WRIA 40 DIVERSION SCREENING AND FISH PASSAGE INVENTORY REPORT

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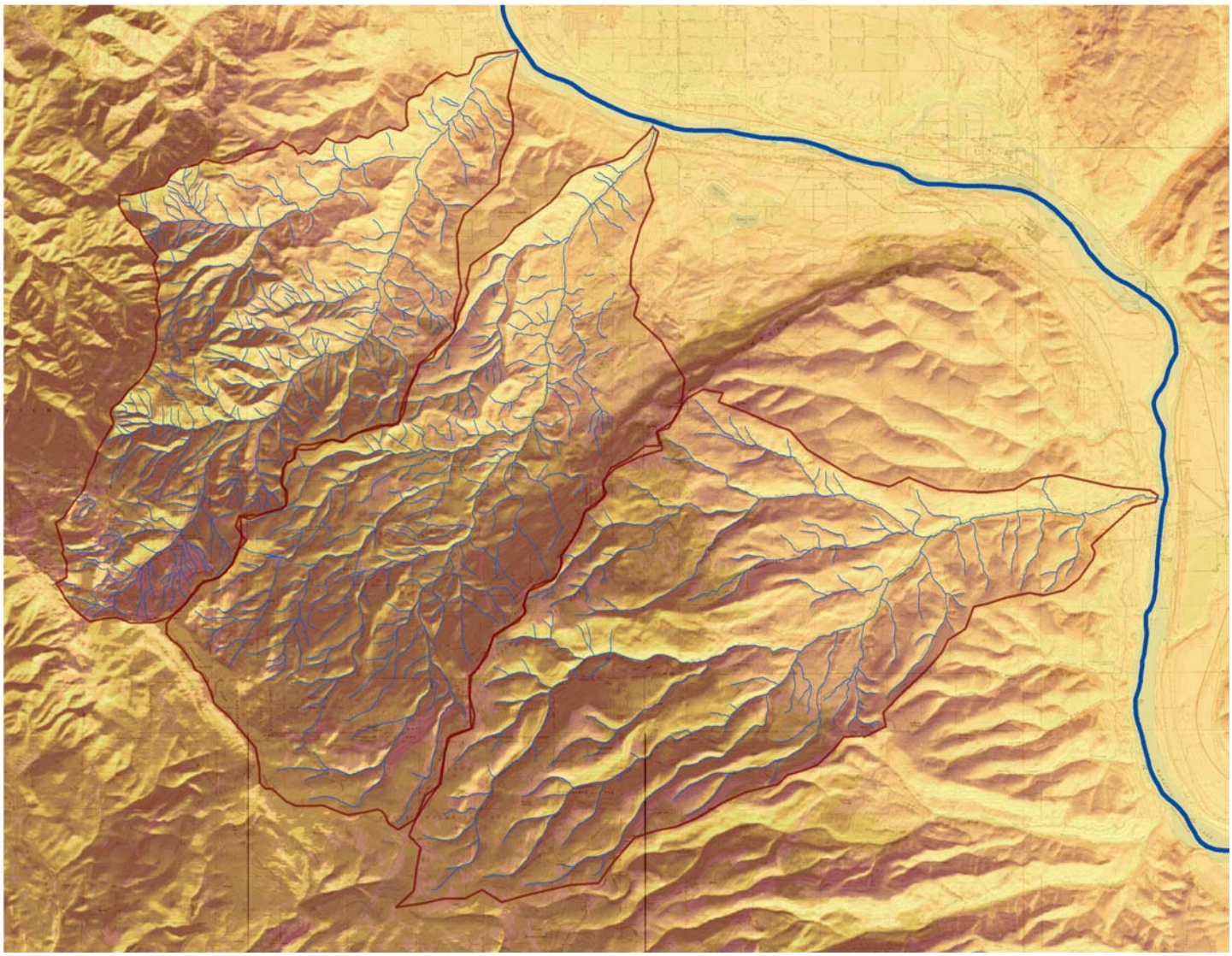
November 16, 2006



Washington State Department of Fish and Wildlife

HABITAT PROGRAM
TECHNICAL APPLICATIONS DIVISION

Diversion Screening and Fish Passage Inventory Report for Colockum Creek, Stemilt Creek and Squilchuck Creek

November 2006

For fulfillment of contract deliverables for WDFW Project # 05-2457;
U. S. Fish and Wildlife Service Contract # X-1-D-22

This report is available online in pdf format at: http://wdfw.wa.gov/hab/tapps/erta_west.htm

For more information about WDFW fish passage inventories, contact Dave Caudill, WDFW
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INTRODUCTION

Surface Water Diversion Screening and Fish Passage Barrier Inventory

The Washington Department of Fish and Wildlife (WDFW) conducted a comprehensive diversion screening and fish passage barrier assessment for three streams in Chelan County, Water Resource Inventory Area (WRIA) 40, from April to August 2006. WDFW's North Central Region 2 staff manages this portion of WRIA 40.

The U. S. Fish and Wildlife Service funded the inventory through the Federal Restoration and Irrigation Mitigation Act (FRIMA). This project assessed available habitat on private and public lands downstream of the Colockum Wildlife Area to the Columbia River and addressed two factors limiting anadromous salmonid populations:

1) Salmonid mortality resulting from contact with unscreened or inadequately screened surface water diversions
2) Human-made barriers to fish passage

Unscreened or insufficiently screened surface water diversions frequently result in fish injury or direct mortality. Gravity diversion ditches resemble side channels in which juvenile salmonids normally find refuge. Consequently, when diversion head gates are shut, access back to the main channel is cut off and the channel or diversion ditch is subject to desiccation. Impingement or mutilation from inadequate screens (i.e., gaps or oversized screen openings) also increases mortality of juveniles. Excessive approach velocity can draw juveniles into unscreened diversion pipes, where they are mutilated when contacting pump mechanisms, causing costly damage to pumps and disrupting irrigation schedules.

Productive habitat becomes inaccessible for fish migration when human-made structures such as dams, culverts, fords and pipeline crossings become barriers. Unimpeded passage is paramount to obtaining access to suitable spawning gravel and juvenile rearing habitat, maximizing carrying capacity. Resident trout are equally in need of full stream access, migrating upstream or downstream, in order to maximize genetic interchange.

Locations of human-made structures assessed for fish safety and/or fish passage are referred to as sites for this report. Structures existing at the sites are identified as features. A partial list of features affecting fish safety or fish passage includes gravity diversions, pump diversions, culverts, dams, fishways. A site may contain one or more features associated with it. For example, a dam may accompany a surface water diversion or be equipped with a fishway to facilitate fish passage. Stream measurements stated in River Miles (RM) are approximated from the confluence.

The primary goal of this inventory is to assess unscreened or inadequately screened surface water diversions. The secondary goals are to identify fish passage barriers and to assess the potential available habitat gain for each feature. This report summarizes the results from three tributaries to the Columbia River within the Alkali-Squilchuck Subbasin--Colockum, Stemilt and Squilchuck creeks (Fig.1), which lie south of the city of Wenatchee and drain

directly into the Columbia River at RMs 450.0, 461.9 and 464.0, respectively (Andonaegui 2001).

Information collected provides a snapshot in time based on 2006 stream conditions. Data obtained from the diversion screening and fish passage inventory and concurrent habitat survey will allow for prioritization for correction of noncompliant surface water diversions and fish passage barriers to ensure compliance with Washington State laws (RCW 77.55.040, RCW 77.55.060).

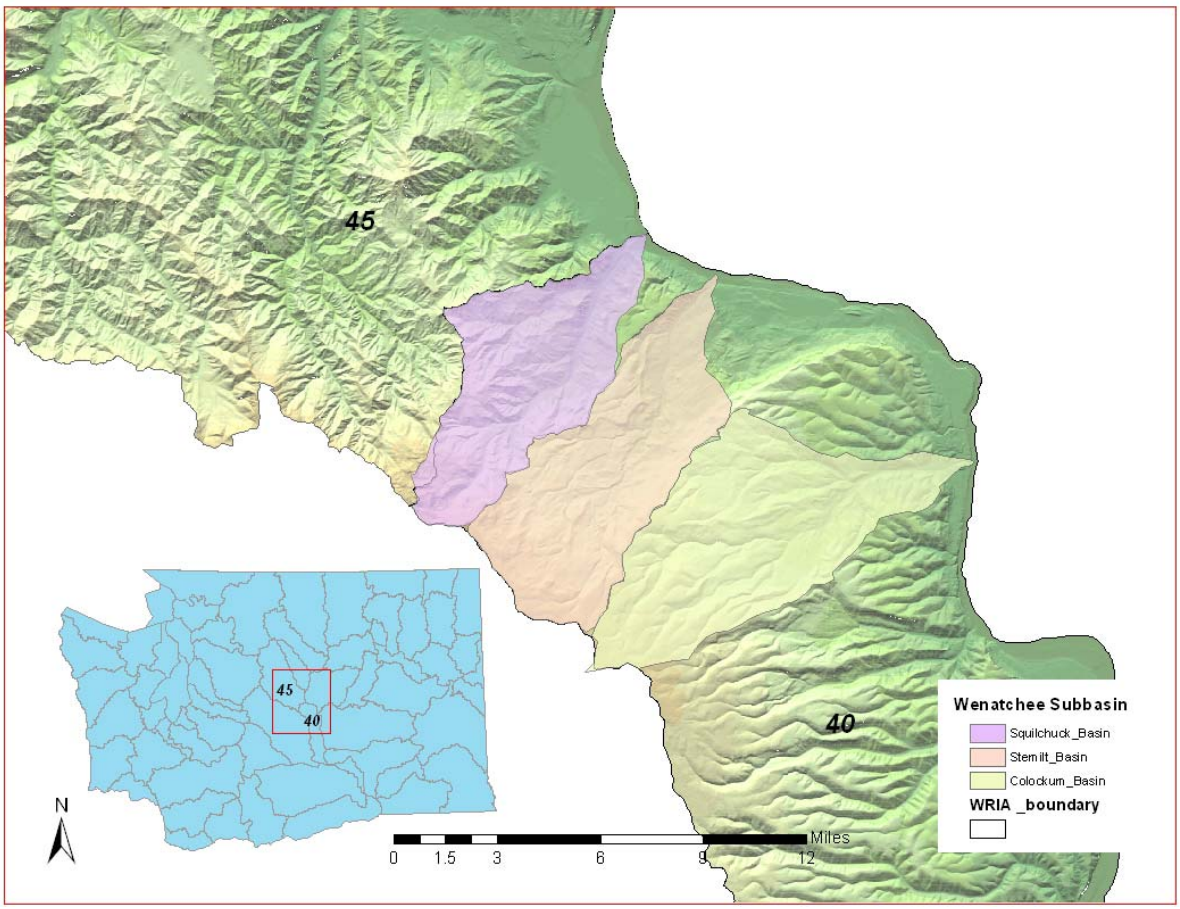

Figure 1. Alkali-Squilchuck Subbasin includes Squilchuck, Stemilt and Colockum watersheds.

