

South Puget Sound Wildlife Area
Fish Passage and Diversion Screening
Prioritization Inventory

Habitat Program
Technical Applications Division
Habitat and Passage Projects Section

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INTRODUCTION

The Washington Department of Fish and Wildlife (WDFW) is committed to providing leadership in restoring salmon and trout (salmonid) populations in Washington State. WDFW conducts Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization projects, which address two factors limiting salmonid populations:

- ?? Human-made barriers to fish passage such as culverts and dams
- ?? Salmonid mortality from unscreened or inadequately screened water diversions

When culverts and dams are barriers to fish migration, productive habitat becomes inaccessible. Both adult and juvenile salmonids need to move freely up and downstream to find suitable spawning gravel or disperse from the redd into rearing habitat. Even resident trout need full access to all habitat types to spawn, rear, maximize genetic interchange and survive varying flow conditions.

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. However, when diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system.

Inventories of fish passage barriers and water diversions are being conducted on each of the Wildlife Areas owned or managed by WDFW. The inventories and habitat surveys document and prioritize for correction all human-made fish passage barriers and unscreened or inadequately screened diversions to ensure compliance with Washington State laws (RCW 77.55.060, RCW 77.55.040).

For this report, the location of a fish passage or safety structure is referred to as a site. The structure at that site is referred to as a feature.

Features affecting fish passage include:

- ?? Culverts
- ?? Dams
- ?? Fishways

Features affecting fish safety include:

- ?? Gravity diversions
- ?? Pump diversions

A site may have one or more features associated with it such as a gravity diversion with a dam to impound water and direct it to the diversion. A dam may be equipped with a fishway to facilitate fish passage around the dam.

This report summarizes the results of the South Puget Sound Wildlife Area inventory with preliminary plans and recommendations to correct the problems identified.

SITE DESCRIPTIONS

South Puget Sound Wildlife Area

The South Puget Sound Wildlife Area is comprised of six units located in Pierce and Thurston Counties, Washington: South Puget Sound Urban Interpretive Center, McNeil, Gertrude and Pitt Islands, Scatter Creek and the Ohop Farm, which cover approximately 5,575 acres (See Figure 1), (WDFW 1997). Other smaller parcels of WDFW land inventoried include: Skookumchuck, Nisqually and Black River.

South Puget Sound Urban Interpretive Center

The South Puget Sound Urban Interpretive Center is a 90 acre parcel of land in the heart of Lakewood. The Lakewood (formerly South Tacoma) Fish Hatchery is located on this property. Current plans are to restore the native oak-woodland prairie ecosystem with associated natural spring and wetland environments. When completed the area will be a showcase urban wildlife environmental center, open to the public for walking and hiking tours and public school environmental education purposes (WDFW 1997).

McNeil, Gertrude and Pitt Islands

These islands are located in the southern portion of Puget Sound approximately 11 km southwest of Tacoma. In 1983, the State of Washington received ownership for McNeil, Gertrude and Pitt Islands from the U. S. Bureau of Prisons. Management is divided between Washington Department of Fish and Wildlife, which manages 3,119 acres of upland and tidelands, and Washington State Department of Corrections which operates the prison and manages 1,326 acres of farmland, the penitentiary complex, the vocational annex and various segments of land on McNeil Island (WDFW 1997).

Management of the islands consists mainly of enforcing the wildlife restrictions within the quitclaim transfer deed. These restrictions state that the islands will be a sanctuary for the unmolested feeding and breeding of wildlife and will be specifically unavailable to the public (WDFW 1997).

Scatter Creek

The Scatter Creek unit is located in Thurston County, 32 km south of Olympia. The approximately 816 acre property consists mainly of extremely porous glacial outwash plain which supports a unique Idaho fescue/Balsamroot short-grass prairie with associated wildflower, moss, lichen, fern, tree and shrub species (WDFW 1995).

Scatter Creek is fed by surface runoff, groundwater and the outflows of two private hatcheries just upstream of the wildlife area. Historically Scatter Creek originated at McIntosh Lake, east of Tenino, but the streambed was filled in and water flow was cut off when Military Road was built in the mid-1900's. There are records of a winter coho run up Scatter Creek, and there is local knowledge of native cutthroat trout and Atlantic salmon observations (WDFW 1995).

