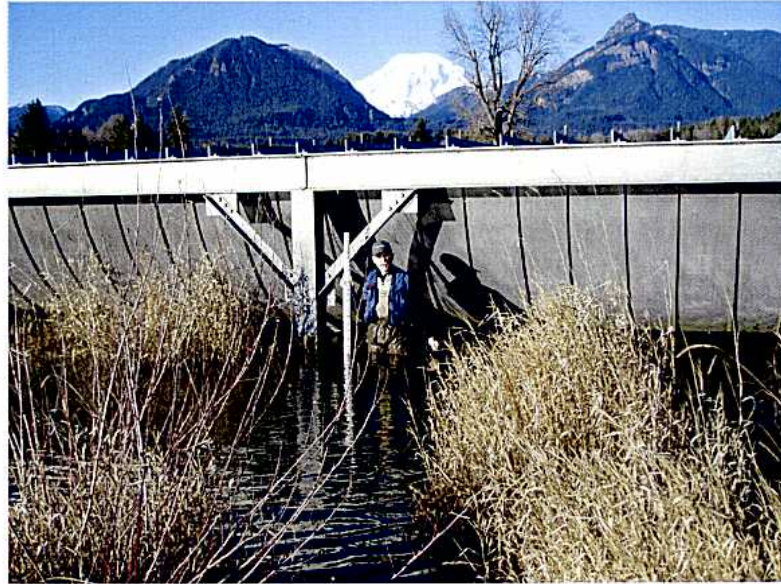


PRELIMINARY DRAFT
**HALL CREEK AND SNYDER CREEK
FISH PASSAGE**



Prepared for:
Energy Northwest

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January 2005

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2004

SECTION 1: INTRODUCTION

The Packwood Lake Hydroelectric Project (Project) includes a tailrace channel that crosses over Snyder and Hall creeks. The goal of this study was to establish if the tailrace channel impacts fish migration and channel connectivity, and to establish whether the tailrace channel is a barrier to fish and/or has a negative impact on channel connectivity.

Project Operation

Lake Creek is located at the outlet of Packwood Lake and flows to the northwest approximately 5.3 miles to the upper Cowlitz River where it enters at approximately River Mile (RM) 129.2. Water used to produce power for the Project is diverted from Lake Creek at approximately elevation 2857 ft msl and delivered to the powerhouse at about elevation 1057 ft msl. Generation water then is returned to the upper Cowlitz River via a tailrace channel which carries water about 8,000 ft from the Powerhouse to where it joins the Cowlitz River at approximately RM 125.2.

Both Hall Creek and Snyder Creek cross under the tailrace (see Figure 1). Snyder Creek enters a vertical drain in a stilling basin on the upstream side of the tailrace; it exits via a horizontal culvert encased in concrete on the downstream side into a small basin attached to a channel that eventually drains into Hall Creek. The tailrace flume is suspended for 360 ft over Hall Creek, which passes underneath the flume in a marshy area.

SECTION 2: METHODS

EES Consulting, Inc., on behalf of Energy Northwest, surveyed Snyder Creek and Hall Creek in the immediate vicinity of the tailrace channel and flume. In the case of Hall Creek, the span under the flume was measured (vertically and horizontally); for Snyder Creek, the drain, grate, upstream and downstream water surface elevations, and downstream control were surveyed. Photographs were taken of both areas.

SECTION 3: RESULTS

3.1 Hall Creek

EES Consulting, Inc. surveyed passage at both the upstream and downstream side of the flume where it crosses Hall Creek. Upstream of the flume, Hall Creek enters a marsh and extends laterally for over 50 feet. Hall Creek passes under the flume in a 36-ft section where depths range between 2.5 ft and 3.1 ft. At the time of the survey the water surface elevation of Hall Creek was the same as the bottom of the flume. The calculated area under the flume at this location was approximately 100 ft², (36 ft in width \times average depth of 2.8 ft). Even if the water depth were to increase so that it backed up onto the flume, there would still be 100 ft² of passage with relatively evenly-distributed, laminar flow under the flume; there would not be any velocity barriers. In addition, there were other areas where Hall Creek passed under the flume with clearance. Photos 1 and 2 portray the flume where it

spans Hall Creek. Figure 1 shows the location of Hall Creek relative to the project powerhouse and tailrace.