Stream Selection Criteria

The Colockum, Stemilt and Squilchuck watersheds were selected for study by WDFW Region 2 staff to supplement data contained in the Salmon, Steelhead and Bull Trout Habitat Limiting Factors Water Resource Inventory Report (Andonaegui 2001) released by the Washington State Conservation Commission. Anadromous salmonid utilization has been documented in Colockum, Stemilt and Squilchuck creeks according to the Washington State Salmon and Steelhead Stock Inventory report (SASSI, WDFW 1993). These streams also support resident rainbow/cutthroat and introduced brook trout (B. Steele, pers. comm., 2006).

Low instream flows and desiccation naturally occur in some reaches of Colockum, Stemilt and Squilchuck creeks. In addition, many small tributaries in this subbasin are seasonally dry, transporting surface flow only during storm events and spring runoff. Tributaries lacking flow during the time frame salmonids would be utilizing them were not included in this inventory.

In 2001, Chelan County inventoried adjacent county roads for fish passage barriers. The Washington Department of Natural Resources (DNR) also previously inventoried road crossings contained on their lands. WDFW's inventory completed data records of previously identified features, if needed, as well as assessed the quantity and quality of potential habitat gain for each barrier. RH2 Engineering, under contract from Chelan County and direction from the Squilchuck/Stemilt Watershed Planning Unit, is currently conducting an assessment of water supply and storage within the two watersheds. The Watershed Plan Report is tentatively due for release in July 2007 (B. Sullivan, RH2 Engineering, pers. comm., 2006).

Colockum Watershed Overview (WRIA 40.0760)

The Colockum Creek headwaters begin at the southern end of Naneum Ridge, traveling east approximately 13 miles (mi) before entering the Columbia River at RM 450.0. Elevation ranges from 5,800 feet (ft) at the headwaters to 550 ft at the mouth. The lower 4.3 mi of Colockum Creek meanders through private ownership surrounded by orchards and pastures. The remaining area is managed by state and federal agencies for timber production and recreation.

Stream flow is primarily from snowmelt and fluctuates from year to year. Flow naturally tapers through the summer months after heavy spring runoff has subsided. Numerous draws in the lower basin input water only during storm events and spring runoff and were not included as productive habitat for anadromous fish species. ESA listed chinook and summer steelhead utilize reaches within Colockum Creek and its tributaries. Resident rainbow/cutthroat trout as well as planted brook trout are currently found throughout the watershed (B. Steele, WDFW, pers. comm., 2006). Barrier correction and restoration efforts could benefit these species as well as Columbia River coho.

Ivy Walker and Kingsbury canyons enter Colockum Creek from the left bank at RM 2.6. Both tributaries experience late summer drying. Ivy Walker Canyon was assessed as non-fish bearing and was not surveyed. Kingsbury Canyon was surveyed to the end of fish use at RM 0.6. Robinson Canyon, another non-fish bearing tributary, enters Colockum Creek from the right bank at RM 2.8.

Colockum Creek splits into North Fork and South Fork Colockum creeks at RM 5.4. The north fork basin area is the larger of the two; therefore, the habitat survey continued along the north fork as the mainstem. SF Colockum Creek, originating at 5,600 ft elevation on the northern slope of Naneum Ridge, is the largest tributary of Colockum Creek, with most of its 6.8 mi^2 basin lying within the Colockum Wildlife Area. An unnamed tributary to SF Colockum Creek enters from the right bank at RM 1.2. The last fish-bearing tributary to NF

Colockum Creek enters from the right bank at RM 6.9. This unnamed spring originates at approximately 5,000 ft elevation and travels in a narrow, steep canyon defined by talus slopes.

Colockum Creek was adjudicated in 1913 with no provisions for minimum instream flow (Andonaegui 2001). Water use and permeable soils reduce the amount of surface flow reaching the mouth of Colockum Creek during the summer low flow period. There are no organized irrigation districts operating in the Colockum watershed.

Stemilt Watershed Overview (WRIA 40.0808)

Stemilt Creek lies between the Squilchuck Creek and Colockum Creek drainages on the northwest side of Jumpoff Ridge. Stemilt Creek originates at 6,300 ft elevation at Naneum Ridge, traveling 12.7 mi northerly before entering the Columbia River at RM 461.9. Fish bearing tributaries to Stemilt Creek include Orr Creek (RM 4.4), Little Stemilt Creek (RM 6.8), an unnamed creek (RM 7.1) and Middle Creek, which drains to Orr Creek (RM 2.0). Numerous seasonally dry washes, draining to the lower mainstem, transport water only during storm events and spring runoff. The lower 6.0 mi flow through private agriculture property.

Fish species potentially utilizing Stemilt Creek and its tributaries for spawning and rearing include ESA listed chinook and steelhead. Coho, in addition to other salmonid species, may also benefit from correction and restoration efforts. Resident rainbow/cutthroat trout as well as planted brook trout are currently found throughout the watershed (B. Steele, WDFW, pers. comm., 2006).

The Stemilt watershed was adjudicated in 1926 with no provisions for minimum instream flow (Andonaegui 2001). Claims for surface water diversions date to the late 1800's with many of those same families residing in the watershed today. The Stemilt watershed is a highly productive fruit producing area within central Washington resulting from years of prudent irrigation water management. As the need for irrigation water increased, storage ponds were created throughout the watershed. Four irrigation districts currently operate in the Stemilt watershed: Kennedy-Lockwood Irrigation District, Lower Stemilt Irrigation District, Stemilt Irrigation District and Wenatchee Heights Reclamation District. A few surface water diversions purposefully transfer water across drainages within the Stemilt watershed and, in one instance, into the adjacent watershed via a network of ditches, dikes and pipes.

Squilchuck Watershed Overview (WRIA 40.0836)

The Squilchuck Creek watershed is the northernmost watershed within WRIA 40, originating near Mission Peak at 6,800 ft elevation, traveling 10.6 mi northeast to the Columbia River. The lower 9.6 mi flow through private property. The upper mile is contained within the Mission Ridge Ski Area and is cooperatively managed by state, federal and private entities. The Colockum Wildlife Area envelops the headwater tributaries.

Fish-bearing tributaries to Squilchuck Creek include Pitcher Canyon Creek (RM 2.1), an unnamed creek flowing through Squilchuck State Park (RM 7.2), Miners Run Creek (RM 7.0) and an unnamed tributary to Miners Run Creek (RM 0.4). Lake Creek at RM 9.7 exceeds the average gradient limit to be considered productive for anadromous fish, however resident fish populations thrive in ponds near the top of the drainage. Numerous seasonally dry drainages transport water only during severe storm events and spring runoff.

Fish species potentially utilizing Squilchuck Creek and its tributaries for spawning and rearing include ESA listed chinook and steelhead. Resident rainbow trout, west slope cutthroat trout and brook trout (planted) are currently found throughout the watershed. Coho juveniles have been found in the lower 0.3 mi of Squilchuck Creek and could also benefit from correction and restoration efforts (B. Steele, WDFW, pers. comm., 2006).

The Squilchuck watershed was adjudicated in 1926 with no provisions for minimum instream flow (Andonaegui 2001). Claims for surface water diversions date to the late 1800's, with several pioneering families residing in the watershed today. The demand for irrigation water has dictated land use practices as evidenced by numerous points of diversion, as well as the need to transport water from the adjacent watershed, the Columbia River and the Wenatchee River to cover shortfalls. Residential development in the watershed has increased dramatically over the last several years.

Five irrigation districts operate in the Squilchuck watershed: Wenatchee Heights Reclamation District (from Stemilt Creek), Squilchuck-Miller Irrigation, Squilchuck Water Users Association, Beehive Irrigation District and the Highline Ditch. Squilchuck-Miller Irrigation users have senior water rights, providing a continuous water supply despite seasonal changes in stream flow. The Beehive Diversion is located on Lake Creek, which was not included in this inventory. The Squilchuck Water Users Association allows individual surface water diversions to operate to their maximum capacity until natural stream flow drops below a predetermined threshold, at which time the diversions are required to shut down. The Highline Ditch diverts water from mainstem Squilchuck Creek year round (B. Sullivan, RH2 Engineering, pers. comm., 2006).

METHODS

Landowners were identified using parcel information from the Chelan County Assessor's Office. Letters describing the project and requesting property access and active participation were sent to private landowners located within Colockum, Stemilt and Squilchuck watershed basins. Reply letters and self addressed, stamped envelopes were also included to facilitate responses and to reduce the cost of contacting each individual landowner personally. WDFW personnel made every attempt to accommodate special requests, such as day-of notification and answering additional questions and concerns regarding this project. Persons denying stream access were contacted at the time of the physical habitat survey only to mark property boundaries so that the crew could exit and reenter the stream expeditiously.

Feature Inventory

A crew of two WDFW personnel walked each stream, beginning at its mouth, until reaching its headwaters or the Colockum Wildlife Area boundary, whichever came first. Human-made features encountered during the survey were identified and evaluated for fish safety (gravity diversions and pump diversions) and fish passage (culverts, dams, etc.) using methodologies described in *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

Each encountered feature received a unique Site ID number except for associated features (*e.g.* dam with diversion), which share a common Site ID. At each site, measurements of the human-made structure were taken as well as a general description of the area. Each surface water diversion feature failing the screening evaluation was classified as noncompliant. Each fish passage feature failing evaluation was classified as a barrier then evaluated for percent passability (WDFW 2000). Geographic locations were recorded using a Trimble GeoExplorer II in decimal degrees based on the WGS84 datum. Feature dimensions were measured with a Sokkia 7.1 meter (m) telescoping stadia rod. Slope and length of culverts were measured with a Laser Technology Inc. laser (Model Impulse LR) mounted on a monopod.

Habitat Assessment

Physical habitat surveys were conducted in order to assess the quantity and quality of available habitat upstream of barrier sites. WDFW crews conducted physical habitat surveys on Colockum, Stemilt, Squilchuck creeks and their tributaries concurrently with feature evaluations. Another WDFW crew concurrently surveyed stream reaches contained within the Colockum Wildlife Area. Data collected by both teams were combined in order to quantify potential habitat upstream of human-made barriers within each watershed. Detailed passage barrier and habitat data for the Colockum Wildlife Area can be obtained by contacting Dave Caudill (see contact page).

