Appendix C:
DRAFT Fish Salvage Plan

Gold Ray Dam Project
Fish Passage & Salvage Plan for Dam Removal

Submitted To:

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EXECUTIVE SUMMARY

The design-build team of Slayden Construction Group, Inc. (SCG), River Design Group, Inc. (RDG) and HDR, Inc. was retained by Jackson County Roads and Parks to perform environmental studies, dam removal design and permitting, and deconstruction of the Gold Ray Dam. The existing concrete dam was built in 1941 and consists of a 38 foot high concrete structure spanning 360 feet across the Rogue River. As part of the deconstruction plan it is necessary that fish passage be maintained to the fullest extent possible and existing fish within the construction zone be protected.

A two step deconstruction plan has been developed that consists of isolating half of the dam and removing it and then isolating the other half and removing it down to natural conditions. A detailed fish passage and salvage plan has been developed in consultation with the Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS). During the first phase of dam isolation, fish passage will be maintained through the existing fish ladder under similar conditions that currently exist at the site. A daily monitoring plan is provided to ensure fish passage conditions are reviewed on a regular basis with proper corrective actions if necessary.

After the south portion of the dam is removed, a pilot channel will be created for the entire river. The river flow will be transitioned through the removed portion of the dam and through the pilot channel. Fish salvage will take place in the reservoir area once the river is diverted to the removed dam area and the pilot channel. Fish passage during removal of the north half of the dam will be through a free-flowing channel with minor improvements as necessary for passage.

Once the dam is removed, fish passage will be similar to historical conditions. Based on bathymetric surveys of the reservoir area, there appear to be no fish passage barriers in the mainstem Rogue River. Likewise, historical documents show that there were no fish passage barriers near the existing dam location. The confluence of Bear Creek with the Rogue River will be stabilized to ensure continuous fish passage at the completion of the project. Additional observations and adjustments are planned for the Bear Creek confluence after the first winter when streambed elevation of the mainstem Rogue River adjusts downward.

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1 INTRODUCTION

1.1 Project Scope

The design-build team of Slayden Construction Group, Inc. (SCG), River Design Group, Inc. (RDG) and HDR, Inc. was retained by Jackson County Roads and Parks to develop environmental studies, complete dam deconstruction designs, procure necessary permits, and remove the Gold Ray Dam. As part of this process, a fish passage plan is required that addresses fish passage during deconstruction of the dam and long-term fish passage after the dam is removed. This plan covers the following topics:

1) Describe existing fish passage facilities.
2) Identify how fish passage will be maintained during deconstruction of the dam.
3) Describe the fish salvage and dewatering approach to dam removal.
4) Identify how fish passage will be maintained after deconstruction of the dam.

A vicinity map for the Gold Ray Dam project area is included in Figure 1-1.

Figure 1-1. Project vicinity map for Gold Ray Dam project on the Rogue River.

2 METHODS

The following section outlines RDG's methods for evaluating the existing conditions and preparing design plans for fish passage. A combination of field surveys and remote sensing were used to assess existing conditions for baseline information.

2.1 Site Investigation and Survey

Existing site conditions and field surveys were completed using various methods. First, Watershed Sciences, Inc. collected Light Detection and Ranging (LiDAR) data for the project area in May 2009. Next, RDG completed detailed field data collection in September 2009 to characterize and survey the existing site conditions at the dam along with conditions upstream in the reservoir area and in the river downstream of Gold Ray Dam. Data collection included topographic survey of the existing fish ladder, concrete dam, and surrounding structures. Water surface elevations were collected along with velocity profiles at the fish ladder for calibration of the hydraulic model. RDG data collection efforts utilized a total station (Topcon 211d) with data collector and a survey-grade GPS (Trimble R8) system to georeference the site. RDG also established horizontal and vertical control benchmarks for use throughout the project area.

Figure 2-1. Surveying the existing fish ladder with a survey-grade GPS and total station.

Max Depth Aquatics, Inc. performed a hydroacoustic bathymetric survey of the Rogue River in and around the project site to develop bathymetric information. Finally, Watershed Sciences integrated both LiDAR and bathymetric surveys into seamless models of terrestrial bare earth and submerged bathymetry. The vertical accuracies for the LiDAR data and bathymetric data are 3 cm and 5 cm, respectively (Watershed Sciences 2009). The resulting elevation model of the project site allows hydraulic modeling of existing conditions and likely hydrological outcomes of the alternative scenarios.

Hydraulic modeling data were evaluated in HEC-RAS 4.0 (HEC 2008) and displayed using AutoCAD Civil 3D. ArcGIS programs were used to develop field base maps and visualization figures. Programs included ArcGIS Version 9.1 (ESRI 2005a) and ArcGIS extensions, Spatial Analyst (ESRI 2005b) and 3D Analyst (ESRI 2005c).

2.2 Hydrology

The site has an operational river gage just downstream from Gold Ray Dam that has been operational since 1905. The Rogue River at Raygold gage (USGS 14359000) is located at 42° 26' 15" latitude and 122° 59' 10" longitude (NAD 27) and has a drainage area of 2,053 square miles at River Mile 125.8. The flow has been regulated at the gage since the construction of Lost Creek Dam on the Rogue River upstream of Gold Ray Dam in February 1977. To obtain regulated flow return intervals, a Log-Pearson Type III methodology, as outlined in Bulletin 17B "Guidelines for Determining Flood Flow Frequency" was used on the yearly peak flows. The predicted peak discharges for the gage are summarized in Table 2-1.

Table 2-1. Predicted stream discharge for Rogue River at Gold Ray Dam based on regional regression equations from OWRD and HEC-SSP.

Frequency	OWRD Flow (cfs)	Comments
2-yr	26,000	
5-yr	37,600	
10-yr	44,500	
25-yr	65,000	Restoration design stability flow
50-yr	74,600	
100-yr	98,000	Floodplain management flow
Est. Bankfull Discharge	16,000	~1% duration flow
Avg Daily Flow	2,850	Average daily flow

In addition to general hydrologic conditions, there is specific interest in river flows during the in-water work period of June 15 through August 31. It has also been determined that an in-water work period extension of one and a half months is necessary to complete the project; therefore, an analysis of average daily flows was developed from OWRD data for the last 30 years from June 15 through October 15. Table 2-2 summarizes the data and provides an envelope for fish passage design scenarios.

Table 2-2. Average daily discharge ranges for Rogue River at Gold Ray Dam based on most recent 30 years of OWRD data.

June 15 – Oct 15	Average (cfs)	Min (cfs)	Max (cfs)
High Flow	2,710	1,410	4,700
Low Flow	1,350	900	2,100
Average Flow	1,910	1,250	3,150
5% Exceedance	2,210	(high fish passage flow)	
95% Exceedance	1,360	(low fish passage flow)	

2.3 Hydraulic Modeling

Hydraulic modeling for the fish passage plan was performed using HEC-RAS 4.0 software and standard spreadsheets with weir equations. The one-dimensional hydraulic river model was calibrated to known discharges and water surface elevations on two separate days based on the active stream gage reading at the time of survey. The discharge data were used to enhance the accuracy of the model and ensure the validity of roughness coefficients.

3 EXISTING CONDITIONS

3.1 Historical Context

Gold Ray Dam was originally constructed in 1904 and consisted of a log crib structure with fish ladders on each side of the dam. In 1941 a concrete structure was completed just downstream of the log crib dam as shown in Figure 3-1. A fish ladder was blasted into the bedrock and built with concrete and is still in place in the current configuration as shown in Figure 3-2.

Figure 3-1. 1941 photo of concrete dam being built along with fish ladder and burning of the log crib dam. (photo courtesy of PacifCorps historical records)

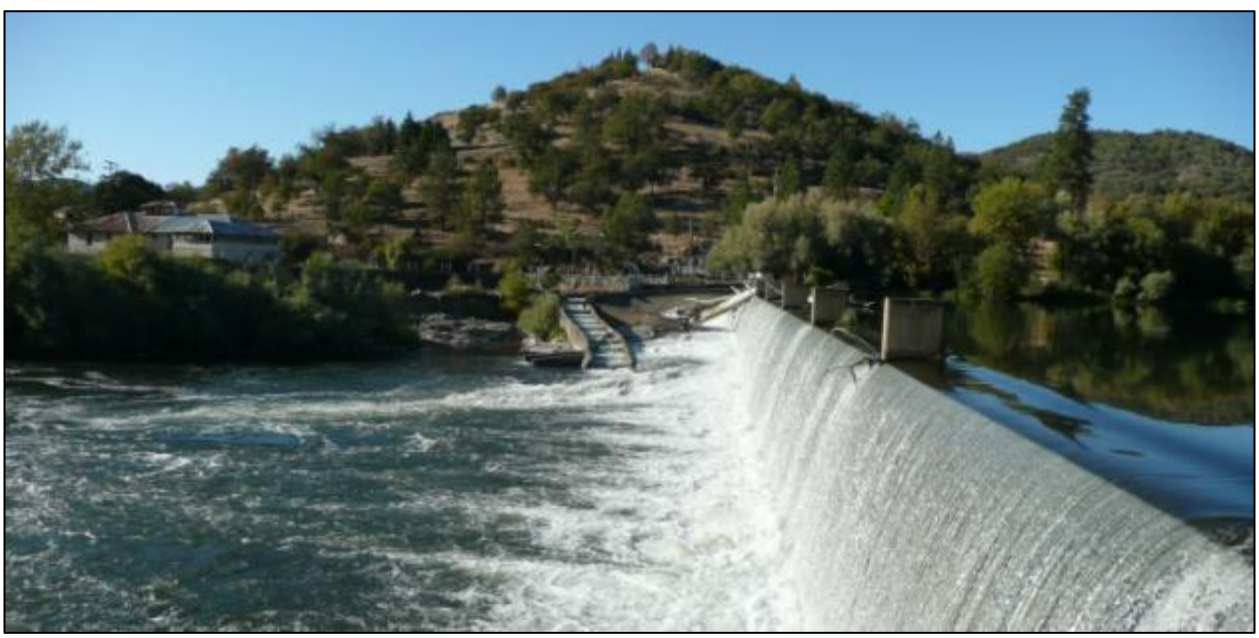

Figure 3-2. Existing view of Gold Ray Dam and fish ladder with total flow of 1,310 cfs.

3.2 Hydrology

The Rogue River is a low gradient gravel-bed river that has a local reach slope of approximately 0.22 percent in the project area. General hydrologic patterns for the Rogue River are driven by rainfall and groundwater inflow. Peak flows normally occur in November through May in response to abundant rainfall, snow melt, and runoff as soils are often fully saturated through the rainy season. Likewise, the Rogue River is regulated by Lost Creek Dam which reduces peak flows during high flow events. Figure 3-3 illustrates the daily average flows near Gold Ray Dam resulting from the last 30 years of regulation.

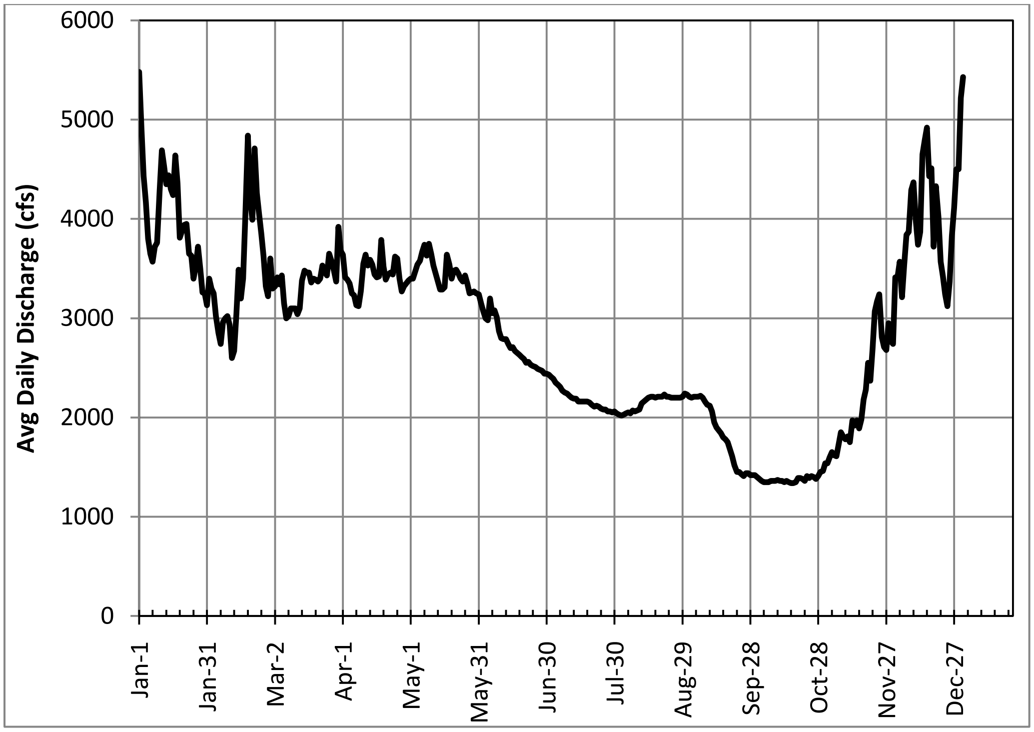

Figure 3-3. The daily average flows at Raygold Gage reflecting river regulation at Lost Creek Dam over the last 30 years.

3.3 Hydraulics of Existing Fish Passage Facilities

The existing dam is a run-of-the-river type structure that does not have mechanisms to control flows. The existing concrete dam acts as a weir with flow going over the dam similar to a broad crested weir. In addition, water flows down the fish ladder and a small portion of water flows down the powerhouse raceway. Figure 3-4 shows the existing upstream entrance to the fish ladder in relationship to the dam structure.

Figure 3-4. Looking upstream at the fish ladder flow control structure with 3,800 cfs total flow in river.

The hydraulic characteristics of the dam and fish ladder were developed to understand existing conditions and calibrate the existing weir coefficients. Table 3-1 summarizes the stage-discharge relationship for the dam and fish ladder. A broad crested weir coefficient of 3.05 was determined for the concrete dam for a discharge of 1,310 cfs based on a known water surface and discharge. In addition, water surface elevations and weir conditions were measured for the fish ladder to determine an estimated flow rate and to calibrate the integrated system.