3.2 *Snyder Creek*

Snyder Creek originates from Snyder Lake and enters a vertical drain on the upstream side of the tailrace (see Figure 1). The drain is covered by a grate, with openings as large as 9.6 in X 6in. At the time of the survey, the grate was covered with 1.23 ft of water (see Photos 3 and 4).

Below the grate, the creek drains vertically 4.65 ft before connecting with a concrete-encased culvert which extends across and underneath the tailrace. The water surface elevation on the upstream side (i.e., above the drain) was only 0.27 ft higher than the downstream side of the drain; a riffle immediately downstream of the culvert opening is the hydraulic control for the opening (see Photos 5 and 6). Figure 1 shows the location of Hall Creek relative to the project powerhouse and tailrace. Figures 2 and 3 show the Snyder Creek drain in plan and profile view, respectively.

Currently, most of the culvert is filled with sediment passing down Snyder Creek and through the grate. Only the top 6 in – 8 in is currently clear, and all flow is directed towards this top and the opening. A deep pool exists immediately downstream of the crossing with a hydraulic control 0.16 ft below the downstream water surface elevation.

SECTION 4: DISCUSSION

4.1 *Hall Creek*

Hall Creek is passable at all flows. The area that Hall Creek drains is extremely low gradient, and it tends to inundate a wide area laterally. However, Hall Creek does have a main channel and its thalweg where it crosses under the tailrace flume is over 3.0 ft in depth on the date of the survey. With a cross-sectional area of 100 ft², the opening under Hall Creek can easily accommodate fish passage at much higher flows without creating any velocity barriers to fish under these conditions.

4.2 *Snyder Creek*

The openings in the grate upstream of the flume vary in size, with the largest ones measuring 9.6 in X 6 in. Openings of this size would probably allow passage of coho salmon. Given the size of Snyder Creek, it is unlikely that Snyder Creek would support Chinook salmon.

Currently, it is feasible that coho could swim up Snyder Creek and effectively pass through the culvert and travel upstream through the drain. Energy Northwest staff has seen fish above the drain previously. Passage, however, could be facilitated by: 1) replacing the drain with a new drain cover with bigger openings, and 2) dredging out the culvert. Provided the hydraulic control is maintained downstream, the culvert and drain will stay submerged and passage would be improved. Energy Northwest staff has observed the drain submerged even during summer low flows (R. Crawford, personal communication, December 27, 2004).

SECTION 5: CONCLUSION

In conclusion, the tailrace flume does not impede fish passage at Hall Creek. Fish passage is currently possible in Snyder Creek; however, passage could be improved at minimal expense by unplugging the culvert and replacing the current drain cover on the upstream side of the tailrace channel.



Photo 1. Hall Creek upstream of flume.



Photo 2. Hall Creek downstream of tailrace flume.



Photo 3. Drain at Snyder Creek, upstream side of tailrace.



Photo 4. Drain and stilling well on Snyder Creek, upstream side of tailrace.



Photo 5. Riffle acting as control for pool, downstream side of tailrace.



Photo 6. Downstream entrance of culvert on Snyder Creek, below tailrace.