Surveys began at the confluence of each stream. The distance from the mouth to the first encountered human-made barrier, referred to as the downstream check, was measured to the nearest tenth meter using a hip chain with biodegradable thread. The purpose of the downstream check is to ensure no natural barriers exist that would preclude anadromous access. Gradient, channel description, predominant flora, canopy, water temperature and instream cover were also noted, as well as land use conditions that may affect stream or water quality. Surveyed stream lengths are reported as a total of the downstream check plus the available upstream habitat.

Habitat sampling began immediately upstream of the first encountered barrier. The sampling frequency was chosen based on the overall stream length. One 60-meter sample was taken per reach. A reach is any section of stream with similar physical characteristics. The first two pools and riffles in each sample were recorded for length, wetted width, ordinary high water width, water depth and substrate composition. Lengths of each additional pool and riffle were measured until reaching the end of the sample section. Rapids were also

measured when encountered within the 60-meter sample section. The survey continued until changes in stream characteristic warranted breaking reach wherein a new sample began.

Crewmembers independently determined quantitative values for spring influence, instream cover, juvenile abundance and percent canopy cover before collaborating and assigning values for each. Habitat Quality Modifiers (HQMs) were assigned to identify productive spawning and rearing habitat and were classified as good, fair, poor or no value. Spawning modifiers were determined by the instream substrate composition suitable for spawning. Riparian vegetation abundance, channel morphology, instream cover, seasonal flow and water temperature determined rearing modifiers.

Surveys were terminated when the headwaters or a natural point barrier was encountered. Surveys also ended when reaching the wildlife area boundary per the project's funding parameters. Detailed information about conducting physical habitat surveys can be found in *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

Prioritization

Data analyses were performed using MS Excel spreadsheets designed by WDFW to generate a Screening Priority Index (SPI) number for each noncompliant surface water diversion and a Fish Passage Priority Index (PI) number for each fish passage barrier. Priority index numbers consolidate variables that affect project feasibility into unique values that provide guidance when selecting projects for funding. Calculated values can be modified in response to new available data. The SPI reflects potential juvenile fish mortality due to diverted flow, wherein increasing the flow rate increases the probability for mortality and, consequently, raises the SPI. Diversions with higher SPI values receive greater priority for diversion screening. The PI reflects expected passage improvement, habitat production potential, fish stock condition, stock mobility and project cost. As the PI number increases, potential utilization by fish stocks increases, and consequently, higher priority is given for feature correction. All data and site photos were entered into WDFW's statewide Fish Passage and Diversion Screening Inventory Database (FPDSI).

RESULTS

Landowner Responses

Letters requesting stream access on private lands were sent to 372 landowners in March 2006 (Table 1). Collectively in the three watersheds, 95% granted access, 4% denied access and 1% were undecided. All Colockum watershed landowners granted property access (100%). Stemilt watershed landowners granted access to 95% of privately owned parcels. The two denied parcels were later determined as being located on non-fish bearing drainages and did not impact the inventory. Squilchuck watershed landowners granted access to 94% of privately owned parcels. However, several of the denied parcels were located on the Squilchuck Creek mainstem, which negatively impacted the sampling continuity through these areas.

Table 1. Landowner responses to access request letters sent by WDFW.

	Colockum Cr	Stemilt Cr	Squilchuck Cr	Totals
Landowners	24	64	284	372
Positive	24	61	268	353
% Positive	**100**	**95**	**94**	**95**
Negative	0	2	14	16
% Negative	**0**	**3**	**5**	**4**
Undecided	0	1	2	3
% Undecided	**0**	**2**	**1**	**1**

Colockum Watershed

Thirty-nine features were identified and evaluated in the Colockum watershed: 6 non-compliant surface water diversions and 15 barriers to fish passage. The remaining 18 features pose no hindrance to fish migration (Table 2). Three culverts, three fords and one dam with a gravity diversion are located upstream of a barrier waterfall. Four natural barrier waterfalls were identified that preclude anadromous fish migration upstream. Two of those (982306 and 982308) are located on SF Colockum Creek. Another (960453) is located on an unnamed tributary to SF Colockum Creek and the last (960383) is located on an unnamed tributary to NF Colockum Creek.

Table 2. Quantity and feature types encountered during the Colockum Creek inventory.

Feature	Number Identified	Non-compliant	Passable/ Compliant	Barriers	Unknown
Culverts	10		2	8	
Dams	6		0	6	
Bridges	9		9	0	
Fords/puncheons	8		7	1	
Other	0				
Gravity Diversions	6	6	0		
Pump Diversions	0				
Total	**39**	**6**	**18**	**15**	

WDFW personnel surveyed approximately 28,000 m (17.5 mi) on Colockum Creek and its fish-bearing tributaries beginning at the Columbia River and ending at the headwaters contained within the Colockum Wildlife Area. All documented barriers warrant repair or removal and block ample habitat upstream. Figure 2 shows the locations of noncompliant diversions and barrier features within the Colockum watershed. Table 3 lists the physical attributes of fish passage features, assigned PI values and potential habitat gain for sites located in the Colockum watershed that are privately owned or county owned. Table 4 lists the physical attributes of surface water diversions and assigned SPI values for sites located in the Colockum watershed that are privately owned or county owned.

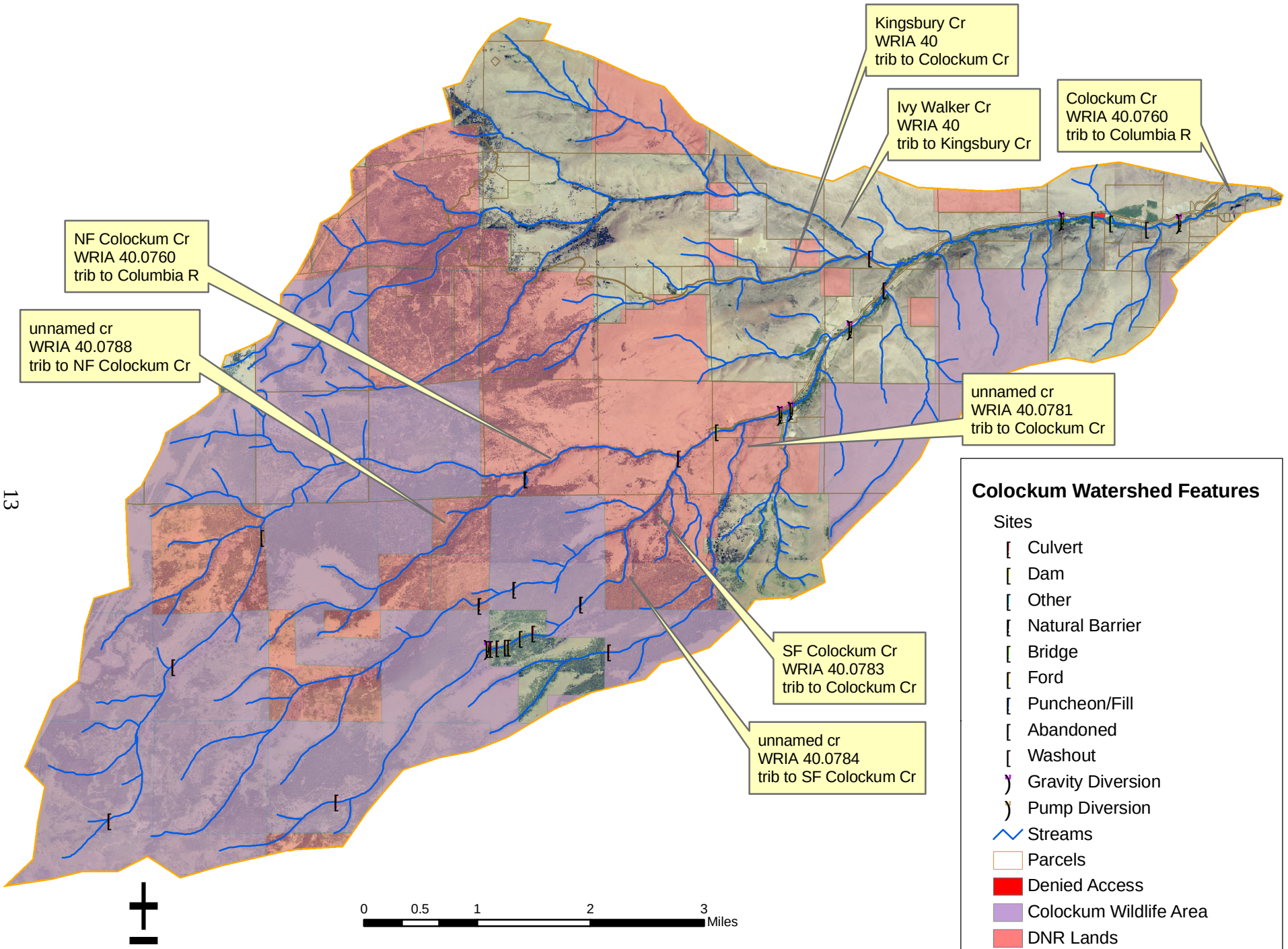

Figure 2. Colockum watershed overview of tibutaries and feature locations, July 2006.

Table 3. Private and county owned fish passage features within the Colockum watershed.

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m^2)	Rearing Area (m^2)
960375	Colockum Cr	Columbia R	40.0760	CO, ST, RT	County	Bridge	No	100				
960384	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	33	21.76	26,377	35,670	59,485
960389	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Washout	No	100				
960385	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Bridge	No	100				
960386	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Bridge	No	100				
960387	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	0	23.47	24,732	31,841	55,513
960376	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Bridge	No	100				
960377	Colockum Cr	Columbia R	40.0760	CO, ST, RT	County	Bridge	No	100				
960378	Colockum Cr	Columbia R	40.0760	CO, ST, RT	County	Bridge	No	100				
960379	Colockum Cr	Columbia R	40.0760	CO, ST, RT	County	Culvert	No	100				
960388	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	33	18.78	20,044	25,511	41,377
960380	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Bridge	No	100				
960390	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	33	17.88	18,619	23,411	37,706
960391	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	0	19.63	18,447	23,217	37,268
960381	Colockum Rd	Columbia R	40.0760	CO, ST, RT	Private	Bridge	No	100				
960451	Unnamed	Colockum Cr	40	CO, ST, RT	Private	Culvert	No	100				
982306	SF Colockum Cr	Colockum Cr	40.0783	n/a	n/a	Natural	Yes					
982308	SF Colockum Cr	Colockum Cr	40.0783	n/a	n/a	Natural	Yes					
960393	Unnamed	SF Colockum Cr	40.0784	RT	Private	Culvert	Yes	0				
960394	Unnamed	SF Colockum Cr	40.0784	RT	Private	Ford	Yes	33				
960397	Unnamed	SF Colockum Cr	40.0784	RT	Private	Ford	No	100				
960398	Unnamed	SF Colockum Cr	40.0784	RT	Private	Ford	No	100				
960399	Unnamed	SF Colockum Cr	40.0784	RT	Private	Culvert	Yes	0				
960395	Unnamed	SF Colockum Cr	40.0784	RT	Private	Culvert	Yes	0				
960396	Unnamed	SF Colockum Cr	40.0784	RT	Private	Dam	Yes	33				
960453	Unnamed	SF Colockum Cr	40.0784	n/a	n/a	Natural	Yes					
960383	Unnamed	NF Colockum Cr	40.0788	n/a	n/a	Natural	Yes					

Fish Codes: **CH** = chinook, **CO** = coho, **ST** = steelhead, **RT** = rainbow/cutthroat, ***** = no data available

Table 4. Surface water diversions within the Colockum watershed.