Table 3-1. Existing stage-discharge for Gold Ray Dam based on calibrated model.

Water Surface Elev. (ft)	Head on Dam (ft)	Dam Discharge (cfs)	Avg Flow Velocity Dam (ft/sec)	Head on Fish Ladder (ft)	Fish Ladder Weir Flow (cfs)	Total Discharge (cfs)
1150.80	0.90	936	2.89	1.20	37	973
1151.00	1.10	1,265	3.20	1.40	46	1,311
1151.20	1.30	1,625	3.48	1.60	56	1,682
1151.40	1.50	2,014	3.74	1.80	67	2,082
1151.60	1.70	2,430	3.98	2.00	79*	2,509
1151.80	1.90	2,872	4.20	2.00	79*	2,951
1152.00	2.10	3,337	4.42	2.00	79*	3,416
1152.20	2.30	3,825	4.63	2.00	79*	3,904
1152.40	2.50	4,334	4.82	2.00	79*	4,413
1152.60	2.70	4,865	5.01	2.00	79*	4,943
1152.80	2.90	5,415	5.19	2.00	79*	5,494
1153.00	3.10	5,985	5.37	2.00	79*	6,064
1153.20	3.30	6,573	5.54	2.00	79*	6,652
1153.40	3.50	7,180	5.71	2.00	79*	7,259

* Water overflows sides of fish ladder walls above 2 feet, however, ODFW adjusts the upstream flashboards to control the amount of flow down the fish ladder at high flows so a simple estimate of 79 cfs is used for high flow conditions.

ODFW utilizes an energy dissipation factor (EDF) as a surrogate for velocity criteria in fishways in accordance with Oregon Administrative Rule (OAR) 635-412-0035. An analysis of the existing fish ladder was performed to determine typical EDFs at high and low fish passage flows, 2,210 cfs and 1,360 cfs respectively for the time period of June 15 – October 15. Table 3-2 summarizes the EDF's for the existing fish ladder based on the high and low fish ladder flows down the fish ladder. Compensation for flow splits in the fish ladder has been made at pools 9 and 2.

Table 3-2. Average EDFs for existing fish ladder with high and low fish passage.

Fish Ladder Pool	Pool Flow Rate (cfs)	Weir Elevation (ft)	Avg Velocity Over Weir (ft/sec)	Pool Volume (cubic ft)	Pool Average EDF
Low Fish Passage Flow of 46 cfs					
12	46.00	1145.50	3.9	1053.2	2.7
11	46.00	1144.40	3.7	747.0	**4.2**
10	46.00	1143.20	3.7	1324.2	2.6
9	46.00	1141.90	6.5	2731.9	1.4
8	30.21	1140.70	3.0	960.9	2.4
7	30.21	1139.50	3.1	539.0	**4.2**
6	30.21	1138.10	3.1	577.6	**4.6**
5	30.21	1136.90	3.3	606.3	3.7
4	30.21	1135.70	3.0	528.7	**4.3**
3	30.21	1134.50	3.2	540.9	**4.2**
2	30.21	1133.00	3.8	680.1	**4.2**
1	15.20	1132.00	2.4	460.1	2.1
High Fish Passage Flow of 71 cfs					
12	71.00	1145.50	4.5	1101.8	**4.0**
11	71.00	1144.40	4.3	790.5	**6.2**
10	71.00	1143.20	4.3	1369.6	3.9
9	71.00	1141.90	7.5	2788.3	2.1
8	46.63	1140.70	3.5	993.1	3.5
7	46.63	1139.50	3.6	569.9	**6.1**
6	46.63	1138.10	3.6	610.4	**6.7**
5	46.63	1136.90	3.8	640.1	**5.5**
4	46.63	1135.70	3.5	562.3	**6.2**
3	46.63	1134.50	3.7	574.4	**6.1**
2	46.63	1133.00	4.4	716.7	**6.1**
1	20.49	1132.00	2.6	473.6	2.7

Red numbers represent EDF values above 4 and outside of acceptable criteria.

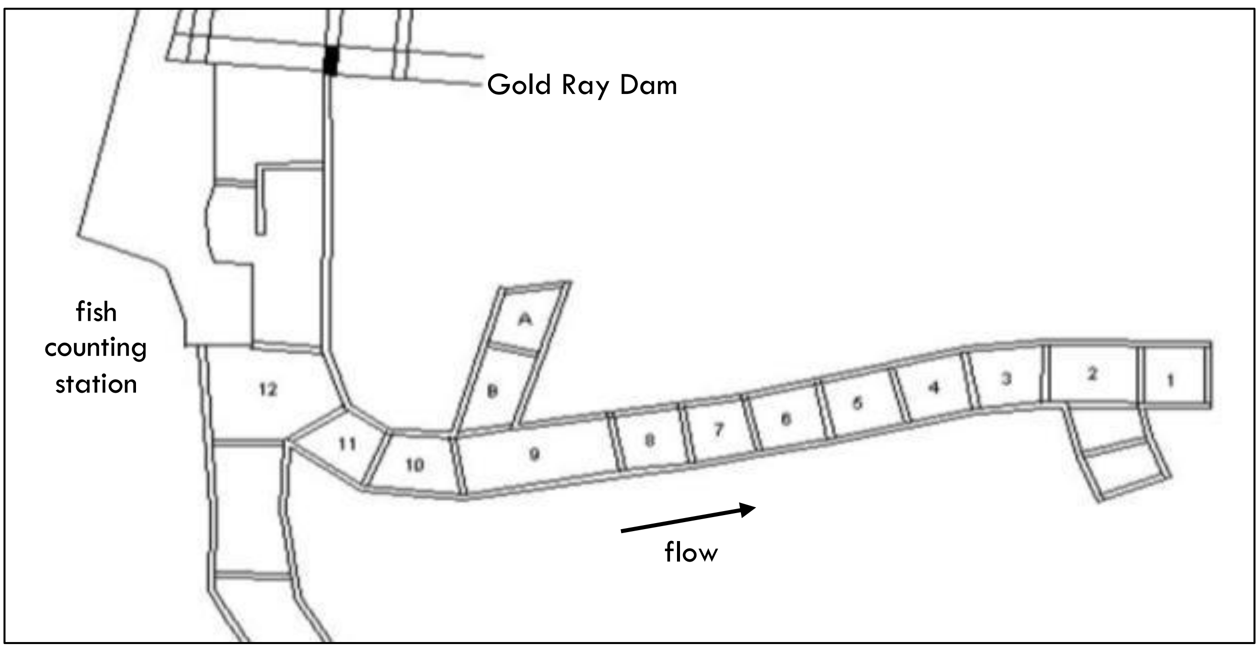

Figure 3-5. Existing fish ladder at Gold Ray Dam with pools labeled for reference.

Based on the existing conditions it is apparent that the fish ladder does not meet current criteria for fish passage. The EDF values exceed 4.0 for several of the fish ladder pools at low flow conditions and most pools are above 4.0 at high fish passage flow. In addition, step heights between weirs exceed 1.25 feet. Several other criteria, such as attraction flows, are not met by the existing fish ladder. These shortcomings can be improved upon for temporary fish passage during dam removal as described later in this report.

3.4 Fisheries

The following fisheries information was developed based on general salmonid characteristics and also from information provided by ODFW fisheries biologist Jay Doino. These sections present the migration, spawning and rearing characteristics of the three target salmonid species; coho salmon, Chinook salmon (spring and fall), and steelhead (summer and winter).

3.4.1 Coho salmon

Migration and Spawning: Coho salmon typically migrate through this section of the Rogue River from September through January. Adults migrating upstream may rest in pools or other areas with slow currents and cover features. Adult spawning occurs primarily in tributaries from November through January, with the peak occurring in December. Time required for egg incubation varies with temperature, and eggs or coho salmon fry could be within gravels anytime between November and May.

Rearing: Fry remain in tributary streams as juveniles before smolting and migrating down the Rogue River to salt water during spring or possibly fall of the year following emergence. Peak downstream migration occurs April – July. Like other salmonids, juvenile coho salmon require cold water (less than 64 °F or 17.8 °C), high dissolved oxygen levels, and deep pools for feeding and cover from predators. Access to tributary streams to find refuge from high flows in the winter is also important. Winter parr are especially dependant on slow water habitat for survival.

3.4.2 Spring Chinook salmon

Migration and Spawning: Adult spring Chinook salmon enter this reach of the Rogue River from March until August with the bulk of the run arriving from mid-April to mid-July. Before spawning, adult Chinook salmon hold in pools, preferring deep pools with cool water, abundant large wood, and undercut banks for cover. Peak spawning occurs during September and October. Chinook salmon die after spawning, providing an important marine-derived nutrient source to Rogue River. Time required for egg incubation varies with temperature and spring Chinook fry typically emerge from gravels beginning in January through March.

Rearing: Unlike steelhead and coho salmon, juvenile Chinook salmon only spend a few weeks to months near their spawning grounds before migrating to salt water and are usually out of the freshwater system by late summer. Like other salmonids, juvenile Chinook salmon require cold water temperatures (less than 64 °F), high dissolved oxygen levels, and deep pools for feeding and cover from predators. Access to tributary streams to find refuge from high flows in spring is also important.

3.4.3 Fall Chinook salmon

Migration and Spawning: Adult fall Chinook salmon enter this reach of the Rogue River from mid-August to mid-November. Spawning occurs in the fall with the peak occurring during October and

November. Chinook salmon die after spawning, providing an important marine-derived nutrient source to Rogue River. Time required for egg incubation varies with temperature but fall Chinook fry typically emerge from gravels beginning in February through April.

Rearing: Unlike steelhead and coho salmon, juvenile Chinook salmon only spend a few weeks to months near their spawning grounds before migrating to salt water and are usually out of the freshwater system by late summer. Like other salmonids, juvenile Chinook salmon require cold water temperatures (less than 64 °F), high dissolved oxygen levels, and deep pools for feeding and cover from predators. Access to tributary streams to find refuge from high flows in spring is also important.

3.4.4 Winter steelhead

Migration and Spawning: Adult winter steelhead migrate into this reach of the Rogue River to spawn from January through May. Peak spawning occurs in March and April in low/moderate gradient streams. Some winter steelhead also spawn in the mainstem Rogue River. Eggs or fry can be present in the gravel from February to June.

Rearing: Juvenile steelhead can remain in the Rogue River for one to two years before migrating as smolts to salt water. Juvenile steelhead are likely to use both the mainstem and cool water tributaries for rearing. They can be found in riffles and pools with cover, large wood, and cool water temperatures (less than 64 °F or 17.8 °C), and high dissolved oxygen levels. Winter steelhead may make seasonal migrations into and out of tributaries and the mainstem Rogue River throughout their freshwater residence time.

3.4.5 Summer steelhead

Migration and Spawning: Adult summer steelhead migrate into this reach of the Rogue River from May through December. Two peaks in migration occur, the first being in June and July, and the second occurring in October and November. Spawning occurs primarily in tributaries to the Rogue from December through March, with the peak of the spawn occurring in January and February. Summer steelhead typically prefer smaller, sometimes ephemeral tributaries, than winter steelhead. Time required for egg incubation varies with temperature and eggs or steelhead fry can be present in the gravel from December through June.

Rearing: Juvenile steelhead can remain in the Rogue River for one to two years before migrating as smolts to salt water. Juvenile steelhead are likely to use both the mainstem and cool water tributaries for rearing. They can be found in riffles and pools with cover, large wood (Figure 3-4), and cool water temperatures (less than 64 °F or 17.8 °C), and high dissolved oxygen levels. Summer steelhead often make seasonal migrations into and out of tributaries and the mainstem Rogue throughout their freshwater residence time.

3.4.6 Non-salmonid Species

Other native non-salmonid species of freshwater fish found in the Rogue River include Pacific lamprey, Klamath smallscale sucker, speckled dace, prickly sculpin, and riffle sculpin. Non-native species found in the river may include redside shiner, largemouth bass, smallmouth bass, black crappie, bluegill, catfish, brown bullhead, yellow perch, carp, green sunfish, goldfish, American shad, gambusia, spotted bass, Umpqua pikeminnow, fathead minnow, golden shiner, pumpkinseed, and crayfish.

3.4.7 Fisheries Periodicity

A fish presence and life stage chart was developed by Oregon Department of Fish and Wildlife (ODFW) to determine fish usage of the Rogue River throughout the year. Salmonid presence is referenced to the time of year (Table 3-3) to help identify critical usage during dam removal activities.

Table 3-3. Fish periodicity chart based on ODFW historical information and field biologists' observations.

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UPSTREAM ADULT MIGRATION												
Winter Steelhead		X	X X	X								
Summer Steelhead						X X	X X			X X	X X	
Spring Chinook salmon				X	X X	X X	X					
Fall Chinook salmon								X	X X	X X		
Coho salmon										X	X X	
ADULT SPAWNING												
Winter Steelhead			X	X X	X							
Summer Steelhead					primarily spawn in tributaries							
Spring Chinook salmon									X	X X		
Fall Chinook salmon										X	X X	
Coho salmon					primarily spawn in tributaries							
EGG INCUBATION THROUGH FRY EMERGENCE												
Winter Steelhead												
Summer Steelhead					primarily spawn in tributaries							
Spring Chinook salmon												
Fall Chinook salmon												
Coho salmon					primarily spawn in tributaries							
JUVENILE REARING												
Winter Steelhead					may be present but most rear in tributaries							
Summer Steelhead					may be present but most rear in tributaries							
Spring Chinook salmon												
Fall Chinook salmon												
Coho salmon					may be present but most rear in tributaries							
DOWNSTREAM JUVENILE MIGRATION												
Winter Steelhead				X X	X X	X						
Summer Steelhead				X X	X X	X						
Spring Chinook salmon						X X	X X	X X				
Fall Chinook salmon						X X	X X	X X				
Coho salmon				X X	X X	X X						

X - Denotes peak timing

3.5 Summary

The existing dam is essentially an in-line weir with no flow control capabilities that can easily be modeled with the standard weir equation. The existing fish ladder does not meet current criteria for fish passage due to excessive jump heights and energy dissipation criteria. There is the potential for encountering a substantial number of fish in the mainstem Rogue River, both adult and juvenile, during deconstruction of the dam.

