Gales Creek Fish Passage Assessment and Prioritization

Washington County, Oregon



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Abstract

Washington County conducted a fish passage inventory of the culverts acting as stream crossings in the Gales Creek watershed during the fall of 2008 to identify barriers to migratory fish passage. In Oregon, a culvert is considered a barrier when it inhibits passage of migratory fish any time the stream discharge is between the 10% and 95% exceedance flow for the migration period. The inventory followed the format and methodology established during the 2006 Dairy-McKay culvert inventory (see "Dairy-McKay Fish Passage Assessment and Prioritization", December 2006). Field inspections for the Gales Creek watershed were conducted on 95 culverts, 43 of which were surveyed and prioritized. Barrier determination was based on the swimming ability of juvenile cutthroat trout, using the BLM Coarse Screen Filter Version 2.2 (Appendix C) as a passage standard. Indeterminate barriers were further analyzed with FishXing 3 *beta* to confirm their ability to pass fish. The 52 non-surveyed culverts were identified as cross-tiles or crossings over non-fish bearing streams. Culverts identified as high priority barriers were organized in groupings based on geographic location, stream connectivity, and ease of construction.

Objectives

- Assess fish passage status within the Washington County road system in the Gales Creek watershed.
- Identify which road-stream crossings act as fish passage barriers (barriers) through field surveys.
- Prioritize and group the barriers to set the groundwork for future replacement.
- Develop a method for incorporating barrier removal into overall maintenance project selection.
- Expand partnerships to speed replacement of high priority barriers and improve migratory fish access to high quality habitat.

I. Introduction

<u>Overview</u>

Washington County surveyed the culverts carrying fish bearing streams within the Gales Creek watershed to identify existing barriers. The collected information was then used to develop a prioritization scheme, ranking the surveyed barriers based on culvert and habitat conditions. The identified high priority barriers were placed into groups based on geographical proximity, stream connectivity potential, and construction logistics. The survey and barrier ranking followed the system developed during the Dairy-McKay watershed survey and prioritization.

Background

Washington County has incorporated fish passage design elements within the culvert replacement program for many years. However, project selection focuses on structurally deficient culverts with limited consideration for potential ecological benefits. This results in barriers to high quality habitat remaining in place until the culverts are replaced due to

structural concerns. In 2006 Washington County conducted a survey of barriers in the Dairy-McKay watershed, giving the County an opportunity to integrate environmental benefits into the current maintenance and replacement strategy through securing funding dedicated to the improvement of fish habitat.

An additional requirement to inventory barriers comes from Oregon House Bill 3002, which requires all artificial obstructions on streams with current or past migratory fish populations to provide upstream and downstream passage if certain "triggering" events occur. The bill also requires the Oregon Department of Fish and Wildlife (ODFW) to complete and maintain a statewide inventory of all artificial obstructions. The County's inventory supports ODFW's efforts to complete the statewide inventory.

Partners Involved

The assessment and prioritization were undertaken in collaboration with the Bureau of Land Management (BLM), Oregon Department of Fish and Wildlife (ODFW), and Tualatin River Watershed Council (TRWC). Because the nature of this project does not fall within the direct realm of road maintenance, Washington County sought additional funding to complete the assessment. BLM used Title II funds of the Secure Rural Schools and Community Self-Determination Act to help fund the project with the desire to improve migratory fish counts in streams running through BLM land and gain a more complete inventory of state fish passage barriers.

In 2007, the County participated in ODFW's Fish Passage Barrier Data Standard Taskforce as a technical advisor in developing a consistent statewide methodology for documenting and sharing data on barriers. The data collection for the Gales Creek assessment closely follows this developed standard, ensuring the methodology and data can easily be utilized by other transportation agencies, resource agencies, or watershed councils. Eventually the data collected in the Dairy-McKay and Gales Creek assessments will be incorporated into the Oregon Fish passage Barrier Data Standard dataset.

The assessment will also be made available to the Tualatin River Watershed Council as an aid in prioritizing restoration opportunities. This tool will help the TRWC achieve priority action items in the Tualatin River Watershed Action Plan: "Action Item 1 – Assess watershed conditions to help prioritize restoration activities" and "Action Item 2 - Conserve and improve fish and wildlife habitat (focusing on anadromous fish)".

