

## Panther Grade Barrier Analysis June 20, 2012

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The Panther Grade stream feature is a compound barrier composed of multiple falls (four), complex chutes and boulder cascade on the South Fork of Battle Creek at Panther Grade at river mile (rm)18.85.

Physical passage criteria at a range of stream flows on anadromous fish passage is continuing to be collected at the Panther Grade site on South Fork Battle Creek downstream of the proposed Lassen Lodge Hydroelectric Power Project.

Criteria to determine passage conditions at the Panther Grade feature include; water surface elevations in the jump pools, vertical distances of falls, and horizontal distances from the crest of falls to jump pool and jump water depths were collected at the four potential passage locations have been collected since May, 2011. Three site visits have been performed; May 5, 2011 (200+/-cfs), November 22, 2011 (24+/- cfs) and May 11, 2012 (100+/- cfs). The anadromous fish passage criteria measurements for the three site visits are presented in Table One.

Stream flow was measured on May 11, 2012 at the established stream gauging location above the old Highway 36 Bridge. A stream flow accretion factor of approximately 7 cubic feet per second (cfs) was added to the discharge to allow for the spring inflow that occurs at the Panther Grade reach above the falls.

The stream discharge measurement was 93 cfs at the gauging site and allowing for a 7 cfs accretion the total discharge at the Panther Grade feature was approximately 100 cfs.

The depths of the jump pools at the range of the flows measured are insufficient to provide passage for anadromous fish past the Panther Grade structure.

Jump pool depths should be 1.5 times the height of the vertical distance of the water surface of the jump pool to the crest at the top of the falls.

Passage Conditions at Four Candidate Passage Locations:

### **Site One**

The first candidate passage site is located on the right waters bank. The site passes the majority of the stream flow ranging from an estimated 60-80 % of the total flow for the site. The vertical distance from jump pool water surface to the crest of the falls exceeds the criteria of a jump pool depth 1.5 times greater than the vertical distance.

The jump pool contains a large boulder and adjacent boulders that the descending water lands on at all flows that observations were taken at. The position of the boulders at the base of the falls indicate that the boulders in the jump pool limit passage at higher flows than what were measured.

## **Site Two**

The second candidate passage location passes an estimated flow of 10-20% of the total flow at different discharges. The presence of a rock in the jump pool completely restricts passage at low flow.

Jump pool depths increased with discharge. The jump pool depths are insufficient to meet the minimum depth criteria of 1.5 times the vertical distance for fish to pass the site.

## **Site Three**

The third candidate passage location passes an estimated flow of 10-15% of the total flow at different discharges. The presence of a rock in the jump pool completely restricts passage at low flow.

Jump pool depths increased with discharge. The jump pool depths are insufficient to meet the minimum depth criteria of 1.5 times the vertical distance for fish to pass the site.

## **Site Four**

The fourth candidate passage location passes an estimated flow of 05-10% of the total flow at different discharges. The presence of a rock in the jump pool completely restricts passage at low flow and high flows.

Jump pool depths increased with discharge. The jump pool depths are insufficient to meet the minimum depth criteria of 1.5 times the vertical distance for fish to pass the site.

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Table One. Physical Passage Criteria Panther Grade, South Fork Battle Creek below Lassen Lodge Hydroelectric Project.

	Panther Grade (RM 18.50) Passage Sites				
	Site One	Site Two	Site Three	Site Four	Discharge
<b>Jump Pool depth</b>					
November 22, 2011	rock	rock	rock	rock	17 cfs
May 5, 2011	rock	3.80'	3.00'	2.40'	180 cfs
May 11, 2012	rock	3.00'	2.5'	rock	100 cfs
<b>Vertical Height</b>					
November 22, 2011	12.0'	7.00'	6.40'	4.50	17 cfs
May 5, 2011	10.00'	11.00'	N/A	6.00'	180 cfs
May 11, 2012	12.00	7.00	6.00	4.50	100 cfs
<b>Gage Height</b>					
November 22, 2011	N/A	N/A	N/A	N/A	17 cfs
May5, 2011	N/A	N/A	N/A	N/A	180 cfs
May 11, 2012	N/A	100.72'	100.72	100.72	100 cfs

Vertical Height-distance from water surface in jump pool to water surface at landing.

Jump Pool Depth-Depth of water in jump pool

Discharge-Stream flow estimated from rating curve or measured during time of visit.

Gage Height- Staff gage reading at Panther Grade to determine water surface elevations and depths of jump pools.

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