4 DECONSTRUCTION PHASING AND FISH PASSAGE

This section provides an overview of the deconstruction plan and concepts for fish passage during removal of the existing dam. Gold Ray Dam will be removed in two distinct phases to facilitate upstream and downstream fish passage while minimizing risk to fish. The deconstruction plan first isolates the south side of the dam and removes it in Phase 1. The second phase isolates the north side of the dam and removes the remaining infrastructure on the north as described below.

4.1 Phase 1 Deconstruction

In-water work for deconstruction of the dam is proposed to start on June 15, 2010. Figure 4-1 provides an overview of project phasing and Drawing 3.0 provides steps for each procedure at the site.

Figure 4-1. Aerial photo of Gold Ray Dam showing Phase 1 and 2 boundary.

Figure 4-2 includes an aerial photo of the project area and relates the location of the proposed steps for the dewatering and fish salvage effort. The proposed steps for Phase 1 include:

1. Access river from the south along the railroad tracks and create a staging area on the north side of the railroad tracks and upstream of the dam approximately 100 feet.

2. Import round river rock, angular material and river sand via train cars from local commercial sources and Savage Rapids Dam leftover material. Aggregate will range in size from 1 inch to 12 inches and be utilized to build an access road/cofferdam across Tolo Slough to the existing land using approximately 1,500 cubic yards of material.

3. The fish salvage plan shall be activated for Tolo Slough and the entire slough area shall be defished by lowering the water elevation with pumps. Entire salvage shall take less than 24 hours.

4. Import round river rock, angular material and river sand via train and build cofferdam to center of existing concrete dam. Approximate quantity of temporary aggregate fill is 4,000 cubic yards.

5. Import round river rock, angular material and river sand via train and build cofferdam to isolate downstream area of existing concrete dam from moving water as shown in Figure 4-2. Approximate quantity of temporary fill material is 1,000 cubic yards.

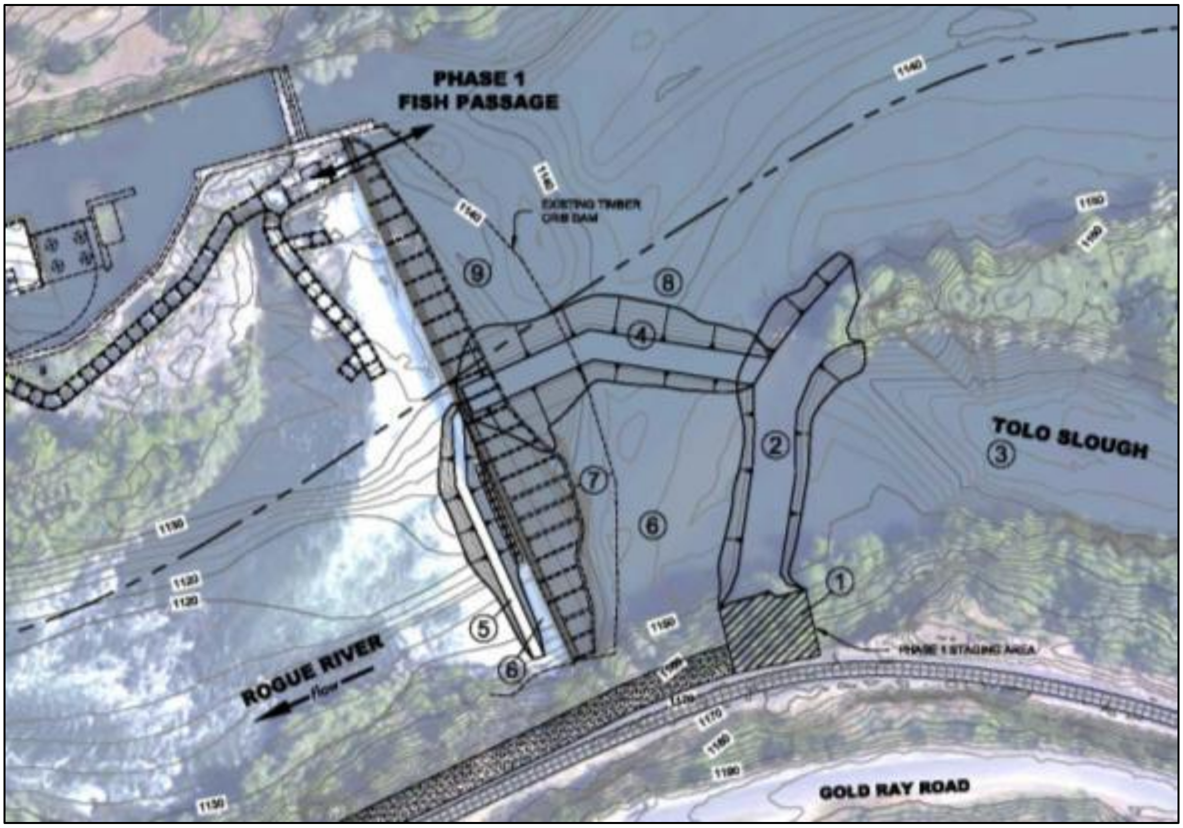

Figure 4-2. Phase 1 showing work area isolation with cofferdams and each step numbered.

6. The fish salvage plan shall be activated for the isolated area by first lowering the water level with pumps then defishing with seine nets and electroshocking if necessary.

7. Remove isolated section of concrete and timber crib dam down to existing bedrock and dispose of off-site or stockpile and stage concrete to fill in powerhouse forebay on north side of dam (see phase 2 drawings).

8. Remove approximately 100 ft of temporary cofferdam by incrementally lowering the cofferdam and allowing the reservoir area to dewater in a controlled manner. Invoke fish salvage plan for Kelly Slough area and mainstem Rogue River fringe area.

9. Perform fish salvage and defishing of area between existing concrete dam and log crib dam on north side of existing dam.

The Phase 1 removal plan creates a robust design for removing the dam while minimizing risks. First, it allows for a strategic fish salvage effort in Tolo Slough without interrupting fish passage during the beginning of the in-water work period. Second, it creates a controlled environment around the south portion of the dam that is isolated from moving water and minimizes the potential for disturbance of aquatic resources. Third, the plan maintains fish passage through the existing fish ladder. Finally, the plan allows for a controlled drawdown of the reservoir area and Kelly Slough that is reversible if unforeseen circumstances arise. It will be critical that the drawdown of the reservoir area is completed in a controlled manner that can be stopped and even reversed if high numbers of fish are stranded or unreachable.

4.2 Phase 1 Fish Passage

Fish passage during dam removal is a critical component required to make this project successful and minimize aquatic resource disturbances. Our team is familiar with the different techniques that were used for fish passage at both the Savage Rapids Dam and Gold Hill Dam removal projects since we were involved with both projects. In addition, we have determined by input from ODFW and NMFS that a window of little or no fish passage would best be done during **August 9-13**. With this date in mind we have the following approach to fish passage during deconstruction of the Gold Ray Dam that provides flexibility and adaptability.

Fish passage will be maintained from June 15 through August 9 through the existing fish ladder on the north side of the dam. Table 4-1 provides a stage-discharge curve for the existing fish ladder based on actual measurements and calibration of the dam as a weir. As a result of isolating the southern portion of the dam, the total weir length will go from 360 ft to approximately 170 ft. Table 4-1 summarizes the change in water surface elevation over the dam weir to further understand the hydraulics. It is likely that the typical water surface change will be approximately 1ft higher during Phase 1 deconstruction and no higher than 1.6 ft based on historical maximum daily average flows.

Table 4-1. Fish passage flows during deconstruction with Phase 1 cofferdams installed.

30-year Record June 15 – Oct 15	Water Surface Elev. Existing Conditions (ft)	Water Surface Elev. with Cofferdam (ft)	Change in Water Surface (ft)
5% Exceedance (2,210 cfs)	1151.5	1152.5	1.0
95% Exceedance (1,360 cfs)	1151.1	1151.8	0.7
Max Avg Daily Flow (4,700 cfs)	1152.5	1154.1	1.6

As a result of the potential increase in water surface, the potential for more water going down the fish ladder exists. This is not an ideal situation since the current fish ladder does not meet current criteria for drop height (i.e. exceeds 12 inches) or energy dissipation. However, the existing upstream surface water inlet to the fish ladder is a weir with variable control by means of boards as illustrated in Figure 4-3. It is proposed that the flow in the fish ladder be adjusted by using the existing wood boards to control the amount of flow that goes down the existing fish ladder during Phase 1 of the deconstruction. In addition to the variable upstream control, we are proposing to open the historical fish ladder at Pool 12 that flows (west) down to the powerhouse to allow water to overflow out of the existing fish ladder. If the total fish ladder flow is maintained at 80 cfs or less and the flow is evenly split at Pool 12, EDFs will be less than 4 in the existing fish ladder. This altered configuration will actually be an improvement over existing fish passage conditions. Steel plates or sandbags will be placed at the upstream wall of the downstream section (i.e. entrance) of the fish ladder to reduce turbulence. The ladders will be monitored on a daily basis and adjustment will be made using stop boards, sand bags, and additional measures as necessary and directed by ODFW and/or NMFS personnel.

Figure 4-3. A view downstream at the fish ladder flow control structure with 3,800 cfs total flow in the river (left). The right photo is an upstream view at the upper end of the fish ladder showing the variable control weir structure with adjustable boards.

The current downstream entrance to the fish ladder operates in a progressive manner based on flow conditions. As flows increase over the dam, the entrance progressively gets drowned out. The fish ladder continues to operate as stage increases as illustrated in Figure 4-4. It is anticipated that the fish ladder will continue to function in this manner during the Phase 1 deconstruction process; however, if it is determined that it is not functioning in an adequate manner, modifications to the fish ladder will be made. One option would include building up the left wall of the fish ladder using sand bags or steel plates to reduce cross-flows at the fish ladder entrance. This should not be a problem though since there is another entrance in this cross-flow direction that will provide ample opportunity for fish passage.

Figure 4-4. Downstream entrance to fish ladder.

4.3 Phase 1 Fish Passage Monitoring

The following monitoring activities will be implemented daily to ensure that fish passage is being maintained to the maximum extent possible throughout the duration of Phase 1. Additional monitoring actions may be required as the project progresses, but at a minimum the following shall be done daily:

- Record date and flow at USGS "Ray Gold" station
- Adult fish observation by biologist wearing polarized glasses. From atop the counting station, record observation time and look for adult fish in river below the dam, primarily for fish backed up due to passage difficulties. Estimate the number of adults by species if possible that are observed and make notes about groupings and behavior.

- Count the number of successful and unsuccessful jumps at the ladder entrance, preferably for at least 15-30 minutes. Observations in morning or evening are preferred. Make notes of general observations about river conditions, ladder conditions, and fish behavior. If entrances to the ladders are submerged, use this time to observe fish in the ladder. The entrance to the ladder at the powerhouse tailrace should also be observed.
- Observe fish in the ladder and document problems with fish passing the weirs.
- Look for pools where water flows over the sides of the fish ladder – especially in the uppermost pools in the ladder.
- Observe the final jump over the dam to ensure flashboard placement is not creating an excessive jump height for fish.
- Observe the dam crest for fish falling back over the dam.

Observations and potential fish passage delays/problems shall be reported to ODFW immediately. The project will be required to address any problems impacting fish passage that are caused by project activities. Email a report summarizing monitoring activities to the natural resource agencies on a daily basis. The report period may be relaxed pending results in the field and approval of ODFW and NMFS. Suggestions for improvements are encouraged, but changes to the procedure may be made only with the agreement of ODFW and NMFS.

4.4 Phase 1 to 2 Fish Passage Delay

The river will be routed through the southern portion of the dam after the southern section of the dam is removed. In order to route the river through this area, there will be a transitional time period where the water will be drawn down and will no longer flow over the dam and fish ladder. Based on fisheries concerns and coordination, it is planned that this transitional period will happen during the week of **August 9–15** to minimize the potential risk to adult fish passage. Based on the past 30 years of gage data, the average flow during this time period is 2,150 cfs.

The reservoir has an approximate stored volume of 15 million cubic feet of water that must be drained down in order to get to the base river flow of approximately 2,150 cfs. The stored volume of water will be lowered by incrementally removing a portion of the cofferdam upstream of the removed portion of dam. It is anticipated that the flow rate will be increased around 200 to 300 cfs above river flows and it will take between 14 and 21 hours to draw the reservoir down. Table 4-2 summarizes the variable drawdown time based on the increased flow rate. The other critical factor that will impact drawdown time is the fish salvage and defishing effort. As the reservoir area is lowered, at least two crews will be in boats and on the shore ensuring that fish are not stranded in pooled areas. In addition, the existing fish ladder will be defished before water levels are cutoff to the fish ladder.

Table 4-2. Drawdown time for the reservoir area at various flow rate increases during the Phase 1 cofferdam lowering.

Increased flow rate above river flow rate (cfs)	Drawdown time to match river flow rate (hours)
100	42
200	21
300	14
400	11
500	8

The transition of water from over the dam and fish ladder (Phase 1) to the removed section of Gold Ray dam will take approximately two days depending on fish stranding and fish salvage requirements. During this drawdown period, there will be no fish passage through the fish ladder and no upstream fish passage through the new channel. It is anticipated that the delay will not exceed three days based on our knowledge and understanding of the existing conditions and time for removing potentially stranded fish.

4.5 Phase 2 Deconstruction

After the southern portion of the dam is removed, the entire Rogue River will flow through the removed section of dam. This will simplify removal of the northern portion of the dam as it will primarily be in an area of non-moving water. Figure 4-5 includes an aerial photo of the project area and the steps involved with the Phase 2 dam deconstruction. The following steps describe the Phase 2 removal plan.

1. Access river from the north and create a staging area on the north side of the river, north of the powerhouse by approximately 100 feet.

2. Import round river rock, angular material and river sand via dump trucks. Aggregate will range in size from 1 inch to 12 inches and be utilized to build an access road across the existing raceway to cutoff flows to the powerhouse.

3. Fish salvage plan shall be activated for the isolated powerhouse area. The salvage plan includes lowering the water surface with pumps and using seine nets, dip nets, and electroshocking if necessary to remove fish from the powerhouse area.

