FINAL

LAKE CREEK

PHYSICAL HABITAT ASSESSMENT SURVEY

Prepared For

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PHYSICAL HABITAT ASSESSMENT SURVEY

1.0 INTRODUCTION

As part of the study to develop information to support the 401 Water Quality Certification of the Packwood Lake Hydroelectric Project (Project), Energy Northwest has agreed to take part in a collaborative scoping process to evaluate, recommend, and propose appropriate instream flows for Lake Creek below the Project drop structure for incorporation into the subsequent FERC license for the Project. A physical habitat survey was conducted to the assess fisheries habitat of Lake Creek. Information gathered will be used in conjunction with the USFS sampling, stream profile maps, hydrology and location of anadromous barriers to: 1) segment the stream into study reaches; 2) select potential transects; and 3) determine study reach and transect weighting using the Instream Flow Incremental Methodology (IFIM).

2.0 METHODS

A physical habitat survey of Lake Creek as described in the draft study protocols was conducted in April and May 2004. Lake Creek was surveyed in a downstream direction from the drop structure to quantify existing habitat conditions. Data were collected and consolidated, habitat frequencies were calculated, and the creek was segregated into distinct study reaches.

2.1 Habitat Type

Habitat was sampled every 150 feet down the stream channel. At each station, a cross-sectional habitat type was assigned, as described in Table 2-1.

2.2 Wetted and Bank Full Channel Width

A surveying tape was used to measure the wetted channel width at the observed flow. The bank full channel width was then assessed.

2.3 Mean Depth

Depths were taken at three locations across each transect (sampled at ¼, ½, and ¾ of the width). The three depths were then averaged and used as a variable in determining the habitat type.

2.4 Gradient and Elevations

A clinometer was used to determine the slope from one transect to the next and establish gradient values for each reach. A digital altimeter recorded the altitude at each transect.

2.5 Dominant and Subdominant Substrate

A proximal assessment across the width of the transects was used to determine the dominant and subdominant substrate present. Table 2-2 describes the substrate code used during the survey of Lake Creek (WDFW 2004). The substrate type comprising the highest percentage of coverage across the

transect was documented as the dominant substrate and the substrate with the second highest percentage was coded as the subdominant substrate.

2.6 Video and Photos

Narrative videos as well as cross-sectional photos were taken of each transect in an effort to provide visual representation of the various habitat types and to better document areas of Lake Creek that are difficult to access and rarely studied. Technical difficulties precluded taking still photos and video of a portion of Reaches 3 and 4 on April 5, 2004.

2.7 Distance Along Stream

A hip chain was used to verify distances between transects, measure lengths of all of the study reaches and confirm the overall length of Lake Creek from the drop structure to the Lake Creek confluence with the Cowlitz River.

2.8 Ancillary Information

Any potential fish passage barriers and chutes were documented and photographed. Any barriers deemed to have potential fish passage issues will be further surveyed during the instream flow study. Major tributaries and areas of significant inflow were also documented during the surveys.

Table 2-1. Microhabitat Type Coding and Description		
Code	**Habitat Name**	**Habitat Description**
1	Pool	Slower velocity and deeper, non-turbulent flow with a strong hydraulic control.
2	Lateral pool	Pool formed on the margin of the stream as a result of structural element, substrate composition, or thalweg location. (Generally, at least ½ of the pool perimeter interfaces with the adjacent habitat unit).
3	Plunge pool	Flow at head is vertical passing over an obstruction: fast, turbulent often with a bubble plume down the center.
4	Glide	Smooth, generally unbroken surface, generally laminar flow, moderate to shallow depth, often smaller substrates.
5	Riffle	Shallow with moderate velocities (less than run), lateral bottom profile is usually uniform; surface is broken but not turbulent like a run, gradient <4%.
6	Run	Like a glide except faster velocities and somewhat more turbulent; surface may be broken by protruding rocks.
7	Boulder garden	A run with lots of randomly placed large boulders causing flow irregularities, flow is not necessarily turbulent.
8	Chute	All the flow is concentrated in a narrow area. Flow is fast to very fast.
9	Rapid	Water (rough, turbulent surface) usually with a standing wave at the hydraulic jump that occurs at the bottom as the flow rapidly decelerates into a pool, though it could merge into a riffle; water surface slope 2.5 – 4%
10	Cascade	Turbulent flow with pronounced vertical drops causing a stepped gradient, substrate often boulders and cobble.
11	Braided channel	One or more divisions of the stream channel separated by islands of substrate not well vegetated.
12	Split channel	More than one permanent channel.
13	Side Channel	A flow dependant channel separate from the permanent channel.
14	Plunge Pool Tailout	A transitional area where turbulent water from a plunge pool begins to settle out. Typically preceding a run or glide.
15	Falls	A large vertical drop. Water typically plunges into a pool, substrate often bedrock or large boulders.

Table 2-2. Substrate Coding (WDFW 2004)		
Code	**Type of Substrate**	**Dimensions**
1	Silt, Clay, or Organic	
2	Sand	
3	Small Gravel	0.1-.5”
4	Medium Gravel	.5-1.5”
5	Large Gravel	1.5-3”
6	Small Cobble	3-6”
7	Large Cobble	6-12”
8	Boulder	>12”
9	Bedrock	

3.0 RESULTS

Appendix A contains the physical habitat assessment data collected at each station along Lake Creek. Appendix B includes the photographs of the habitat units quantified during the survey. Appendix C incorporates the photos of selected transects for the instream flow study as well as documented and potential anadromous barriers. These appendices are included on a CD; full descriptions of these data sets are given below.

3.1 Habitat Assessment

Energy Northwest partitioned Lake Creek into five distinct reaches based primarily on changes in gradient along the length of the stream. Figure 3-1 graphically represents the breaks in slope and the coordinated reach segmentation. Lake Creek is a high gradient, stair-step type creek with a long series of cascades and plunge pools comprising a majority of the streams habitat. Table 3-1 summarizes reach definition, length, and mean slope for each study reach.

Table 3-1. Summary of study reaches, Lake Creek.

