

APPENDIX E.3.1

***TECHNICAL MEMORANDUM FOR
FISHERIES STUDY***

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1.0 Introduction

Studies of aquatic biological resources in the Similkameen River were conducted in the vicinity of the Enloe Hydroelectric Project to updated previous studies (Okanagan County Public Utility District 1981, 2005; FERC 1992) for the license application. Studies were conducted during the spring, summer and fall of 2006 and 2007 to evaluate potential Project impacts on aquatic and fishery resources.

This report describes methods used in characterizing habitats and species. A results section presents data from observations conducted during the field portion of the study and describes habitat types and aquatic species assemblages present in the study area. The discussion section relates these observations to existing data and describes trends and status of sensitive species.

2.0 Methods

STUDY AREA

The Enloe Dam is located on the Similkameen River 8.8 river miles (RM) upstream of the confluence with the Okanogan River. This Project Site is approximately three miles northwest of Oroville, WA and two miles south of the Canadian border. The study area for the ENTRIX aquatic resources surveys included that part of the Similkameen River from the confluence with the Okanogan River (RM 0.0) upstream to the Enloe Dam and within the reservoir to approximately RM 10.3 (Figure 1).

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[App E.3.1 – Figure 1 Fisheries Study Area]

3.0 Habitat Assessments

2006 SURVEYS

ENTRIX biologists conducted aquatic habitat surveys following methods described by Hawkins et al. (1993), Rosgen Channel Typing-Level 1 (1994, 1996), Flosi et al. (1998), and the USFS (2003). Biologists mapped habitats using direct observations noting key characteristics within and along the stream channel. The surveyors used Global Positioning System (GPS) receivers to record the location of each sampling or observation site. Microhabitats shorter in length than the wetted width of the channel were not mapped. ENTRIX biologists used the following characteristics for the assessments:

- Type of riparian vegetation and percentage of bank coverage
- Stream bed substrate composition
- Instream cover components such as bank overhang, large woody debris and/or root wad (wood debris greater than 10 centimeters in diameter and 1.5 meters in length), boulders and emergent vegetation.
- Amount and quality of salmonid spawning habitat (species, substrate size, percent gravel, embeddedness¹, hydraulic conditions)
- Stream dimensions (wetted width, depth)
- Stream gradient
- Water quality (temperature, dissolved oxygen and total dissolved gasses)

Substrate composition for the entire submerged area of a habitat unit and the relative proportion of the dominant and sub-dominant particle size were determined by visual estimation and recorded on the field data sheets. Substrate categories included:

- Organic/Silt/Clay (< 0.06 mm)
- Sands (0.06- 2 mm)
- Fine Gravel (2-16 mm)

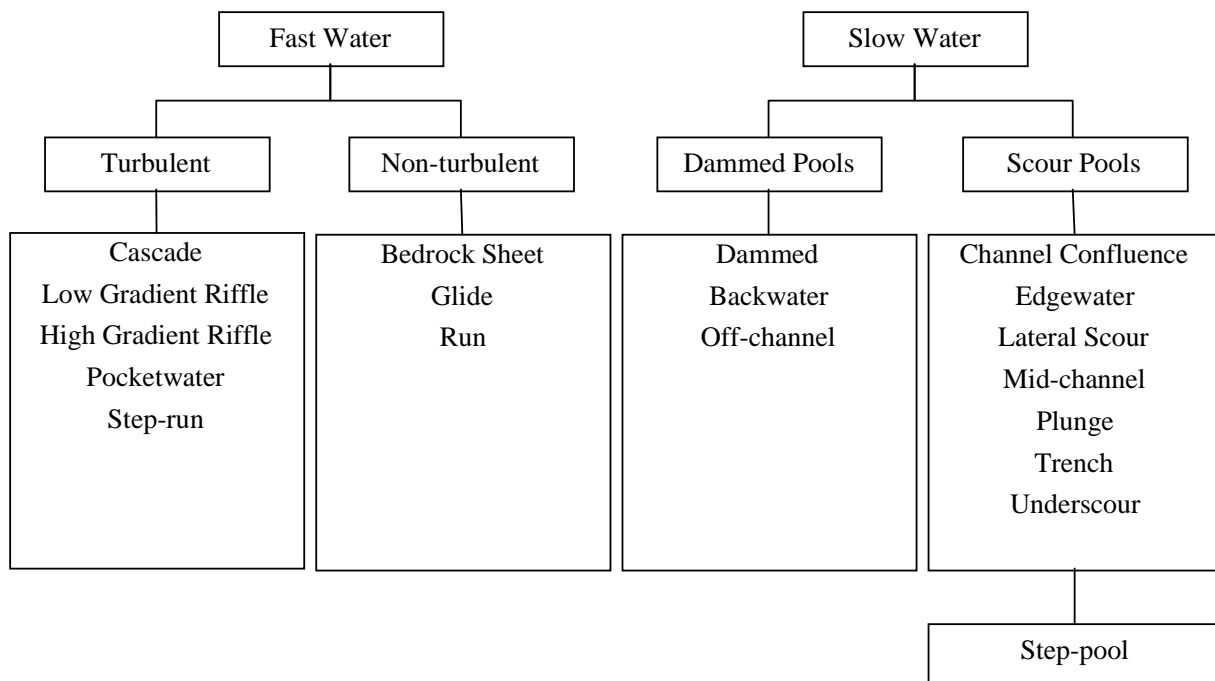
¹ Embeddedness rates the degree to which rocks (gravel, cobble, and boulders) and LWD are covered or buried in sediments of the stream bottom.