Watershed Selection

The Gales Creek watershed (HUC 1709001002) is a subwatershed of the Tualatin River (HUC 17090010), located in northwest Oregon and flowing into the Willamette River. The Tualatin River watershed drains 712 square miles of forest, agricultural plains, and urban area. The urban areas, comprising 15% of the watershed, include southwest Portland, Hillsboro, Tigard, and Beaverton and contain some of Oregon's fastest growing urban populations. Forest and agriculture take up 50% and 35% of the remaining area, respectively. (Tualatin River Watershed Council website)

The Gales Creek watershed has been identified as critical habitat for winter steelhead within the Tualatin River basin. It is the smallest watershed within the basin, draining

77.9 square miles (49,481 acres), approximately 11% of the basin in western Washington County. Dominated by agriculture and forestry, its headwaters stem from the eastern slopes of the Coast Range Mountains. The watershed drains in a southeasterly direction, joining the Tualatin River downstream of River Mile 57 near the city of Forest Grove. The Tualatin River serves as rearing and migration habitat for salmon and steelhead, and the Gales Creek watershed also contains essential salmonid habitat and critical habitat for spawning, rearing, and migration of winter steelhead. The headwaters of Gales Creek and its tributaries flow through state-managed and private industrial forestlands. The City of Forest Grove owns a large portion of land that comprises the Clear Creek subwatershed, managing it for municipal drinking water supply and potential timber harvest. The Gales Creek watershed lies almost entirely within Washington County, with a small area extending into Tillamook County to the west. The watershed includes mountainous regions, foothills, and plains, resulting in several different stream reach and habitat types.



Figure 1. Gales Creek Watershed Location (Breuner, N.)



Figure 2. Gales Creek Watershed and Sub-Watersheds (Breuner, N.)

Species of Concern

The fish species of concern include Upper Willamette River Winter Steelhead (*Oncorhynchus mykiss*), currently listed as threatened under the Endangered Species Act, and all other migratory fish found in the Willamette basin, as determined by the Oregon Department of Fish and Wildlife Fish Passage Task Force. Juvenile cutthroat trout (*O. clarkii*) are used as a design species as they represent the weakest species and life history of anticipated migratory fisheries within this watershed, excluding lamprey. Coho salmon (*O. kisutch*) are not native to the watershed but have acclimated to the basin, exist well with other species, and have value as game fish. Gales Creek has been identified as Critical Habitat and Essential Salmonid Habitat (ESH) for Upper Willamette River winter steelhead (*O mykiss*) and is accounted for in the barrier prioritization by incorporating the barrier's proximity to streams with these designations.

Survey Scope

Fish passage assessments range from detailed data collections to simplified measurements of surrogate barrier indicators. While a hydraulic analysis of each culvert provides a detailed description of a culvert's barrier level, the effort and time required to collect the necessary data for each culvert is excessive based on Washington County's needs. Instead, the high priority barriers in the watershed were identified using BLM's Coarse Screen Filter (Appendix C) and Fish Xing, then ranked relative to one another; allowing the County to adopt a more simplified approach to the culvert surveys. A more detailed survey and assessment of culvert finalists will be completed before replacement. This method has been adopted from the Dairy-McKay culvert survey conducted in 2006, and based upon site visits, accurately prioritizes barriers within the Gales Creek subwatershed.

II. Inventory

Culvert Selection

The first step in the culvert inventory is to identify County culverts associated with fish bearing waterways in the Gales Creek watershed. Based on ODFW input, it is assumed that all streams in the Gales Creek watershed currently have, or historically had, the potential to support fish. Through the use of Geographic Information System (GIS) mapping, 15" diameter and larger culverts are displayed on USGS 7.5' quadrangle maps in order to identify all County owned stream crossings. The survey team then investigates the mapped culverts and road-stream crossings to confirm the accuracy of the database. The function (stream crossing or cross-tile) of the culvert is evaluated and culverts acting as stream crossings are surveyed. If there are no stream features (bed and banks) or off-channel refuge habitat (floodplains, wetlands, and side channels) present at the culvert site, it is labeled as a cross-tile and removed from the barrier list.