Reach	River Mile	Elevation (ft)	Mean Slope
1	0.0-0.7	1,105-1,213	2.9%
2	0.7-1.3	1,210-1,440	7.3%
3	1.3-3.5	1,440-2,367	8.0%
4	3.5-4.9	2,360-2,680	4.3%
5	4.9-5.3	2,680-2,857	8.4%

3.1.1 Reach 1 (RM 0.0-0.7)

Reach 1 is the lowest gradient of the five reaches, rising approximately 100 feet from the mouth of Lake Creek to RM 0.7 located near the Forest Service boundary (mean gradient of 2.9%). Twenty-five transects were analyzed with cascades and plunge pools comprising a majority of the habitat types identified. Runs, trench pools, and a boulder garden made up the remaining transects documented.

Boulder and cobble were the primary substrate types identified throughout the reach. Wetted and channel widths ranged from 15-60 feet and 27-98 feet, respectively. Deep pools are lacking in this reach, with cross-sectional depths never greater than 2.1 feet.

3.1.2 Reach 2 (RM 0.7-1.3)

Reach 2 is 0.6 miles in length and rises approximately 210 feet from the Forest Service boundary. In this reach, Lake Creek courses through a narrow, bedrock controlled canyon. Twenty-one transects were analyzed. Cascades, pools, and runs made up over 95% of the transects measured. Wetted and channel widths were from 10-200 feet and 15-200 feet, respectively. The average depth of the transects ranged from 0.4-5.0 feet.

Boulder and cobble were again the two dominant substrate types present at transect locations and throughout the reach. Gravel were absent above a barrier (chute) located at approximately RM 1.05; however, gravels were present below the chute and canyon, where gradient was less. Intermediate slopes were as high as 12% on the habitat types measured. Above RM 1.0, substrates were mostly large substrates. Gravels were not apparent until below RM 1.0, where Lake Creek exited the canyon and gradients decreased.

The potential barrier at RM 1.05 will be surveyed using the methodologies described in Powers and Orsborne (1985)

3.1.3 Reach 3 (RM 1.3-3.5)

Reach 3 is a high gradient (mean gradient of 8%), 2.2 mile-long-stretch of Lake Creek through a steep canyon. Lake Creek rises approximately 950 feet in this reach. Seventy six transects were measured in Reach 3 and over 80% of the transects that were analyzed were cascades, falls, or pools. Average depths throughout this reach ranged from 0.2 to 2.6 feet with boulder and cobble predominating. Wetted and channel widths ranged from 6-200 feet and 6-245 feet, respectively, with slopes between transects reached as high as 100% at two large falls and were typically as high as 8-10%.

At RM 2.05, a 15 to 20-ft waterfall prevents any anadromous passage beyond this point. Large falls and chutes likely to be barriers to fish movement are most abundant in Reach 3; 12 potential barriers were documented in this reach (see Appendix C).

3.1.4 Reach 4 (RM 3.5-4.9)

Reach 4 rises approximately 450 feet in 1.4 miles (average gradient of 4.3%), with the upper half of the reach being steeper than the bottom half. Forty four tansects were measured in this reach and their mean depths ranged from 0.3 to 1.9 feet deep. A majority of the habitat in this reach consisted of pools, runs and cascades. Cobble and boulder were the dominant substrates, although the highest concentration of gravel present the entire length of Lake Creek was observed in the lower half of Reach 4. Wetted and channel widths ranged from 6-160 feet and 6-195 feet, respectively.

3.1.5 Reach 5 (RM 4.9-5.3)

Reach 5 is a 0.4 mile stretch extending up to the downstream edge of the drop structure. Fifteen transects were measured and consisted primarily of glides, cascades, and plunge pools. This reach rises 177 feet from RM 4.9 to the drop structure with boulders, cobble, and sand the dominate substrate types. Wetted and channel width ranged from 7-36 feet and 24-54 feet, respectively. Mean gradient for this reach is 8.4%.

Habitat frequencies for each study reach are presented in Table 3-2. Appendix A contains the raw field notes for the habitat survey. When split, braided or side channels were encountered, the habitat type found in these channel was quantified and incorporated into the calculations (i.e., run, glide). Split, braided and side channels were noted and quantified; however, the number of each of these habitat types was not included in the calculations.

3.2 Instream Flow Transect Selection

Based upon the habitat frequencies observed during the physical habitat survey, Table 3-3 summarizes the study reaches and habitat types selected for the instream flow study. Study Site 2, located at RM 1.3, is situated in a transition zone and represents habitats found in both Reaches 2 and 3. Photos of IFIM transects are included in Appendix C.

3.3 Anadromous Barrier Identification

Numerous falls and chutes that are barriers to upstream migration of resident and anadromous fish exist in Lake Creek. Previous investigations by the USFS identified a downstream anadromous fish barrier at RM 1.95. This bedrock falls, approximately 25 – 30 feet tall, is unchanged by any subsequent flood events in Lake Creek and remains a barrier. Energy Northwest also identified a potential barrier in a

steep canyon near RM 1.03; a bedrock falls and chute complex that has been documented (see Appendix C). As stated earlier, further surveying and measurements will be taken in conjunction with the instream flow study to confirm if this chute is a barrier to anadromous fish.