- Coarser Gravel (16- 64 mm)
- Cobble (64- 127 mm)
- Rubble (127-250 mm)
- Boulder (250- 4000 mm)
- Bedrock

Aquatic habitat typing used the Hierarchical Habitat Classification System modified from Hawkins et al. (1993) (Figure 2).

Dissolved oxygen (DO), pH and conductivity measurements were taken using a Hydrolab meter (i.e., Standard Method 4500-O G, membrane electrode method). Measurements were taken at most sample areas during the morning and later in the day. A water quality study was conducted during the same time period and within the same general study area as the fisheries studies. The water quality report will incorporate the water quality measurements collected in this study, where appropriate. The Water Quality Report includes a substantially more robust set of data that looked at the same water quality parameters of this study as well as total dissolved gasses. This report will not provide results of the water quality data but the Water Quality technical report is available from the District.

Figure 2: Hierarchical Habitat Classification System Used in the Similkameen River



2007 SURVEYS

ENTRIX biologists conducted fish abundance and distribution surveys twice, during March and July 2007, to represent typical stream temperature and flows, as well as the presence of fish life stages. Fish surveys in the reservoir were conducted using, beach seines, minnow traps, and gill-nets.

Beach Seine

Beach seine sampling was conducted at four locations (sites BS1 through BS4) on the east bank of the reservoir. Sites BS1 and BS2 are located downstream and upstream of the boat ramp (Figure 1). Sites BS3 and BS4 are located in the upstream portion of Enloe Reservoir at Shanker's Bend.

Biologists conducted beach seine sampling with a seine measuring 30 feet long by 5 feet high and with a mesh size of $\frac{1}{4}$ inch. A sampling team pulled the net upstream over a distance of 30 to 45 feet at each site.

Minnow Trap

During each sampling event, ENTRIX biologists set minnow traps along the lateral margins of the reservoir at locations indicated on Figure 1 (TS1 through TS7). These locations were selected during the ENTRIX 2006 survey. Two traps tethered to an onshore anchor point were set at each site in approximately 1 and 4-foot depths.

The traps consist of two pieces of a galvanized steel mesh with their bases hinged together forming a barrel-shaped enclosure. The traps are approximately 16 inches long with a 9-inch diameter and a 1-inch opening on each end. Traps were baited with a mixture of salmon roe and "Power Bait" (a commercial fishing product) wrapped in cheesecloth. Traps were set for approximately 24 hours.

Gill Netting

ENTRIX biologists conducted gill net surveys in the reservoir during the March and July. Four gill nets were placed in the following locations (see Figure 1):

- Immediately downstream of BS1
- 150 yards upstream of BS4
- Immediately upstream of TS4
- Immediately upstream of TS3

The gill nets are 8 feet deep with four 10-ft panels of differing mesh size arranged from smallest to largest. The nets were placed approximately 5 to 10 yards from shore perpendicular to the current with the smallest mesh placed closest to shore. Each net

was tethered to an onshore anchor point and held in place with mushroom anchors. Nets were set for 24 hours.

4.0 Fish Abundance and Distribution

ENTRIX biologists conducted fish abundance and distribution surveys three times during 2006 to represent typical stream temperature and flows, as well as the presence of fish life stages. Surveys were conducted on the following dates:

- 6 and 7 July
- 11 through 13 August
- 11 through 14 September

ENLOE DAM RESERVOIR

Fish surveys in the reservoir were conducted using, beach seines, minnow traps, and electrofishing during the 2006 field season.

Beach Seine

Beach seine sampling was conducted during each of the three sampling events at two locations (sites BS1 and BS2) on the east bank of the reservoir. These were located downstream and upstream of the boat launching facility (Figure 1). Two additional sites farther upstream were surveyed by beach seine in the downstream portion of Shanker's bend during the first survey.

Biologists conducted beach seine sampling with a seine measuring 30 feet long by 5 feet high and with a mesh size of $\frac{1}{4}$ inch. A sampling team pulled the net upstream over a distance of 30 to 45 feet at each site. Relative abundance was estimated by calculating a "catch per unit effort" (CPUE) for each survey.

Minnow Traps

During each sampling event, ENTRIX biologists set minnow traps along the lateral margins of the reservoir at locations indicated on Figure 1 by "TS#." Sites TS1, TS2, and TS3 were on the east bank, while TS4, TS5, TS6, and TS7 were on the west bank (Figure 1). The survey team selected locations with cover and other features attractive to fish, if such structure was present. Two traps were set at each site in approximately 1 and 4-foot depths. A tether fastened the traps to an anchor point on shore.

The traps consisted of two pieces of a galvanized steel mesh with their bases hinged together forming a barrel-shaped enclosure. The traps were approximately 16 inches long with a 9-inch diameter and a 1-inch opening on each end. Bait consisted of salmon

roe and “Power Bait”, a commercial fishing product, wrapped in cheesecloth. Traps were set for a minimum of 24 hours. Catch rates were too low to calculate CPUE for the minnow trap surveys.