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	Surface Diversion	Compliant Screen	Flow (gpm)	SPI
960384	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	33	Gravity	No	139	5.17
960387	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	0	Gravity	No	593	7.42
960388	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	33	Gravity	No	331	6.41
960390	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	33	Gravity	No	184	5.54
960391	Colockum Cr	Columbia R	40.0760	CO, ST, RT	Private	Dam	Yes	0	Gravity	No	185	5.54
960396	Unnamed	SF Colockum Cr	40.0784	RT	Private	Dam	Yes	33	Gravity	No	*	*

Fish Codes: **CH** = chinook, **CO** = coho, **ST** = steelhead, **RT** = rainbow/cutthroat, ***** = no data available

Stemilt Watershed

Seventy features were identified and evaluated in the Stemilt watershed: 16 non-compliant surface water diversions and 36 barriers to fish passage. The remaining 17 features pose no hindrance to fish migration (Table 5). One dam (960449) has no available habitat gain upstream for salmonids; therefore, it did not receive a passage determination. One natural waterfall (982314) was identified on the Stemilt Creek mainstem that precludes upstream migration of anadromous fish species.

Table 5. Quantity and feature types encountered during the Stemilt Creek inventory.

Feature	Number Identified	Non-compliant	Passable/ Compliant	Barriers	Unknown
Culverts	13		2	11	
Dams	17			16	1
Bridges	11		11	0	
Fords/puncheons	10		4	6	
Other	3		0	3	
Gravity Diversions	16	16	0		
Pump Diversions	0				
Total	**70**	**16**	**17**	**36**	

WDFW personnel surveyed approximately 34,000 m (21.3 mi) on Stemilt Creek and its tributaries beginning at the Columbia River and ending at the headwaters. All documented barriers warrant repair or removal and block ample habitat upstream. Figure 3 shows the locations of noncompliant diversions and barrier features within the watershed. Table 6 lists the physical attributes of fish passage features, assigned PI values and potential habitat gain for sites located in the Stemilt watershed that are privately owned or county owned. Table 7 lists the physical attributes of surface water diversions and assigned SPI values for sites located in the Stemilt watershed that are privately owned or county owned.

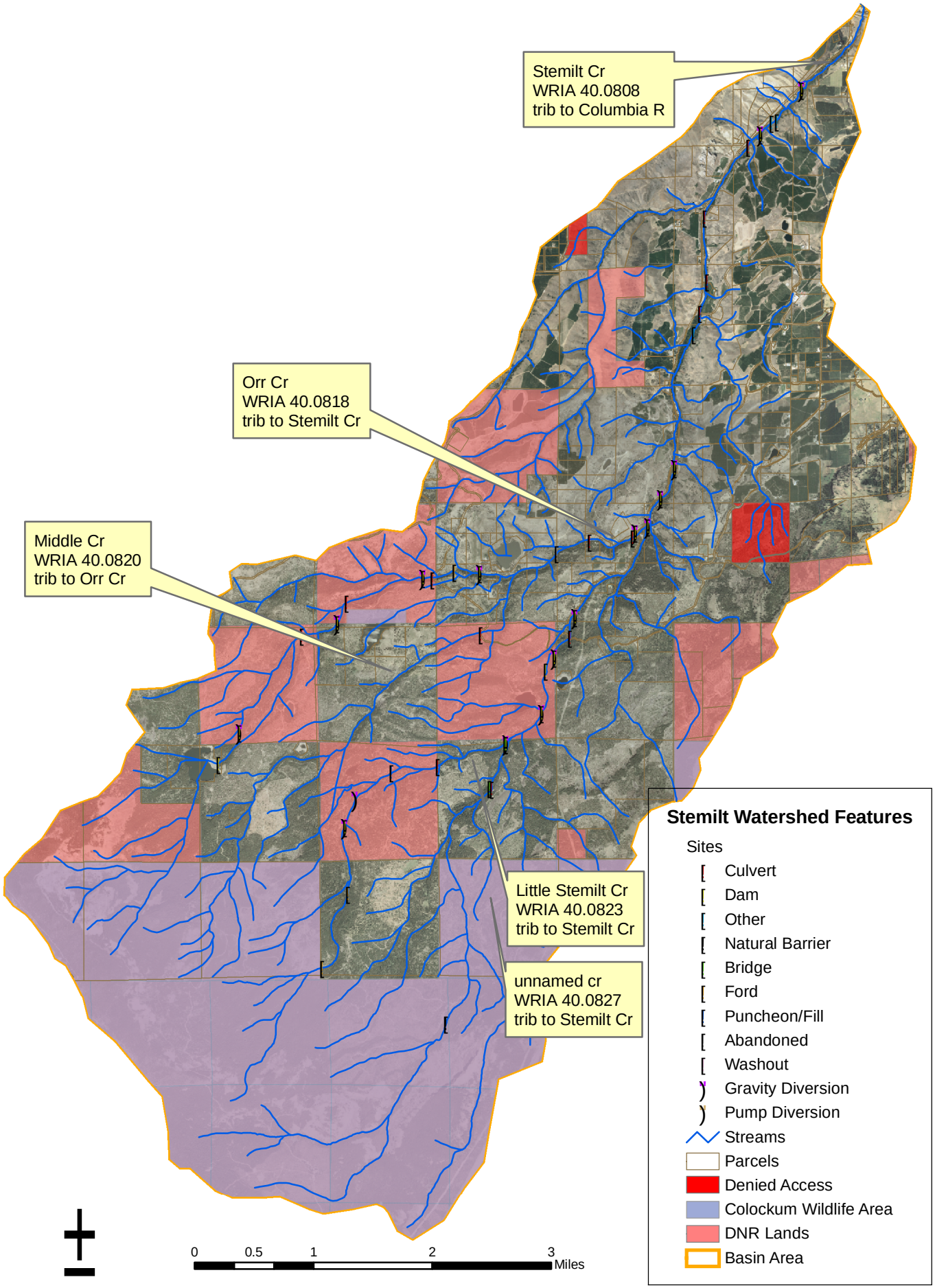

Figure 3. Stemilt watershed overview of tributaries and feature locations, April 2006.

Table 6. Private and county owned fish passage features within the Stemilt watershed.

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m2)	Rearing Area (m2)
960400	Stemilt Cr	Columbia R	40.0808	CH, CO, ST, RT	Private	Bridge	No	100				
960401	Stemilt Cr	Columbia R	40.0808	CH, CO, ST, RT	County	Bridge	No	100				
960418	Stemilt Cr	Columbia R	40.0808	CH, CO, ST, RT	Private	Bridge	No	100				
960402	Stemilt Cr	Columbia R	40.0808	CH, CO, ST, RT	County	Bridge	No	100				
960403	Stemilt Cr	Columbia R	40.0808	CH, CO, ST, RT	Private	Bridge	No	100				
960419	Stemilt Cr	Columbia R	40.0808	CH, CO, ST, RT	Private	Dam	Yes	0	20.14	32,330	29,016	66,826
960420	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Other	Yes	33	13.28	31,758	28,888	65,526
960421	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Other	Yes	0	14.66	31,678	28,876	65,404
960405	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Ford	No	100				
960404	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	14.64	31,440	28,809	64,895
960406	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Culvert	Yes	0	12.97	31,176	28,496	60,231
960407	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Culvert	Yes	0	12.72	29,903	27,204	55,759
960408	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Bridge	No	100				
960409	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Culvert	Yes	33	11.36	28,974	26,575	52,945
040195	Stemilt Cr	Columbia R	40.0808	ST, RT	County	Culvert	No	100				
960422	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Other	Yes	0	13.77	28,179	26,458	51,239
960410	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Ford	No	100				
960411	Stemilt Cr	Columbia R	40.0808	ST, RT	County	Bridge	No	100				
960412	Stemilt Cr	Columbia R	40.0808	ST, RT	County	Bridge	No	100				
960423	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	33	12.24	26,188	25,670	47,925
960424	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Ford	No	100				
960413	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	12.13	25,701	25,178	46,534
960414	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Ford	Yes	67	10.14	25,473	25,856	45,900
960415	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Bridge	No	100				
960425	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	13.34	25,255	24,676	45,332
960416	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Ford	Yes	67	8.63	13,042	16,733	25,137
960417	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	11.31	12,680	16,524	24,423
040203	Stemilt Cr	Columbia R	40.0808	ST, RT	County	Culvert	Yes	33	9.20	12,330	16,173	23,980

Table 6. (cont)

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m2)	Rearing Area (m2)
960436	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	67	8.36	11,624	14,867	22,324
960450	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	9.97	11,624	14,867	22,324
960427	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	10.92	11,236	14,135	21,582
960428	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	33	9.69	10,580	12,854	20,127
960426	Big Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Bridge	No	100				
982314	Big Stemilt Cr	Columbia R	40.0808	ST, RT	n/a	Natural	Yes					
960441	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	10.50	10,773	6,932	16,648
040129	Orr Cr	Stemilt Cr	40.0818	ST, RT	County	Culvert	Yes	33	8.53	10,508	6,690	16,225
960442	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Culvert	Yes	67	7.00	9,855	5,802	14,963
960443	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Abandoned	No	100				
960444	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	9.17	5,372	3,674	9,693
960445	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Ford	Yes	0	8.97	4,946	3,233	8,849
T21R20E-15	Orr Cr	Stemilt Cr	40.0818	ST, RT	County	Culvert	Yes	0	7.99	4,605	2,964	8,372
960446	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	7.92	4,455	2,800	8,074
960447	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	7.98	2,892	993	5,548
960448	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	5.41	585	528	1,170
960449	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	n/a					
T21R20E-14	Middle Cr	Orr Cr	40.0820	ST, RT	County	Culvert	Yes	0	3.78	610	164	423
960431	Little Stemilt Cr	Stemilt Cr	40.0823	ST, RT	Private	Puncheon	Yes	67	5.20	3,615	4,256	7,112
960432	Little Stemilt Cr	Stemilt Cr	40.0823	ST, RT	Private	Dam	Yes	0	6.35	2,281	2,411	5,105
960433	Little Stemilt Cr	Stemilt Cr	40.0823	ST, RT	Private	Ford	Yes	67	4.44	1,419	1,485	3,359
960434	Little Stemilt Cr	Stemilt Cr	40.0823	ST, RT	Private	Ford	Yes	0	3.77	151	126	276

Fish Codes: **CH** = chinook, **CO** = coho, **ST** = steelhead, **RT** = rainbow/cutthroat, ***** = no data available

Table 7. Surface water diversions within the Stemilt watershed.