Atlantic salmon, escaped from a hatchery just south of the north unit, are rearing in Scatter Creek. Current plans are to install redundant protection on the hatchery affluent, dewater the

hatchery pollution abatement ponds to remove the Atlantic salmon in the ponds and reduce the Atlantic salmon population in Scatter Creek (Kerwin, pers. comm.). Upstream of the hatcheries, Scatter Creek was dry on January 2, 2003 and grass growing in the channel indicates flows are rare.

Ohop Farm

The 40 acre Ohop Farm, located approximately seven miles southwest of Eatonville, consists of meadows, riparian vegetation and forested upland with Ohop Creek, a tributary to the Nisqually River, traversing it. Ohop Creek supports a small population of anadromous fish (WDFW 1997). Ohop Creek is the southernmost Washington stream supporting pink salmon and stream surveys report up to 80 fish per mile. Coho and Chinook salmon also inhabit this stream (WDFW 2002).

Skookumchuck

Pacificorp manages the Skookumchuck Wildlife Enhancement Area, 966 acres of land below the dam for wildlife, farming and forestry. The WDFW owns two small parcels of land within the wildlife enhancement area. One parcel is an access area to Skookumchuck River and the other encompasses the coho rearing ponds off of Skookumchuck road.

Nisqually and Black River

No features were found on these properties. The WDFW owned land adjacent to Nisqually National Wildlife Refuge is in the tide flats outside the diked area and on the steep hillslope west of McAllister Creek. Several spring-fed streams flowing down this hillslope are initially fish bearing but gradients exceed twenty percent within a short distance upstream of the confluences with McAllister Creek.

Most of the Black River property lies in the flood plain of the Black River and a small section of land lies between Gate Road and a railroad easement to the south. Two fish bearing streams flow through the property.

Figure 1. South Puget Sound Wildlife Area with Surrounding Satellite Units.

METHODS

Inventory/ Feature Evaluation

The inventory encompassed all units of the South Puget Sound Wildlife Area and additional lands associated with the stream habitat surveys. The Wildlife Area (WLA) manager provided assistance with the location of the various units, access to highly restricted McNeil Island and known fish passage features within the WLA.

A road inventory was conducted by driving or walking all roads along known and possibly fish bearing streams within the WLA. All features found in potentially fish bearing waters were assigned a Site ID number and their geographical locations were recorded using GPS or determined from maps. Data collection and evaluation methodologies for all features are described in the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

The potential for fish presence is determined based on stream size, gradient, fish observation and flow duration. Streams that are greater than 0.61 meters (2 feet) wide measured at the ordinary high water width, less than 20 percent gradient and maintain three continuous months of flow are considered fish bearing. Each potentially fish-bearing stream is walked to measure the habitat, locate additional features not found during the road inventory, and determine the extent of potential fish use. Detailed notes of the habitat, referenced by hip chain distance, are recorded during the habitat survey. All human-made features associated with fish bearing waters are evaluated for fish passage (culvert, dams, fishways) or fish safety (water diversions).

Expected fish species utilization not only includes those species currently inhabiting the stream, but also those that potentially could or have been known to use the stream. Expected fish species utilization is determined by direct observation and by using resources such as the Washington State Salmon and Steelhead Stock Inventory (WDF *et. al.* 1992), Washington State Salmonid Stock Inventory Bull Trout/Dolly Varden Appendix (WDFW 1998), Streamnet, and by personal communication with WDFW regional biologists.

Fish Passage Priority Index

The Fish Passage Priority Index (PI) model consolidates variables which affect a project's potential resource benefit, (species utilization, passage improvement, production potential, habitat gain, project cost, and fish stock mobility and health) resulting in a numeric indicator of relative priority. On streams where fish passage barriers were identified, habitat assessments, data analysis and barrier prioritization were completed per the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

Screening Priority Index

The Screening Priority Index (SPI) model consolidates the variables relevant to water diversions, (species utilization, volume of flow, production potential, project cost, and fish

stock mobility and health) resulting in a numeric indicator of relative priority. PI and SPI are not comparable, because the PI reflects potential production and the SPI reflects potential mortality. In the SPI, the volume of diverted flow is used to estimate the number of adult equivalent salmonids potentially killed by the unscreened or inadequately screened diversion. The SPI is described in the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

Prioritization

The PI and SPI values are intended to be used as a guide to prioritizing projects. Expected species utilization anticipates correction of downstream human-made barriers preventing anadromous access, but may be refined to reflect the feasibility of restoring anadromous access or habitat. Production values predicted for the PI assume all upstream human-made barriers will be corrected. The PI and SPI values are dynamic, allowing for modification as new information becomes available.