Electroshocking

ENTRIX biologists conducted electroshock surveys in the reservoir only during the July and August surveys. Each electrofishing survey consisted of a biologist making a single pass with a backpack electroshocker. Voltage and pulse widths followed guidelines described by NOAA Fisheries (2000) for the appropriate conductivity of the reservoir. These protocols included not using the shockers when sensitive fish species may be spawning, or if redds² are observed in the immediate area.

DOWNSTREAM OF ENLOE DAM

Snorkel Surveys

Because of the potential presence of sensitive species listed as threatened or endangered, capture sampling techniques could not be used downstream of the Enloe Dam. Thus, ENTRIX biologists conducted surveys using snorkeling to assess fish distribution and abundance.

Snorkeling surveys were conducted in August and September, 2006 at sites shown on Figure 1. Snorkeling did not occur during the July sampling event because the water was too turbid to effectively observe fish. Up to three swimmers examined each site with a single pass. When two or three swimmers conducted a survey, they were placed equidistant across the channel. In pool and run habitats, surveyors started upstream of the site and snorkeled with the current. Water depth and velocity determined the survey direction in riffle areas. The biologists recorded the number, species, and size of observed fish using underwater writing materials. The fish were classified into three size categories: small (shorter than 100 millimeters [mm]), medium (100-300 mm), and large (longer than 300 mm).

When the surveyors encountered a salmonid, additional habitat variables were also recorded including behavior, distance from the shore, relative depth of the fish, and dominant substrate. When conditions allowed, the biologists placed markers at the location of the sighting and conducted current velocity readings.

² A redd is a depression created by the female fish using her body and tail, partially suspending the gravel allowing river current to move it downstream.

5.0 Results

HABITAT CHARACTERISTICS

Reservoir

ENTRIX biologists surveyed the portion of the reservoir between the Enloe Dam and approximately RM 9.0 where fish sampling stations were located (Figure 1). Within the surveyed area, submerged bed substrates were mostly sand and silt, with LWD, gravel, and cobble at some sites (Table 1). Steep bedrock (conglomerate) slopes that continued underwater, dominated portions of the shoreline (e.g., TS4, Figure 1).

Bank vegetation along the reservoir included willows, various grasses, and poison oak (Table 1). Little aquatic vegetation was observed, with the exception of a few patches of submerged grasses during the earlier samplings.

Of the fish sampled in the reservoir, only largemouth bass, common carp and yellow perch spawn in lake habitats. Because these three species are non-native, habitat surveys to assess possible spawning sites for resident species were not conducted in the reservoir.

Table 1: Summary of Reservoir Habitat Observations

Survey Site	Habitat Types		Submerged Substrate		Riparian Vegetation		Habitat Features ¹
	Aquatic Habitat	Shoreline Habitat	Dominant	Sub-dominant	Dominant	Coverage	
Trap Sites							
TS-1	Steep bedrock slope	Stepped bank	Bedrock (100%)	NA	None	NA	None
TS-2	Sandy shallows	Beach	Sand (90%)	Organic debris (10%)	Grass	60%	EV
TS-3	Sandy shallows	Vegetated slope	Sand (90%)	Organic debris (10%)	Willow/Poison Oak	80%	RW
TS-4	Cobbly shallows	Vegetated slope	Cobble (60%)	Silt/Clay (40%)	Herbaceous	80%	EV
TS-5	Steep sandy slope	Vegetated slope	Sand (70%)	Boulder (10%)	Herbaceous	60%	None
TS-6	Bedrock Bench	Sheer rock slope	Bedrock (80%)	Organic debris (10%)	Sage brush	10%	EV, LWD
TS-7	Sandy pool	Bedrock bench	Sand (80%)	Cobble (20%)	No data	NA	LWD
Beach Seine Sites							
BS-1	Muddy shallows	Beach	Silt/Clay (100%)	NA	Willow/ Herbaceous	80%	EV
BS-2	Muddy shallows	Beach	Silt/Clay (100%)	NA	Willow/ Herbaceous	80%	LWD
BS-3&4	No data						