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	Suface Diversion	Compliant Screen	Flow (gpm)	SPI
960419	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	Gravity	No	112	6.53
960404	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	Gravity	No	983	4.68
960423	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	33	Gravity	No	2,101	5.66
960413	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	Gravity	No	1,078	4.78
960425	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	Gravity	No	1,675	5.35
960417	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	Gravity	No	2,171	5.70
960436	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	67	Gravity	No	620	4.17
960427	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	0	Gravity	No	4,490	6.84
960428	Stemilt Cr	Columbia R	40.0808	ST, RT	Private	Dam	Yes	33	Gravity	No	2,240	5.74
960441	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	Gravity	No	*	*
960444	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	Gravity	No	8,980	8.13
960446	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	Gravity	No	11,480	8.64
960447	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	Gravity	No	1,100	4.81
960448	Orr Cr	Stemilt Cr	40.0818	ST, RT	Private	Dam	Yes	0	Gravity	No	3,291	6.32
960452	Little Stemilt Cr	Stemilt Cr	40.0823	ST, RT	Private		Yes		Gravity	No	225	3.23
960432	Little Stemilt Cr	Stemilt Cr	40.0823	ST, RT	Private	Dam	Yes	0	Gravity	No	2,379	5.83

Fish Codes: **CH** = chinook, **CO** = coho, **ST** = steelhead, **RT** = rainbow/cutthroat, ***** = no data available

Squilchuck Watershed

One hundred twenty-five features were identified and evaluated in the Squilchuck watershed: 27 non-compliant surface water diversions, two diversions with unknown compliance status and 49 barriers to fish passage. The remaining 47 features pose no hindrance to fish migration (Table 8). Two natural waterfalls (960501 and 960502) were identified on Miners Run Creek and an unnamed tributary to Miners Run Creek, respectively, which preclude upstream migration of anadromous fish species.

Table 8. Quantity and feature types encountered during the Squilchuck Creek inventory.

Feature	Number Identified	Non-compliant	Passable/ Compliant	Barriers	Unknown
Culverts	29		5	24	
Dams	31		13	18	
Bridges	25		25	0	
Fords/puncheons	1		1	0	
Other	7		0	7	
Gravity Diversions	28	26	0		2
Pump Diversions	4	1	3		
Total	**125**	**27**	**47**	**49**	**2**

WDFW personnel surveyed approximately 20,500 m (12.8 mi) on Squilchuck Creek and its tributaries beginning at the Columbia River and ending at the headwaters. All documented barriers warrant repair or removal and block ample habitat upstream. Figure 4 shows the locations of noncompliant diversions and barrier features within the watershed. Table 9 lists the physical attributes of fish passage features, assigned PI values and potential habitat gain for sites located in the Squilchuck watershed that are privately owned or county owned. Table 10 lists the physical attributes of surface water diversions and assigned SPI values for sites located in the Squilchuck watershed that are privately owned or county owned.

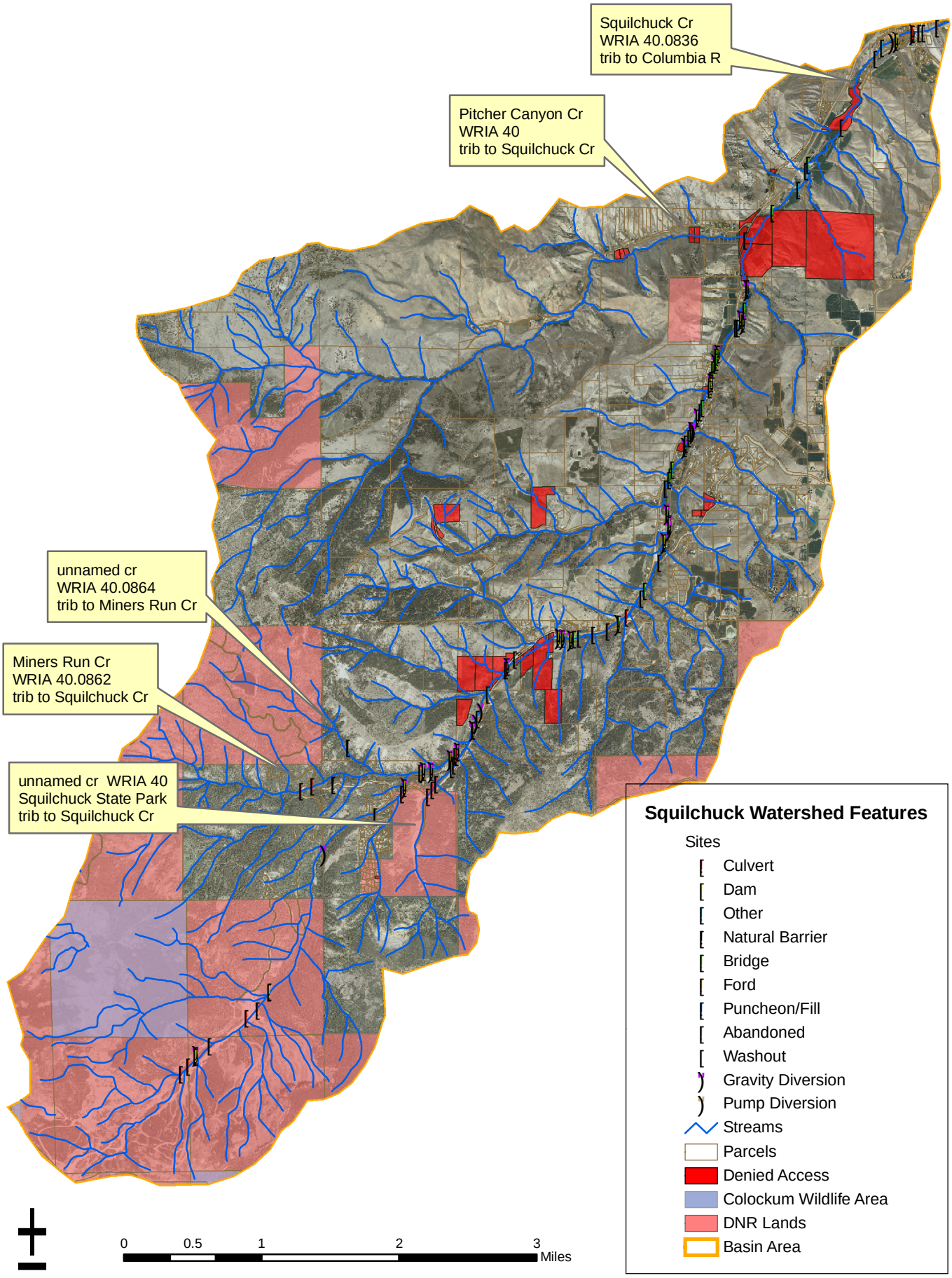

Figure 4. Squilchuck watershed overview of tributaries and feature locations, August 2006.

Table 9. Private and county owned fish passage features within the Squilchuck watershed.

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m^2)	Rearing Area (m^2)
040162	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Culvert	Yes	67	13.02	20,350	9,798	35,998
960347	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Bridge	No	100				
960348	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	County	Culvert	No	100				
960349	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Dam	No	100				
970003	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	County	Culvert	Yes	0	20.21	20,169	9,705	35,652
960352	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Dam	No	100				
960354	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Other	Yes	33	19.67	19,815	9,638	34,849
040185	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Culvert	No	100				
040180	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Culvert	Yes	33	15.66	18,422	9,023	31,853
960355	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Bridge	No	100				
960356	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Other	Yes	0	11.97	18,269	8,967	31,631
040176	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Other	Yes	0	10.74	17,719	8,764	30,851
960358	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
040157	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Culvert	Yes	0	10.57	15,620	8,364	29,131
040156	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	33	10.58	15,620	8,364	29,131
960361	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960362	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960363	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	11.57	15,151	8,206	28,136
960364	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Other	Yes	0	11.57	15,151	8,206	28,136
960350	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	Yes	0	10.44	15,024	8,189	27,981
960365	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	8.67	14,624	7,994	27,093
960366	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960367	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960368	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	8.66	14,514	7,943	26,878
960369	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960370	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	11.42	14,514	7,943	26,878
960371	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	11.42	14,514	7,943	26,878

Table 9. (cont)

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m^2)	Rearing Area (m^2)
960372	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	8.66	14,514	7,943	26,878
960373	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	11.34	14,253	7,864	26,272
960374	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960454	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960455	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Other	Yes	33	10.19	13,872	7,686	25,625
960456	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
970001	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	No	100				
960459	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960460	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960461	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960462	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960463	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960464	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
970002	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	Yes	0	9.83	12,680	6,659	22,870
960465	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960466	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960467	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960469	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
040166	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	No	100				
960470	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
040190	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960471	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
040175	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	Yes	0	9.16	10,861	6,044	18,293
960472	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
040192	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	Yes	0	9.08	10,591	5,613	17,746
040178	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Culvert	Yes	0	9.04	10,441	5,527	17,550

Table 9. (cont)