RESULTS

Inventory

The following tables summarize the features found during the inventory. All sites on fish bearing waters within the WLA are listed in Table 2 by owner and unit. Table 3 is a prioritized list of all fish passage barriers requiring repair and Table 4 lists the unscreened or inadequately screened water diversions requiring repair on land owned and/or managed by WDFW.

Table 1. Number of fish passage and water diversion features requiring repair within the South Puget Sound Wildlife Area listed by unit.

Wildlife Area Units	Number of Features Requiring Repair			Unit Totals
	Culverts	Dams	Diversions	
SPS Urban Interpretive Center	0	1	0	1
McNeil Island	1	6	5	12
Scatter Creek	2	0	0	2
Ohop Farm	0	0	0	0
Skookumchuck	0	0	0	0
Black River	0	0	0	0
Nisqually	0	0	0	0
Feature Totals	3	7	5	15

Fish passage barriers with limited habitat gain (LHG) are lower priority and will be considered for correction after the higher priority barriers are fixed. A complete list of all sites inventoried during the South Puget Sound Wildlife Area inventory, including sites outside the Wildlife Area, is in Appendix A. Detailed descriptions and maps of each stream surveyed follow the tables.

Table 2. Features located on fish bearing streams within the South Puget Sound Wildlife Area. The codes in the Repair Status column indicate the feature status where RR = Repair Required, OK = feature is not a barrier or safety issue, no repair required, LHG = Limited Habitat Gain and UD = repair status is undetermined. PD = Pump Diversion

Site ID	Stream	wria	Feature Type	Repair Status	Unit	Owner Type
981869	Unnamed to Chambers Cr	12.0000	Dam	OK	Interp. Cntr.	WLA/Prvt
981870	Unnamed to Chambers Cr	12.0000	Dam/FW	RR	Interp. Cntr.	WLA/Prvt
981733	Eden Cr	15.0094	Culvert	OK	McNeil IS	WLA
981735	Eden Cr	15.0094	Dam/PD	RR/UD	McNeil IS	WLA
981736	Eden Cr	15.0094	Culvert	OK	McNeil IS	WLA
981737	Eden Cr	15.0094	Dam	RR	McNeil IS	WLA
981740	Butterworth Res.	15.0094	Culvert	OK	McNeil IS	WLA
981750	Luhr Cr	15.0095	Dam/PD	RR/UD	McNeil IS	WLA
981751	Luhr Cr	15.0095	Culvert	RR	McNeil IS	WLA
981753	Floyd Cove Res	15.0000	Dam/PD	RR/UD	McNeil IS	WLA
981757	Bradley Cr	15.0093	Dam/PD	RR/UD	McNeil IS	WLA
981767	Butterworth Res.	15.0094	PD	UD	McNeil IS	WLA
981770	Milewa Cr	15.0000	Dam	RR	McNeil IS	WLA
981726	Unnamed to Scatter Cr	23.0000	Culvert	RR	Scatter Cr	WLA
981727	Unnamed to Scatter Cr	23.0000	Culvert	LHG	Scatter Cr	WLA
981849	Skookumchuck River	23.0761	Dam	OK	Skookumchuck	Private
342758	Unnamed to Skookumchuck River	23.0000	Culvert/ Fishway	OK	Skookumchuck	WLA

Table 3. Fish passage barriers requiring repair within the South Puget Sound Wildlife Area sorted by Unit and PI (Priority Index) value.