To focus on stream reaches likely to have fish presence, culverts smaller than 15 inches in diameter not associated with mapped streams are excluded from the inventory, as they generally serve as drainage cross tiles. Additionally, culverts carrying streams with gradients over 15% are excluded from the inventory because that gradient represents the

upper limit of migratory fish use. Stream gradient is measured in the field using a clinometer upstream and downstream of each culvert. Because the clinometer is an imprecise instrument, the reading is coupled with the survey team's visual evaluation of the site.

A total of 95 culverts were mapped as potential barriers in the Gales Creek watershed. Field inspections ruled out 52 culverts, most of which were cross tiles lacking stream features. A complete survey was performed on the remaining 43 culverts in order to identify and prioritize the barriers. Of the 43 surveyed, five culverts were found to pass migratory fish based on surrogate site indicators or Fish Xing analysis.

Assessment Methodology

The Gales Creek culvert assessment and prioritization follows the method used for the 2006 Dairy-McKay study. In order to conduct an accurate and rapid assessment, surrogate indicators of hydraulic performance introduced by the US Forest Service were measured. These measurements were determined to be appropriate both for the amount of site data collected, and the ability to comparatively rank multiple barriers within the watershed (Clarkin, Kim et al).

The field assessment was based on the BLM's *Fish Passage Through Road Crossing Assessment* (Appendix A). Several parameters collected by the BLM were omitted due to existing county records or lack of applicability to county needs. The goal of the survey method was to capture sufficient information to rank barriers relative to other County barriers surveyed, instead of establishing an in-depth determination of fish passage. The culvert rankings of 2006 demonstrated the ability of the County's barrier assessment to accurately identify and rank the barriers within an individual watershed. Using the same approach on the Gales Creek culvert survey produced an accurate assessment of the barriers within the watershed. Surveying both the Gales Creek and Dairy-McKay watersheds with a single assessment tool allows Washington County to assess barriers by watershed or combine watersheds in a single County or Tualatin basin database. Appendix B contains the County's Fish Passage Assessment Form.



Field determination of culvert slope

Measuring active channel width





The culvert survey measures four surrogate indicators to determine a culvert's ability to pass fish: culvert gradient, stream active channel width, inlet blockage, and outlet perch. These surrogates are chosen based on the understanding that functional fish passage culverts closely resemble the stream channel they carry. Sediment retention also indicates a culvert's ability to pass fish, but as only a small percentage of county culverts retain sediment, it is not used as a barrier indicator.

Table 1. Surrogate	Indicators
--------------------	------------

Surrogate Indicator	Culvert Attribute Described	Biological Attributes Described
Culvert Gradient	Flow velocity, similarity to carried body	Maximum swim velocity
Stream Active Channel Width	Flow velocity, similarity to carried body, undersized culverts	Maximum swim velocity
Inlet Blockage	Hydraulic conditions at inlet, ability to pass material	Maximum jump height/ maximum swim velocity
Outlet Perch	Hydraulic conditions at inlet, undersized culverts	Maximum jump height

The measured indicators are entered into a database, analyzed using BLM's coarse screen filter (Appendix C), and categorized as Red, Grey, or Green. Red culverts are considered barriers, green culverts do not inhibit fish migration, and grey culverts are indeterminate. The indeterminate culverts are further analyzed using Fish Xing and hydrological data to determine their barrier status by assessing their ability to pass migratory fish during flows between the 10% and 95% levels. The flow levels are calculated using the Rational Method and the Peak Discharge Estimation tool provided by the State of Oregon Water Resources Department. Because the assessment is based on the migration abilities of juvenile cutthroat, a culvert may be considered a barrier even though it does not inhibit the migration of other species or adult cutthroat. Therefore, multiple criteria, in addition to barrier severity, were combined to create the barrier prioritization.

III. Barrier Prioritization Methodology

The culverts in the Gales Creek watershed are ranked based on five criteria: barrier severity, habitat quality, habitat length, proximity to ESH, and proximity to Critical Habitat.