4. Import round river rock or angular material to build an access road on upstream side of existing log crib dam. The approximate quantity of temporary aggregate fill is 300 cubic yards.

5. Remove existing log crib dam and dispose of off-site.

6. Isolate the downstream end of the fish ladder area and powerhouse using a floating silt curtain or imported aggregate material. Approximate quantity of temporary aggregate fill is 1,000 cubic yards.

7. The fish salvage plan shall be activated for the isolated area. The plan will include lowering the water surface with pumps if possible and then using seine nets and electrofishing to remove fish from the isolated area.
8. Remove the existing concrete dam structure, timber crib dam, fish ladders, and powerhouse. Concrete and rubble shall be broken into 2 ft by 2 ft pieces and all exposed rebar and steel will be removed. Use the rubble to fill in the forebay and create a safe and stable slope per the grading plan and restoration plan.

9. Remove the existing temporary cofferdam material and place over fill as shown in the restoration plan. The prepared surface will then be planted.

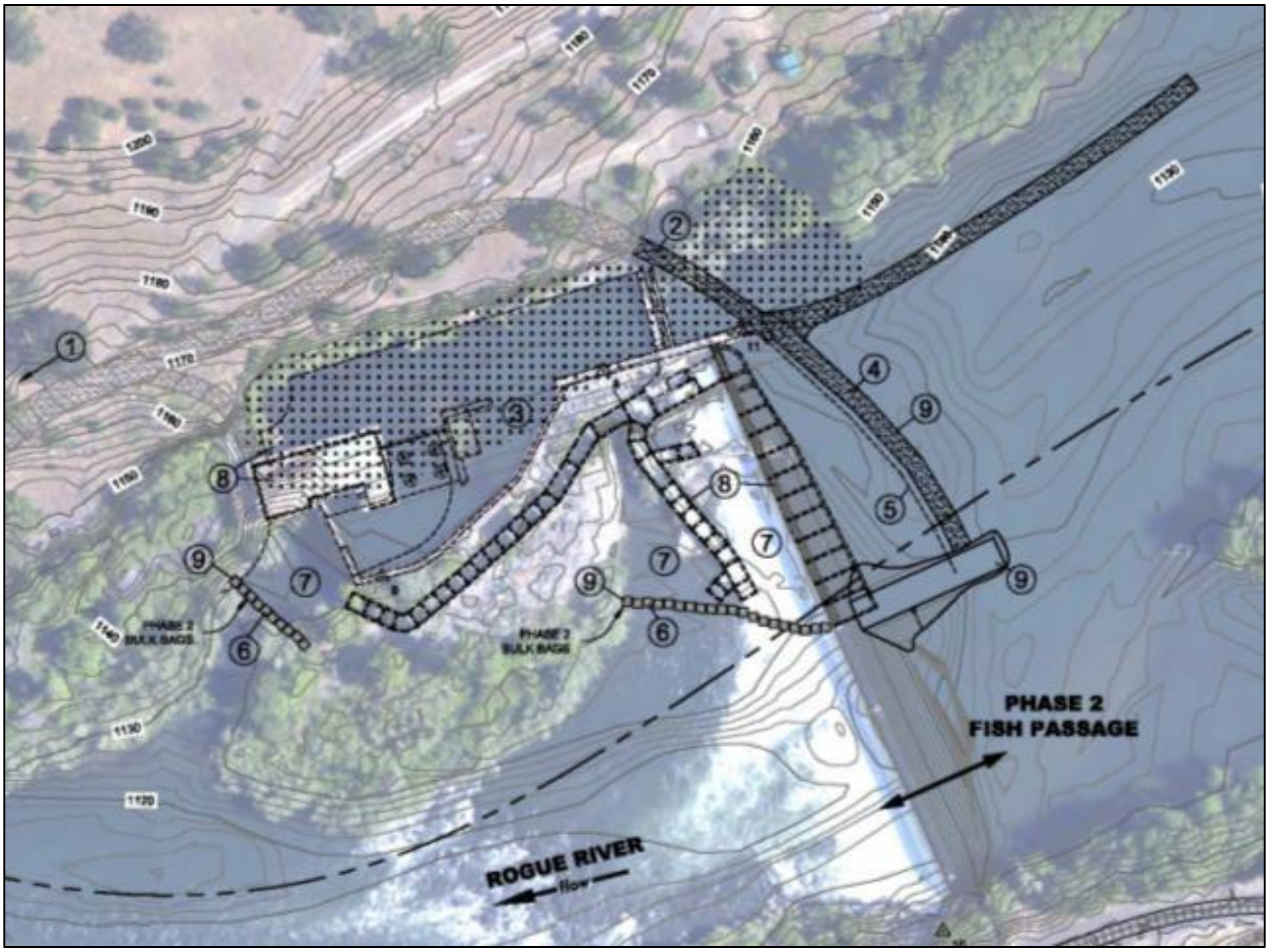

Figure 4-5. Phase 2 work area isolation to remove northern portion of dam and numbered steps.

4.6 Phase 2 Fish Passage

After the southern portion of the dam is removed, the entire Rogue River will flow through the removed section of dam. As an example, during the Savage Rapids Dam removal project the entire river was necked down to the radial gate openings as illustrated in Figure 4-6. During this flow of 1,300 cfs, the river was less than 60 feet wide and had an average velocity of less than 6 ft per second (fps) based on actual measurements taken during dam deconstruction.

Figure 4-6. The Savage Rapids dam removal project showing 1,300 cfs going through radial gates with an average velocity of 6 fps and channel width of less than 60 ft.

A HEC-RAS 4.0 hydraulic model was developed to evaluate hydraulic conditions for fish passage during Phase 2 deconstruction when the river is routed through the removed section of dam. Figure 4-7 provides a schematic of the cross-section locations utilized for the HEC-RAS model. Figure 4-8 illustrates the water surface profile through the opened area for fish passage.

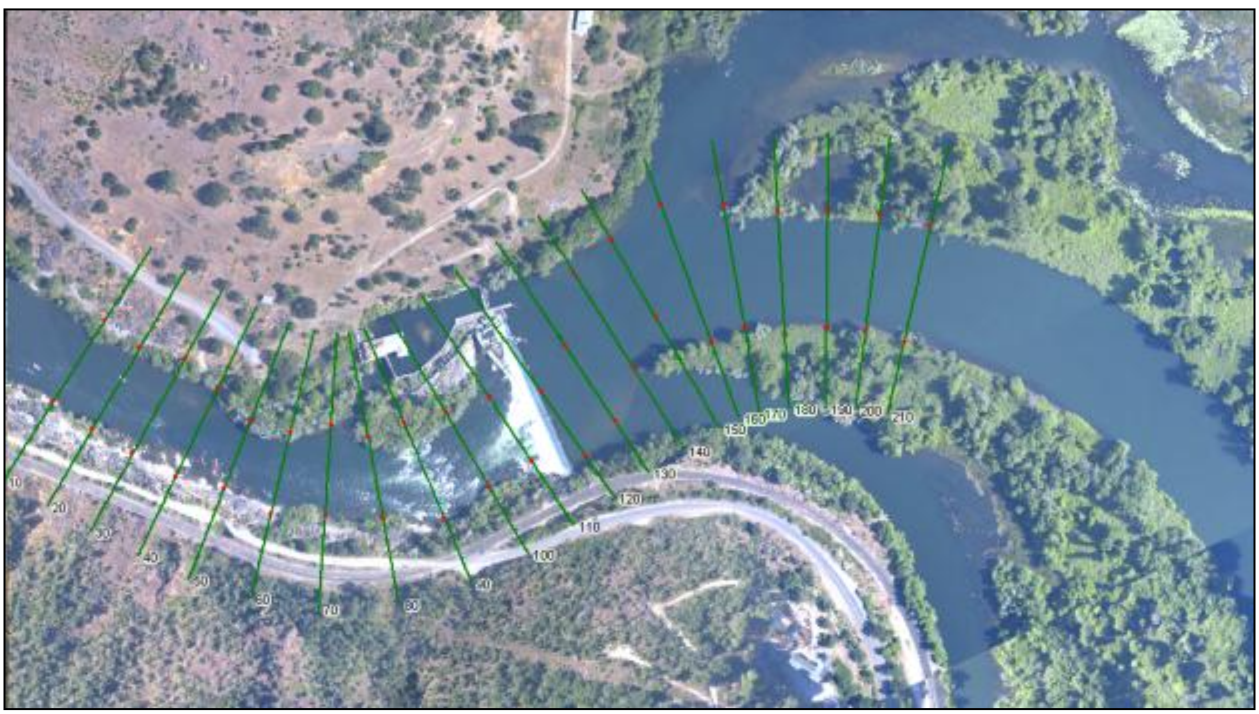

Figure 4-7. The hydraulic model schematic showing cross-section locations used for the fish passage design.

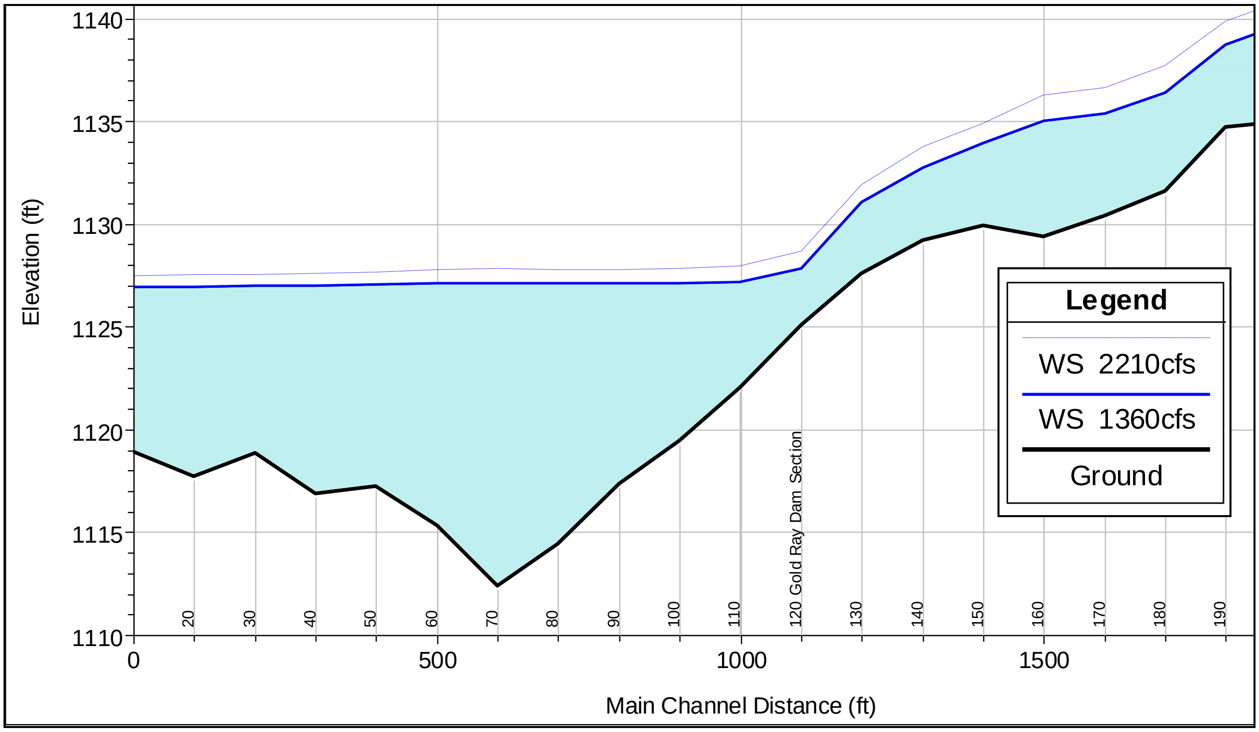

Figure 4-8. The longitudinal water surface profile for high fish passage and low fish passage flows going through removed portion of dam.

Once the southern portion of the dam is removed and the area is still isolated by the cofferdams, fine sediment and gravels will have to be excavated and removed to create a channel for the river. This channel will require approximately 5 to 10 ft of vertical excavation. The width of the channel will be approximately 60 to 80 ft at the bottom and have side slopes of 2:1 as shown in Figure 4-9. This figure shows a comparison of cross-sections from the existing elevations to the proposed channel dimensions for fish passage. Based on fish passage flows and the proposed channel geometry, it is expected that average flow velocities will be in the range of 2-6 fps with isolated areas up to 9 fps as shown on Figure 4-10.

In order to facilitate upstream fish passage, a series of bulk bags will be installed throughout the fish passage channel to provide flow variability, subcritical pocket pools, energy dissipation and holding spots for upstream fish passage. Bulk bags (see Figure 5-1) have been successfully used for other projects to provide stable points with water velocities exceeding 10 fps. In addition, the bulk bags have significant flexibility for adding and moving them around to create the best conditions possible for fish passage.

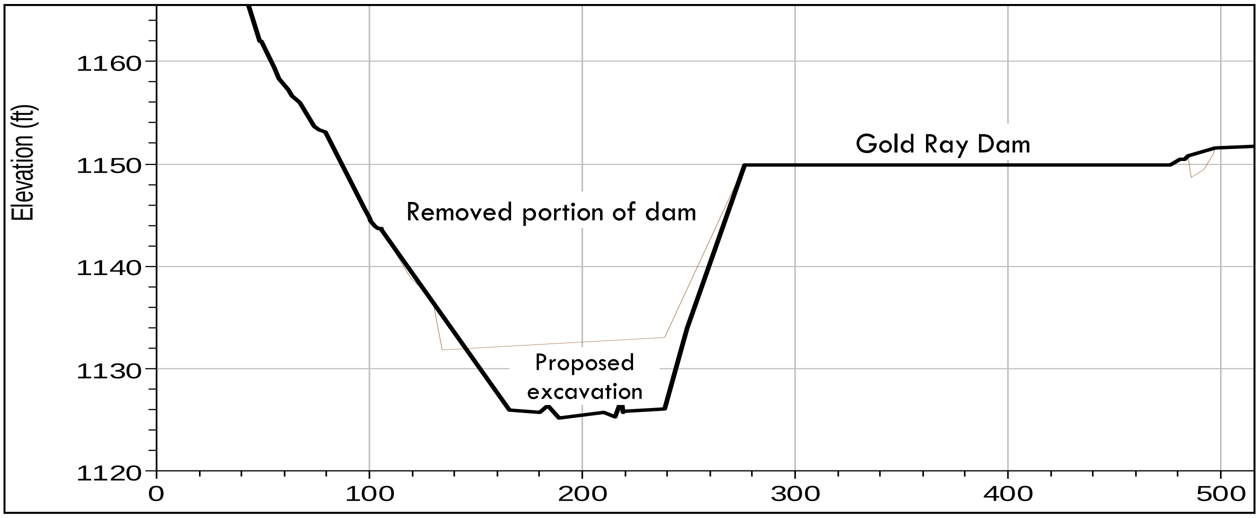

Figure 4-9. Cross-section comparison showing existing ground (- - -) and proposed opening at dam for fish passage.