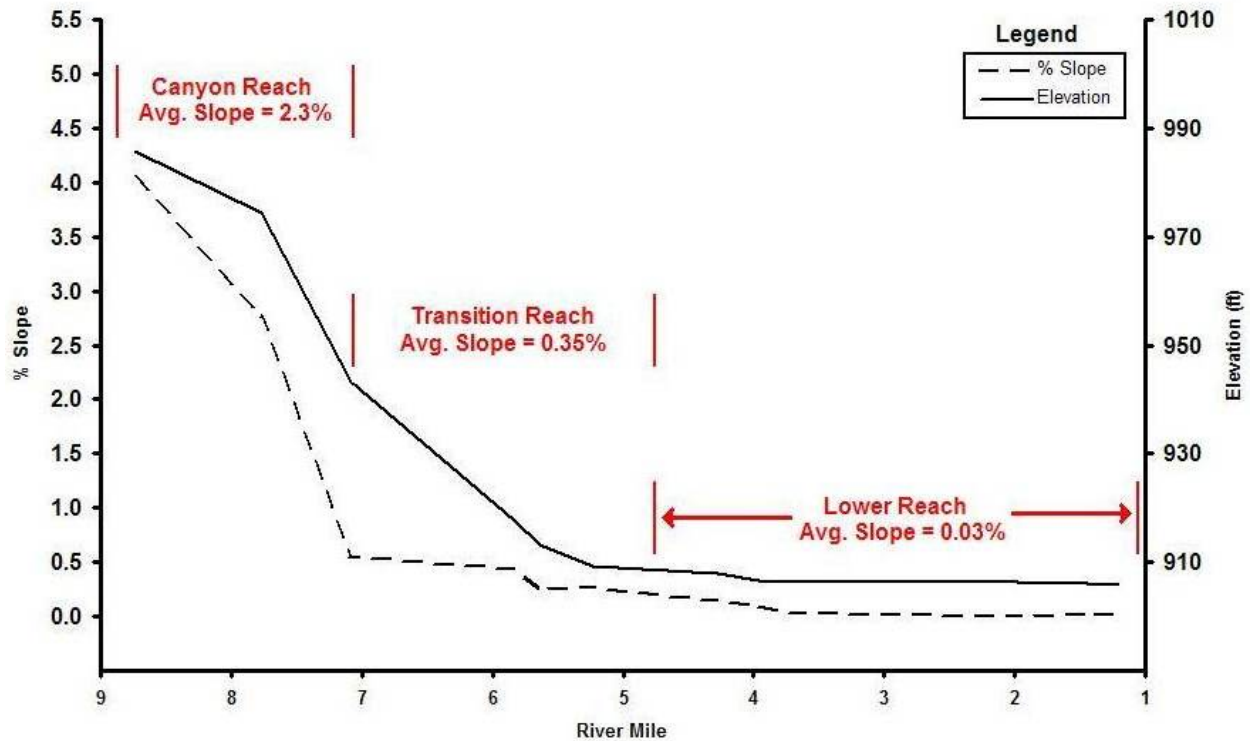
¹ Habitat feature codes: EV = emergent vegetation, LWD = large woody debris, RW = rootwads and overhanging vegetation

**Table 2: Summary of Habitat Characteristics Downstream of Enloe Dam
Depth Measurements Were Determined by Visual Estimation**

Survey Site	Habitat Type	Wetted Width	Length	Mean Depth	Submerged Substrate		Riparian Vegetation		Habitat Features ¹
					Dominant	Sub-dominant	Dominant	Coverage	
Reach 1									
U1	Pool (100%)	80 ft	600 ft	NA ²	Sand (85%)	Boulder (10%)	Herbaceous	20%	B, LWD, UB
U2	Riffle (63%)	160 ft	200 ft	3 ft	Rubble (45%)	Bedrock (35%)	Herbaceous	20%	B, A
	Pool (37%)	150 ft	125 ft	10 ft	Bedrock (90%)	Sand (10%)			
Reach 2									
U3 ³	Run (86%)	60 ft	250 ft	1.5 ft	Cobble (60%)	Sand (20%)	Willow	10%	A, SC
	Riffle (14%)	60 ft	50 ft	1 ft	Cobble (60%)	Rubble (10%)			
U4	Run (100%)	140 ft	3500 ft	3 ft	Rubble (60%)	Cobble (40%)	Willow	80%	B, AS
Reach 3									
1	Run (100%)	120 ft	250 ft	2 ft	Cobble (60%)	Gravel (40%)	Cottonwood/ Alder/Willow	90%	B, BC, BR, RR
2	Riffle (100%)	150 ft	275 ft	<1 ft	Cobble (60%)	Gravel (40%)	Cottonwood/ Alder/Willow	50%	B, SC, BC, LWD, UB, BR
2 (Side Channel)	Pool (83%)	80 ft	130 ft	1 ft	Sand (80%)	Gravel (10%)	Cottonwood/ Alder/Willow	50%	B, SC, BC, LWD, UB, BR
	Riffle (17%)	40 ft	55 ft	<1 ft	Gravel (85%)	Cobble (15%)			
3	Run (86%)	120 ft	200 ft	1.5 ft	Gravel (75%)	Cobble (10%)	Cottonwood	50%	B, SC, BC
	Pool (14%)	50 ft	80 ft	4 ft	Cobble (60%)	Boulder (30%)			
4	Pool (100%)	80 ft	150 ft	2.5 ft	Sand (65%)	Gravel (30%)	Willows/ Herbaceous	60%	B, SC, C, BC, LWD, UB
5	Run (80%)	80 ft	300 ft	1.5 ft	Gravel (50%)	Sand (20%)	Alder	90%	B, C, SC, BC
	Riffle (20%)	60 ft	100 ft	<1 ft	Gravel (80%)	Cobble (10%)			
6	Run (71%)	30 ft	200 ft	<1 ft	Gravel (50%)	Silt (20%)	Alder	90%	B, C, SC, LWD, UB
	Pool (29%)	25 ft	100 ft	2.5 ft	Sand (60%)	Gravel (25%)			

¹ Habitat Feature Codes: A = alcove, AS = artificial structure, B = beach, BC = braided channel, C = confluence, BR = bar, EV = emergent vegetation, LWD = large woody debris, RR = rip-rap, SC = side channel, UB = undercut bank ² Site was too deep to visually estimate depth. River bottom was not visible. ³ Site U3 was a long side channel

Figure 3: Chanel Gradient (defined as % slope) and Elevation of the Similkameen from the Base of Enloe Dam at RM 8.8 to the Confluence with Okanogan River at RM 0.0



Downstream of Enloe Dam

Preliminary observations and examination of habitat characteristics downstream of Enloe Dam indicated that three distinct reaches were present (Figure 3, Table 2). The reaches were separated by differences in stream gradient, habitat type, and dominant substrates.