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m^2)	Rearing Area (m^2)
960474	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Other	Yes	0	9.92	10,268	5,397	17,113
960475	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960476	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960477	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960478	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	7.46	10,023	5,277	16,687
960479	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960480	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Other	Yes	67	7.22	9,296	4,776	15,253
040182	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	No	100				
960482	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960484	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960486	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960487	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960488	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
960489	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Bridge	No	100				
960490	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	33	7.87	7,930	3,706	12,151
960491	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	8.49	6,834	3,547	11,316
960492	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	8.38	6,732	3,435	11,041
960493	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Ford	No	100				
960494	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100				
040186	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	Yes	33	6.17	4,698	2,917	9,096
040188	Squilchuck Cr	Columbia R	40.0836	ST, RT	County	Culvert	Yes	0	6.62	4,290	2,655	8,033
960504	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Dam	Yes	0	6.62	4,290	2,655	8,033
960505	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Dam	Yes	0	5.41	1,658	1,812	2,682
960351	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Culvert	Yes	0	4.55	1,658	1,812	2,681
960506	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Culvert	Yes	0	3.54	889	1,233	1,945
960507	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Culvert	Yes	0	3.21	626	689	1,317

Table 9. (cont)

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	PI	Habitat Gain (m)	Spawning Area (m^2)	Rearing Area (m^2)
960508	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	3.21	626	689	1,317
960509	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Dam	Yes	0	3.21	626	689	1,317
960510	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Dam	Yes	0	2.88	435	459	853
960511	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Culvert	Yes	0	2.36	254	233	389
960512	Squilchuck Cr	Columbia R	40.0836	ST, RT	Unknown	Culvert	Yes	0	2.09	126	103	236
040135	Pitcher Canyon Cr	Squilchuck Cr	40	ST, RT	County	Culvert	Yes	0	3.78	936	13	422
960496	Unnamed	Squilchuck Cr	40	ST, RT	Private	Culvert	Yes	0	2.33	832	48	367
960497	Unnamed	Squilchuck Cr	40	ST, RT	Private	Culvert	Yes	0	2.33	832	48	367
960495	Unnamed	Squilchuck Cr	40	ST, RT	Private	Dam	Yes	0	2.50	657	48	325
960498	Unnamed	Squilchuck Cr	40	ST, RT	Private	Culvert	Yes	0	1.83	387	43	141
960499	Unnamed	Squilchuck Cr	40	ST, RT	Private	Culvert	Yes	0	1.77	320	42	121
960513	Unnamed	Squilchuck Cr	40	ST, RT	County	Culvert	Yes	0	1.63	211	34	88
960501	Miners Run Cr	Squilchuck Cr	40.0862		n/a	Natural	Yes					
040091	Miners Run Cr	Squilchuck Cr	40.0862	ST, RT	County	Culvert	Yes	0				
040090	Miners Run Cr	Squilchuck Cr	40.0862	ST, RT	County	Culvert	Yes	0				
960502	Unnamed	Miners Run Cr	40.0864		n/a	Natural	Yes					

Fish Codes: **CH** = chinook, **CO** = coho, **ST** = steelhead, **RT** = rainbow/cutthroat, ***** = no data available

Table 10. Surface water diversions within the Squilchuck watershed.

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	Surface Diversion	Compliant Screen	Flow (gpm)	SPI
960349	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Dam	No	100	Pump	Yes	45	
960352	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private	Dam	No	100	Pump	Yes	35	
960353	Squilchuck Cr	Columbia R	40.0836	CK, CO, ST, RT	Private				Pump	Yes	35	
040156	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	33	Gravity	No	*	*
960362	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	63	2.60
960363	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	Gravity	No	153	3.25
960365	Squilchuck Cr	Columbia R	40.0386	ST, RT	Private	Dam	Yes	67	Gravity	No	81	2.10
960368	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	Gravity	No	9	1.60
960372	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	Gravity	No	561	4.06
960456	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	*	*
960457	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	No	*	*
960458	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	*	*	*
960461	Squilchuck Cr	Columbia R	40.0386	ST, RT	Private	Dam	No	100	Gravity	No	*	*
960465	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	76	2.73
960466	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	*	*
960468	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	No	*	*
960469	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	*	*
960473	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Pump	No	78	2.75
960476	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	9	1.60
960477	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	50	2.46
960478	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	67	Gravity	No	*	*
960481	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	No	*	*
960483	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	No	18	1.90
960485	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	No	18	1.90
960487	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	18	1.90
960488	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	*	*
960490	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	33	Gravity	No	*	*

Table 10. (cont)

Site ID	Stream	Tributary to	WRIA	Potential Fish Species	Owner Type	Feature Type	Barrier	% Pass	Surface Diversion	Compliant Screen	Flow (gpm)	SPI
960491	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	Gravity	Yes	700	
960492	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	Gravity	No	*	*
960494	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	No	100	Gravity	No	800	4.44
960503	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private				Gravity	No	58	2.55
960508	Squilchuck Cr	Columbia R	40.0836	ST, RT	Private	Dam	Yes	0	Gravity	No	674	3.00

Fish Codes: **CH** = chinook, **CO** = coho, **ST** = steelhead, **RT** = rainbow/cutthroat, ***** = no data available

DISCUSSION

Colockum Watershed
Habitat Assessment-Mainstem

The mouth of Colockum Creek is a sinuous, low gradient alluvial fan bordered by brushy understory riparian species (Fig. 5). Several large-scale suckers and numerous juvenile salmonids were observed at the confluence. Two hundred meters upstream, the canyon walls are more confined and canopy cover increases. Numerous trout/salmonids, ½" to 4" in length, were observed in pools and riffles. Chinook rearing occurs in the lower reaches of Colockum Creek downstream of the bridge on Tarpiscan Road for approximately 1,000 m to the confluence with the Columbia River.

At 231 m, a steep, narrow canyon begins. This 50-meter long section is dominated by cascades of car-size boulders and up to two-meter deep pools, large woody debris (LWD) jams and little to no riparian vegetation. Gradient averages 10% through the canyon then transitions to 2-3% and opens onto a wide valley floor with meandering stream morphology. Cobble and gravel dominant the substrate. All pools teem with 3-4" salmonids. Push-up boulder dams at several residences dot the area from the end of the canyon to the bridge on Tarpiscan Road, however these dams do not impede fish passage.

Fry abundance decreases upstream of Tarpiscan Road yet remains well dispersed throughout the mainstem. Instream cover is high due to undercut banks and LWD. Successive beaver dams and ponds occur approximately 2,000 m to 4,500 m from the mouth, providing excellent rearing habitat.

Stream characteristics remain relatively constant throughout the 4.3 mi of private ownership in lower Colockum Creek, except for a few specific locations where riparian clearing and livestock use has decreased bank stability and altered the substrate composition. Rearing and spawning potential were both assessed as good to excellent.

Reaches through publicly owned lands, upstream of private parcels, were also assessed as possessing good to excellent rearing and spawning potential. This high-energy stream tends to reroute itself as a result of LWD jams, providing excellent off-channel rearing habitat. The physical habitat survey ended at the headwaters.

Habitat Assessment-Tributaries

Four fish-bearing tributaries were surveyed in the Colockum watershed. The first, an unnamed creek, locally referred to as Kingsbury Creek, is a small tributary to mainstem Colockum Creek. This minor stream meanders through a brushy cattle pasture. Unrestricted cattle access has caused an influx of fine sediments that have buried preexisting gravel beds. An engineered impoundment located further upstream was not assessed because upstream fish access ends before reaching this structure. Due to its size, tendency to go subsurface and degraded habitat quality, this tributary is unlikely to offer

sufficient rearing or spawning habitat for salmonids unless land use practices are changed.

SF Colockum Creek is the second fish-bearing tributary of Colockum Creek. Extensive braiding occurs immediately upstream of the confluence. The streambed meanders through the valley floor. Talus slopes upstream of the Colockum Creek Wildlife Area boundary confine SF Colockum Creek. Debris jams hold back a significant quantity of material and may temporarily impede fish passage. Anadromous access ends at 4,300 m due to a five-meter vertical falls (982306). Coho are restricted to the lower 1,800 m due to natural gradient limits that prevent upstream access. Steelhead can pass through all reaches until encountering the waterfall; however, spawning and rearing occurs only in the lower 2,400 m due to stream gradient restrictions (14%+) in the upper reaches. Resident trout can utilize all reaches of SF Colockum Creek. Excellent rearing and spawning habitat exists throughout the drainage for resident species.

An unnamed tributary enters SF Colockum Creek approximately 1,800 m from the confluence with Colockum Creek. Steep, talus slopes border this complex, high gradient stream. Rearing and spawning potential in the lower reaches were assessed as good to excellent for steelhead and resident trout. High gradient precludes coho from utilizing this stream. A natural barrier waterfall (960453) is located at 1,550 m. Habitat above the falls is segmented due to multiple fish passage barriers and the felling of riparian cover throughout a single private parcel located within the Colockum Wildlife Area.

An unnamed right bank tributary to NF Colockum Creek provides 175 m of habitat for anadromous fish species due to a natural gradient barrier (>20%) located at this point.

Feature Inventory

Thirty-nine features were inventoried in the Colockum watershed. The first fish passage barrier (960384) on Colockum Creek is located approximately 1,500 m upstream of the mouth of Colockum Creek. The full span, boulder dam was partially blown out and evaluated as 33% passable. Flow trickles through and under the remaining boulders with no plunge pool to aid passage. A gravity diversion located on the left bank was shut down at the time of survey and had collected brushy debris around the intake pipe from spring flows. The barrel screen attached to the intake pipe is noncompliant due to an excessive screen mesh opening (Fig. 6). Correction of this site could potentially open 59,485 m^2 of rearing habitat and 35,670 m^2 of spawning habitat, as well as prevent impingement of juvenile fish on the screen or entrainment within the diversion.

The largest potential habitat gain for salmonids on mainstem Colockum Creek is located upstream of site 960387, a poured concrete dam and noncompliant gravity diversion used for orchard irrigation (Fig. 7). Correction of this total passage barrier could open 55,513 m^2 of rearing habitat and 31,841 m^2 of spawning habitat. Although this feature is the second barrier on mainstem Colockum Creek, this site is a greater barrier to fish passage compared to that of the dam located 1,645 m downstream (0% and 33% passage, respectively); therefore, this site received higher priority index values for passage and

screening. Three more dams with gravity diversions (960388, 960390, 960391) exist on mainstem Colockum Creek. Each is used for irrigation and/or stock water. All are similarly constructed of a visqueen-lined, push-up boulder dam directing flow into an unscreened diversion pipe. Refer to tables 3 and 4 for detailed information of these features.

Debris transport, due to heavy spring runoff, washed out a previously assessed barrier culvert (960389) located under the Bonneville Power Administration access road on mainstem Colockum Creek 431 m upstream of the mouth. The structural plate steel culvert is currently resting along the left bank 50 m downstream of the crossing site. Although the site is currently 100% passable, removal of this culvert is recommended to prevent debris collection.