Figure 3-1. Lake Creek Stream Gradient

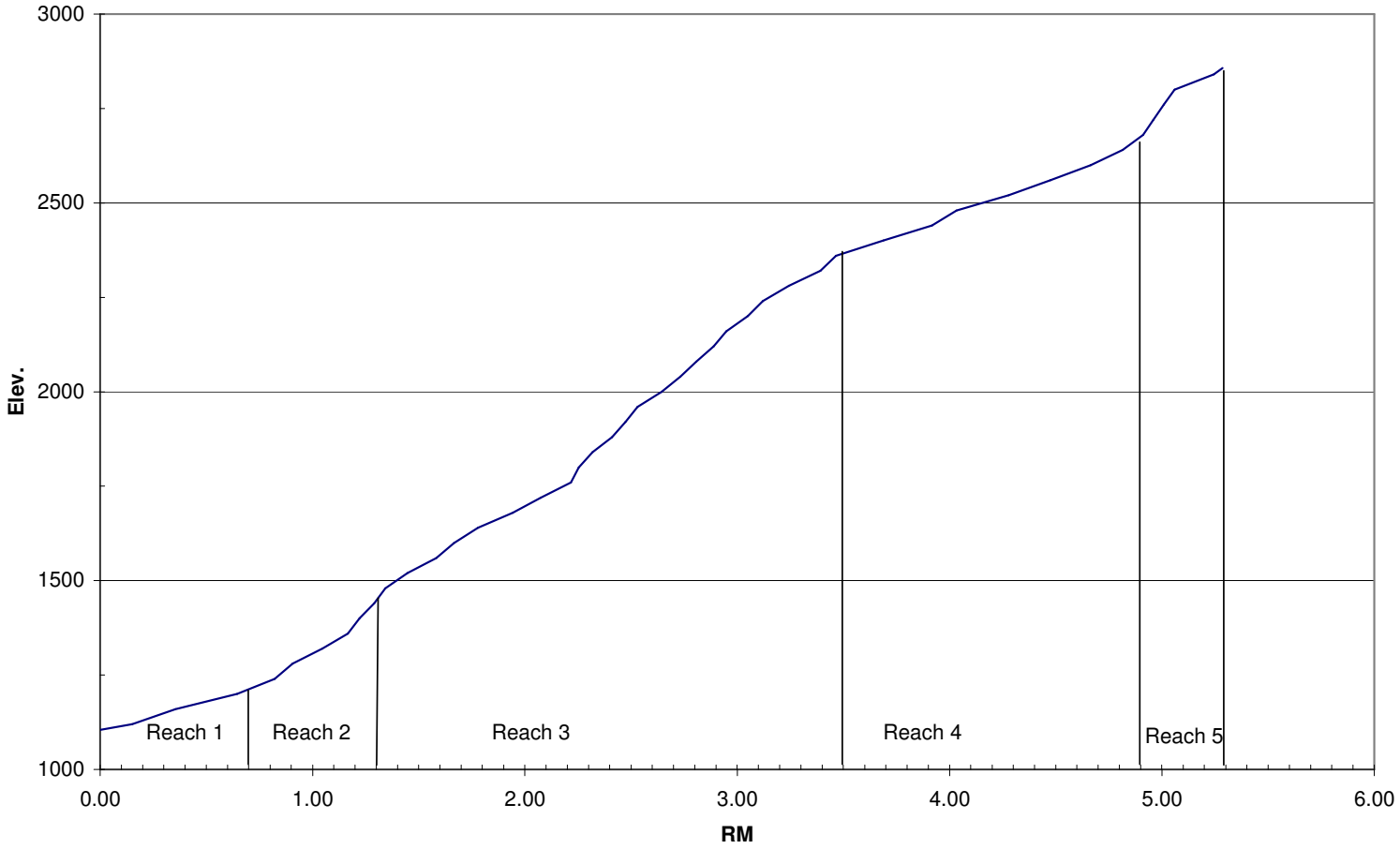

Table 3-2. Lake Creek Habitat Frequencies by Reach

Reach 1 (RM 0.0-0.7)			
Code	**Habitat Type**	**Frequency**	**% of Total**
1	Pool	0	0.0
2	Lateral Pool	0	0.0
3	Plunge Pool	3	12.0
4	Glide	4	16.0
5	Riffle	0	0.0
6	Run	10	40.0
7	Boulder Garden	0	0.0
8	Chute	1	4.0
9	Rapid	0	0.0
10	Cascade	6	24.0
11	Braided Channel	0	0.0
12	Split Channel	0	0.0
13	Side Channel (1)	0	0.0
14	Plunge Pool Tailout	1	4.0
15	Falls	0	0.0
Total Habitat Units		**25**	

Reach 2 (RM 0.7-1.3)			
Code	**Habitat Type**	**Frequency**	**% of Total**
1	Pool	2	9.5
2	Lateral Pool	0	0.0
3	Plunge Pool	4	19.0
4	Glide	2	9.5
5	Riffle	0	0.0
6	Run	6	28.6
7	Boulder Garden	0	0.0
8	Chute	2	9.5
9	Rapid	0	0.0
10	Cascade	5	23.8
11	Braided Channel	0	0.0
12	Split Channel (1)	0	0.0
13	Side Channel	0	0.0
14	Plunge Pool Tailout	0	0.0
15	Falls	0	0.0
Total Habitat Units		**21**	

Reach 3 (RM 1.3-3.5)			
Code	**Habitat Type**	**Frequency**	**% of Total**
1	Pool	3	3.9
2	Lateral Pool	1	1.3
3	Plunge Pool	12	15.8
4	Glide	10	13.2
5	Riffle	0	0.0
6	Run	8	10.5
7	Boulder Garden	0	0.0
8	Chute	8	10.5
9	Rapid	0	0.0
10	Cascade	26	34.2
11	Braided Channel	0	0.0
12	Split Channel (6)	0	0.0
13	Side Channel (3)	0	0.0
14	Plunge Pool Tailout	5	6.6
15	Falls	3	3.9
Total Habitat Units		**76**	

Reach 4 (RM 3.5-4.9)			
Code	**Habitat Type**	**Frequency**	**% of Total**
1	Pool	3	6.8
2	Lateral Pool	0	0.0
3	Plunge Pool	6	13.6
4	Glide	6	13.6
5	Riffle	0	0.0
6	Run	16	36.4
7	Boulder Garden	1	2.3
8	Chute	0	0.0
9	Rapid	0	0.0
10	Cascade	11	25.0
11	Braided Channel	0	0.0
12	Split Channel (6)	0	0.0
13	Side Channel	0	0.0
14	Plunge Pool Tailout	1	2.3
15	Falls	0	0.0
Total Habitat Units		**44**	

Reach 5 (RM 4.9-5.1)			
Code	**Habitat Type**	**Frequency**	**% of Total**
1	Pool	1	6.3
2	Lateral Pool	0	0.0
3	Plunge Pool	3	18.8
4	Glide	6	37.5
5	Riffle	0	0.0
6	Run	2	12.5
7	Boulder Garden	0	0.0
8	Chute	0	0.0
9	Rapid	0	0.0
10	Cascade	2	12.5
11	Braided Channel (1)	0	0.0
12	Split Channel (1)	0	0.0
13	Side Channel	0	0.0
14	Plunge Pool Tailout	2	12.5
15	Falls	0	0.0
Total Habitat Units		**16**	

Table 3-3. Proposed Instream Flow Study Sites and Transects

Reach 1: RM 0.0 – 0.7. Study Site at RM 0.1 – 0.3	
Transect	Transect Description
A	Glide
B	Run
C	Low Gradient Cascade/Run
D	Plunge Pool Tailout
E	Plunge Pool
F	Run
G	Plunge Pool Tailout
H	Low Gradient Cascade/Plunge Pool
I	Plunge Pool