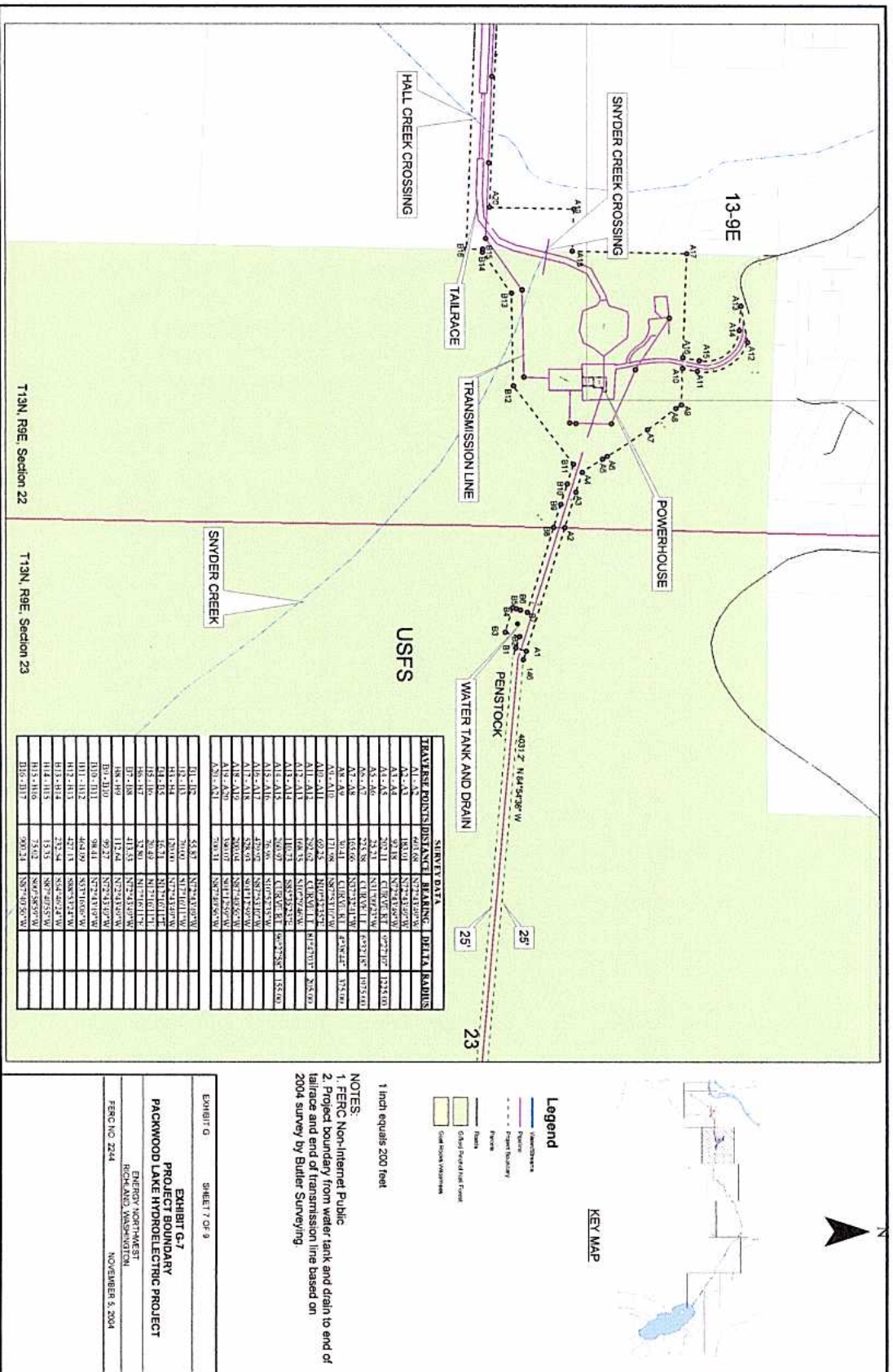


Figure 1 – Snyder Creek and Hall Creek Stream Crossings

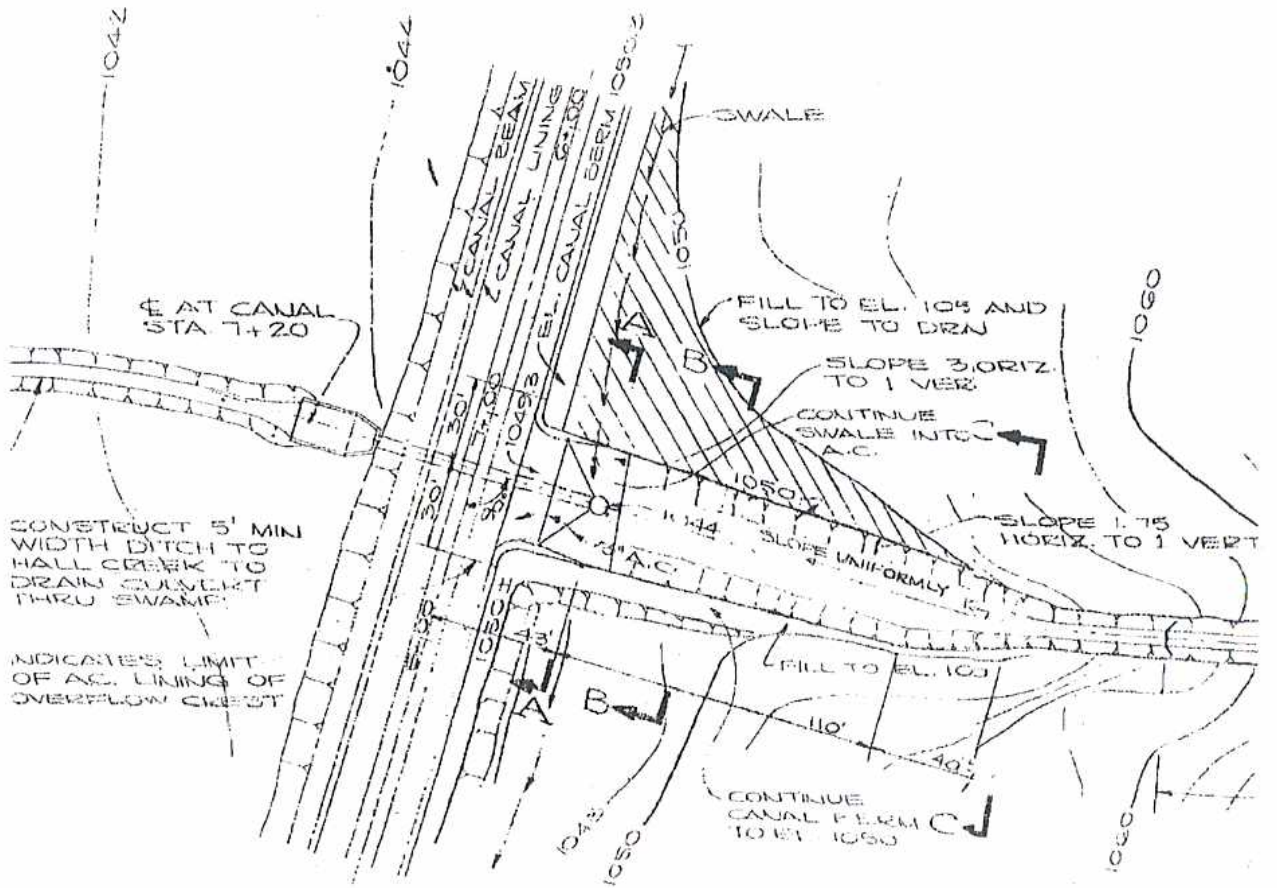


