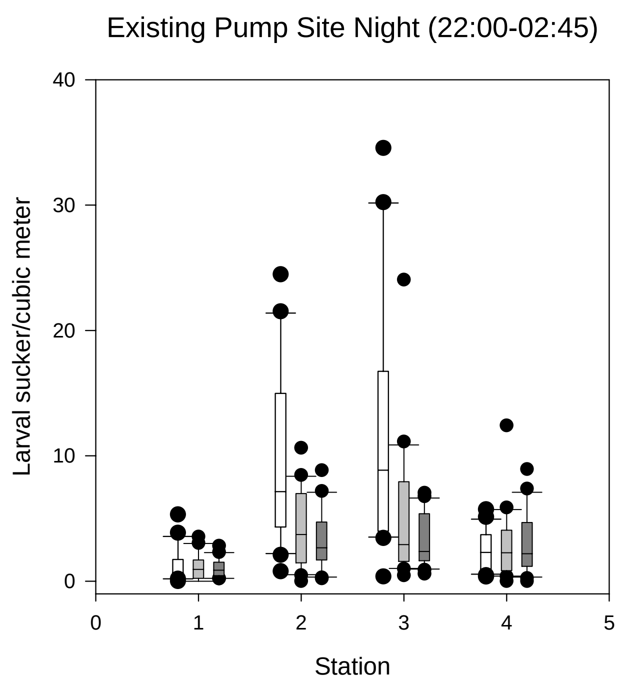
Ranges of larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.



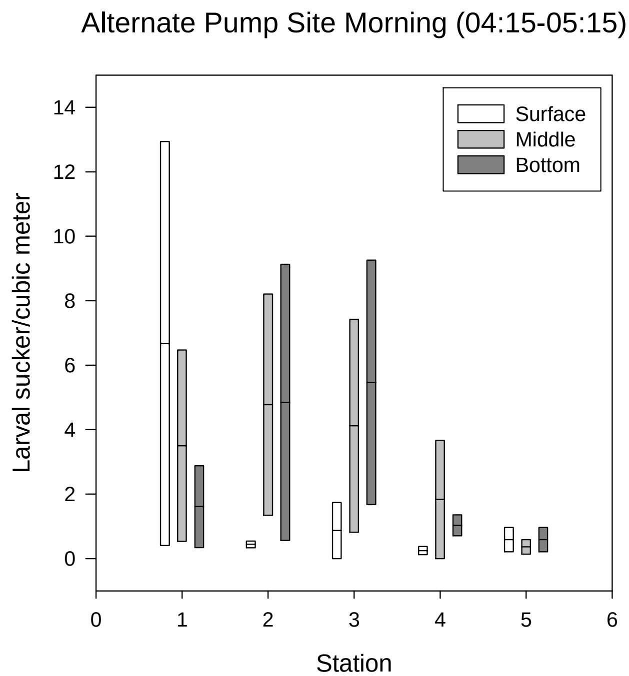


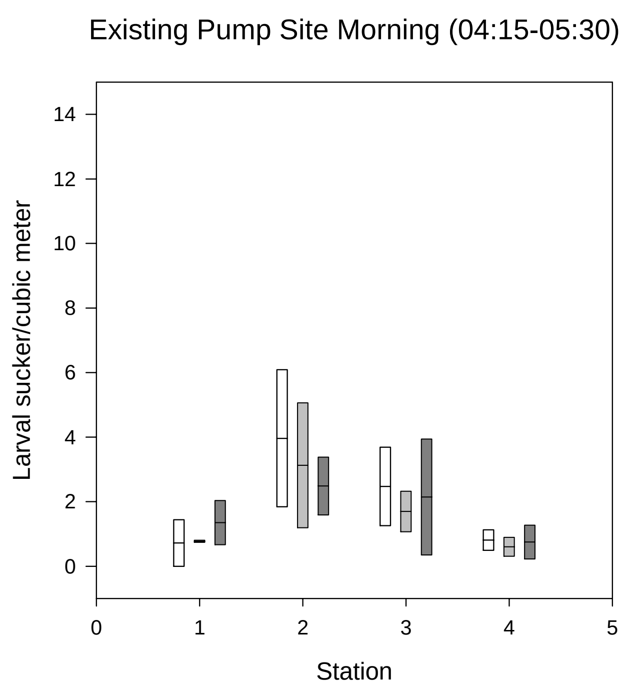
Appendix D. Ranges of larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.