Site ID	Stream	Tributary to	Expected Species Utilization ¹	Feature Type	% Pass-able	Additional Barriers		Habitat Gain			Priority Index (PI)
						Up-stream	Down-stream	Survey Length (m)	Spawning (m ²)	Rearing (m ²)	
SPS Urban Interpretive Center											
981870	Unnamed	Chambers Cr	CH/CO/SH/SCT/RT	Dam	67	0	0	237	52.64	1435.50	15.20
McNeil Island Unit											
981751	Luhr Cr	Puget Sound	CH/SCT	Culvert	0	1	0	351	25	1,956	8.39
981735	Eden Cr	Puget Sound	RT	Dam/PD	0	1	0	1,300	0	39,386	6.31
981737	Eden Cr	Puget Sound	RT	Dam	0	0	1	765	0	29,558	5.87
981757	Bradley Cr	Puget Sound	SCT	Dam/PD	0	0	0	115	0	5,479	5.17
981753	Floyd Cove	Puget Sound	SCT	Dam/PD	0	0	0	70	0	4,408	4.90
981770	Milewa Cr	Puget Sound	SCT	Dam	0	0	0	150	0	4,236	4.85
981750	Luhr Cr	Puget Sound	SCT	Dam/PD	0	0	1	216	0	1,775	3.90
Scatter Creek Unit											
981726	Unnamed	Scatter Cr	CO/SH/SCT/RT	Culvert	67	1	0	1,399	15	1,575	9.91
981727	Unnamed	Scatter Cr	RT	Culvert	67		0	190			LHG

¹ Species Codes:

CH - Chum, CO - Coho, SH - Steelhead, SCT – Searun Cutthroat, RT - Resident trout, DB - Dolly Varden/Bull trout, RB - Rainbow trout. PD – Pump Diversion. LHG – Limited Habitat Gain

∞

Table 4. Water diversions within the South Puget Sound WLA.

Site ID	Stream	Tributary to	Ownership Type	Diversion Type	Compliant Screen?	Flow (gpm)	Screening Priority Index (SPI)
McNeil Island Unit							
981767	Butterworth Res.	Eden Cr	WDFW	Pump Diversion	No	UD ¹	UD ¹
981735	Eden Cr	Puget Sound	WDFW	Pump Diversion	No	UD ¹	UD ¹
981750	Luhr Cr	Puget Sound	WDFW	Pump Diversion	No	UD ¹	UD ¹
981753	Floyd Cove	Puget Sound	WDFW	Pump Diversion	No	UD ¹	UD ¹
981757	Bradley Cr	Puget Sound	WDFW	Pump Diversion	No	UD ¹	UD ¹

¹ UD – Undetermined. Flow and SPI could not be determined because pump information was not available and intakes are offshore.

Figure 2. Map of South Puget Sound Urban Interpretive Center.

The following descriptions detail the fish passage barriers, water diversions and physical habitat of each stream surveyed. Refer to tables 2, 3 and 4 for feature, habitat and priority index information and the map figures for site locations. Photographs of each feature follow the descriptions beginning on page 17.

South Puget Sound Urban Interpretive Center Unit

Unnamed Tributary to Chambers Creek – WRIA (Map on page 9, Figure 2)

This tributary is the outflow of the Lakewood Fish Hatchery located on the WLA. Springs and two deep wells pump groundwater to the hatchery and the outflow from the concrete raceway flows naturally for 351 meters to the confluence with Chambers Creek. In this natural section of stream, there are two dams. The first dam encountered, site **981869** is 29 meters upstream of the confluence with Chambers Creek. This concrete dam is passable only because the stream has carved a new channel around the end of the dam.

Site **981870**, is 85 meters upstream of the first dam. This second dam, equipped with a fishway, is a partial barrier due to outfall drops of 0.50 meters and 0.55 meters out of the weir pools. The fishway has three slots for stop planks but only two are used. Even if the third slot were used, the drops would still exceed the maximum allowable outfall drop of 0.24 meters, and it would cut the length of each pool in half.

Because the WLA boundary extends to the middle of the stream, the second dam is half on WLA land and half on private land. Since the stream has diverted around the right bank side of the first dam (WLA side), it is now entirely on private land (Kessler 2003). Ownership needs to be verified. The landowner having adjacent property along this stream is considering removal of at least one of the downstream dams (Jenkins 2003).

Several ponds have been dug utilizing springs on the WLA and overflows from the ponds go into the hatchery system. The ponds are currently used to study western pond turtles. None of these human-made, isolated ponds are suitable salmon habitat.