DNR previously evaluated a barrier culvert under Ingersoll Road on NF Colockum Creek. The streambed above the culvert is heavily loaded with sediment and debris deposition. Ingersoll Road may be compromised at times of high flow.

Three barrier culverts, one barrier ford crossing, one barrier dam and a noncompliant gravity diversion (960393 – 960399) are located on an unnamed tributary to SF Colockum Creek within a single private parcel located within the Colockum Wildlife Area. All culverts were evaluated as 0% fish passable. The ford and dam are each 33% fish passable. The gravity diversion lacks adequate screening to prevent entrapment of juvenile resident trout. A barrier waterfall (960453) precludes anadromous access to these sites. No barriers were found on Kingsbury Creek, SF Colockum Creek or the unnamed tributary to NF Colockum Creek.

Reconnecting fragmented habitat, increasing fish passage and decreasing juvenile mortality by correcting all passage barriers and screening surface water diversions could realistically be attained in the Colockum watershed due to the low quantity of barriers, habitat quality and current fish distribution.

Stemilt Watershed
Habitat Assessment-Mainstem

The confluence of Stemilt Creek is brushy and confined until crossing the Alcoa-Malaga Highway. This high-energy stream channel is dominated by boulder and cobble at 5% gradient. Frequent feeder bluffs input localized deposits of loose fine sediments. Chinook and coho access is halted 2,200 m from the mouth due to a sustained gradient of 14% (maximum 19%) with boulder rapids and areas of bedrock scour. Gradient decreases to 4% and rapids transition to riffles beyond 2,300 m until reaching the Orr Creek confluence wherein higher gradient (10-15%) results in more rapids, braiding and LWD jams. Large woody debris jams also increase as private parcels transition to harvested forests. Spawning and rearing potential were assessed as good to excellent.

Stemilt Creek splits into Big Stemilt Creek and Little Stemilt Creek approximately 12,000 m upstream of the mouth. Another WDFW crew concurrently surveyed Big

Stemilt Creek, contained within the Colockum Wildlife Area. Excellent spawning gravel is found in several large braids upstream of the boundary on Big Stemilt Creek. Juvenile fish were observed in many pools created by LWD. A series of bedrock waterfalls ends anadromous access approximately 1.5 mi upstream of the wildlife area boundary.

Habitat Assessment-Tributaries

Four fish-bearing tributaries were surveyed in the Stemilt watershed. The first, Orr Creek, is a left bank tributary to Stemilt Creek. Orr Creek meanders through private properties downstream of Stemilt Loop Road. Potential spawning habitat was assessed as fair due to embedded gravels in some reaches. Rearing potential was also assessed as fair due to intermittent surface flow. Adult and juvenile trout were observed in isolated pools.

Orr Creek enters managed timberland upstream of Stemilt Loop Road. Orr Creek unnaturally dewaters in areas immediately downstream of several surface water diversions. Numerous braids contain excellent spawning potential and pools created by LWD provide rearing habitat. The physical habitat survey was terminated at the Upper Wheeler Reservoir where anadromous access ends. Numerous headwater springs are located above the reservoir. Orr Creek appears adversely affected by past logging practices and residential development as evidenced by reduced habitat quality throughout reaches lacking a riparian buffer.

Middle Creek is a right bank tributary to Orr Creek. Middle Creek lacks surface flow for 1,100 m upstream of the confluence to above the Stemilt Loop Road crossing, except during high spring runoff. Flow was checked at this crossing in late April, May and mid July 2006, wherein April yielded the only appreciable surface flow. Most surface flow from Middle Creek is transported through a series of ditches, stream channels and pipes. WDFW terminated the physical habitat survey 600 m upstream of the Stemilt Loop Road crossing due to sustained lack of surface flow. Rearing and spawning quality were assessed as poor.

Little Stemilt Creek is a left bank tributary to Stemilt Creek that meanders through DNR managed timberland. Gravel riffles transition to boulder-dominated cascades and spring influence is high in the upper drainage. Juvenile fish were observed in pools throughout the stream in mid June. Little Stemilt Creek splits into two, equally sized branches approximately 5,500 m upstream of the confluence. The physical habitat survey was terminated at this point because both branches failed to meet the three-foot minimum ordinary high water width criteria. Spawning and rearing potential were assessed as good.

An unnamed right bank tributary to Stemilt Creek provides limited habitat gain for steelhead and resident trout. This spring-fed stream originates in a wooded wetland immediately upstream of the Road 5 (green dot) road crossing owned by DNR. Pools created by LWD provide excellent rearing habitat. Also, numerous fry were observed in

a pool at the upstream end of culvert. Spawning areas are limited due to the lack of gravel. Potential fish use ends at the spring source 365 m upstream of the confluence.

Feature Inventory

Seventy features were identified in the Stemilt watershed. The first encountered fish passage barrier (960419) is located 1,500 m upstream of the mouth of Stemilt Creek. The full span, concrete dam impounds water for orchard irrigation and blocks all fish species (Fig. 8). A gravity diversion intake box is attached to the dam footing, which flows to a settling box located on the left stream bank. Screening attached to the intake box is noncompliant due to excessive screen mesh opening (Fig. 9). Correction of this site could open 66,286 m^2 of rearing habitat and 29,016 m^2 of spawning habitat, as well as prevent impingement of juvenile fish on the screen or entrainment within the diversion. This site received the highest priority index value and the third highest screening priority index value.

Another notable barrier (960406) on Stemilt Creek is a series of four, ten inch, smooth steel culverts under a private road crossing (Fig. 10). The culverts were set at various depths; some with negative slopes and are too small to handle high flows, resulting in flooding over the road and erosion of the stream banks. Even at moderate flows, the velocity inside the culverts is too great for fish to pass. Correction of this site could open 60,231 m^2 of rearing habitat and 24,496 m^2 of spawning habitat for summer steelhead and resident trout.

Nine gravity diversions and associated dams on mainstem Stemilt Creek all fail to provide safe fish passage. Several dams are full span concrete structures with various types of head gate structures. All have excessive hydraulic drops and a few have the capability of diverting all natural stream flow. Most sites have a diversion intake pipe embedded into a concrete dam. Several diversion intake pipes are fitted with debris screens, however these screens fail to prevent juvenile fish from passively entering the diversion. Refer to Tables 7 and 8 for detailed information on these features.

Two ecology block dams, for Clear Lake (960427) and Lily Lake (960428) diversions, blew out during high spring flows in 2006 (Figs. 11-13). These sites are scheduled to receive permanent concrete dams and fish bypass screens prior to the 2007 irrigation season. Preparations are currently underway at Lily Lake (K. Juchmes, Stemilt Irrigation Dist., pers. comm., 2006).

Five gravity diversions located on Orr Creek fail to prevent fish mortality or provide fish passage. Each of the lower three diversion dams (960441, 960444 and 960446) dewaters the stream for several meters. Site 960446 received the highest screening priority index value (8.64) for Orr Creek due to its capability to divert over 11,000 gpm at full capacity (Fig. 14). Approximately 1,000 m downstream, site 960444 received the second highest SPI due to its capability of diverting almost 9,000 gpm. The upper two diversions (960447 and 960448) consist of pressure treated timber boxes set in the stream to facilitate flow metering. These structures could potentially divert all stream flow when

check boards are in place. All five received barrier status due to excessive hydraulic drops at the spillways. None of the diversions are equipped with fish bypass screening. Numerous juvenile trout were observed in the diversion boxes. It is likely that the boxes have inadvertently created ideal trout spawning habitat. Four of the five sites are owned and operated by private irrigation districts.

Two diversions were found on Little Stemilt Creek. Site 960452 appears to be inactive as determined by disconnected PVC pipes strewn throughout the area and garbage accumulation in the settling box. This diversion was used to fill Wood Pond. The last diversion (960432) on Little Stemilt Creek is constructed similarly to those on Orr Creek and is owned by the same irrigation district (Fig. 15). An excessive hydraulic drop at the outlet makes this site 0% fish passable. Neither diversion on Little Stemilt Creek is fitted with a fish bypass screen.

Two pipeline crossings (960420 and 960421) on Stemilt Creek trap debris and cause substrate deposition behind the blockages. Excessive hydraulic drops have developed at both sites as a result of prolonged debris collection. Placing these pipes above the stream banks would allow for natural transport of stream materials. All previously discussed sites block chinook, coho, steelhead salmon and resident rainbow/cutthroat trout. The remaining barriers on Stemilt Creek block passage of steelhead and resident trout due to a natural gradient barrier excluding access for chinook and coho.

One mainstem barrier culvert (040203) and one tributary barrier culvert (040129) are owned by Chelan County. The 10 ft box culvert (040203) on Stemilt Hill Road was set too shallow and at an excessive slope, which prevents retention of natural streambed material. An excessive hydraulic drop now exists at the outlet. Another county owned culvert (040195) on the mainstem is 100% passable. This culvert is a bottomless arch, which allows material to pass through the culvert while maintaining a natural streambed. Culvert 040129 on Orr Creek has an excessive hydraulic drop (0.25 m) at the outlet and a slope of 7.2%, making it a total passage barrier. Adult fish were observed in the plunge pool. The remaining two barrier culverts (960407 and 960409) on Stemilt Creek are privately owned. One privately owned culvert (960442) on Orr Creek is also a passage barrier.

Two ford crossings (960414 and 960416) were evaluated as partial blockages to fish passage on Stemilt Creek. At each site, stream widening and grading, caused from vehicular use, created sheeting flow and excessive hydraulic drops at the downstream ends. Three other privately used fords are 100% fish passable. A ford located on Orr Creek is a total barrier to fish passage because it is prone to drying from continuous regrading of the substrate from vehicle use. One puncheon and two ford crossings were evaluated as fish passage barriers on Little Stemilt Creek. Driving vehicles in streams is discouraged due to its inevitability to create or impact spawning habitat by intentionally or unintentionally manipulating the streambed. Subsequently, fish mortality occurs during early life stages while the crossing is used (C. Detrick, WDFW, pers. comm., 2006).

The Stemilt watershed offers good to excellent spawning and rearing potential for anadromous salmonids and resident trout throughout the mainstem and the two larger tributaries, Orr Creek and Little Stemilt Creek, as evidenced by fish presence of all life stages. Lack of connectivity on Middle Creek inhibits upstream migration of steelhead and bidirectional migration of resident trout species. Productive habitat is limited to the upper reaches in this drainage. Reconstruction of the lower 1,000 m of natural stream channel would be necessary to provide anadromous access, however this scenario is unlikely to provide adequate stream flow to be beneficial due to current water management practices. A more realistic solution would be to install compliant screening on surface water diversions located on Orr Creek and Little Stemilt Creek and to modify or retrofit existing dams to accommodate fish passage. Diversion management practices would remain unaffected.