Barrier Severity

The determination of barrier severity is based on the *BLM Coarse Screen Filter Version* 2.2 (Appendix C). The filter identifies a culvert's barrier level based on the migration requirements of juvenile salmonids and was chosen because of its stringent ratings, compatibility with Fish Xing, and similarity to the surveys performed on BLM land in the Dairy-McKay watershed. The filter evaluates surrogate barrier indicator data collected during the culvert inventory in order to define the barrier severity. The surrogate indicators include culvert type, gradient, width, blockage, and outlet perch or jump height. The culvert type determines the maximum gradient of a culvert and the extent to which a culvert can impinge a stream channel before it becomes a barrier. A culvert also becomes a barrier when there is a ten percent blockage at the upstream inlet, or a jump or perch greater than six inches at the outlet. After each barrier type is evaluated, the number of identified barriers are added to arrive at a total score (0-4) for barrier severity.

The assessment was created for migratory salmonids, thus passage for lamprey was not taken into consideration. A perched culvert, independent of its perch height, is typically a barrier for Brook Lamprey, a species found in many Tualatin River streams. Though are excluded from this assessment, culverts within the Gales Creek watershed that are barriers to lamprey passage are generally barriers to juvenile cutthroat trout as well. Washington County uses the stream simulation method when replacing culverts, ensuring passage for lamprey along with all other migratory fish.

Habitat Quality

Habitat quality is determined using a method developed from an Audubon Society habitat assessment (Appendix D). Instream and surrounding areas are evaluated to provide an overall habitat score for each culvert site. The assessment provides a brief and reliable quantitative metric to compare habitat between culverts. Each culvert receives a score from 1-4, with the highest score indicating the best habitat.

Habitat Length

The upstream habitat length is determined by measuring the stream and tributary lengths upstream of the road crossing on the USGS topographic map at the 1:24,000 scale. Maps and field conditions do not always correspond as some culverts show no mapped streams, but have water present; while others indicate stream presence, but lack flow at the culvert site. The stream length is measured using GIS or Terrain Navigator Pro, with a base habitat length of 0.1 miles assigned to surveyed culverts without a measurable mapped stream length. Habitat length is scored and weighted on a 1-4 scale, with higher scores indicating greater upstream habitat length.

Proximity to Essential Salmonid Habitat (ESH) (as identified by Oregon Department of State Lands)

Essential Salmonid Habitat is defined as the habitat necessary to prevent the depletion of native salmon species (chum, sockeye, Chinook and Coho salmon, and steelhead and cuthroat trout) during their spawning and rearing life history stages (Oregon Department of State Lands). ESH designation applies to habitat associated with salmonid species considered sensitive, threatened, or endangered. Tributaries within the Tualatin Basin have been mapped as ESH streams due to the listed status of Upper Willamette River steelhead and Upper Willamette River spring Chinook salmon. The importance of ESH streams to the preservation of these threatened species in the Tualatin Basin is the basis for including this criterion in the prioritization ranking. The distance to the nearest ESH stream was measured using USGS topographic maps, an ESH GIS layer, and Terrain Navigator Pro (Maptech). Culverts were ranked based on proximity to ESH with the scores ranging between 0 and 1. Because the fish passage assessment includes all migratory fish, proximity to ESH streams did not weigh as heavily in the prioritization ranking as the other criteria.

Proximity to Critical Habitat (CH) (as identified by Department of Interior)

The Department of Interior has designated streams within the Gales Creek watershed as Critical Habitat for endangered Upper Willamette River steelhead. The Gales Creek watershed is unique in that it is the only watershed within the Tualatin Basin with this designation. The Department of Interior defines Critical Habitat as habitat essential to the conservation of an endangered or threatened species. The proximity to the nearest Critical Habitat stream was measured using USGS topographic maps, a Critical Habitat GIS layer, and Terrain Navigator Pro (Maptech). Culverts received a value between 0 and 1 based on their proximity to Critical Habitat. While Critical Habitat is important, the fish passage assessment addresses passage for all migratory fish. Therefore, proximity to Critical Habitat is included, but does not weigh heavily in the prioritization ranking.



Barriers in close proximity to Critical Habitat block important spawning and rearing habitat for migratory fish.