Appendix D (continued). Ranges of larval sucker catch per unit effort for two proposed water diversion sites (Alternate and Existing) on the lower Williamson River from May 8, 15, 22, 28, and June 4, 2004, by day, night, and early morning hour blocks. Times given are in military hours representing the block of time that averaged samples were collected.





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APPENDIX C

BEST MANAGEMENT PRACTICES

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BEST MANAGEMENT PRACTICES

Best management practices (BMPs) are a set of mechanisms used to minimize environmental impacts associated with construction and related activities. The following BMPs have been selected and tailored for site-specific conditions to protect terrestrial and aquatic resources for all alternatives.

Construction operations should be performed in such a manner as to comply, and ensure all subcontractors to comply, with: (a) all applicable federal, state, and local laws, orders, regulations, and water quality standards concerning the control and abatement of water pollution; and (b) all terms and conditions of the applicable permits issued by the permit issuing authority. If there is a conflict between federal, state, and local laws, regulations, and requirements, the most stringent should apply.

<u>Pollution and Erosion Control Plan (PECP) and Supporting Measures</u>

A PECP should be developed for each project; it should include methods and measures to minimize erosion and sedimentation associated with the project. The PECP elements shall be in place prior to and at all times during the appropriate construction phases. All project actions will follow all provisions of the Clean Water Act and provisions for maintaining water quality standards as described by Oregon Department of Environmental Quality.

<u>Spill Prevention Control and Containment Plan (SPCCP)</u>

A Spill Prevention Control and Containment Plan (SPCCP), which describes measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc), will be written. The SPCCP should contain a description of the hazardous materials that will be used, including inventory, storage, handling, and monitoring.

<u>Minimize Site Preparation-Related Impacts</u>

Site preparation should be completed in the following manner:

a. Flag boundaries of clearing limits associated with site access, riparian crossings, stream crossings, staging areas, and stockpile areas to minimize overall disturbance and disturbance to vegetation.

b. Establish staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, etc) along existing roadways or turnouts beyond the 100-year floodprone area in a location and manner that will preclude erosion into or contamination of the stream or floodplain.

c. Minimize clearing and grubbing activities required for preparation of staging or stockpile areas. Stockpile large wood, trees, riparian vegetation, other vegetation, sand, and topsoil removed for establishment of staging area for site restoration.

d. Place sediment barriers around disturbed sites where potential erosion may enter the stream directly or through road ditches, which are connected to the stream.

Minimize Heavy Equipment Fuel/Oil Leakage

The following methods should be used to minimize fuel/oil leakage from construction equipment into the stream channel and floodplain:

a. All equipment used for instream work should be cleaned and leaks repaired prior to arriving at the project. Remove external oil and grease, along with dirt and mud. Inspect all equipment before unloading at site. Thereafter, inspect equipment daily for leaks or accumulations of grease, and fix any identified problems before any leaks enter streams or areas that drain directly to streams or wetlands.

b. Equipment used for instream or riparian work should be fueled and serviced in an established staging area. When not in use, vehicles should be stored in the staging area.

Minimize Earthmoving-Related Erosion

The following methods should be used to minimize sedimentation resulting from earthmoving construction activities:

a. Minimize amounts of construction debris and soil falling into streams by installing appropriate erosion control barriers prior to construction. Such barriers should be maintained throughout the related construction and removed only when construction is complete. When possible, remove debris or large earth spills that have fallen into the channel.

b. Delineate construction impact areas on project plans and confine work to the noted area. Confine construction impacts to the minimum area necessary to complete the project.

c. Keep a supply of erosion control materials (e.g., silt fence and straw bales) on hand to respond to sediment emergencies. Use sterile straw or weed-free certified straw bales to prevent introduction of noxious weeds.

d. Cease all project operations, except efforts to minimize storm or high flow erosion, under high flow conditions that result in inundation of the project area.

e. Stockpile native streambed materials above the bankfull elevation for later use in project restoration. To prevent contamination from fine soils, these materials shall be kept separate from other stockpiled materials that are not native to the streambed.

Minimize Stream Crossing Sedimentation

The following methods should be used to minimize turbidity and sedimentation resulting from use of stream crossings and access roads:

a. No equipment should be driven in the flowing water portion of the stream channel except at designated stream crossings.

b. Where temporary stream crossings are essential, crossings should be identified on project plans, should be designated at the project site, should not increase risks of channel rerouting due to high water conditions, and should avoid potential spawning areas when possible.

c. Stream and riparian crossings should be minimized and conducted at right angles to the main channel where possible.

d. Existing roadways or travel paths will be used whenever reasonable.