McNeil Island Unit

All McNeil Island streams of any size have been dammed to create reservoirs for human use and past agricultural activities. Water from three reservoirs along the north shore, Luhr, Floyd Cove, and Bradley Creeks, is currently or has historically, been pumped through aqueducts to Butterworth Reservoir. Water from Butterworth Reservoir is piped down to Eden Creek Reservoir where a filtration plant purifies and distributes the water to correctional facilities and residential homes on the island. Butterworth Reservoir water is also pumped to the north facility complex. Milewa Creek, also dammed, does not have any pump facilities (Kessler 2003).

Figure 3. Map of McNeil Island unit.

According to a water facilities operator, the screens on the pump intakes are basically trash racks with bars spaced about two inches apart. Fish that get into the system do not survive the chemical treatment or successive pump systems. The trout in Butterworth reservoir are all 12 to 18 inches long and do not enter the pump intake. These trout are planted annually since there is no available spawning habitat to sustain the population. The juveniles of lake reproducing species such as bluegill and bass get into the pump intakes (Loosveldt 2003). If made accessible to salmonids, the reservoirs could provide substantial amounts of rearing habitat. The streams flowing into these reservoirs are small and shallow, approximately 0.61 meters (2.0ft) wide, and have mainly sand or silt substrate with very little spawning habitat.

Gertrude Island, off the northeast shore of McNeil Island provides a haul-out for harbor seals and nesting for great blue herons. Pitt Island lies off the northwest coast of McNeil Island in Pitt Passage. Observed from McNeil Island, neither island is large enough to support any fish bearing streams.

Eden Creek – WRIA 15.0093

The two reservoirs on Eden Creek completely alter or inundate the original channel of Eden Creek, thus it is impossible to visually determine if the stream was historically fish bearing. Butterworth reservoir is stocked regularly with rainbow trout since there is no spawning habitat available to sustain a natural population.

The Eden Creek dam, site **981735** and the Butterworth dam, site **981737**, are total barriers. Two passable culverts are located downstream of Eden Creek dam. Just downstream of the dam, site **981736**, is a 0.76 meter diameter pipe. The dam controls the flow and the culvert is backwatered at high tide. There is no drivable road at this site or any obvious reason for the culvert to exist. The second culvert, site **981733**, under Coastal Road, is a bottomless arch, 2.5m wide by 0.95m high. It is also tidally influenced and does not require repair.

An offshore pump house on Butterworth Reservoir, site **981767**, pumps water to the north facility complex.

Luhr Creek – WRIA 15.0095

Spring-fed Luhr Creek flows out of the forested hills on the northwest side of McNeil Island into Pitt Passage. The first barrier encountered is a culvert, site **981751**, under Coastal Road at the stream's outlet into Puget Sound. The downstream end of this 0.31 meter diameter culvert is tidally influenced. Due to slope and velocity, this culvert is a total barrier.

Approximately 60 meters upstream is a barrier dam and pump diversion at site **981750**. The earthen dam has a sloping concrete spillway that is a barrier due to insufficient water depth (sheetflow) and slope. The pump is located in a pump house on the dam and the intake is in the reservoir. Screening and pump information was unobtainable. Water is pumped through an underground aqueduct to Butterworth Reservoir. The outlet into Butterworth Reservoir, site **981766**, is not screened and could pose a hazard to resident fish in the reservoir as it provides a flow that may be attractive to trout.

Luhr Creek continues for about 130 meters upstream of the Luhr Reservoir before becoming less than 0.61 meters (2.0 ft) wide at the ordinary high water mark.

Floyd Cove– WRIA 15.0000

Coastal Road becomes the dam, site **981753**, impounding water at Floyd Cove. A culvert under the road acts as a spillway for the dam with the outfall going directly into Puget Sound at high tide and falling onto the beach at low tide. Outfall drop ranges from about 0.20 meters at high tide to 2.5 meters at low tide. A pump building contains the pump equipment and the intake, not visible, is apparently offshore in the reservoir. Pump information and intake screening could not be determined.

Four small streams flow into the reservoir from the surrounding hillside. Two streams have natural stream bottoms with a small amount of gravel but are less than 200 meters long. The other two streams have vegetated substrates indicating flow is limited to rainfall runoff.