Reach 2: RM 0.7 – 1.3. Reach 3: RM 1.3 – 3.5 Site at RM 1.25 – 1.5	
Transect	Transect Description
A	Chute
B	Plunge Pool
C	Run
D	Plunge Pool/Cascade
E	Plunge Pool Tailout
F	Plunge Pool
G	Pool Tailout/Glide
H	Wide Run

Reach 4: RM 3.5 – 4.9. Study Site at RM 4.03	
Transect	Transect Description
A	Glide Narrow Chute (cobble/boulder)
B	Narrow Cascade/Plunge Pool (boulder w/perched gravel)
C	Narrow Run (boulder w/perched gravel)
D	Pool Tailout/Glide (boulder/cobble)
E	Pool
F	Head of Pool below Cascade

Reach 5: RM 4.9 – 5.4. Study Site at RM 5.3	
Transect	Transect Description
A	Plunge Pool
B	Narrow Run (boulder and cobble)
C	Pool (bedrock on sides; cobble/gravel on margins)
D	Split Channel Glide (boulder/cobble)
E	Run (below plunge pool)
F	Split Channel Run w/lateral pool
G	Wide Glide
H	Wide Pool
I	Riffle (gravel/cobble)

4.0 **REFERENCES**

Powers, P.D. and J.F. Orsborn. 1985. Analysis of barriers to upstream fish migration. An investigation of the physical and biological conditions affecting fish passage success at culverts and waterfalls. Part 4 of 4. Bonneville Power Administration. Contract DE-A179-82BP36523. Project 82-14.

Washington Department of Fish and Wildlife. 2004. Draft Instream Flow Guidelines. June, 2004.

Appendix A

Physical Habitat Survey
Lake Creek from Mouth to Drop Structure
at Packwood Lake

Lake Creek Habitat Survey

Distance (ft)	River Mile (RM)	Habitat Type Code (See Table 2-1)	Elev-ation (ft MSL)	Slope (%)	Channel Width (ft)	Wetted Width (ft)	Photo No.	Transect No.	Date	Substrate, Dominant	Substrate, Subdominant	Depth. 1/4	Depth 1/2	Depth 3/4	Depth Mean	Comments
0	0	6	1105	1.5	54.2	30.5	1	0	4/4/04	Cobble	Boulder	0.9	1.3	0.8	1.0	Confluence w/Cowlitz
150	0.03	6/**4**		2	45.1	27.3	2	150	4/4/04	Cobble	Boulder	0.8	1.3	0.9	1.0	
300	0.06	6		1.5	59.5	27.1	3	300	4/4/04	Boulder	Cobble	0.6	1.3	1	1.0	
450	0.09	4,14		2	32.2	23.9	4	450	4/4/04	Cobble	Gravel	1	1.4	0.6	1.0	Glide Plunge pool tailout
600	0.11	10		3.5	44.7	24.9	5	600	4/4/04	Boulder	Cobble	2	1	1.5	1.5	**Good site - behind cedar house**
750	0.14	6,3	1120	2	46.3	27.1	6	750	4/4/04	Boulder	Cobble	1.5	2	0.3	1.3	Plunge pool, cascades, plunge pool tailout, run, glide all here
900	0.17	10		4	28.4	29.3	7	900	4/4/04	Boulder	Cobble	0.8	0.5	1.3	0.9	SS1 - Transect A - classic Pool, Pool Tailout, Cascade, Run, Glide
1050	0.20	6,2			66.4	33.6	8	1050	4/4/04	Cobble	Boulder	0.1	0.4	1.6	0.7	
1200	0.23	3		4	30.2	21.8	9	1200	4/4/04	Boulder	Cobble	1	2.1	0.5	1.2	
1350	0.26	10,2		2	56.8	30.1	10	1350	4/4/04	Boulder	Sand	1.1	1.8	1.5	1.5	Under Highway 12 bridge
1500	0.28	14		1.5	32.3	20.5	11	1500	4/4/04	Cobble	Sand	0.9	2	1.6	1.5	
1650	0.31	3		2	34.0	23.6	12	1650	4/4/04	Boulder	Sand	1.5	2.5	+	2.0	Bridge 2 - Study site B
1800	0.34	6	1160	2.5	28.4	16.9	13	1800	4/4/04	Cobble	Boulder	1.5	1.8	0.6	1.3	
1950	0.37	10		4	53.5	40.0	14	1950	4/4/04	Boulder	Gravel	0.5	1.3	1	0.9	
2100	0.40	6		3	61.2	26.5	15	2100	4/4/04	Boulder	Cobble	1.5	1.8	0.6	1.3	Site C - Very good study site - wide area, runs, glide, plunge pool
2250	0.43	2,6		2.5	27.1	15.4	16	2250	4/4/04	Boulder	Cobble	0.9	2.4	3	2.1	
2400	0.45	6		2	44.3	35.4	17	2400	4/4/04	Boulder	Cobble	1.2	1	1.3	1.2	Potential Study Site – D; wide glide, narrow plunge pool, boulder, run
2550	0.48	13,10		3	65.2	58.7	18	2550	4/4/04	Boulder	Gravel	1.3	1	0.6	1.0	Small side channel with cascade
2700	0.51	6		3	98.0	54.0	19	2700	4/4/04	Boulder	Cobble	1.5	+	0.3	0.9	Wide transect on bend
2850	0.54	6,7		2	44.4	36.0	20	2850	4/4/04	Boulder	Cobble	+	0.2	1.5	0.9	Chute
3000	0.57	10		4	58.2	33.5	21	3000	4/4/04	Boulder	Cobble	0.5	1.6	+	1.1	
3150	0.60	8		2.5	47.7	35.6	22	3150	4/4/04	Boulder	Cobble	0.2	2	1.5	1.2	Chute in wide channel
3300	0.63	4	1200	3	52.7	30.3	23	3300	4/4/04	Boulder	Sand	1.4	2.1	1.6	1.7	
3450	0.65	6		1.5	39.2	29.1	24	3450	4/4/04	Cobble	Boulder	12	1.2	1.2	4.8	
3600	0.68	4		4	33.1	20.4	25	3600	4/4/04	Boulder	Sand	0.6	1.5	1.7	1.3	
3750	0.71	6		1	45.3	39.0	26	3750	4/4/04	Boulder	Sand	1.4	2.1	0.1	1.2	Chute 50 ft below
3900	0.74	4			80.6	32.3	27	3900	4/4/04	Cobble	Boulder	1.1	1.5	1.2	1.3	