Minimize Sedimentation through Dewatering

To minimize project-related sediment introduced into the stream and to help meet state turbidity standards, methods to isolate the in-channel project include the following:

a. Divert flow with pumps or structures such as cofferdams constructed with nonerosive devices, such as sandbags, bladder bags, or other means that divert water. Diversion dams constructed with material mined from the stream or floodplain are not permitted.

b. The temporary bypass system may consist of non-erosive techniques, such as a pipe or a plastic-lined channel, both of which must be sized large enough to accommodate the predicted peak flow rate during construction. In cases of channel rerouting, water can be diverted to one side of the existing channel.

c. Dissipate flow at the outfall of the bypass system to diffuse erosive energy of the flow. Place the outflow in an area that minimizes or prevents damage to riparian vegetation. If the diversion inlet is not screened to allow for downstream passage of fish, place the diversion outlet in a location that facilitates safe re-entry of fish into the stream channel.

Site Restoration

Methods to minimize sedimentation through site restoration include the following:

a. Upon project completion, remove project-related waste. Initiate rehabilitation of all disturbed areas in a manner that results in similar or better than pre-work conditions through spreading of stockpiled materials, seeding, and/or planting with native seed mixes or plants. If native stock is not available, use soil-stabilizing vegetation (seed or plants) that does not lead to propagation of exotic species.

b. Complete necessary site restoration activities as soon as possible after the last construction phase.

Landscape Preservation

Care should be taken to preserve the natural landscape and habitat for endangered species. Operations should be conducted to prevent unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. Movement of crews and equipment within the rights-of-way and over routes provided for access to the work shall be performed in a manner to prevent damage to grazing land, crops, or property. When no longer required, construction roads should be restored to original contours and made impassable to vehicular traffic.

Upon completion of the work, and following removal of construction facilities and required cleanup, land used for construction purposes and not required for the completed installation shall be scarified and regraded, as required, so that all surfaces blend with the natural terrain and are left in a condition that will facilitate natural revegetation, provide for proper drainage, and prevent erosion.

Protection, Repair, and Replacement of Existing Vegetation

Vegetation should be protected from damage or injury caused by construction operations, personnel, or equipment by the use of protective barriers or other approved methods. Removal of existing vegetation not specifically required to be removed would require prior approval.

Replacements for vegetation damaged beyond repair should be acquired from a native plant nursery that propagates local stock, not a horticultural variety.

Timing of Construction Activities

Minimize erosion by allowing road construction-related activities to operate only during low runoff periods. Soil erosion and sedimentation are directly related to runoff. Furthermore, equipment should not be allowed to operate when ground conditions are such that detrimental puddling occurs and ruts from vehicle tracks reach 4 inches or more in 500 feet.

The following are guidelines for timing of construction activities:

a. Erosion control (e.g. placement of straw bales) should be kept current throughout the project.

b. Construction of road drainage and other erosion control measures should be carried out as soon as possible after earthwork is completed.

c. The Oregon State Guidelines for Timing of In-water Work to protect fish and wildlife will be followed unless a waiver is sought. Waivers may be sought from time to time in emergency situations (such as catastrophic floods that wash roads out that require immediate replacement) or other factors affecting the timing of the project.

d. The project activities will be conducted in a manner to ensure that turbidity levels are minimized. Short-term violations for required instream construction work (i.e., restoration measures, etc.) are acceptable.

e. Sites where temporary roads are constructed will be restored and reseeded with certified weed-free native vegetation in coordination with U.S. Forest Service (USFS) forest management plans.

Debris and Excavation Material

a. Excavated materials shall be kept out of live streams unless it is designed to be placed there (ie. riprap, etc.).

b. Sediment-producing materials will not be left within the 100 year floodplain any longer than necessary to construct the facility. Once the construction is complete, fill material will be removed and properly disposed of in upland areas. If a flood is anticipated during the construction period, the fill shall not be placed within the 100-year floodplain.

Abatement of Air Pollution

The Contractor shall comply with applicable federal, state, and local laws and regulations and with the requirements of this paragraph concerning the prevention and control of air pollution. Should a conflict exist in the requirements for abatement of air pollution, the most stringent requirement shall apply. The Contractor shall utilize such methods and devices as are reasonably available to prevent, control, and otherwise minimize atmospheric emissions or discharges of air contaminants.

