Yakima River Basin Study

Fish Passage at Cle Elum Dam
Technical Memorandum

U.S. Bureau of Reclamation
Contract No. 08CA10677A ID/IQ, Task 4.1

Prepared by

Reclamation

HDR Engineering, Inc.

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office

State of Washington
Department of Ecology
Office of Columbia River

March 2011

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The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The Mission of the Washington State Department of Ecology is to protect, preserve and enhance Washington's environment, and promote the wise management of our air, land and water for the benefit of current and future generations.

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1.0 Introduction

This technical memorandum summarizes proposed fish passage facilities at the Cle Elum Dam, a Bureau of Reclamation (Reclamation) water storage dam in the Yakima River Basin, southwest Washington. Key elements for the storage facility are listed below (Reclamation 2008, 2009).

Table 1. Proposed Elements of Fish Passage Facility

Downstream Passage – 5 Chamber Multi-Level Gate Intake Structure	Bypass Q = 100 to 400 cubic feet per second (cfs) over 50-foot pool w/s range
Downstream Fish Conduit	950-foot-long, 7-foot-diameter (21-inch wall thickness)
Upstream Passage/Adult Collection at base of Spillway	6 cfs minimum fish ladder with auxiliary 180 cfs flow as attraction flows to fish ladder
Auxiliary System-(Fish Ladder/Attraction Flows)	180 cfs

This memorandum assimilates three fish passage documents prepared by Reclamation into one summary document. The three individual documents are as follows:

- Cle Elum and Bumping Lake Dams Fish Passage Facilities Planning Report – Draft, September 2008.
- Value Planning – Final Report Cle Elum Dam Fish Passage Facility, July 2009.
- Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project – Draft Environmental Impact Statement, January 2010.

Technical content and conceptual design approach have not been altered. Some of the text has been modified for clarity.

1.1 Background

Cle Elum Dam is one of five major water storage dams in the Yakima Project that were not equipped with fish passage facilities when constructed (see Figure 1). Lake Cle Elum was a natural lake turned to a reservoir by construction of the dam. Lack of fish passage at the dam blocked access to the lake and upstream habitat for anadromous salmonids, which eliminated one of the largest sockeye salmon runs in the Columbia River Basin from the Yakima River Basin. Lack of passage also prevents resident fish such as bull trout from moving throughout the basin.