Lake Creek Habitat Survey

Distance (ft)	River Mile (RM)	Habitat Type Code (See Table 2-1)	Elev-ation (ft MSL)	Slope (%)	Channel Width (ft)	Wetted Width (ft)	Photo No.	Transect No.	Date	Substrate, Dominant	Substrate, Subdominant	Depth. 1/4	Depth 1/2	Depth 3/4	Depth Mean	Comments
4050	0.77	4		2	57	42	103	10050	4/5/04	Cobble	Gravel	1.2	1.4	0.8	1.1	
4200	0.80	6		4	52	40	102	9900	4/5/04	Boulder	Sand	1.2	1.4	0.8	1.1	
4350	0.82	10	1240	4	50	32	101	9750	4/5/04	Boulder	Cobble	0.4	1.3	0.9	0.9	
4500	0.85	10		4	61	48	100	9600	4/5/04	Boulder	Gravel	0.6	0.1	1	0.6	Major tributary, right bank
4650	0.88	10		5	60	42	99	9450	4/5/04	Boulder	Cobble	0.6	+	0.7	0.4	
4800	0.91	3	1280	2	82	68	98	9300	4/5/04	Sand	Boulder	0.8	1.7	1.9	1.5	
4900	0.93							*9200*	4/5/04							Two creeks, left bank
4950	0.94	6		4	65	55	97	9150	4/5/04	Boulder	Cobble	1	0.8	1.1	1.0	
5100	0.97	6		3	47	35	96	9000	4/5/04	Gravel	Boulder	0.5	1	1.1	0.9	
5250	0.99	8		5	15	12	95	8850	4/5/04	Bedrock		1.1	1.2	1.5	1.3	First spawning gravel - small patch
5400	1.02	3		5	50	35	94	8700	4/5/04	Boulder	Sand	1.1	3	+	1.4	
5550	1.05	3	1320	4	45	45	92	8550	4/5/04	Bedrock		3	6	6	5.0	Bedrock chute and falls in canyon
5700	1.08	1		3	18	15	90	8400	4/5/04	Bedrock		3	3	1.6	2.5	Bedrock back small creek on left bank
5850	1.11	1		12	58	45	89	8250	4/5/04	Sand	Boulder	1.9	2.5	1.3	1.9	With Large Wood Debris
6000	1.14	6		4	60	40	88	8100	4/5/04	Boulder	Cobble	1.3	1.5	1.3	1.4	Boulder
6150	1.16	6	1360	4.5	45	32	87	7950	4/5/04	Boulder	Gravel	1.6	1.6	1.6	1.6	Out of bedrock
6300	1.19	10		5	42	30	86	7800	4/5/04	Boulder	Cobble	1.6	+	1.4	1.0	All Bedrock controlled
6450	1.22	3,8	1400	5	15	10	85	7650	4/5/04	Bedrock	Boulder	2.2	2.5	1	1.9	All Bedrock controlled
6600	1.25	3		6	30	25	84	7500	4/5/04	Bedrock	Boulder	2.1	+	1.1	1.1	All Bedrock controlled
6750	1.28	12,10	1440	12	200	200	83	7350	4/5/04	Boulder		0.8	+	0.8	0.5	Split channel, High gradient cascade
6900	1.31	10		5	80	55	82	7200	4/5/04	Boulder	Cobble	0.8	+	+	0.3	Slightly lower gradient
7050	1.34	4	1480	5	60	45	81	7050	4/5/04	Boulder	Cobble	1.6	1.7	1.9	1.7	
7200	1.36	6		5	55	43	80	6900	4/5/04	Boulder	Cobble	0.7	1.8	0.9	1.1	Below cascades; good features for transects
7350	1.39	3		6	45	35	79	6750	4/5/04	Boulder	Sand	1.5	2.3	1.6	1.8	Below cascades
7500	1.42	14,4		5	53	40	78	6600	4/5/04	Boulder	Cobble	1.6	1.1	0.3	1.0	Below cascades
7650	1.45	3	1520	3	35	25	77	6450	4/5/04	Boulder	Cobble	0.6	1.6	0.4	0.9	Below cascades
7800	1.48	10		4	35	25	76	6300	4/5/04	Boulder	Sand	0.6	0.8	1.4	0.9	Series of cascades
7950	1.51	4		4	45	18	75	6150	4/5/04	Boulder	Cobble	1.8	1.8	0.6	1.4	