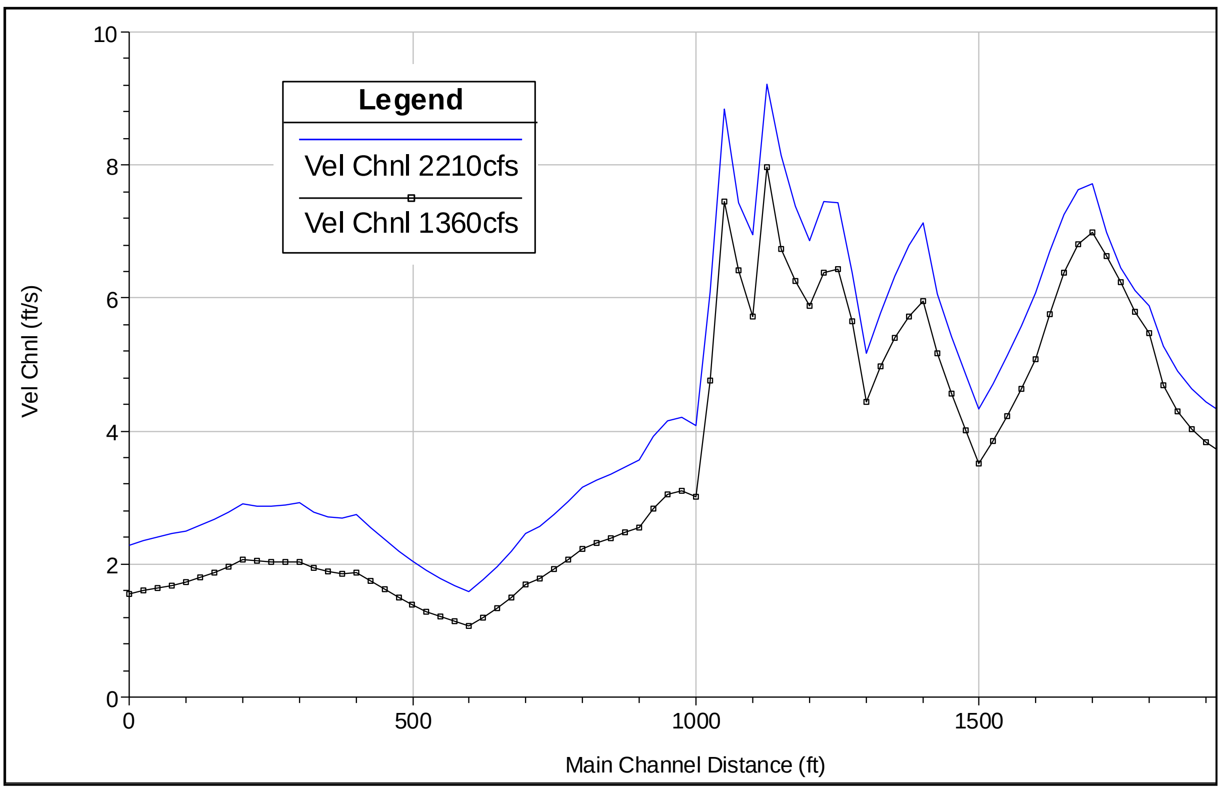

Figure 4-10. Velocity profiles at fish passage flows (1,360 cfs and 2,210 cfs) through the removed section of dam. The existing dam is located at main channel distance 1,000 ft.

4.7 Phase 2 Fish Passage Monitoring

The following monitoring activities will be implemented daily to ensure that fish passage is being maintained to the maximum extent possible throughout the duration of Phase 2. Additional monitoring actions may be required as the project progresses, but at a minimum the following shall be done daily:

- Record date and flow at USGS "Ray Gold" station.
- Measure velocities in the new channel to ensure they are suitable for fish passage.
- Adult fish observation by biologist wearing polarized glasses. Observe at the downstream entrance of the new channel and record observation time and look for adult fish in river below the dam, primarily for fish backed up due to passage difficulties. Estimate the number of adults that are observed and make notes about fish groupings and behavior.
- Observe and document conditions upstream of the dam. Look for problems such as sediment wedges that could impact fish passage. Document any fish observations upstream of the dam location.

Observations and potential fish passage delays/problems shall be reported to ODFW immediately. The project will be required to address any problems impacting fish passage that are caused by project activities. Email a report summarizing monitoring activities to the natural resource agencies on a daily basis. The report period may be relaxed pending results in the field and approval of ODFW and NMFS. Suggestions for improvements are encouraged, but changes to the procedure may be made only with the agreement of ODFW and NMFS. The project must repair any and all secondary barriers that may develop post-construction. Possible secondary barriers in the mainstem and tributaries may include channel headcutting, perching, and chronic stranding areas.

4.8 Dam Deconstruction Schedule

The following schedule is anticipated for deconstruction and site restoration at Gold Ray Dam.

- May 15 – June 15. Mobilize necessary construction equipment and prepare construction zones outside of ordinary high water. Begin importing materials and staging cofferdam materials and bulk bags.
- June 15 – August 6. Phase 1 dam removal of southern portion of Gold Ray Dam. Cofferdam construction to the middle of Gold Ray Dam begins July 1.
- August 9 – August 13. Transition water from over Gold Ray Dam and fish ladder to newly opened channel and removed portion of Gold Ray Dam. Temporary fish passage delays.
- August 16 – September 17. Phase 2 dam removal of northern portion of Gold Ray Dam, fish ladders, and powerhouse.
- September 17 – October 15. Implement bank stability measures and restoration plans for Tolo Slough, Kelly Slough, Bear Creek confluence and historical north channel.

4.9 Deconstruction Conservation Measures

The following measures will be taken during the course of dam deconstruction to ensure minimal impacts to the area in and around Gold Ray Dam.

- Minimize riparian and bank disturbance to the maximum extent possible. Construct temporary cofferdams to provide work platform in the river for dam removal and installation of intake screens and pumping facilities, to minimize disturbance of riparian areas, and to minimize bank erosion and potential turbidity associated with construction activities.

- Revegetate the streambank in the disturbed construction area immediately following construction. Use native perennials and grasses for revegetation. Mitigate areas of wetlands disturbance with native hydrophytic vegetation.

- Revegetate all other disturbed areas above the streambank such as the staging areas, embankments and temporary access roads with native perennials and grasses.

- Minimize alteration or disturbance of streambanks and existing riparian vegetation.

- Protect streambanks with stabilizing materials where bank work is necessary.

- In-water work will be completed during the ODFW in-water work period. The exception to this is extending the in-water work period into October that will allow for better timing of fish passage delays during the transition from fish ladder passage to fish passage in the river during August 9 – 13. Work outside the in-water work period will primarily be outside the active channel area.

5 FISH SALVAGE PLAN

This section provides the concepts for isolating work areas and defishing the isolated areas. The primary focus of the plan is to minimize the potential for fish harm or "take" by isolating the work areas to the maximum extent possible. In addition, the work schedule has been established based on opportune times to minimize the potential risk to aquatic resources as determined by ODFW and NMFS.

5.1 Work Area Isolation

One of the most important aspects of in-water work is isolation of the work area. Work area isolation creates a safer environment for construction activities and protects aquatic species and wildlife from the work area. By reducing or eliminating active stream flow in the work area, it also reduces the risk of sediment or sediment laden waters from entering active river flows.

5.1.1 Timing and River Flows

In-water work will only be performed during the ODFW in-stream work window between June 15th and August 31st. In addition, we are proposing an in-water work period extension until October 15th. This work window is the ideal time based on fish species life stages and presence in the area. This area of the Rogue River is primarily a migration corridor for coho salmon and suitable spawning areas are not located within 300 feet of the dam site.

Just downstream from the Gold Ray dam, the USGS maintains the Raygold river gaging station (USGS 1435900). Based on 30 years of historical Rogue River daily flow data, the anticipated river flows on June 15th are 2,710 cfs and 2,230 cfs on August 31st. Minimum river flows occur in September and October and typically approach 1,400 cfs. The in-water work period and the proposed extension provides a time period of lowest flows that are more manageable during cofferdam construction.

5.1.2 Isolation Plan

The Gold Ray Dam removal will be done in two phases as described in Section 4. Phase 1 includes the removal of the south side of the concrete dam structure that spans across the Rogue River. Phase 2 includes the removal of the north side of the concrete structure that keys into the north bank and was historically the water diversion area for generating power. Both phases will use similar techniques for work area isolation and fish salvage as described in Sections 4 and 5.

Initial isolation of the work area will be done using a combination of gravel cofferdams and bulk bags filled with native river sand and gravels. Bulk bags are made of geotextile fabric and are similar to standard sand bags but on a larger scale. The proposed bulk bags are 6 ft wide x 6 ft long x 5 ft high as illustrated in Figure 5-1 below. Smaller bulk bags will also be used that are 3 ft wide by 3 ft long x 2.5 ft high. This type of water isolation barrier has been successfully used for the Savage Rapids Dam and Gold Hill Dam removal projects just downstream on the Rogue River.


Figure 5-1. Example of bulk bags (left) and gravel cofferdam (right) used in combination for work area isolation on Savage Rapids dam and Gold Hill dam removal projects.

Bulk bags will be filled with native sand and gravels from the Rogue River taken out of the Savage Rapids dam project site (most bags are already filled and will be re-used). After the bags are filled, they will be transported to the Gold Ray Dam and placed by crane or track hoe into the river. Drawings 2.0 to 5.0 outline how the bulk bags will be placed in relationship to the existing dam. Since the bulk bags are placed on the upstream side of the dam, they will isolate moving water across the dam crest. The bulk bag placements will create an increase in water surface elevation on the side of the river that is not isolated but the water surface increase will be less than 2 ft in depth.

The bulk bags filled with native sand and gravels make an ideal work area isolation technique for several reasons. First, they are made of fabric that does not react with water and will not harm aquatic species. Second, if a bag were unintentionally cut on the bedrock or during handling, they are filled with native river sand and gravel that would not cause a noticeable disturbance in the river. Third, the bulk bags are flexible and can deform to match the irregular shape of the river bottom and thus keep out flowing water and fish. Fourth, since each bag is self-contained, the potential for large, catastrophic structure failure is negligible. The overall concept of work area isolation using gravel cofferdams in combination with bulk bags ensures the least amount of potential harm to the river environment during deconstruction of the concrete dam.

On the downstream side of the dam, the area will be isolated with a floating silt/turbidity curtain. These curtains are generally permeable barriers constructed of a flexible reinforced thermoplastic material or geotextile with a flotation material on the top and a ballast chain on the bottom. The curtains are designed to control the distribution of suspended sediment by creating a controlled containment area. When combined with low-flow conditions, turbidity curtains provide a highly effective way to reduce turbid water interaction with clean river water as illustrated in Figure 5-2.

Figure 5-2. Example of a silt curtain isolating an active work area from clean water flowing by the project site. Turbid water contained within the work area by the silt curtain.

5.1.3 Equipment and Conservation Measures

Removal of Gold Ray Dam can be accomplished with standard, heavy civil-works type equipment. Since the contractor has already been selected, we know exactly what equipment is available. Based on the contractor's experience, the following table is a list of anticipated machinery that will be on-site and necessary for the project:

Table 5-1. Equipment necessary for deconstruction of Gold Ray Dam.

Quantity	Equipment Description
1	Trackhoe, Komatsu PC-600 with bucket and thumb extension
2	Trackhoe, Komatsu 220 with hydraulic breaker
2	Volvo off-road dump truck, rubber tires, 15 cubic yard capacity
1	Caterpillar D6 bulldozer, track mounted
1	Hydraulic lifting crane, 120 ton, rubber tires
2	Dump truck, 10 cubic yard capacity
1	8" Diesel pump with screen for dewatering
1	6" Diesel pump with screen for dewatering

When completing in-water work it is necessary to have backup equipment and redundancy in procedures to compensate for unforeseen circumstances. Slayden Construction Group has established relationships with local contractors from previous work at the Savage Rapids Dam and Gold Hill Dam removal projects. These established relationships make it easy to procure additional personnel, equipment, and supplies for backup and redundancy. The local contractors also have direct experience with in-water work area isolation on the Rogue River under the typical river flows that are expected in the project area.

Since the project is a dam removal, minimal materials are necessary. The contractor will have adequate supplies of floating turbidity curtains, bulk bags for temporary cofferdams, silt fence for erosion control, and emergency clean up spill kits. The contractor will implement the same emergency spill containment plan approved for the Savage Rapids Dam removal project that includes notification procedures, cleanup and disposal instructions for different products, a description of quick response containment, supply of sediment control materials, methods for disposal of spilled materials, and employee training for spill containment. No hazardous materials will be used or contained on the project site. In addition, the following conservation measures will be upheld for construction equipment:

- Staging, cleaning, maintenance, refueling and fuel storage will take place in a vehicle staging area placed 150 ft or more from any stream, water body or wetland.
- All heavy equipment operation within 150 ft of any stream water body or wetland will be inspected daily for fluid leaks before leaving the vehicle staging area.
- Any leaks detected will be repaired in the vehicle staging area before the vehicle resumes operation. Inspections will be documented in a record that is available for review on request by the Corps or NMFS.
- All equipment operated instream will be cleaned before beginning operations below the bankfull elevation to remove all external oil, grease, dirt and mud.

5.1.4 Dewatering and Re-watering Sequence

The project work area will be isolated in two phases using temporary cofferdams composed of rock cofferdams in combination with bulk bags filled with native river sand and gravel. The temporary cofferdams will create isolated areas with no flow in order to minimize the risk of contamination from construction-related materials, silt laden waters, and physical harm of aquatic life.