Equipment and vehicles that show excessive emissions of exhaust gases shall not be operated until corrective repairs or adjustments reduce such emissions to acceptable levels.

Burning of cleared materials, combustible construction materials, and rubbish will not be permitted.

Dust Abatement

During the performance of work required by these specifications, or any operations appurtenant thereto, and whether on rights-of-way provided by the Government or elsewhere, the Contractor shall comply with applicable federal, state, and local laws and regulations, with applicable requirements of the U.S. Bureau of Reclamation's (USBR's) "Reclamation Safety and Health

Standards" (RSHS), and with the requirements of this paragraph regarding the prevention, control, and abatement of dust pollution. Should a conflict exist in the requirements for dust abatement, the most stringent requirement shall apply. The Contractor shall be responsible for all damages resulting from dust originating from Contractor operations under these specifications in accordance with the clause entitled "Permits and Responsibilities" and "Administration of Permits and Responsibilities".

The Contractor shall provide all labor, equipment, and materials and shall use efficient methods wherever and whenever required to prevent dust nuisance or damage to persons, property, or activities, including, but not limited to, crops, orchards, cultivated fields, wildlife habitats, dwellings and residences, agricultural activities, recreational activities, traffic, and similar conditions. Methods of mixing, handling, and storing cement, pozzolan, materials for the headwall, and concrete aggregate shall include means of eliminating atmospheric discharges of dust.

Noise Abatement

The Contractor shall comply with applicable federal, state, and local laws and regulations. Should a conflict exist in the requirements for noise abatement, the most stringent requirement shall apply.

Light Abatement

The Contractor shall exercise special care to direct all stationary floodlights to shine downward at an angle less than horizontal. These floodlights shall also be shielded so as not to be a nuisance to surrounding areas. No lighting shall include a residence in its direct beam.

Preservation of Historical and Archaeological Data

Federal legislation provides for the protection, preservation, and collection of scientific, prehistoric, historical, and archaeological data, including relics and specimens, which might otherwise be lost due to alteration of the terrain as a result of any federal construction project.

Should the Contractor, or any of the Contractor's employees or parties operating or associated with the Contractor, in the performance of this contract discover evidence of possible scientific, prehistoric, historical, or archaeological data, the Contractor shall immediately cease work at that location and notify the Contracting Officer, giving the location and nature of the findings. The Contractor shall forward written confirmation to the Contracting Officer within two (2) days. The Contractor shall exercise care so as not to disturb or damage artifacts or fossils uncovered during excavation operations and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the Government.

Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistoric artifact, object of antiquity, or archaeological resource on the public lands of the United States is subject to arrest and penalty of law.

Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

Cleanup and Disposal of Waste Materials

The Contractor shall be responsible for the cleanup and disposal of waste materials and rubbish. The disposal of waste materials and rubbish shall be in accordance with applicable federal, state, and local laws and regulations, with applicable requirements of USBR RSHS and with the requirements of this paragraph. Should a conflict exist in the requirements for cleanup and disposal of waste materials, the most stringent requirement shall apply.

Disposal of hazardous waste and materials.--Materials or wastes, defined as hazardous by 40 CFR 261.3; Federal Standard 313, as amended; or by other federal, state, or local laws or regulations, used by the Contractor or discovered in work or storage areas, shall be disposed of in accordance with these specifications and applicable federal, state, and local laws and regulations. Unknown waste materials that may be hazardous shall be tested, and the test results shall be submitted to the Contracting Officer for review.

Waste materials known or found to be hazardous shall be disposed of in approved treatment or disposal facilities. Hazardous wastes shall be recycled whenever possible.

Waste materials discovered at the construction site shall immediately be reported to the Contracting Officer. If the waste may be hazardous, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

Disposal of Nonhazardous Waste Materials

Waste materials including, but not restricted to, refuse, garbage, sanitary wastes, industrial wastes, and oil and other petroleum products, shall be disposed of by the Contractor. Combustible and noncombustible materials shall be disposed of by removing them from the construction area. Disposal of combustible materials by burning will not be permitted.

Waste materials to be disposed of by removal from the construction area shall be removed prior to completion of the work. Where waste materials are to be dumped, they shall be dumped only at an approved sanitary landfill.

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