Lake Creek Habitat Survey

Distance (ft)	River Mile (RM)	Habitat Type Code (See Table 2-1)	Elev-ation (ft MSL)	Slope (%)	Channel Width (ft)	Wetted Width (ft)	Photo No.	Transect No.	Date	Substrate, Dominant	Substrate, Subdominant	Depth. 1/4	Depth 1/2	Depth 3/4	Depth Mean	Comments
8100	1.53	6		12	85	65	74	6000	4/5/04	Boulder	Cobble	0.89	0.2	1.1	0.7	Steep falls immediately below
8250	1.56	12,10,3		8	100	75	72,73	5850	4/5/04	Boulder	Cobble	+	1.2	0.6	0.6	
8400	1.59	6	1560	6	72	50	71	5700	4/5/04	Boulder	Sand	1.8	+	1.5	1.1	
8550	1.62	10		6	48	32	70	5550	4/5/04	Boulder	Cobble	0.6	+	1.6	0.7	
8700	1.65	10		10	60	54	69	5400	4/5/04	Boulder	Cobble	1	+	0.7	0.6	Middle of cascades
8850	1.68	15	1600	12	90	35	68	5250	4/5/04	Boulder	Cobble	0.6	1	1.5	1.0	Chute/pool immediately upstream
9000	1.70	13,10		9	155	125	67	5100	4/5/04	Boulder	Sand	0.2	+	0.4	0.2	Falls with chute complex
9150	1.73	6		4	37	25	66	4950	4/5/04	Boulder	Sand	1.8	1.6	0.9	1.4	
9300	1.76	10		6	45	35	65	4800	4/5/04	Boulder	Sand	0.7	1.4	1.9	1.3	
9450	1.79	2	1640	6	30	25	64	4650	4/5/04	Boulder		0.5	2.1	+	0.9	
9600	1.82	6		6	85	55	63	4500	4/5/04	Boulder	Sand	0.5	2.1	0.7	1.1	
9750	1.85	12,10		8	105	70	62	4350	4/5/04	Boulder	Cobble	0.5	+	2.3	0.9	
9900	1.88	3		8	55	35	61	4200	4/5/04	Boulder	Cobble	2.1	+	2	1.4	
10050	1.90	12,10,3		8	100	65	59,60	4050	4/5/04	Boulder	Sand	1.1	+	1.8	1.0	
10200	1.93	4	1680	8	50	25	58	3900	4/5/04	Boulder	Gravel	0.6	1.8	0.6	1.0	
10350	1.96	8,10		15	22	15	57	3750	4/5/04	Boulder		0.6	1.2	1.8	1.2	
10500	1.99	12,6		5	100	85	55,56	3600	4/5/04	Cobble	Gravel	1.2	+	0.6	0.6	
10650	2.02	12,10		4	110	85	54	3450	4/5/04	Boulder	Cobble	0.9	+	0.7	0.5	
10800	2.05	12,10		4	245	200	n/a	3300	4/5/04	Boulder	Cobble	1.1	1.1	1.1	1.1	
10950	2.07	15	1720	100	70	70	51,52,53	3150	4/5/04	Bedrock		1.2	0.2	0.2	0.5	
11100	2.10	1		10	100	75	50	3000	4/5/04	Sand	Gravel	2	2	0.5	1.5	
11250	2.13	6		4	40	20	49	2850	4/5/04	Gravel	Cobble	0.5	1.1	0.3	0.6	
11400	2.16	4		4	55	40	48	2700	4/5/04	Sand	Gravel	0.5	1.8	2.1	1.5	
11550	2.19	3		5	50	35	47	2550	4/5/04	Cobble	Boulder	1	1	0.5	0.8	
11700	2.22	14	1760	6	45	30	46	2400	4/5/04	Sand	Cobble	2.6	2.6	0.8	2.0	
11850	2.24	3	1800	7	48	40	45	2250	4/5/04	Sand	Gravel	2.5	3.5	1.9	2.6	
12000	2.27	10		6	45	45	44	2100	4/5/04	Boulder	Sand	0.6	+	1.1	0.6	
12150	2.30	8,10		9	30	12	43	1950	4/5/04	Boulder	-	1.2	1.2	1.4	1.3	
12300	2.33	3	1840	8	65	50	42	1800	4/5/04	Cobble	Boulder	0.6	0.6	0.8	0.7	

Lake Creek Habitat Survey

Distance (ft)	River Mile (RM)	Habitat Type Code (See Table 2-1)	Elev-ation (ft MSL)	Slope (%)	Channel Width (ft)	Wetted Width (ft)	Photo No.	Transect No.	Date	Substrate, Dominant	Substrate, Subdominant	Depth. 1/4	Depth 1/2	Depth 3/4	Depth Mean	Comments
12450	2.36	10		11	54.3	49.3	41	1650	4/5/04	Cobble	Boulder	0.6	0.8	0.8	0.7	
12600	2.39	3		10	40	20		1500	4/5/04	Sand	Boulder	1.3	1.1	1.1	1.2	High gradient chute above
12750	2.41	14	1880	13	36.8	29.3	40	1350	4/5/04	Sand	Boulder	1.4	+	0.2	0.5	Run/cascade
12900	2.44	14		12	38.6	33	38,39	1200	4/5/04	Cobble	Boulder	0.9	+	0.2	0.4	Chute 10 ft upstream; good spot to get out.
12966	2.46	*8*		*25*				*1134*	4/5/04							
13050	2.47	8	1920	20	6	6	37	1050	4/5/04	Boulder	-	0.6	1	0.6	0.7	Falls immediately above.
13200	2.50	14,4		11	46.5	20.1	36	900	4/5/04	Cobble	Gravel	0.6	1.9	0.6	1.0	Confluence, Art Lake Creek
13350	2.53	10,8	1960	2.5	15	13	35	750	4/5/04	Boulder	-	0.8	1.4	0.6	0.9	
13500	2.56	13,10		8	135	120	33,34	600	4/5/04	Boulder	Sand	0.8	+	1.3	0.7	High gradient chute and split channel
13650	2.59	13,8		4.5	79	67.4	32	450	4/5/04	Boulder	Cobble	+	1.1	+	0.4	2 chutes; grouped with plunge pool and cascades
13725	2.60							375	4/5/04							Small creek confluence
13800	2.61	10		8	35	9	31	300	4/5/04	Boulder	Cobble	0.8	0.8	0.8	0.8	
13950	2.64	15	2000	55-140	53	32	29,30	150	4/5/04	Bedrock	-	0.2	0.2	0.2	0.2	Falls about 20 ft tall; face = 55 degrees ; bedrock face
14100	2.67	14		8	62	22.6	28	0	4/5/04	Boulder	Gravel	1	2.1	0.3	1.1	Plung pool tailout
14250	2.70	8		10	48	36		7650	4/6/04	Boulder	Cobble	1	0.8	0.6	0.8	Boulder
14400	2.73	8	2040	40	12	12		7500	4/6/04	Boulder	Cobble	0.6	0.8	1	0.8	in middle of boulder cascade
14550	2.76	8,10		10+	15	11		7350	4/6/04	Boulder	Cobble	0.9	0.9	0.9	0.9	Big slide
14700	2.78	14		4	53	30		7200	4/6/04	Boulder	Cobble	0.8	0.7	0.8	0.8	Huge boulders, lots of large wood debris
14850	2.81	3	2080	5	35	17		7050	4/6/04	Boulder	Cobble	2.1	+	2.3	1.5	Huge boulders
15000	2.84	10		5	60	40		6900	4/6/04	Boulder	Cobble	+	0.8	0.2	0.3	in middle of plunge pool, cascade, plunge pool
15150	2.87	8		8	50	25		6750	4/6/04	Boulder	Cobble	0.2	+	0.3	0.2	All B/R complex; huge boulders
15300	2.90	10	2120	5.5	48	35		6600	4/6/04	Boulder	Cobble	0.5	0.8	1.1	0.8	
15450	2.93	10		6	68	31		6450	4/6/04	Boulder	Cobble	0.4	+	0.4	0.3	
15600	2.95	3,6	2160	8	27	27		6300	4/6/04	Boulder	Sand	1.1	1.2	0.9	1.1	
15750	2.98	1		8	44	33		6150	4/6/04	Boulder	Sand	0.7	2.3	2.1	1.7	
15900	3.01	2,4		10	85	75		6000	4/6/04	Boulder	Cobble	2.2	+	2.7	1.6	Between large cascade, chutes, pools