Bradley Creek – WRIA 15.0093

Coastal Road again doubles as a road and a dam creating Bradley Reservoir, site **981757**. A standpipe and culvert control the water level in the reservoir. The creek is labeled Bradley Creek on the map but the sign in front of the pump station labels it as Bodley Creek. An error made in transcribing the name led to the now official name of Bradley (Kessler 2003). Pump equipment was inaccessible, and screening could not be determined for the intake in the reservoir. Along the south end of the reservoir, Still Harbor Shore Road bisects the pond. The road appears to be an old logging road. At the time of the survey, the road was flooded over and no culvert was evident. Two small streams flow into Bradley Reservoir. Both are considered not fish bearing, as they are less than 0.61 meters (2.0ft) wide measured at the ordinary high water mark.

Milewa Creek – WRIA 15.0000

Milewa Creek Reservoir is another reservoir created by Coastal Road damming Milewa Creek. The dam at this site, **981770** has an overflow culvert that is a total barrier due to outfall drop. No water is pumped from this reservoir. One small, non fish-bearing stream enters the reservoir.

Scatter Creek Unit

Unnamed Tributary to Scatter Creek – WRIA 23.0000

The culvert at site **981726** is a partial barrier to fish passage due to a 1.35% slope. Downstream of the culvert, this low gradient stream flows along the toe of a hillslope through mixed second growth forest. Near the confluence with Scatter Creek several very old, overgrown beaver dams appear to be a barrier to fish passage as salmon fry were observed just downstream in Scatter Creek but not upstream of these beaver dams. Upstream of the culvert, the stream and a tributary, flow out of forested hills with several more beaver dams which are not barriers. One additional barrier, site **981729**, exists on the tributary beyond the WLA boundary. At the boundary this tributary has recently been ditched. The barrier culvert, on private land has a limited amount of habitat gain (<200m) before becoming non fish-bearing.

Figure 4. Map of Scatter Creek unit.

Unnamed Stream – WRIA 23.0000

This stream enters the north boundary of the Scatter Creek unit in open prairie, crossing under a WLA access road at site **981827**. The stream has good flow in winter but is dry by May, within the WLA. Even at high winter flows, the downstream channel is defined for only 190 meters before it spreads out into the prairie grass and quickly disappears into the extremely porous soil. There is no connection to Scatter Creek or the tributary above. Because of this natural barrier, the stream is considered to have only resident fish use and the lesser amount of habitat up or downstream is the habitat gain. The lesser amount of habitat is downstream of the culvert and since it is less than 200m, it is considered a limited habitat gain site. While still requiring repair, it receives a lower priority. Potential fish use is limited to winter rearing habitat.

Ohop Farm Unit

The one feature on this unit is a very long culvert that runs under the grassland to the east of Ohop Creek and outlets into Ohop Creek. The non fish-bearing, spring-fed stream is less than 0.61 meters (2.0ft) wide at the ordinary high water mark.

One potentially fish bearing tributary to Ohop Creek on the WLA has been ditched and re-routed to run parallel to the forest edge before cutting across the grassland to enter Ohop Creek. In an effort to dry the adjacent pastureland, this ditched section collects water from hillside springs and winter runoff. Despite this, portions of the pasture remain wet from springs in the pasture. The ditched section does not create any problems for fish passage or health but may provide an opportunity for habitat enhancement by restoring meander and habitat complexity to the stream.

Skookumchuck

Skookumchuck Dam, built in 1970, is managed by Pacificorp (previously Pacific Power and Light Company) of Portland, Oregon. The dam inundates two miles of spawning habitat and blocks access to 12 additional miles of spring chinook, fall chinook, coho and steelhead spawning areas. Half of the potential coho rearing area and 90 percent of the potential steelhead spawning grounds on the Skookumchuck were above the dam. The power company mitigates this loss under agreements with WDFW by guaranteeing adequate downstream flow for chinook, artificially rearing coho and providing both artificial rearing and fish passage for steelhead (USFWS 1993). A trap and haul operation captures migrating steelhead, trucks them upstream of the dam and releases them back into the river.

The two features on fish bearing streams on this property are sites **981849** and **342758**. Skookumchuck dam, site 981849 is a total barrier, but the resource loss has been mitigated as described in the paragraph above. Site 342758 consists of a pair of culverts under Skookumchuck road with an Alaska steep pass fishway attached to the downstream end of one of the culverts. The fishway and culvert system is considered passable. The water originates from the coho rearing ponds a short distance upstream.