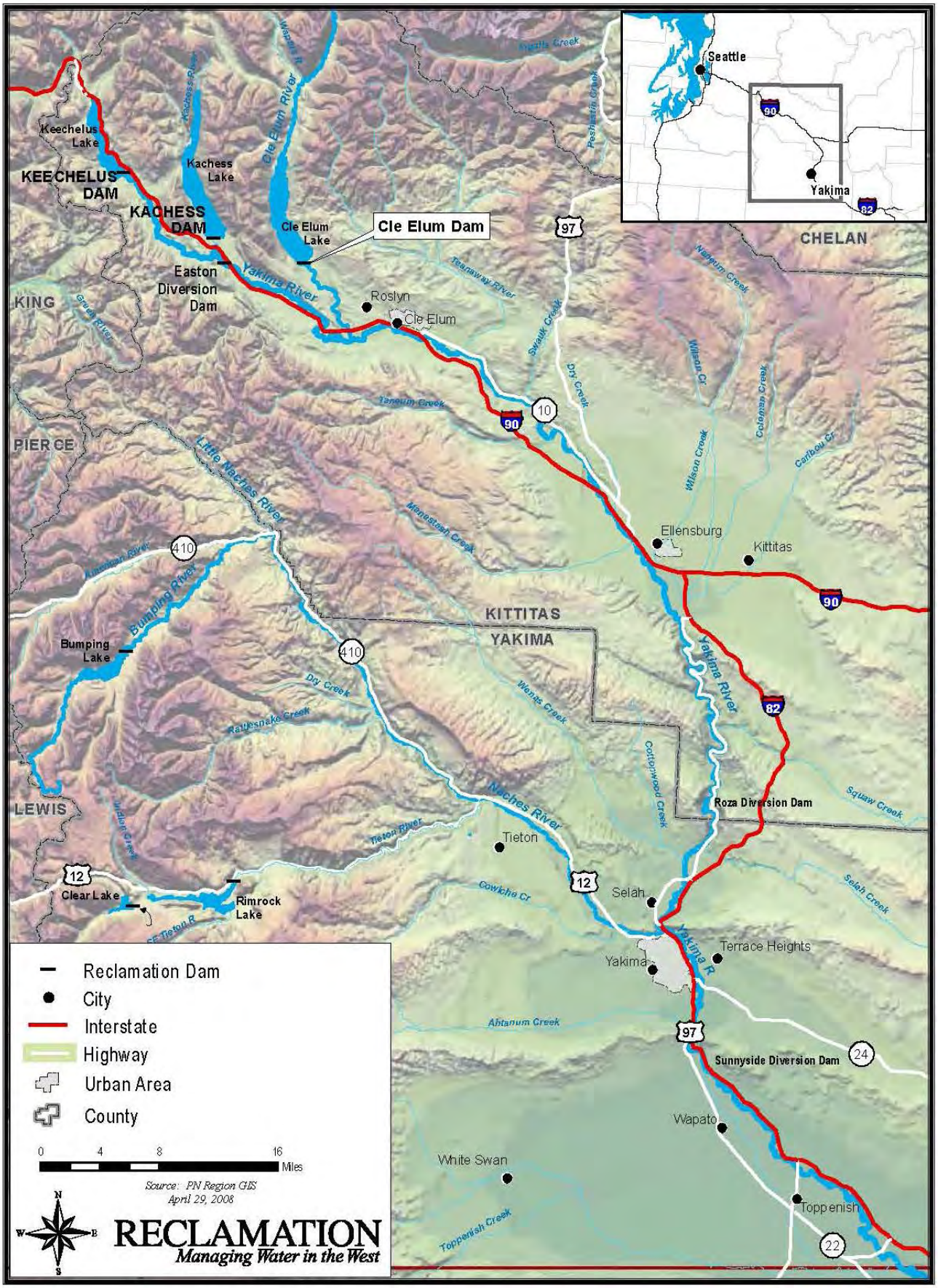

Figure 1. Cle Elum Dam Location

2.0 Fish Passage Facilities

Cle Elum Dam is located at the lower end of a natural lake at river mile (RM) 8.2 on the Cle Elum River, 8 miles northwest of the city of Cle Elum, Washington. The earthfill dam includes the main Cle Elum Dam, a dike adjacent to the left abutment of the dam (left and right refer to an observer facing in the downstream direction), and three small saddle dikes. The dam has a maximum structural height of 165 feet and a crest length of 1,800 feet, including the main dike. The earthfill dam forms a reservoir with a capacity of 436,900 acre-feet, with 427,930 acre-feet available for use. Cle Elum Reservoir has the largest storage capacity and average annual runoff in the Yakima River Basin.

Cle Elum Dam is equipped with a gated spillway (sill elevation 2,223 feet (above Mean Sea Level) with capacity of 40,000 cfs at reservoir elevation 2,240 feet. The spillway consists of radial gates and a concrete-lined open channel in the right abutment. The outlet works consist of a gated control tower and a reinforced concrete conduit through the right abutment of the dam.

Cle Elum releases are greatest in July and August in order to meet most of the Lower Yakima River basin diversion demands during these months. The 5-percent and 95-percent exceedance flows for reservoir releases are 2,946 cfs and 103 cfs, respectively (i.e., flows are higher than 103 cfs 95 percent of the time, but flows exceed 2,946 cfs only 5 percent of the time). The reservoir typically reaches its lowest elevation in September or October when the irrigation season ends. In the winter, water is released to meet downstream demands and to maintain flood-control space. In the spring, water is stored in the reservoir to regulate downstream flows for flood control and to store water for irrigation demands later in the year. The highest reservoir elevations generally occur from May to July depending on the annual water supply.