Lake Creek Habitat Survey

Distance (ft)	River Mile (RM)	Habitat Type Code (See Table 2-1)	Elev-ation (ft MSL)	Slope (%)	Channel Width (ft)	Wetted Width (ft)	Photo No.	Transect No.	Date	Substrate, Dominant	Substrate, Subdominant	Depth. 1/4	Depth 1/2	Depth 3/4	Depth Mean	Comments
16050	3.04	1	2200	8	64	48		5850	4/6/04	Sand	Boulder	2.2	2.1	0.5	1.6	Tributary, Left Bank, ~ RM 3.1
16200	3.07	2,10		5	49	41		5700	4/6/04	Cobble	Gravel	1.8	0.1	0.8	0.9	
16350	3.10	4		4	61	43		5550	4/6/04	Cobble	Boulder	1.6	2.5	1.1	1.7	
16500	3.13	2,4	2240	5	62	47		5400	4/6/04	Cobble	Sand	0.8	1.4	1.6	1.3	
16650	3.15	4		4	58	33		5250	4/6/04	Boulder	Sand	0.8	1.2	1.2	1.1	transition plunge pool/pool/glide
16800	3.18	3		6	77	62		5100	4/6/04	Boulder	Cobble	0.3	0.8	0.7	0.6	
16950	3.21	3		8	49	38		4950	4/6/04	Boulder	Cobble	0.4	1.9	0.7	1.0	
17100	3.24	3	2280	8.5	65	37		4800	4/6/04	Boulder	Gravel	0.6	2	1.9	1.5	5 ft deep
17250	3.27	10	2320	7	71	63		4650	4/6/04	Boulder	Cobble	0.5	+	0.4	0.3	
17400	3.30	10		5	47	17		4500	4/6/04	Boulder	Gravel	0.7	1	0.2	0.6	
17550	3.32	10		4	48	35		4350	4/6/04	Boulder	Cobble	0.6	0.8	0.8	0.7	
17700	3.35	3		4	43	33		4200	4/6/04	Boulder	Cobble	1.3	0.8	0.9	1.0	
17850	3.38	10		5	85	75		4050	4/6/04	Boulder	Gravel	0.6	+	0.5	0.4	
18000	3.50	10	2320	3	52	40		3900	4/6/04	Boulder	Gravel	0.6	+	0.7	0.4	Creek on left bank, RM 3.5
18150	3.53	3		2	26	13		3750	4/6/04	Boulder	Sand	0.2	2.7	2.8	1.9	
18300	3.56	6	2360	3	44	40		3600	4/6/04	Boulder	Gravel	+	1	1.2	0.7	
18450	3.59	3		3	48	28		3450	4/6/04	Boulder	Cobble	1.2	0.8	0.6	0.9	
18600	3.61	10		3	75	58		3300	4/6/04	Boulder	Cobble	0.2	0.6	0.6	0.5	Large boulders
18750	3.64	3		4	48	32		3150	4/6/04	Cobble	Boulder	0.8	1	0.8	0.9	
18900	3.67	6		2	27	14		3000	4/6/04	Cobble	Boulder	0.7	1.3	0.2	0.7	
19050	3.70	10		5.5	49	31		2850	4/6/04	Cobble	Boulder	0.5	+	0.2	0.2	
19200	3.73	6		3	55	42		2700	4/6/04	Boulder	Gravel	0.8	0.6	+	0.5	
19350	3.76	3		5	60	43		2550	4/6/04	Boulder	Sand	+	1.3	0.8	0.7	Middle of Big plunge pool/large cascade/Glide complex
19400	3.77							2500	4/6/04							Hike out spot ; river bend on left bank
19500	3.78	12,10	2400	4	82	66		2400	4/6/04	Boulder	Cobble	+	0.4	0.6	0.3	
19650	3.81	6		3	61	24		2250	4/6/04	Cobble	Boulder	1.1	1.1	0.7	1.0	Just below left bank channel, plunge pool (Gravel upstream, large wood debris, gravel deposits)
19800	3.84	12,6		3	80	41		2100	4/6/04	Cobble	Boulder	0.9	+	0.6	0.5	Tributary, right bank