Figure 5. Map of Skookumchuck unit.

Photographs of fish barriers on WLA lands.

South Puget Sound Urban Interpretive Center.



Figure 6. Site 981870. This concrete dam and fishway partially block access to 237 meters of stream habitat. The outfall drops on the fishway are 0.50 meters and 0.51 meters. Trout were observed in the upstream pool. This stream is the outflow from the Lakewood Fish Hatchery.

McNeil Island fish passage barriers and pump diversions.



Figure 7. Site 981735. Eden Creek Dam, Reservoir and pump equipment. Water is pumped to a water treatment plant.



Figure 8. Site 981737. Building at base of Butterworth dam. Water flows from Butterworth reservoir down to Eden Creek reservoir.

McNeil Island fish passage barriers and pump diversions. (Continued)



Figure 9. Site 981737. Offshore intake for Butterworth Reservoir which pipes water down to Eden Creek Reservoir.



Figure 10. Site 981767. Offshore intake pumps Butterworth Reservoir water to the North Facility Complex.



Figure 11. Site 981751. Luhr Creek barrier culvert outlets directly into Puget Sound. This 40 meter long, 0.31 meter diameter culvert is a total barrier to fish passage.



Figure 12. Site 981750. About 60 meters upstream of site 981751 is Luhr Creek dam and spillway. The spillway, pictured above, is a total barrier due to slope and sheetflow.

McNeil Island fish passage barriers and pump diversions. (Continued)



Figure 13. Site 981766. Looking down on the aqueduct outlet into Butterworth Reservoir, which originates in Luhr Creek Reservoir. This is submerged at higher lake levels.



Figure 14. Site 981753. Coastal Road/Floyd Cove Dam. Reservoir on right, Pitt Passage on left. Overflow standpipe and culvert spill water into Sound.



Figure 15. Site 981757. Bradley Reservoir on right with standpipe overflow. Puget Sound at upper left.



Figure 16. Site 981770. Milewa Creek Reservoir is about 1.0m above the high tide line of Puget Sound. An overflow culvert spills water into the Sound.

Scatter Creek fish passage barriers.



Figure 17. Site 981726. Unnamed tributary to Scatter Creek. This 1.12 meter diameter culvert is a barrier due to a 1.35 percent slope.



Figure 18. Site 981727. Unnamed stream with limited habitat gain. Stream goes subsurface downstream in very porous soil.

DISCUSSION

The habitat within the Urban Interpretive Center is highly altered making it difficult to determine historical fish use. The water source for the Lakewood Fish Hatchery comes from two wells and spring water piped directly to the hatchery. The spring produces approximately 2500 gallons of water per minute and the two wells produce about 650 gpm (Jenkins 2003). This continuous flow feeds the stream that starts at the hatchery raceway outflow and flows in a fairly natural channel to Chambers Creek. If a channel to the spring source was restored this would add about 100 meters of stream to the overall length.

McNeil Island reservoirs, while potentially providing large amounts of rearing habitat, are extremely limited in spawning habitat and further investigation is needed to determine the sustainability of fish populations. Flow duration in the potential spawning habitat should also be examined to determine if flows coincide with spawning periods for the species potentially utilizing the streams.

In the Scatter Creek unit, the overgrown beaver dams on the tributary to Scatter Creek near the confluence impede fish passage.

While no fish barriers exist on the Ohop Farm, the natural stream courses of two Ohop tributaries have been altered. Ohop Creek lacks sinuosity and habitat complexity. Incisement is degrading the streambed of Ohop Creek and the unstable banks continually erode, adding fine sediments to the substrate.

RECOMMENDATIONS

Of the 10 fish passage barriers identified on WDFW lands during the South Puget Sound WLA inventory, nine of the barriers are prioritized for correction. One is a limited habitat gain site (<200m in length). The four pump diversion intakes and the aqueduct outlet in McNeil Island reservoirs require proper screening. WDFW is committed to removing fish passage barriers and installing screens on diversions on WDFW lands.

The next step for WDFW, after identifying and prioritizing fish passage barriers and inadequately screened diversions, is project scoping which will determine the feasibility of barrier correction, diversion screening and habitat enhancement projects.

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APPENDIX A

A comprehensive list of all features evaluated during the Lake Terrell and Tennant Lake Wildlife Area Fish Passage Barrier and Surface Water Diversion Inventory. Features are sorted by Site ID number.