Proposed fish passage facilities for Cle Elum Dam include both downstream juvenile passage and upstream adult passage, as shown in Figure 2 (Reclamation 2010).

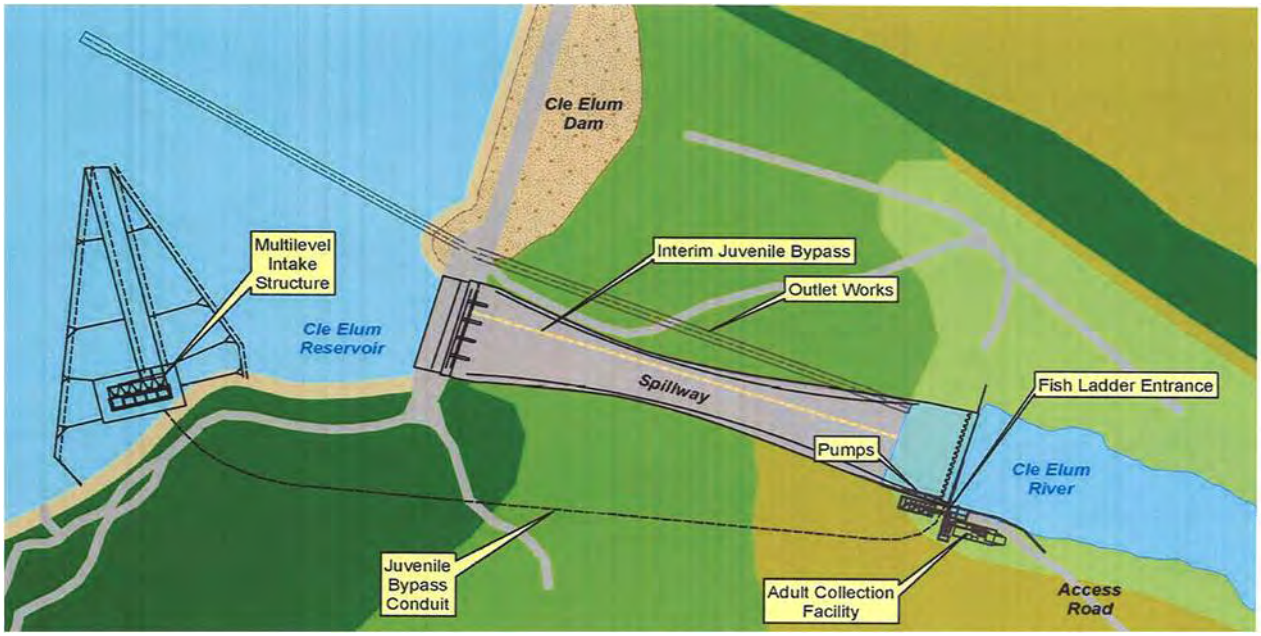

Figure 2. Cle Elum Dam Upstream and Downstream Fish Passage Facilities

2.1 Downstream Fish Passage

The basic concept for downstream passage is to provide surface releases in enough volume to attract migrating juvenile fish to an overflow gate in the reservoir. These releases would lead to a conduit that would safely discharge the fish downstream from the dam. The downstream passage facilities would include a multilevel gated concrete intake structure located against the right bank abutment and a conduit through the right abutment of the dam. The gates would allow release of fish passage flows any time the reservoir water surface is in the upper 50 feet of full pool.

Downward-opening gates would be used to provide surface release, or weir flow (100 to 400 cfs), to attract fish from the reservoir into the intake structure. Fish would then spill over a series of weirs and pools, depending on the water surface elevation of the reservoir, into a reinforced concrete fish passage conduit that would be 7 feet in diameter and 950 feet long. Fish would move through the conduit into the spillway stilling basin and then be able to move down river. The proposed downstream fish passage facilities were designed to maximize passage for the majority of the season when smolts are migrating in early March to June, even in drier years.