Phase 1 consists of installing cofferdams around the southern portion of the concrete dam. Once the cofferdams are installed and the fish are removed according to the Fish Salvage Plan, a floating silt curtain will be installed downstream of the dam to isolate the area from moving water and aquatic resources. This area will not need to be dewatered because the dam removal can occur in standing water. Silt and turbid water from construction activity will be contained within the cofferdam and floating silt curtain. After removal of the concrete dam, construction activity will be ceased for at least 12 hours on the south side to allow for silt and sediment to settle out of the water column in the isolated area. After this time the floating silt curtain will be removed and active water will be re-introduced to the site. The cofferdams will then be removed at a controlled rate to ensure that minimal disturbance to the area occurs. Introduction of active water will be monitored and stopped for 1-hour intervals if necessary to reduce turbidity in the water.

Phase 2 consists of isolating the north side of the concrete dam. Since the southern portion of the dam will be removed, no water should be flowing over the north side of the dam and most of the work should be able to take place in relatively dry conditions. The northern portion or the dam will be isolated by leaving in a portion of the southern cofferdam near the middle of the river and then isolating the downstream portion of the dam with a floating silt curtain. After the area is isolated the Fish Salvage Plan will be enacted to remove all fish and aquatic organisms. After removal of fish, the site will have a minimal amount of standing water and will not require pumping.

After removal of the northern portion of the dam, construction activity will cease in the area for 12 hours to allow fine sediment and silt to settle out of the water column if it is present. The temporary cofferdams and bulk bags will be removed in a controlled manner to allow water to be reintroduced into the northern side of the river channel; however, it is anticipated that no running water will be introduced to the area due to low flows. If the water becomes turbid, cofferdam removal will stop and allow for an equilibrium state to develop where no silt or turbidity is being developed. This procedure will continue until the cofferdam and bulk bags are removed and the river is free flowing in the historical flow pattern.

5.2 Fish Salvage

Isolation of the work area, fish removal, and release of fish will be conducted or directed by a fisheries biologist who possesses the competence to ensure safe handling of all Endangered Species Act (ESA) listed fish and other aquatic organisms, and who is also experienced with work area isolation techniques. The fish salvage plan is put together on a multi-level effort that uses a combination of isolation and strategic handling of fish to minimize risks to aquatic resources. The fish salvage plan uses handheld dip nets, seine nets, and backpack electrofishing units in isolated pool areas as described below.

5.2.1 Species

Section 3.4 of this report describes the likely fish species at the Gold Ray Dam project site. All fish and aquatic species will be removed from isolated work areas. From a fish salvage standpoint, the primary focus will be on native salmonids and special status species as identified by the ESA listing.

One important component of the fish salvage plan is to anticipate the potential areas and abundance of native salmonids. In order to aid in this understanding, a review of the 2004 airborne thermal infrared (TIR) report by Watershed Sciences was undertaken to gain insight into the stream temperature regime. Figure 5-3 shows the area around Gold Ray Dam and illustrates that water temperatures in Kelly Slough (19.8°C) and Tolo Slough (20.4°C) are substantially higher than the mainstem Rogue River (16.7°C).

Optimum conditions for coho salmon juvenile rearing and growth includes water depths between 0.3 - 1.2 meters, water velocities between 0.09 - 0.30 m/sec, abundant riparian vegetation, highly oxygenated water, and water temperatures averaging 11.8-14.6°C during the summer (Laufle et al, 1986). Literature suggests that preferred water temperature for rearing juvenile Chinook salmon ranges from 12-18°C (Raleigh 1986). As a result of the elevated temperatures in comparison with the mainstem Rogue River, it is likely that the abundance of native salmonids in Kelly Slough and Tolo Slough will be relatively low during the construction time period.

Anticipated species found in the slough areas during construction include warm water fishes such as largemouth bass, brown bullhead, bluegill, and a variety of cyprinids.

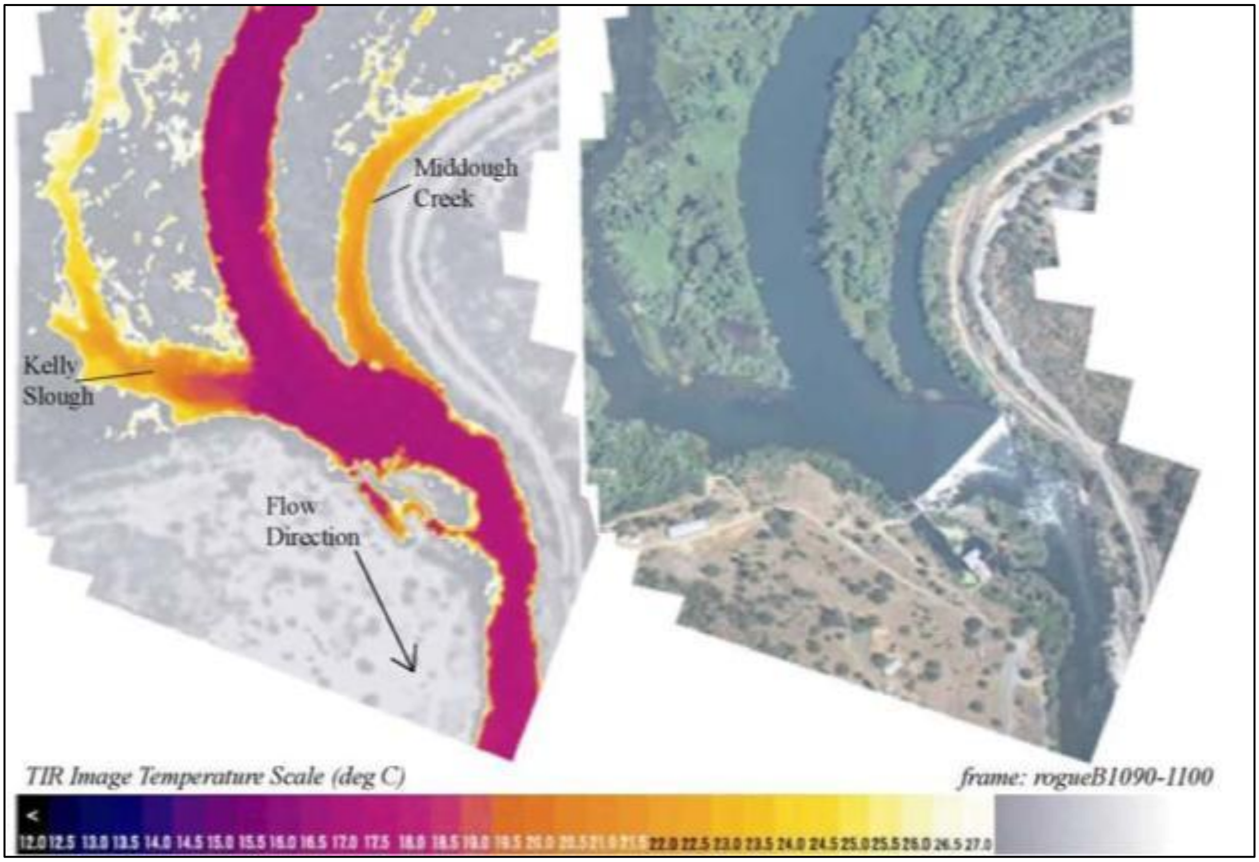

Figure 5-3. TIR/color ramp image pair showing the confluence of Middough Creek (Tolo Slough, 20.4°C), Kelly Slough (19.8°C) and Rogue River (16.7°C). The study was performed on July 31, 2003.

It is also possible that large numbers of Pacific lamprey ammocoetes are present in the impounded area. Ammocoetes reside in fine sediments and organic material. Traditional electrofishing can force ammocoetes deeper into the sediment. As areas dewater, lamprey will emerge from the sediments. Therefore, the project must be careful to investigate dewatered areas for emerging lampreys. The fish salvage crew should also be prepared to salvage adult lampreys from cracks and crevices in and around the dam. In addition to lamprey, there is also the likelihood for the following organisms: turtles (check for marks, measure carapace length, and release on-site), crayfish, and freshwater mussels

The following steps will be taken to ensure all fish and aquatic wildlife are properly handled and removed from the isolated work areas and reservoir drawdown areas.

5.2.2 Initial Isolation

The quickest and safest way to minimize potential harm to fish and aquatic resources is effective isolation of the work areas. Clean gravel cofferdams and bulk bags filled with native river sediments will be installed as described in the deconstruction plan found in Section 4.

Phase 1 entails isolation of the left portion of the dam and Tolo Slough (Figure 5-4). This will help reduce the area to be defished to a more manageable size while isolating the work area from active flow. Velocities in this area are less than 1 fps and ideal for seine nets. Phase 2 will primarily focus on river-right where most areas will dewater as a result of routing the river through the removed portion of the dam.

Figure 5-4. The project area showing Tolo Slough and Kelly Slough in relation to the Rogue River and Gold Ray Dam.

5.2.3 Fish Removal in Isolated Areas and Mainstem

In cofferdam work areas and other isolated areas, the first step will be to reduce the volume of water to the fullest extent possible to help consolidate fish and improve salvage efforts. By reducing the water volumes, it will be easier to improve capture and salvage success using seine nets and electrofishing equipment, if necessary. Reducing water volume will be done using diesel powered pumps with a pumping capacity of 1,000 to 3,000 gallons per minute (gpm). To reduce fish exposure, pump intakes will be set near the water surface and fitted with approved wire fish screens that prevent impingement or entrainment of fish.

Water will be drawn down in a controlled manner with fish salvage crews continuously monitoring the pumps, newly exposed areas, and fish numbers for crowding. If isolated pockets or pools are uncovered, they will be defished with dip nets and electrofishing equipment will be used if necessary. Pumping will be reduced once manageable water levels are obtained that can easily be waded and de-fished.

After waters are reduced to a manageable level, seine nets (made from 9.5 mm stretched nylon mesh) will be used in order to remove fish from the isolated in-water work site. An on-site biologist will determine the pass methods and the number of times each area will be seined. Once the seining becomes ineffective, areas conducive to electrofishing may be electrofished by the on-site biologist. If electrofishing is necessary to adequately de-fish the area the following requirements will be in place:

Electrofishing will only be conducted when a biologist with 100 hours of electrofishing experience is on-site to conduct or direct all activities associated with capture attempts. The directing biologist will be familiar with the principles of electrofishing including the interrelated effects of voltage, pulse width and pulse rate on fish species and associated risk of injury/mortality. The directing biologist will have knowledge regarding galvanotaxis, narcosis and tetany, their respective relationships to injury/mortality rates, and have the ability to recognize these responses when exhibited by fish.

The following table will be used as guidelines for electrofishing in water likely to support ESA-listed juvenile fish. Visual observation of the size classes of fish in the work area is helpful to avoid injury to larger fish by the mistaken assumption that they are not present.

	Initial Setting	Conductivity (µS/cm)	Maximum Settings
Voltage	100 V	less than 100	1100 V
		100-300	800 V
		greater than 300	400 V
Pulse Width	500 µs		5 ms
Pulse Rate	15 Hz		60 Hz

The on-site biologist will consult with ODFW to ensure electrofishing during the in-water work window is appropriate in this location of the Rogue River during the construction time period.

Each session will begin with low settings for pulse width and pulse rate. If fish present in the area being electrofished do not exhibit an appropriate response the settings will be gradually increased until the appropriate response is achieved (galvanotaxis). Minimum effective voltage settings are dependent upon water conductivity and will need to increase as conductivity decreases. Higher voltages elevate the risk of serious injury to fish removal personnel. The lowest effective setting will be used to minimize personnel safety concerns and help minimize fish injury/mortality rates.

The operator will not allow fish to come into contact with the anode and will keep fish approximately 0.5m away from the anode. Extra care will be taken near in-water structures, undercut banks or pool areas where fish densities may be high.

Electrofishing will be performed in a manner that minimizes harm to fish. Once an appropriate fish response (galvanotaxis) is noted, the stream segment will be worked systematically, moving the anode continuously in a herringbone pattern through the water. The number of passes will be kept to a minimum and an area will not be electrofished for an extended period of time. Adequate staff to net, recover and release fish in a prompt manner will be present. Fish will be removed from the electrical field immediately and recovered when necessary. Fish will not be held in net while continuing to capture additional fish.

Personnel will observe and document the condition of the captured fish, noting dark bands on the body and extended recovery time. If these signs are noted, the settings for the electrofishing unit will be adjusted. Specimens will be released immediately upstream of the block nets in an area that provides refuge. Each fish will be completely recovered prior to release (see Fish Release section).

Electrofishing will not occur when turbidity reduces visibility to less than 0.5 meters and will not occur when water temperature is above 18°C or below 4°C.

Water surface elevation will be lowered in the mainstem Rogue River during the transition from Phase 1 to Phase 2 of dam removal. During this controlled drawdown period, at least two crews will be monitoring the upstream reservoir area and Kelly Slough using boats for access. The on-site biologist will determine the best methods for fish salvage that will include dip nets, seine nets, and electroshocking if necessary. It is anticipated that relatively small (less than 200 sq. ft.), isolated pools could be exposed as the drawdown progresses. If a significant pool area that creates the potential for large numbers of trapped fish is exposed, the drawdown can be stopped to deal with the situation and even reversed if necessary.

5.2.4 Fish Release

For the period between capture and release, all captured aquatic life will be immediately put into dark colored five gallon buckets filled with clean river water. Fish will be transferred in the buckets to net pens located upstream from the work area in clean, low velocity flowing water. Fish removal personnel will provide: a healthy environment for the stressed fish; minimum holding periods; and low fish densities in net pens to avoid effects of overcrowding. Large fish will be kept separate from smaller prey-sized fish to avoid predation during containment. Non-native gamefish shall be relocated to a suitable location by ODFW personnel. Upon coordination with the salvage activities, ODFW will transport the non-native species from the site access road to the depository location.