Site ID	Stream	WRIA	Feature Type	Repair Status	WLA Unit	Owner Type
342757	Troller Run	23.0829	Culvert	NFB	Skookumchuck	County
342578	Unnamed to Skookumchuck R	23.0000	Culvert/FW	OK	Skookumchuck	Co./WLA
343008	Unnamed to Thompson Cr	23.0000	Culvert	NFB	Skookumchuck	Private
981726	Unnamed to Scatter Cr	23.0000	Culvert	RR	Scatter Cr	WLA
981727	Unnamed to Scatter Cr	23.0000	Culvert	LHG	Scatter Cr	WLA
981728	Unnamed to Scatter Cr	23.0000	Culvert	NFB	Scatter Cr	WLA
981729	Unnamed to Scatter Cr	23.0000	Culvert	LHG	Scatter Cr	Private
981733	Eden Cr	15.0094	Culvert	OK	McNeil IS	WLA
981734	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981735	Eden Cr	15.0094	Dam/PD	RR	McNeil IS	WLA
981736	Eden Cr	15.0094	Culvert	OK	McNeil IS	WLA
981737	Eden Cr	15.0094	Dam	RR	McNeil IS	WLA
981738	Unnamed to Butterworth	15.0000	Culvert	NFB	McNeil IS	WLA
981739	Unnamed to Butterworth	15.0000	Culvert	NFB	McNeil IS	WLA
981740	Butterworth Res.	15.0094	Culvert	OK	McNeil IS	WLA
981741	Unnamed to Butterworth	15.0000	Culvert	NFB	McNeil IS	WLA
981742	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981743	Unnamed to Puget So.	15.0000	Dam	NFB	McNeil IS	WLA
981744	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981745	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981746	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981747	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981748	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981749	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981750	Luhr Cr	15.0095	Dam/PD	RR	McNeil IS	WLA
981751	Luhr Cr	15.0095	Culvert	RR	McNeil IS	WLA
981752	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981753	Floyd Cove Res.	15.0000	Dam/PD	RR	McNeil IS	WLA
981754	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981755	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981756	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981757	Bradley Cr	15.0093	Dam/PD	RR	McNeil IS	WLA
981758	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981759	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981760	Anderson Pond	15.0000	Culvert	NFB	McNeil IS	WLA
981761	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981762	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981763	Anderson Pond	15.0000	Culvert	NFB	McNeil IS	MICC

Site ID	Stream	WRIA	Feature Type	Repair Status	WLA Unit	Owner Type
981764	Unnamed to Anderson Pond	15.0000	Dam	NFB	McNeil IS	WLA
981765	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981766	Luhr Cr	15.0095	Pump Div	NFB	McNeil IS	WLA
981767	Butterworth Res.	15.0094	Pump Div	UD	McNeil IS	WLA
981768	Unnamed to Puget So.	15.0000	Dam	NFB	McNeil IS	WLA
981769	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981770	Milewa Cr	15.0000	Dam	RR	McNeil IS	WLA
981771	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981772	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981773	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981774	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981775	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981776	Unnamed to Puget So.	15.0000	Culvert	NFB	McNeil IS	WLA
981843	Unnamed to Skookumchuck R	23.0000	Culvert	NFB	Skookumchuck	Private
981844	Unnamed to Skookumchuck R	23.0000	Culvert	NFB	Skookumchuck	Private
981845	Unnamed to Skookumchuck R	23.0000	Culvert	NFB	Skookumchuck	Private
981846	Unnamed to Thompson Cr	23.0000	Culvert	NFB	Skookumchuck	Private
981847	Unnamed to Thompson Cr	23.0000	Culvert	NFB	Skookumchuck	Private
981848	Unnamed to Thompson Cr	23.0000	Culvert	NFB	Skookumchuck	Private
981849	Skookumchuck River	23.0761	Dam	OK	Skookumchuck	Private
981869	Unnamed to Chambers Cr	12.0000	Dam	OK	UIC	Private
981870	Unnamed to Chambers Cr	12.0000	Dam/FW	RR	UIC	WLA/Prvt
981871	Unnamed to Ohop Cr	11.0000	Culvert	NFB	Ohop	WLA