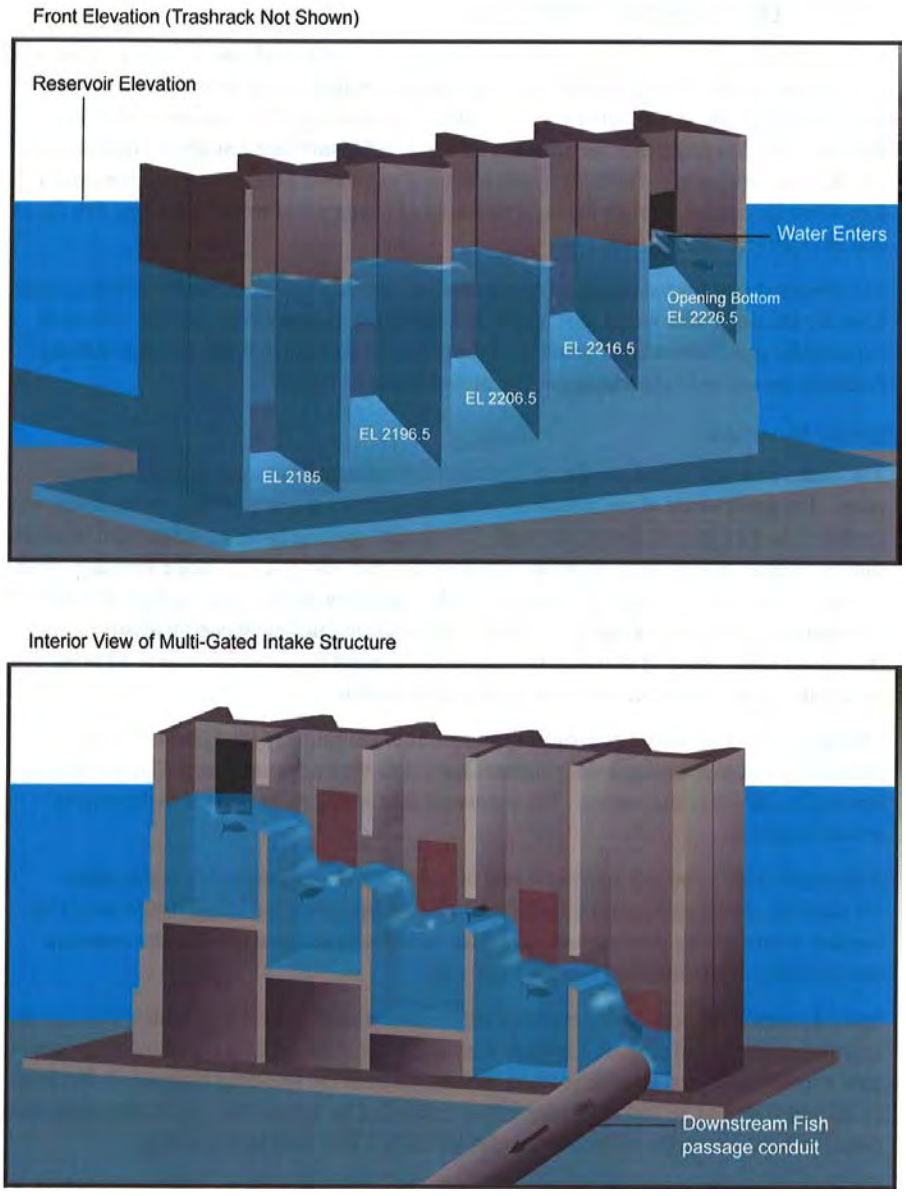

Figure 3. Proposed Intake Structure

The intake structure would be located against the right bank abutment and oriented to minimize the need for excavation. The deep approach channel will require periodic dredging. A trashrack with 1-foot bar spacing would be placed on the upstream side of the gates. Juvenile fish would easily pass through the trashrack openings, but larger debris would be blocked from entering the structure. The plan includes an automated trashrake system to handle debris that accumulates on the trashrack.