Reach 1 is the canyon reach with the Enloe Dam as the upper boundary and includes survey sites U1 and U2 (Figure 1). Reach 1, which was characterized by deep pools interspersed with rapids, had a greater channel gradient (Figure 3) than the lower reaches. The dominant substrate was bedrock with a sand channel along the center. This reach also had the greatest depths (Table 2).

Reach 2 was a transition between the canyon and the lower gradient valley and included U3 and U4 (Figure 1). This reach contained a mixture of characteristics shared by the higher gradient canyon and wider alluvial meandering portion of the river. The reach progressed from a high to moderate slope (Figure 2), with a mixture of run, pool, and riffle habitat types (Table 2). While most of the reach contained smaller substrate

than found in the canyon reach, such as cobble and sand, there were also some larger boulders common in the upstream canyon reach.

The lowest reach, Reach 3, was characterized as a braided, low gradient valley stream (Figure 2). This reach included sites 1 through 8 (Figure 1). Cobble and gravel dominated the streambed substrate in Reach 3, though pockets of sand and areas dominated by boulders were also present. The majority of the channel areas were composed of pools and runs with riffles in the side channels (Table 2).

FISH ABUNDANCE AND DISTRIBUTION

Upstream of Enloe Dam

Fish sampling in the reservoir consisted of electrofishing, beach seine, and minnow traps. ENTRIX biologists conducted sampling along the shoreline based on the lack of previous information on smaller fish that use this habitat and potential effects from the Project would be more likely in this habitat. In addition, electrofishing was found to be ineffective, likely due to high water conductivity, and was discontinued after the August survey. Beach seine sampling was conducted at two locations on the east side of the reservoir between RM 8.9 and RM 9.0, and two locations downstream of Shankers bend near RM 10.0 and RM 10.2 (Figure 1). Minnow traps were deployed at seven locations along both sides of the reservoir between the dam and RM 9.0 (Figure 1).

Seven species of fish were collected by the beach seine and minnow trap sampling. The dominant family of species present in the reservoir was Cyprinidae (minnows) at approximately 53 percent of the total catch with an average length of just over 3 inches. The next most common family with 30 percent of the total observations was Centrarchidae (bass and sunfish). A majority of the Centrarchids collected was largemouth bass. Catostomidae (suckers) comprised approximately 10 percent of the total catch. Though not all of the suckers were identified to species, they were all determined to be either largescale suckers or bridgelip suckers. None of the observed suckers exhibited mouths that were conspicuously overhung by the snout, a defining characteristic of the longnose sucker, which is the only other Catostomid known to occur in the Okanogan drainage. Other families collected during the ENTRIX survey include Cottidae (sculpins) Percidae (perch). None of the fish species collected upstream of the dam were state- or federally-listed as threatened or endangered and no salmonids were captured.

The July sampling had the largest number of fish and the most species captured, while the September survey had the least in both categories. The most effective survey method in terms of fish caught was beach seining. The CPUE for beach seines was the number of fish caught per square foot covered by the seine. Because of low catches in September (Table 3), the beach seine catch data was pooled and the total CPUE was 0.075 fish per square foot.

Table 3: Fish Species Collected from Enloe Reservoir during the Summer of 2006

Date	Beach Seines			Minnow Traps			% of Catch
	07/07	08/11	09/14	07/07	08/11	09/14	
Catostomidae (Suckers)							
<i>Catostomid spp.</i> - Suckers	22	1	0	0	1	0	10.2%
Cottidae (Sculpin)							
<i>Cottus spp.</i> - Unidentified Sculpin	2	0	0	0	0	1	1.3%
Centrarchidae (Bass)							
<i>Micropterus salmoides</i> - Largemouth	53	16	0	0	0	0	29.4%
Cyprinidae (Carp & Minnows)							
<i>Cyprinus carpio</i> - Common Carp	14	0	0	0	0	0	6.0%
<i>Cyprinidae spp.</i> - Unidentified Minnows	68	28	1	4	4	3	46.0%
<i>Richardsonius balteatus</i> - Redside Shiner	2	0	0	1	0	0	1.3%
Percidae (Perch)							
<i>Perca flavescens</i> - Yellow Perch	13	1	0	0	0	0	6.0%
Total	174	46	1	5	5	4	

Reservoir

The addition of gill nets to the sampling effort in 2007 allowed for the capture of larger fish that were using deeper habitats thus the mean sample length increased for the most abundant families of fish collected. In 2006 collected cyprinids had an average length of just over 3 inches, while in 2007, the mean length of cyprinids in the samples was 5.7 inches. In addition, three species of fish were collected from Enloe Reservoir during July of 2007 that were not observed in the ENTRIX 2006 study. Chiselmouth (*Acrocheilus alutaceus*) and peamouth (*Mylocheilus caurinus*) were collected from gillnets, and mountain whitefish were collected from a beach seine in Shanker's Bend (Table 4). Chisel mouth and Peamouth are known to occur in the upper Similkameen drainage (Wydoski and Whitney 2003); however they had not been documented in the Project Vicinity during previous studies (IEC Beak 1984, Okanogan PUD 1981).