Frequent monitoring of water temperature and well-being of the specimens will be done to assure that all specimens will be released unharmed. Captured aquatic life will be released immediately upstream of the isolated stream reach in a pool or area that provides cover and flow refuge. Each fish will be completely recovered prior to release. One person will be designated to transport specimens in a timely manner to the site selected for upstream release. All work area isolation, fish removal and fish release activity will be thoroughly documented. Specifically, any injuries or mortalities to ESA-listed or proposed species will be provided to NOAA Fisheries.

5.3 Erosion and Pollution Control Plan

An erosion and sediment control plan has been prepared for the site and is contained in the construction drawing set. The plans provide details for minimizing the potential for erosion and sediment-laden waters from leaving the site or entering the active river flow. These plans are being submitted to Oregon Department of Environmental Quality for the NPDES 1200-C permit for construction activities greater than 1-acre in size. The Rogue River in this area is water quality limited due to temperature but no Total Maximum Daily Load (TMDL) has been established.

Work in and around the site will be done during the summer months of June through October and no activity is scheduled during wet weather conditions. To reduce the potential for contamination of water bodies, only the specific supplies and equipment needed to complete the project will be stored on-site. Work area isolation techniques are being used to collect and treat all construction discharge water, using the best available technology applicable to site conditions, to remove construction debris, sediment, and other pollutants potentially present in the project area.

5.3.1 Vehicle Staging and Maintenance

No on-site storage of fuel, regulated or hazardous products is planned for the project. Vehicle staging, cleaning, maintenance, and refueling will be in a vehicle staging area placed 150 feet or more from the Rogue River as designated on the plans. All vehicles operated within 150 feet of water will be inspected daily for fluid leaks before leaving the vehicle staging area. Leaks will be repaired before the vehicle resumes operation. Documented inspection records will be made and kept for viewing upon request. Before operations begin and as often as necessary during operation, all equipment will be steam cleaned until all visible external oil, grease, mud, and other visible contaminates are removed. All cleaning will be performed in the vehicle staging area. All stationary power equipment (e.g., generators, cranes, stationary drilling equipment) operated within 150 feet of any stream, water body or wetland will be "diapered" to prevent leaks, unless suitable containment is provided to prevent potential spills from entering any stream or water body.

Vehicle maintenance will not be conducted at the site, with the possible exception of unplanned breakdowns requiring repairs in-place or in the parking/staging area. Slayden Construction Group maintains a written spill control plan, and employees are trained to install immediate containment in case of a spill and notify the on-site supervisor. The supervisor will determine if the spill can be addressed in-house with emergency spill kits or if a spill response contractor is required. Slayden Construction Group has an established arrangement with the following three spill response contractors: Northwest Firefighters, Stayton Environmental Inc., and First Strike Environmental.

5.3.2 Contact Person and Inspections

Jackson County will provide daily on-site inspections of all construction activities to ensure erosion and pollution control plans are fully implemented. The assigned people from Jackson County are Mike Kuntz (541-774-6228), Russ Logue (541-774-6255), Dave Scroggins (541-774-6379) and John Vial (541-774-6238). In addition, River Design Group will provide regular inspections of the site to ensure the erosion and pollution control plans are fully implemented. The contact person is Scott Wright (541-738-2920). If monitoring or inspection shows that the erosion controls are ineffective, work crews will be mobilized immediately to repair, replace, or reinforce controls as necessary. The contractor's representative for maintaining the site is Rick Blankenship (Slayden Construction Group) and can be contacted at 503-871-4042. He has received formal training in erosion and sediment control measures. Both individuals are experienced in implementation of erosion and sediment control measures and have in-water work experience on dam removals.

Additional measures will be provided, as necessary and appropriate, including submittal of an Action Plan if required, to minimize runoff of surface water from the site that contains excessive amount of sediment. The appropriateness of current measures will be assessed continuously by Mike Kuntz (Jackson County) or his representative, Scott Wright (River Design Group), and Rick Blankenship (Slayden Construction Group).

6 FISH PASSAGE AFTER DAM REMOVAL

Once the dam is removed and the river is allowed to flow in an unimpeded condition, short-term and long-term changes to the channel boundaries and longitudinal profile are expected. This section provides an overview of expected conditions based on hydraulic modeling, sediment transport modeling, and analysis of historical documents for the reservoir area.

6.1 Gold Ray Dam Location

Several historical photos of the dam location prior to construction of the dam are available to help understand conditions prior to dam construction. Figure 6-1 shows the project site before the log crib dam and Gold Ray Dam were built. The picture clearly identifies areas of bedrock grade control and significant amounts of mobile sand and gravels. These conditions are similar to what is expected at the site after the dam is removed. Pre-dam bathymetry was also obtained from historical drawings and helps provide even more insight into conditions before the dam was built. These historical documents help provide evidence into expected conditions once the dam is removed. Based on the historical documentation and likely conditions after removal, there appears to be no fish passage barriers at the existing dam location once the project is completed.

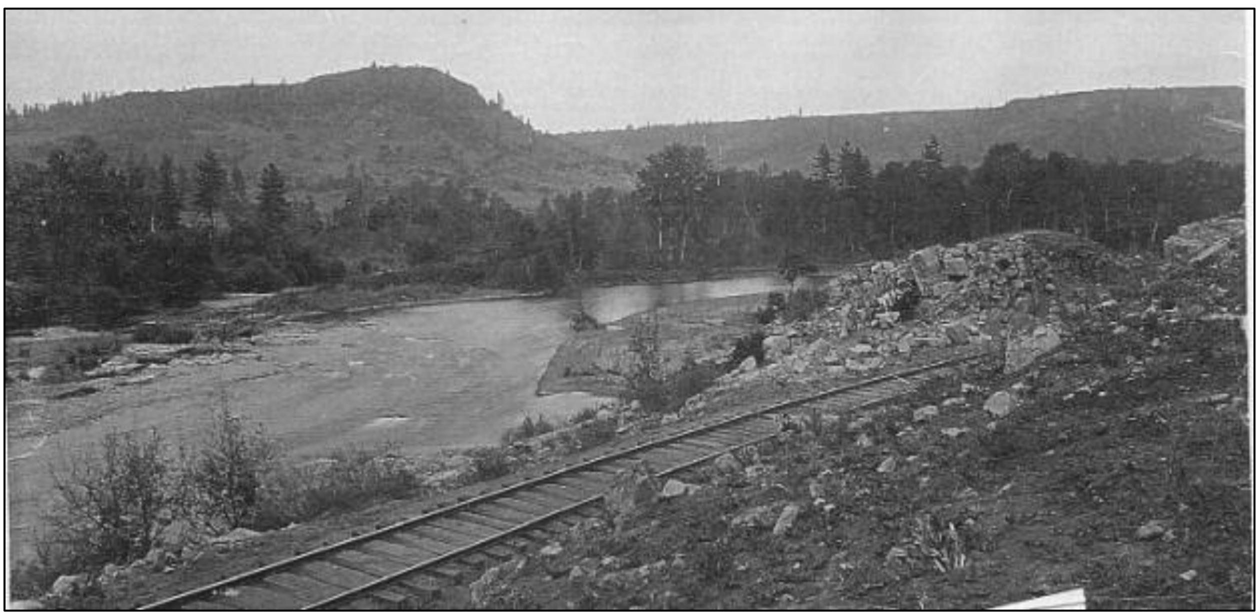

Figure 6-1. Picture of Gold Ray Dam area prior to construction of any dams showing bedrock, gravel bars and vegetation communities. Picture highlights anticipated river morphology post-removal.

The existing bathymetry approximately 200 feet upstream of the dam shows deep scour pools at the confluence with Kelly Slough and an apparent lack of stored sediment behind the dam. It is anticipated that this condition will be maintained after dam removal and the outside bend area will continue to transport sediment past the current dam location. Based on the historical documentation and likely conditions after removal, there appears to be no fish passage barriers at the existing dam location once the project is completed due to sediment accumulation and/or bedrock locations.

A historical channel analysis was completed for the reservoir area to compare changes in channel pattern over time as shown in Figure 6-2.

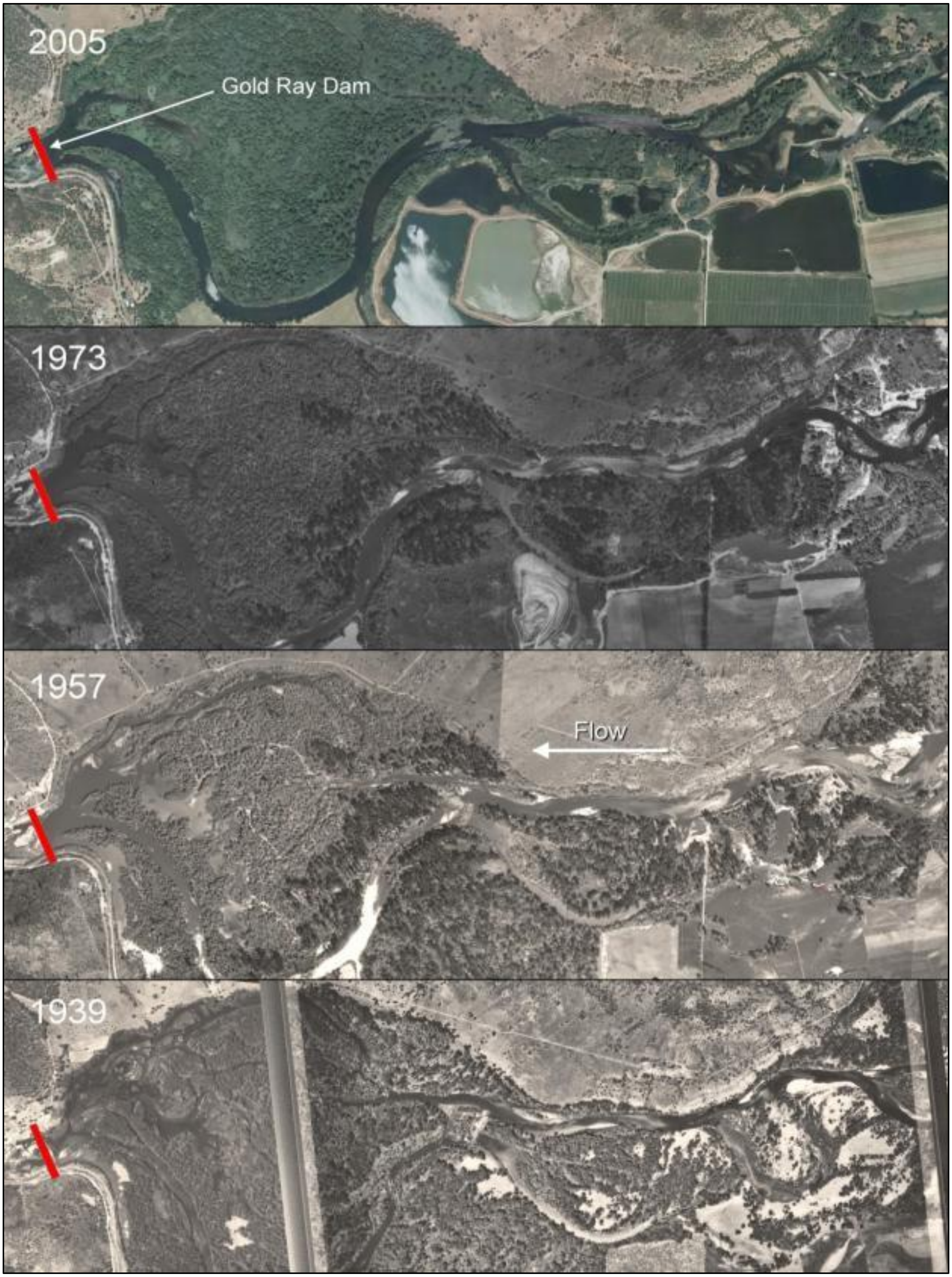

Figure 6-2. Historical aerial photos showing channel changes for reservoir area of Gold Ray Dam.

Historical channel changes over time show a multi-thread, distributed channel network that changed into a single-thread dominated channel. As a result of this transformation to a prevailing single-thread channel, the river has maintained a large cross-sectional area and increased stream power. This transformation has minimized the amount of sediment accumulation directly in the channel behind the existing dam. Therefore, mainstem Rogue River fish passage conditions in the drained reservoir area may actually be better than historical conditions that created a distributed channel network with shallow water depths during summer months and peak migration of fall Chinook salmon.

6.2 Tolo Slough Confluence

Tolo Slough sits on the southern side of the Rogue River and drains into the Rogue River at the existing Gold Ray Dam location. The slough appears to have been historically fed by Middough Creek and was possibly part of the multi-channel network that once occupied the area. The slough also receives overland water from the floodplain as a result of high stages on the Rogue River. Historical topographic surveys show that Tolo Slough was likely connected with Bear Creek during high flow events. Comparisons of historical maps of the area with current aerial photos show that the upper end of Tolo Slough has been filled in and vegetated, thus, reducing the overall length of the slough and reducing the direct connectivity with Middough Creek. Development of home sites has also had an impact on the overall connectivity of Tolo Slough with surface water sources.

Once the dam is removed and the Rogue River reaches a long-term, stable streambed slope, Tolo Slough will operate as a backwater area that is backwatered only during yearly high flows for short durations, typically less than a week. Surface water from the Rogue River will convey across the upstream floodplain and into Tolo Slough at peak flows greater than the 10-year event. Therefore, provisions have been made in the restoration plan to provide connectivity at the confluence of Tolo Slough with the Rogue River to ensure stability and that there is no fish stranding in the slough. Upstream fish passage into Tolo Slough will only be during high flow events with provisions for the fish to return to the mainstem Rogue River.

6.3 Kelly Slough Confluence

Kelly Slough was historically the mainstem Rogue River prior to construction of the dam in 1904. General Land Office (GLO) maps from 1855 show the present location of Kelly Slough as the main thread of a multi-thread river network in the reservoir area. Over time and as a result of the dam, it appears that fine sediment has filled in the Kelly Slough area and the elevated surface has been colonized with vegetation and become stable. Water still flows down Kelly Slough as a result of overland and floodplain flows from the Rogue River during elevated flows on the mainstem. After removal of the dam, it is predicted that this connection with the mainstem will be less frequent due to the downward incision of the Rogue River that decreases water surface elevations.