Figure 2 Snyder Creek Plan View Drawing

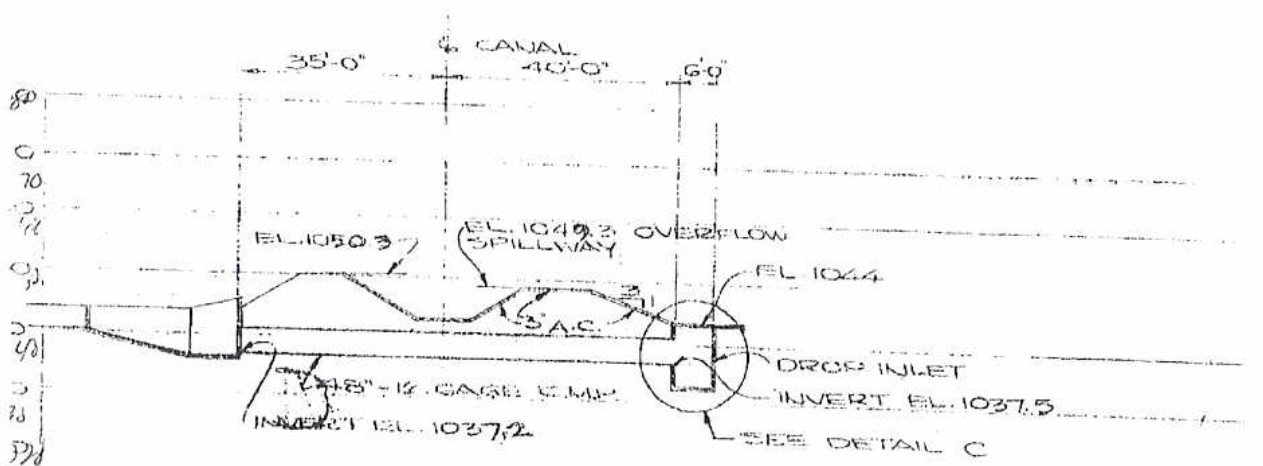


Figure 3 – Snyder Creek Profile View Drawing