Table 4: Fish Species Collected in the Enloe Reservoir during 2007

	Beach Seine		Minnow Trap		Gill Net		% of Catch
	3/22	7/24	3/22	7/24	3/22	7/24	
Catostomidae (Suckers)							
<i>Catostomid spp.</i> - Suckers	0	2	1	0	0	2	6.70%
Cottidae (Sculpin)							
<i>Cottus spp.</i> – Unidentified Sculpin	0	0	1	0	0	0	1.30%
Centrarchidae (Bass)							
<i>Micropterus salmoides</i> – Largemouth Bass	0	16	0	0	0	0	21.30%
Cyprinidae (Carp & Minnows)							
<i>Acrocheilus alutaceus</i> - Chiselmouth	0	0	0	0	0	8	10.70%
<i>Cyprinus carpio</i> – Common Carp	0	0	0	0	0	0	0.00%
<i>Cyprinidae spp.</i> – Unidentified Minnows	0	1	0	1	0	0	2.70%
<i>Mylocheilus caurinus</i> - Peamouth	0	0	0	0	0	2	2.70%
<i>Ptychocheilus oregonensis</i> - Northern Pikeminnow	0	0	0	3	0	16	25.30%
<i>Richardsonius balteatus</i> - Redside Shiner	1	0	11	1	0	0	17.30%
<i>Rhinichthys cataractae</i> - Longnose Dace	3	3	0	0	0	0	8.00%
Percidae (Perch)							
<i>Perca flavescens</i> - Yellow Perch	0	1	0	0	0	0	1.30%
Salmonidae (Salmon, Trout & Whitefish)							
<i>Prosopium williamsoni</i> - Mountain Whitefish	0	2	0	0	0	0	2.70%
Total	4	25	13	5	0	28	100%

Downstream of Enloe Dam

Smallmouth bass dominated the fish assemblage in Reach 1, in the canyon habitat below the dam (Table 5). The snorkeling survey team also observed rainbow trout, suckers, and northern pikeminnow in this area. Adult Chinook salmon were observed jumping at multiple locations, but were not counted because they could not be seen underwater due to poor visibility and pool depths beyond the visual range of the biologists. The data does not indicate a clear distinction in abundance between sampling dates in this reach (Table 5).

Suckers (Catostomidae) dominated Reach 2, the transition area, with more fish observed in September (Table 5). Bass (largemouth and smallmouth) were also relatively abundant in August, mountain whitefish in September, and northern pikeminnow with equal numbers in August and September. Rainbow trout were also more abundant in Reach 2 than in Reach 1.

Cyprinidae (minnows) were the most abundant fish in the low gradient habitats of Reach 3 with more observations than any other species or group (Table 5). The snorkeling

survey team could not identify these fish to the species level because of their small size. Suckers and bass were also relatively abundant.

Table 5: Fish Species Observed Downstream of Enloe Falls during the Summer of 2006

Date (mm/dd)	Reach 1		Reach 2		Reach 3		% of Catch
	07/07	08/11	09/14	07/07	08/11	09/14	
Catostomidae (Suckers)							
<i>Catostomid spp.</i> – Suckers	0	1	53	176	29	314	22.0%
Centrarchidae (Bass)							
<i>Micropterus salmoides</i> – Largemouth	0	0	12	7	42	25	3.3%
<i>Micropterus dolomieu</i> – Smallmouth	13	20	32	8	101	92	10.2%
Cottidae							
<i>Cottus spp.</i> – Unidentified Sculpins	0	0	1	3	3	6	0.5%
Cyprinidae							
<i>Cyprinus carpio</i> – Common Carp	0	0	0	0	0	13	0.5%
<i>Cyprinid spp.</i> – Unidentified Minnows	0	0	5	0	472	737	46.6%
<i>Ptychocheilus oregonensis</i> – Northern Pikeminnow	0	1	21	21	15	0	2.2%
Salmonidae							
<i>Oncorhynchus mykiss</i> – Rainbow Trout (juveniles)	3	1	16	8	115	77	8.4%
<i>Oncorhynchus mykiss</i> – Steelhead (adults)	0	0	0	0	0	3	0.1%
<i>Oncorhynchus nerka</i> – Sockeye	0	0	2	0	0	13	0.6%
<i>Oncorhynchus tshawytscha</i> – Chinook	0	0	0	0	0	33	1.3%
<i>Prosopium williamsoni</i> – Mountain Whitefish	0	0	1	24	41	47	4.3%
Total Observations	16	23	143	247	818	1360	

Of the salmonids observed in the study area below the dam, rainbow trout were the most abundant in Reach 3 with greater numbers in the August sampling period. Most (73 percent) of the rainbow trout in all reaches were between 4 and 12 inches long (total length). Habitat characteristics were recorded for a sub-sample of the rainbow trout observations. The trout were typically located in areas with water depths between 0.9 and 3.3 feet and an average depth of 2.2 feet. Water velocity readings ranged from 0 feet per second to 2.9 feet per second, with an average velocity of 1.5 feet per second. The trout were associated with various forms of cover.