In order to effectively deal with overland floodplain flows into Kelly Slough from the mainstem Rogue River, a stabilization plan has been developed for the confluence area. The plan utilizes a bank stabilization strategy that uses large rock, wood, and vegetation to stabilize the area as water re-enters the Rogue River. This approach will ensure short-term stability and preserve options for future restoration of Kelly Slough at a later date.

6.4 Bear Creek Confluence

Historical field surveys of the reservoir area, done in 1929, show the confluence of Bear Creek with the Rogue River. Based on these historical surveys, the confluence location has not changed over time; however, the mainstem Rogue River has transitioned during this time period. Historical surveys show the mainstem Rogue River as a multi-channel river network with several small channels instead of the single-thread system currently in place. The current single-thread alignment occupies a channel location that maintains the historical confluence location for Bear Creek.

Water surface elevations were surveyed in 1929 over a distance of 4,000 ft from the confluence upstream after the log crib dam had been installed at Gold Ray Dam. Based on this hydraulic gradient survey, the approximate water surface slope of Bear Creek was 0.0026 ft/ft. This appears to be consistent with historical photos of Bear Creek showing a pool and riffle morphology stream with gravel bars and vegetation (Figure 6-3).

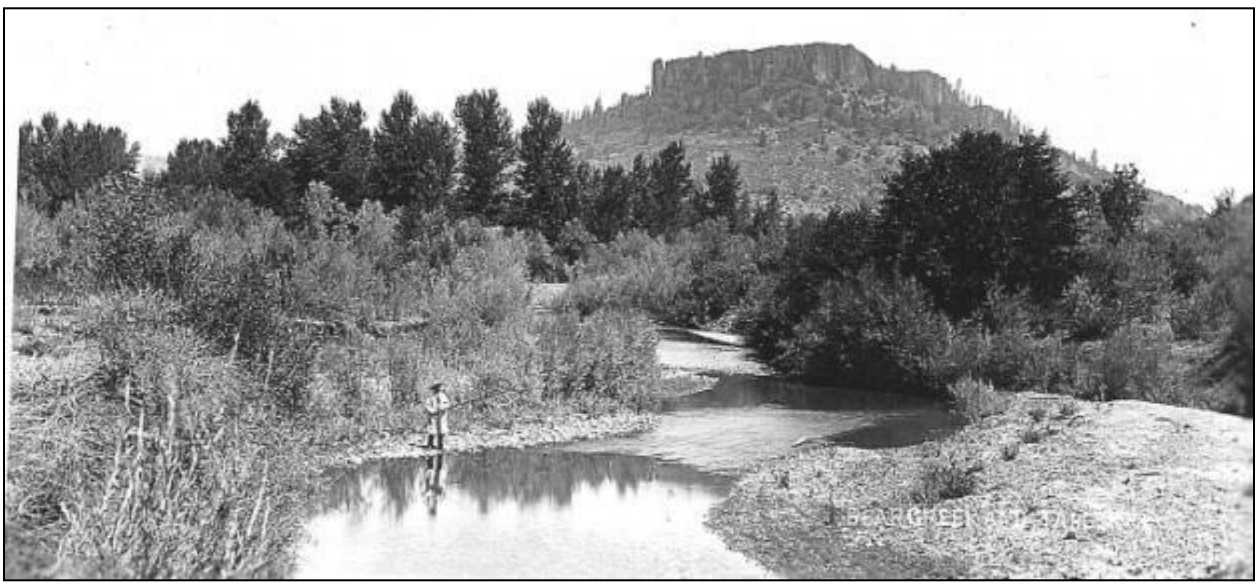

Figure 6-3. Historical photo of Bear Creek near the confluence with the Rogue River and Table Rock in the background (circa ~1885).

Water surface elevation of the mainstem Rogue River was likely 10 feet lower at the confluence than it currently exists. The existing higher water level created a backwater condition in Bear Creek and likely influenced sediment deposition in the lower 4,000 ft of the stream. After Gold Ray Dam is removed, hydraulic and sediment modeling shows a streambed and water surface drop at the confluence area. The mainstem Rogue River is anticipated to lower approximately 2 – 4 feet based on modeling results. This will create a potential fish passage problem during low flow conditions due to the loose streambed sediment and steep gradient at the confluence area. In order to ensure fish passage during all flows, the confluence area will require restoration and stabilization for long-term fish passage.

Due to the timing of the dam removal and anticipated changes to the Rogue River after the first winter, a two phased approach is necessary to ensure year-round fish passage at the confluence area. Phase 1 will be implemented immediately after removal of the Gold Ray Dam and consists of creating a clear and defined connection to the existing streambed elevation of the mainstem

Rogue River. This connection will be created by shaping the existing gravels and installing engineered riffles (i.e. grade control) and large wood in a stable pattern that ensures fish passage. These materials will be designed to withstand 25-yr peak flow events. Phase 2 will take place the following year after winter flows have scoured the Rogue River at the confluence area. The anticipated bed lowering is on the order of 2–4 ft. The confluence area will be reconstructed to provide a clear connection down to the lower mainstem elevation. This restoration effort will be constructed using a combination of engineered riffles and large wood to provide adequate complexity and stability in the confluence area. On-going monitoring of the dam removal site will ensure continued observations of fish passage and notification if fish passage is not being provided. Drawings in Appendix A outline the multi-phased restoration strategy for the confluence area that will restore a stable connection with the mainstem Rogue River.

6.5 Long-Term Monitoring and Maintenance

The major goal of the Gold Ray Dam removal is to facilitate fish passage and develop a natural river corridor that sustains quasi-natural ecosystem functions and river processes. A comprehensive monitoring team and proposal is being developed for the Gold Ray Dam removal project spearheaded by the Rogue Valley Council of Governments (RVCOG). This endeavor is a collaborative effort between private, state and federal entities to develop a robust monitoring plan. Funding from NMFS has already been established for monitoring the site for four years and to evaluate the cumulative effects of removing three major fish passage barriers from the Rogue River (i.e. Savage Rapids Dam, Gold Hill Dam, and Gold Ray Dam).

It is expected that ODFW's ongoing salmonid monitoring programs will yield data concerning how the projects affect Rogue River salmonid numbers (spring and fall Chinook salmon, spring and fall steelhead, cutthroat trout, southern Oregon-northern California coastal coho salmon). Likewise, ODEQ and RVCOG monitoring is expected to produce temperature, turbidity, dissolved oxygen, and nutrient data. Southern Oregon University (SOU) proposes to monitor channel morphology and hydrological changes in the channel and vegetation complex above Gold Ray Dam. In addition, Robert Hughes (Oregon State University) is proposing an assessment of physical and biological effects of dam removal.

As a result of the proposed monitoring, there will be adequate observations of the area for at least five years to ensure fish passage is sustained as anticipated. If inadequacies are identified during monitoring, Jackson County will be notified and a plan will be developed to address the deficiencies. It is anticipated that the area will return to quasi-natural conditions and fish passage will be similar to or better than historical conditions.

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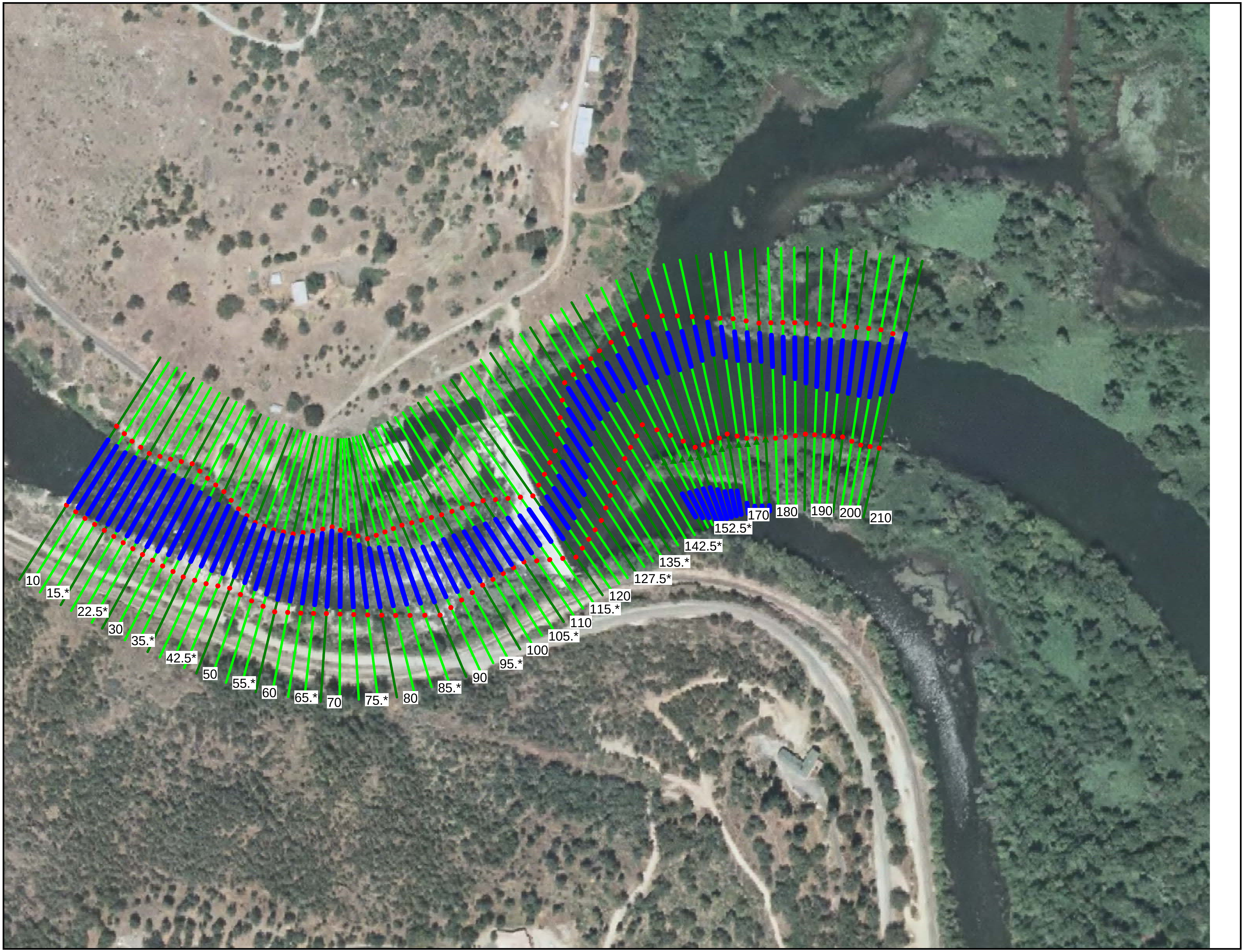
APPENDIX A

DRAWINGS

APPENDIX B

HYDRAULIC MODELING



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HEC-RAS Modeling Results for Fish Passage during Phase 2 Deconstruction

River Sta	Profile	Min Ch El (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Shear Chan (lb/sq ft)	Flow Area (sq ft)	Top Width (ft)
210	1360cfs	1135.25	1140.31	3.40	0.80	400.28	124.70
200	1360cfs	1135.02	1139.78	3.84	1.05	354.52	119.98
190	1360cfs	1134.73	1138.68	5.46	2.26	248.86	101.89
180	1360cfs	1131.60	1136.65	6.98	3.45	194.75	76.60
170	1360cfs	1130.40	1135.54	5.09	1.71	267.42	124.95
160	1360cfs	1129.38	1135.18	3.52	0.79	386.84	173.59
150	1360cfs	1129.90	1134.08	5.95	2.49	228.59	135.36
140	1360cfs	1129.22	1133.10	4.43	1.42	306.71	108.40
130	1360cfs	1127.59	1131.17	5.88	2.57	231.48	89.01
120	1360cfs	1125.08	1128.68	5.73	2.41	237.39	86.12
110	1360cfs	1122.00	1127.25	3.01	0.57	452.57	108.67
100	1360cfs	1119.44	1127.13	2.55	0.15	532.37	119.06
90	1360cfs	1117.37	1127.10	2.23	0.11	609.05	127.96
80	1360cfs	1114.42	1127.10	1.70	0.06	800.85	136.15
70	1360cfs	1112.41	1127.11	1.08	0.02	1264.28	172.28
60	1360cfs	1115.32	1127.09	1.39	0.04	979.28	144.49
50	1360cfs	1117.21	1127.05	1.88	0.07	723.55	124.18
40	1360cfs	1116.88	1127.01	2.04	0.09	666.66	144.13
30	1360cfs	1118.85	1126.97	2.07	0.10	658.55	173.21
20	1360cfs	1117.71	1126.95	1.72	0.06	790.12	163.83
10	1360cfs	1118.93	1126.94	1.56	0.05	872.89	165.36
210	2210cfs	1135.25	1141.45	4.00	1.04	552.50	141.72
200	2210cfs	1135.02	1140.89	4.43	1.31	498.53	138.90
190	2210cfs	1134.73	1139.83	5.88	2.41	375.86	119.86
180	2210cfs	1131.60	1137.93	7.72	3.99	286.23	93.36
170	2210cfs	1130.40	1136.81	6.07	2.29	363.84	138.86
160	2210cfs	1129.38	1136.44	4.33	1.12	510.61	183.46
150	2210cfs	1129.90	1135.11	7.14	3.37	309.63	154.82
140	2210cfs	1129.22	1134.16	5.17	1.79	427.74	120.92
130	2210cfs	1127.59	1132.15	6.86	3.21	322.28	95.23
120	2210cfs	1125.08	1129.59	6.95	3.27	317.86	90.47
110	2210cfs	1122.00	1128.04	4.08	1.02	541.22	114.97
100	2210cfs	1119.44	1127.84	3.56	0.27	619.98	125.38
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80	2210cfs	1114.42	1127.79	2.46	0.12	898.24	144.42
70	2210cfs	1112.41	1127.81	1.59	0.05	1389.29	182.90
60	2210cfs	1115.32	1127.77	2.05	0.08	1079.77	150.14
50	2210cfs	1117.21	1127.68	2.75	0.15	804.60	129.72
40	2210cfs	1116.88	1127.62	2.91	0.18	758.17	156.52
30	2210cfs	1118.85	1127.55	2.90	0.19	762.49	186.04
20	2210cfs	1117.71	1127.52	2.50	0.13	884.12	170.47
10	2210cfs	1118.93	1127.49	2.29	0.11	965.01	169.61