Lake Creek Habitat Survey

Distance (ft)	River Mile (RM)	Habitat Type Code (See Table 2-1)	Elev-ation (ft MSL)	Slope (%)	Channel Width (ft)	Wetted Width (ft)	Photo No.	Transect No.	Date	Substrate, Dominant	Substrate, Subdominant	Depth. 1/4	Depth 1/2	Depth 3/4	Depth Mean	Comments
19950	3.87	14,6		2.5	63	56		1950	4/6/04	Cobble	Gravel	+	0.9	0.8	0.6	
20100	3.90	1		4.5	47	47		1800	4/6/04	Sand	Gravel	2.3	1.1	1.4	1.6	Gravel, bedrock, Boulder.
20250	3.93	8,3,10		3.5	195	160		1650	4/6/04	Boulder	Cobble	1.2	+	1	0.7	3 channels; gravel abundant
20400	3.95	14		4	50	22		1500	4/6/04	Boulder	Cobble	1.7	+	0.8	0.8	
20550	3.98	3		5	40	30		1350	4/6/04	Boulder	Cobble	2	2.1	1.7	1.9	Boulder plunge pool/ large cascade
20700	4.01	10	2440	4.5	47	30		1200	4/6/04	Boulder		0.7	0.2	0.8	0.6	
20850	4.04	1		4	25	18		1050	4/6/04	Sand	Cobble	0.6	2.1	2.6	1.8	
21000	4.07	10		3	18	10	9	900	4/6/04	Boulder		0.3	1.5	1.1	1.0	
21150	4.10	10		4	29	22	10	750	4/6/04	Boulder	Cobble	0.5	0.4	1	0.6	Right bank tributary upstream
21300	4.13	10	2480	2	18	8		600	4/6/04	Gravel	Sand	1.1	1.1	0.6	0.9	Good IFIM site for 200 ft
21450	4.15	10		2	31	20		450	4/6/04	Cobble	Boulder	1	0.4	0.8	0.7	Riffle immediately upstream
21600	4.18	12,4		3	52	30		300	4/6/04	Cobble	Boulder	1	+	0.6	0.5	
21750	4.21	2,10		3	37	20		150	4/6/04	Cobble	Boulder	0.3	+	1.2	0.5	Lateral pool with cascacde
21900	4.24	4		2	24	18		0	4/6/04	Cobble	Boulder	0.8	0.6	0.6	0.7	
22050	4.27	1	2616	1	37	34	108	4800	5/20/04	Boulder	Sand	0.4	1.6	0.8	0.93	
22200	4.30	6	2616	1	49	32	107	4650	5/20/04	Boulder	Cobble	0.9	0.1	0.4	0.47	
22350	4.33	6	2616	1	64	34	106	4500	5/20/04	Boulder	Cobble	+	0.8	0.2	0.50	
22500	4.35	6	2616	2	59	30	105	4350	5/20/04	Boulder	Gravel	0.4	0.2	0.4	0.33	Long series of runs
22650	4.38	12,6	2616	2	82	54	104	4200	5/20/04	Boulder	Cobble	0.2	0.5	0.6	0.43	
22800	4.41	6	2616	1	52	27	103	4050	5/20/04	Boulder	Cobble	0.7	+	0.3	0.50	Connecting upstream plunge pool, plunge pool tailout, Glide to same downstream
22950	4.44	6	2631	2	36	28	102	3900	5/20/04	Cobble	Boulder	0.5	0.5	0.4	0.47	connecting plunge pool/Run/glide upstream to same below
23100	4.47	7	2631	3	68	57	101	3750	5/20/04	Boulder	Cobble	1.1	+	0.6	0.85	Wider than usual; plunge pool/glide upstream
23250	4.50	6	2631	3	44	33	100	3600	5/20/04	Boulder	Gravel	1	0.7	0.3	0.67	Shallow run/glide above, large cascade, run below
23400	4.53	6,2	2643	2	40	29	99	3450	5/20/04	Boulder	Gravel	3	2.1	0.5	1.87	Gradient increases downstream
23550	4.55	1,4	2643	2	21	11	98	3300	5/20/04	Boulder	Cobble	1.9	2.3	1.4	1.87	Long glide above, below
23700	4.58	6	2643	3	48	37	97	3150	5/20/04	Cobble	Boulder	0.9	0.2	0.6	0.57	Long series of glides, runs
23850	4.61	3	2649	3	46	39	96	3000	5/20/04	Boulder	-	0.6	1.9	2.1	1.53	Break in slope; PP above, long glide

Lake Creek Habitat Survey

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																below
24000	4.64	12,6	2648	4	87	74	95	2850	5/20/04	Boulder	Cobble	0.6	+	0.2	0.40	Big boulder field
24150	4.67	14,4	2659	5	34	16	94	2700	5/20/04	Boulder	Cobble	0.6	0.8	0.3	0.57	Between PP and large Cascade
24300	4.70	6	2673	4	29	23	93	2550	5/20/04	Cobble	Boulder	0.6	0.2	0.3	0.37	Almost shallow enough for riffle
24450	4.80	4	2675	2	43	37	92	2400	5/20/04	Cobble	Sand	0.9	1	0.8	0.90	Long, wide glide
24600	4.90	12/6,3	2687	8	47	32	91	2250	5/20/04	Boulder	Cobble	1.1	+	0.4	0.75	
24750	4.93	14	2704	10	14	11	90	2100	5/20/04	Sand	Cobble	0.8	0.8	1.1	0.90	
24900	4.96	10	2719	10	18	11	89	1950	5/20/04	Boulder	-	0.6	+	0.4	0.50	Large pool between; fish observed
25000	4.98	Barrier Falls						1850	5/20/04							
25050	4.99	3	2838	7	6	6	88	1800	5/20/04	Boulder	-	1.6	1.6	0.5	1.23	Between large cascade,Chute
25200	5.01	10,2	2853	8	45	38	87	1650	5/20/04	Boulder	Cobble	1.8	+	0.4	1.10	Large cascade/Run/Pool complex; much wood
25350	5.04	1	2780	4	28	27	86	1500	5/20/04	Boulder	-	2.6	1.3	0.3	1.40	middle of large wood debris field
25500	5.07	3	2789	5	25	25	85	1350	5/20/04	Boulder	-	1.4	+	0.3	0.85	Plunge pool below falls
25590	5.09	Barrier Falls						1260	5/20/04							
25650	5.10	4	2800	7	27	12	84	1200	5/20/04	Boulder	Cobble	0.8	0.6	0.4	0.60	
25800	5.13	3	2827	4	37	19	83	1050	5/20/04	Boulder	Cobble	0.6	+	0.4	0.50	Slight split channel
25950	5.16	4	2827	3	34	20	82	900	5/20/04	Boulder	Cobble	1.6	1.2	1.6	1.47	
26100	5.18	14	2831	4	26	7	81	750	5/20/04	Boulder	Sand	1.4	1.3	0.9	1.20	All large substrate
26250	5.21	14,4	2834	6	24	18	80	600	5/20/04	Boulder	Sand	1.6	1.7	0.9	1.40	Part of plunge pool/Run/plunge pool tailout/Glide complex
26400	5.24	11,4	2839	3	54	36	79	450	5/20/04	Boulder	Cobble	0.4	+	0.2	0.30	Most water on right channel
26550	5.27	4	2846	2	48	31	78	300	5/20/04	Boulder	Sand	0.6	0.6	0.9	0.70	Between Transects B&C
26700	5.30	12,3/6	2871	2	37	26	77	150	5/20/04	Cobble	Boulder	0.5	+	0.6	0.55	Below USGS gage: glide
26850	5.33	4	2871	2		26	76	0	5/20/04	Cobble	Boulder	0.8	1	1.1	0.97	

APPENDIX B

PHOTOGRAPHS

(Available on Energy Northwest web site as a separate file)

APPENDIX C

SELECT TRANSECT PHOTOGRAPHS

(Available on Energy Northwest web site as a separate file)