The CPUEs for the snorkel surveys were calculated as the number of fish observed per square foot of area surveyed by the team. Of the three downstream reaches, Reach 3 had the highest average CPUE (0.002 fish per square foot), and also had had the

highest overall fish count (2,180). Reach 1 had the lowest CPUE (0.001 fish per square foot) and fish count (39).

FRESHWATER MUSSELS

There are four species of mussels thought to occur in the Similkameen River. The Washington Department of Fish and Wildlife (WDFW) (2005a) reported that two species of freshwater mussels occur in the portion of the Similkameen River included in this study by ENTRIX. These include the “western ridged mussel” (*Gonidea angulata*), and the “western pearlshell”³ (*Margaritifera falcata*). According to data from the WDFW, the western ridged mussel is the most abundant species in the Similkameen. WDFW also found the “western floater” (*Anodonta kennerlyi*) upstream of the study area but only in Palmer Creek. The California floater (*Anodonta californiensis*) are known to occur in the Okanogan River, and one individual has been identified in the Similkameen River (Iten, Pers. Com.).

These mussels are typically buried in soft sediments with only the upper edge of the shells exposed. To prevent harm to the mussels by removing them from the substrate and because of the difficulty in discriminating species during a snorkeling survey, the ENTRIX biologists recorded all observations of mussels as “Unidentified Freshwater Mussel”.

The typical length of mussels observed in the 2006 survey was approximately 2 to 3 inches. The ENTRIX biologists found the highest number (200) of mussels at Site 7 in Reach 3. Mussel relative abundance increased downstream from the dam with increasing prevalence of finer sediments.

DISCUSSION

The Enloe Dam was constructed in 1929 on an existing falls that prevented the establishment of anadromous fish populations above the falls (Okanogan County Public Utility District 1981, 2005; FERC 1992). Because of the presence of the falls, the fishery in the upper Similkameen River Basin has historically been restricted to resident species (Table 5) with neither a historic nor a current anadromous component as indicated by previous studies (Mitchell 1980, IEC Beak 1984, Okanogan County Public Utility District 1991). In addition, the studies referenced in Table 6 did not find any federally-threatened or endangered species in the upstream portion of the Similkameen River.

The reservoir extends upstream to approximately RM 11 and averages about 200 feet wide. Since construction of the dam, the reservoir has stored a large amount of

³ Standardized common and scientific names are from Turgeon, D.D. et al. 1998. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks. Second Edition. American Fisheries Society Special Publication 26.

sediment that averages approximately 9 feet deep with a volume of about 400 acre-feet (Okanogan County Public Utility District 2005). Scouring still occurs in narrow areas of the reservoir causing a depression with a maximum depth of 60 feet approximately 500 feet upstream of the dam. Residence time for water in the reservoir under mean flow conditions is about 3 hours (Okanogan County Public Utility District 2005) with an average stream velocity of over 0.5 miles an hour.

Previous studies in the Similkameen River (IEC Beak 1984 and Okanogan PUD 1991) utilized different sampling gear than the ENTRIX (2006) investigation, and the IEC Beak study covered a much broader area, including rivers and streams that join the Similkameen River in Canada. The IEC Beak study relied primarily on backpack electrofishing in shallow areas and snorkeling in deeper areas. Bank seining was used in a few areas, but no seine hauls were taken within or near Enloe reservoir. The IEC beak study found three species that were not observed in the ENTRIX studies; black crappie, Kokanee, and longnose dace. (Table 6). However, only one black crappie was observed in the entire study and Kokanee were only observed dead or spawned out in Sinlahekin Creek, which is above Palmer Lake well above the Project. The IEC Beak study also documented Rainbow trout upstream of Enloe Dam in Canada and no trout were observed between U.S./Canadian border and Enloe Dam.

The Okanogan County Public Utility District study (1991) used boat electrofishing and gill-netting to collect fish above Enloe Dam and snorkel surveys below Enloe Dam. The District documented two species that were not observed in the ENTRIX study; burbot and black crappie (Table 6). Only a single specimen of burbot was collected from an unspecified location in the Okanogan County Public Utility District (1991) study.