Special ramped and converging entrance approaches would be used to gradually increase the approach velocity and provide a smooth transition for the fish as they pass from the reservoir pool over the gates and into the passage facility. Fish would then spill over a series of weirs and pools depending on the water surface elevation of the reservoir. The pools would be deep enough to provide sufficient energy dissipation to protect the fish. The drop structure concept would control the potential drop at all times and allow open channel flow in the outlet conduit. Each of the five drop bays is 20 feet long by 20 feet wide and 20 feet deep with inflow controlled by 8-foot-wide, 16-foot-high roller gates, except the bottom gate, which is 8 feet wide and 8 feet high.

2.2 Fish Passage Conduit

A reinforced concrete conduit would carry passage flows from the upstream intake structure to be discharged into the spillway stilling basin. The conduit would be cast-in-place using cut-and-cover methods varying from 75 to 20 feet deep with a 15-foot-wide working space at the invert and 3:1 side slopes. The excavation for the conduit around the right abutment of the dam would be through native ground with no excavation through dam embankment materials. This would result in a temporary breach of the existing embankment 260 feet wide at the top of the dam. Proper backfill with appropriate filter zones and materials would minimize the potential for seepage or piping. The excavated dam embankment would be replaced with a new zoned embankment that includes a 20-foot-wide impervious core section. Much of the excavated material from the dam would be reused. The existing seepage stability berms would be replaced in-kind to eliminate any piping or seepage concerns.

The 950-foot-long conduit would have an inside diameter of 7 feet, and a minimum wall thickness of 21 inches. The outside would be formed in a horseshoe shape with rounded top. The conduit would be non-pressurized and would have an open-channel flow capacity of about 400 cfs with a maximum velocity of about 12 feet per second (fps). The fish passage conduit would discharge at the base of the spillway into the spillway stilling basin. The downstream fish passage conduit would have no effect on spillway capacity and no changes would be required to operate the spillway.

2.3 Upstream Fish Passage/Adult Collection Facility

The upstream adult fish passage facility would include a fish ladder, and a collection facility. The collection facility would be located about 150 feet downstream from the spillway stilling basin. Locating the adult collection facility and fish ladder on the right bank places the ladder entrance in an area of calm water at the base of the spillway. The combination of the flow from the downstream juvenile passage conduit and the pumped auxiliary attraction flow would provide adequate flows for adult fish to find the ladder entrance. This auxiliary pump would be located in the stilling area near the right bank and operate from July through December, plus whenever the juvenile intake structure is inoperable due to low reservoir levels or high water temperatures (greater than 16° C or 61° F).When adequate numbers of fish were collected in the facility, they would be placed into a fish transport truck that would deliver them to upstream locations in and around the reservoir watershed. The holding pool, fish lock, handling and sorting facilities, and office would be enclosed in a building. An existing access road northeast of the site would be improved to provide access for construction and operation of the collection facility.

2.4 Construction Access

Access for construction of both the downstream and upstream passage features would be from the right side of the dam using a two lane paved road which would cross the river on the proposed County bridge approximately 1,800 feet down stream of Cle Elum Dam. This access road is paved for 4.5 to 5 miles and unimproved gravel for 2 miles. No easements would be needed for use of this road, but special permits would be required for movement of large construction equipment. Other road improvements would include about 2,600 feet of widening and grade improvement and about 1,500 feet of new facility access road alignments at a 10-percent grade. The access roads would later be used for operation and maintenance of the both the downstream passage and upstream collection facilities.

3.0 References

1. Reclamation. 2008, Cle Elum and Bumping Lake Dams Fish Passage Facilities Planning Report – Draft. September 2008. U.S. Department of Interior, Bureau of Reclamation.

2. Reclamation. 2009, Cle Elum Dam Fish Passage Facility – Draft. July 2009. U.S. Department of Interior, Bureau of Reclamation.

3. Reclamation. 2010, Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project – Draft Environmental Impact Statement. January 2010. U.S. Department of Interior, Bureau of Reclamation.

4.0 List of Preparers

NAME	BACKGROUND	RESPONSIBILITY
HDR Engineering, Inc.		
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