Habitat quality throughout the majority of the watershed has remained intact. Correction of all barriers in the Stemilt watershed is feasible, restoring hydraulic function and connectivity of fragmented habitat that would immediately benefit anadromous salmonids and resident species.

Squilchuck Watershed
Habitat Assessment-Mainstem

The mouth of Squilchuck Creek has seen extensive development within the alluvial delta that has created opportunity for frequent flooding. Squilchuck Creek is inundated with compacted fines and gravel throughout the lower 9.6 mi of private ownership. Water turbidity is much greater compared to Colockum Creek and Stemilt Creek. A natural gradient barrier located approximately 2,200 m upstream of the mouth limits upstream migration of chinook and coho. Several beaver dams and ponds occur immediately upstream of the abrupt gradient change. Similar geology occurs in all three surveyed drainages at approximately the same elevation. Spawning potential is impaired due to excessive fines and embedded gravels. Rearing potential is good to excellent.

Landowners denied access to several neighboring parcels, 2,400 m collectively; resulting in a somewhat fragmented habitat survey. One previously inventoried culvert (040180) is located on a denied parcel 1,178 m from the mouth. No additional information was attained for this culvert, although the crossing was previously evaluated as a partial fish passage barrier. Another denied parcel contains the mouth of Pitcher Canyon Creek, the first tributary to Squilchuck Creek. Additional barriers and surface water diversions are likely to exist within these areas given the abundance of features encountered elsewhere. Booming residential development has exacerbated low summer flow conditions and introduced an influx in fine sedimentation, reducing the overall stream health of Squilchuck Creek.

The remaining mile on mainstem Squilchuck Creek is contained in a steep walled canyon through the Mission Ridge Ski Area. Several non-fish-bearing tributaries provide spring input and the presence of aquatic vegetation suggests year-round spring flow. Spawning and rearing potential are good for the majority of this stream section. The habitat survey

was terminated at the point where fish use ends at the base of a basalt talus slope near the top of the drainage.

Habitat Assessment-Tributaries

Four fish-bearing tributaries were surveyed in the Squilchuck watershed. Pitcher Canyon Creek is the first tributary to Squilchuck Creek. A diversion return pipe, located approximately 300 m upstream of the confluence, supplements stream flow in Pitcher Canyon Creek. Spawning potential was assessed as poor and rearing potential as fair due to a lack of complexity in the stream channel. No fish were observed. The physical habitat survey ended once the ordinary high water width of the stream channel decreased below the three-foot minimum for potential fish use.

The second tributary is an unnamed stream originating in Squilchuck State Park. This small stream yields poor quality spawning and rearing potential for resident trout due to excessive fine sediments and a lack of complexity in the stream channel. This tributary joins mainstem Squilchuck Creek via a one-meter drop over the forest floor at 30% gradient. No fish were observed in this creek.

The third tributary is Miners Run Creek, which contributes approximately 30% of the flow to Squilchuck Creek. Fine sediment deposition occurs for 30 m upstream before transitioning to gravel and cobble. Undercut banks, overhanging vegetation and LWD provide ample instream cover for rearing juveniles. Anadromous access ends at a six-meter vertical waterfall (960501). Spawning quality on Miners Run Creek was assessed as fair due to heavily silted gravels. Rearing potential was assessed as good to excellent.

The last fish-bearing tributary, surveyed in the Squilchuck watershed, is an unnamed tributary to Miners Run Creek that may have historically been a small spring. Flow from the Beehive Reservoir has widened the stream channel so that it now meets fish bearing criteria. Fish use ends at a two-tier waterfall (960502). The initial vertical drop is approximately five meters and the second is four meters. Spawning quality was assessed as poor due to excessive siltation and rearing quality was assessed as fair due to the lack of instream cover.

Feature Inventory

One hundred twenty-five features were inventoried in the Squilchuck watershed. The first encountered barrier on Squilchuck Creek is culvert 040162 located under the railroad yard 133 m upstream of the mouth (Fig. 16). Although this three-celled box culvert is 117 m long, the 1% slope barely fails criteria. Two of the three cells are bed loaded to the extent that no flow enters. The center cell takes all flow and; consequently, is likely to be a velocity barrier. Removing material from the outer two cells may allow the culvert to function as designed. This site received the fourth highest priority index value due to being evaluated as 67% passable.

The largest potential habitat gain for salmonids exists upstream of site 970003, a total barrier culvert under S. Wenatchee Avenue (Fig. 17). Correction of this site could open 35,652 m^2 of rearing habitat and 9,705 m^2 of spawning habitat for salmonids. WDFW staff observed large numbers of chinook and steelhead juveniles as well as a few coho juveniles within the reach between these two sites. Additionally, three privately owned, six county-owned and five barrier culverts with unknown ownership exist on mainstem Squilchuck Creek.

The only barrier culvert (040135) on Pitcher Canyon Creek blocks 422 m^2 of rearing habitat and 13 m^2 of spawning habitat. The two remaining barrier culverts, previously inventoried by Chelan County, are located on Miners Run Creek, upstream of a barrier waterfall. Correction of these two sites could benefit resident trout by reconnecting fragmented habitat.

The second largest potential habitat gain for Squilchuck Creek occurs at site 960354; a broken pallet footbridge causing an excessive hydraulic drop that partially blocks all species (Fig. 18). Easy removal of this site could restore access to 34,849 m^2 of rearing habitat and 9,638 m^2 of spawning habitat.

Numerous surface water diversions are present on Squilchuck Creek. All gravity diversions, except one, fail to meet criteria to prevent fish mortality. The single compliant diversion (960491) diverts approximately 700 gpm (Fig. 19). Ironically, the dam for the diversion is a partial barrier to fish passage (Fig 20). The Highline Ditch diversion (960494) requires the installation of a fish bypass screen due its large capacity and year-round operation (Figs 21-22). This diversion received the highest screening priority ranking.

Many other dams for gravity diversions are seasonal barriers. These push-up boulder dams are removed or scattered after irrigation season ends. Of the ten barrier dams, only four are total blockages (960363, 960491, 960492 and 960508). Nineteen diversions had either no dam associated with it or the dam was not a barrier to fish passage. Refer to Table 10 for detailed information on these features.

Most gravity diversions on Squilchuck Creek consist of a single unscreened PVC pipe laid in the stream. These sites could easily become compliant by designing the intake pipe and diversion dam placements in order to reduce the approach velocity yet provide enough slack water to sufficiently submerge the diversion pipes. All intake pipes should be fitted with proper size screening material. Foreign materials should be completely removed from the stream during the off-season to prevent debris collection. Stream enhancement efforts to restore habitat quality should coincide with barrier correction in Squilchuck Creek in order to capitalize on the expenditures.

Figure 5. The mouth of Colockum Creek is an unobstructed, low gradient, sinuous channel. Abundant juvenile salmonids were observed in the lower 1,000 m.

Figure 6. Site 960384, a boulder dam and gravity diversion on Colockum Creek impedes fish passage and lacks proper screening.

Figure 7. This noncompliant gravity diversion (960387) on Colockum Creek lacks a fish bypass screen. This site received the highest priority rankings for passage (23.47) and screening (7.42).

Figure 8. The first barrier (960419) on Stemilt Creek is impassable due to a 1.4 m hydraulic drop over the spillway.

Figure 9. This improperly screened diversion intake (960419) fails to prevent mortality of juvenile salmonids.

Figure 10. Four undersized 0.26 m smooth steel pipes (960406) block fish passage and promote bank erosion during high flow events. Stemilt Creek flows over this private access road for several weeks during spring runoff.

Figure 11. This ecology block dam (960427) for the Clear Lake diversion on Stemilt Creek blew out during high flow runoff in 2006. A concrete dam will replace the current structure and allow for fish passage.

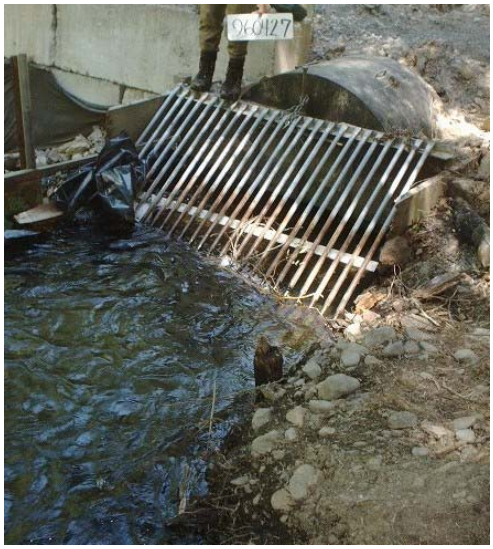

Figure 12. The diversion (960427) associated with the previous photo will have a fish bypass screen installed prior to the 2007 irrigation season.

Figure 13. This dam and diversion (960428) for Lily Lake located on Stemilt Creek also blew out during the 2006 runoff event. A concrete dam with a fish bypass screen will replace this structure.

Figure 14. This dam and diversion (960446) located on Orr Creek is one of three that dewaters the stream channel. Only a trickle of flow seeped through the dam at the time of survey.

Figure 15. This wooden dam and diversion structure (960432) on Little Stemilt Creek lacks a fish bypass screen and blocks passage due to a 0.8 m outfall drop at the spillway. Several other diversions in the watershed were constructed similarly. One such site inadvertently provides spawning habitat within the structure.

Figure 16. This box culvert (040162) located under the railroad yard on Squilchuck Creek is a partial barrier due to excessive slope. Two of three cells are obstructed with vegetation and debris.

Figure 17. This 3.0 m wide box culvert (970003) under S. Wenatchee Ave on Squilchuck Creek is a total barrier to chinook, steelhead, coho and resident rainbow/cutthroat trout and received the highest priority ranking.

Figure 18. A collapsed footbridge crossing (960354) now creates a passage barrier on Squilchuck Creek. This site is one of several debris-causing blockages.

Figure 19. This paddle wheel driven fish bypass screen, called the ORT diversion, associated with the next photo satisfies state law in preventing juvenile fish mortality from surface water diversions.

Figure 20. This push up boulder dam (960491) on Squilchuck Creek would be fish passable by removing the visqueen and placing the boulders appropriately to reduce the sweeping velocity. The intake pipe debris screen was lying on the stream bank.

Figure 21. The Highline Diversion (960494) operates year round. The boulder dam at this site was evaluated as 100% passable.

Figure 22. The Highline Diversion (960494) lacks a fish bypass screen making this site noncompliant.

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