Table 6: Resident Fish Species Documented in the Vicinity of Enloe Dam in Three Separate Studies

Species		Source		
Scientific Name	Common Name	IEC Beak (1984)	Okanogan PUD (1991)	ENTRIX (2006)
Catostomidae				
<i>Catostomus columbianus</i>	Bridgelip Suckers	D ¹	U	U
<i>Catostomus macrocheilus</i>	Largescale Suckers		U/D	U/D
Centrarchidae				
<i>Lepomis spp.</i>	Unidentified Sunfish			U
<i>Micropterus dolomieu</i>	Smallmouth Bass			U
<i>Micropterus salmoides</i>	Largemouth Bass		U/D	U/D
<i>Pomoxis nigromaculatus</i>	Black Crappie	D	D	
Cottidae				
<i>Cottus spp.</i>	Sculpins	D	U/D	U/D
Cyprinidae				
<i>Cyprinus carpio</i>	Common Carp			U/D
<i>Cyprinidae spp.</i>	Unidentified minnows		U	U/D
<i>Ptychocheilus oregonensis</i>	Northern Pikeminnow	D	U	D
<i>Rhinichthys cataractae</i>	Longnose Dace	U/D		
<i>Richardsonius balteatus</i>	Redside Shiner		U	U/D
Gadidae				
<i>Lota lota</i>	Burbot		U	
Percidae				
<i>Perca flavescens</i>	Yellow Perch			U
Salmonidae				
<i>Oncorhynchus sp.</i>	Unidentified Trout		D	
<i>Oncorhynchus mykiss</i>	Rainbow Trout	U*	D	D
<i>Oncorhynchus nerka</i>	Kokanee	U		
<i>Prosopium williamsoni</i>	Mountain Whitefish	D	U/D	D

U = upstream of Enloe Dam, D = downstream of Similkameen Falls, U* = upstream above Project Boundary, in Canada

ENTRIX biologists documented two species that were not found in either of the previous studies; common carp and smallmouth bass (Table 5). The ENTRIX study was designed to sample smaller fish and fish that stayed closer to shore because potential for impact on those fish is likely greater and sampling techniques that target smaller shoreline oriented fish were not utilized in previous studies.

Anadromous and native freshwater fish below the dam including Chinook salmon, rainbow trout, and mountain whitefish historically occurred in the Similkameen River (Okanogan PUD 1981, 2005; FERC 1992). In addition, non-native warm-water fish species have been introduced (WDFW 2005b) into the Okanogan and Columbia River systems and are present in the Similkameen River. These species include cyprinids (minnows and carp), largemouth and smallmouth bass, and yellow perch.

Annual surveys performed by Okanogan Basin Monitoring and Evaluation Project (OBMEP) since 2005 provided specific data on anadromous fish populations and habitat conditions in the Okanogan River basin. The surveys include assessment of the distribution and abundance of anadromous salmonids, redds, and habitat quality. Among the survey sites used is a 8.8-mile stretch of the Similkameen River from the confluence with the Okanogan River up to the Enloe Dam, which overlaps with the survey sites used by ENTRIX. Specific monitoring locations were determined by applying the Environmental Monitoring and Assessment Program⁴ (EMAP) sampling design with a combination of annual locations and panel locations on a 5-year rotating schedule. Of the two sites along the Similkameen, one location (#46) is annual and the other (#352) is a panel site. Site 46 is located in the vicinity of Site U4 in the ENTRIX survey. Site 352 is located further downstream of the ENTRIX survey sites, near the confluence with the Okanogan River.

In 2005, OBMEP performed snorkel surveys in two locations along the stretch of the Similkameen to assess the fish populations. The total number of fish counted at site 46 was 266, which included no salmonids. Suckers were the dominant group with a total of 159 individuals. The fish density was 226.1 fish per square mile. Site 352 had a total fish count of 102, which included one juvenile steelhead trout and three adult sockeye and two adult Chinook salmon. Suckers were the dominant group counted consisting of 38 fish. The total fish density was 194.2 fish per square mile. The density of salmonids was 11.4 fish per square mile. The low number of anadromous fish observed was believed to be partially due to the atypical river conditions during the time of the survey. There was an abnormally warm winter previous to the surveys, which lead to a low snow pack, early runoff, and warmer water temperatures. Due to differences in methods, surveyor experience, and survey times, the results between the OBMEP fish surveys and the ENTRIX work are not possible to compare at this time.

OBMEP also performed surveys of the steelhead redd distribution along the same stretch of the Similkameen in 2005 and 2006. In both years, the surveys were performed on two days during the span of March to April. In 2005, a total of 106 redds were counted, for a density of 18.8 redds per square mile. In 2006, 98 redds were observed with a density of 17.4 redds per square mile. For both years, the majority of redds were found below the bridge crossing in Oroville and above the cross-channel

⁴ See the US EPA Internet site <http://www.epa.gov/esd/land-sci/water/streams.htm> for additional information on EMAP. Accessed January 8, 2007.

with the Okanogan River. This distribution coincides with ENTRIX survey sites U4 through Site 8 (Bottom of Reach 2 and all of Reach 3).

In the OPMEP studies the greatest concentration of redds occurred in the lower braided reach of the Similkameen River between the upstream boundary of the braided reach and the cross channel that flows between the Okanogan River and The Similkameen River (Figure 3). However, OPBMEP documented redds throughout the canyon reach and the transition reach (Figure 3).

The reach between the cross channel and the confluence of the two rivers was not surveyed during either study, but habitat conditions in this reach are similar to those in the reach between the cross channel and the upstream boundary of the braided reach. In all likelihood, steelhead and Chinook use the unsurveyed area.

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