Barrier Prioritization	Score	Scoring Explanation
Barrier Severity	0-4	One point is given per barrier type present. Barrier
		types are Jump, Velocity, Blockage, and Gradient.
Habitat Quality	1	Average rating is <2.5
	2	Average rating is between 2.5 and 5
	3	Average rating is between 5 and 7.5
	4	Average rating is greater than 7.5
Upstream Habitat Length	1	Available upstream habitat is <0.5 mi.
	2	Available upstream habitat is between 0.5 and 1 mi.
	3	Available upstream habitat is between 1 and 1.5 mi
	4	Available upstream habitat is >1.5 mi.
Proximity to ESH	0-1	Barrier distances to ESH were normalized within
		the dataset. One point indicates the barrier is in an
		ESH stream. The barrier furthest from an ESH
		stream received no points.
Proximity to CH	0-1	Barrier distance to CH was normalized within the
		dataset. One point indicates the barrier is in a CH
		stream. The barrier furthest from a CH stream
		received zero points.
TOTAL SCORE	2-14	Barrier prioritization scores were added together to
		determine barrier final scores and rankings.

Table 2. Ranking Scores

Total Score

Adding the barrier severity, habitat length, habitat quality, proximity to ESH, and proximity to CH scores provides a first pass score between 2 and 14 for each culvert. High scores represent culverts with several barrier types, large amounts of high quality upstream habitat, in close proximity to ESH and CH streams. Fifteen culverts were designated high priority barriers and will be the focus of the Action Plan. The remaining barriers will receive attention at a later time.

Once the top priority barriers were identified, additional field visits verified the results. Since the survey completion in 2008, two culverts have been removed from the High Priority Barriers list. The culvert creating a barrier on upper Beaver Creek was structurally failing and replaced with an embedded reinforced concrete box culvert that provides fish passage. The second culvert, the top priority barrier on Thomas Creek was reevaluated and the long stream profile was more accurately surveyed. Though the longstream profile is within the acceptable range at 12.3%, the upstream gradient outside the influence of the culvert is 16.9% over a distance of 184 feet and is a natural barrier to migration. Due to the presence of the natural barrier and discussions with an ODFW biologist, this culvert was removed from the high priority list.

					Habitat	Habitat	Barrier	Barrier	Prox to	Prox	Total
Rank	Road	Milepost	Asset #	Stream Name	Length	Quality	Severity	Туре	ESH	to CH	Score
1	Timber Rd	3.525	1661	Trib to Beaver Creek	3	3	4	Barrier	0.97	0.97	11.93
2	Gales Creek Rd	8.54	1886	White Creek	4	3	2	Barrier	0.99	0.99	10.99
3	Timber Rd	1.94	1677	West Fork Beaver Creek	4	3	2	Barrier	0.99	0.99	10.98
4	Parson Rd	3.112	1855	Trib to Little Beaver Creek	4	3	2	Barrier	0.13	0.13	9.26
5	Gales Creek Rd	1.527	1883	Trib to Gales Creek	3	3	2	Barrier	0.62	0.62	9.24
6	Soda Springs Rd	1.565		Trib to Clear Creek	1	3	3	Barrier	1.00	1.00	8.99
7	Timber Rd	1.653		Trib to Beaver Creek	1	3	3	Barrier	0.99	0.99	8.99
8	Thornburg Rd	0.929	1778	White Creek	4	3	0	Partial	0.98	0.98	8.96
9	Timber Rd	2.863	1678	Trib to Beaver Creek	1	4	2	Barrier	0.98	0.98	8.95
10	Gales Creek Rd	2.102		Trib to Gales Creek	2	3	2	Partial	0.95	0.95	8.90
11	Gales Creek Rd	6.588	1741	Fir Creek	4	3	0	Partial	0.90	0.90	8.80
12	Timmerman Rd	0.878		Trib to Little Beaver Creek	1	3	3	Barrier	0.56	0.56	8.11
13	Soda Springs Rd	1.348		Trib to Clear Creek	1	3	2	Barrier	1.00	1.00	7.99
14	Timber Rd	3.297		Trib to Beaver Creek	1	3	2	Barrier	0.99	0.99	7.99
15	Gales Creek Rd	3.946	1579	Trib to Gales Creek	1	3	2	Barrier	0.99	0.99	7.99

Table 3. High Priority Barriers

Examples of High Priority Barriers



West Fork Beaver Creek



Beaver Creek

IV. Barrier Grouping

Methodology

To optimize the results of the Fish Passage Assessment, the high priority barriers were placed in five groups based on geographic location, stream connectivity, and ease of construction. The four culverts in the fifth grouping are stand alone projects as they are geographically and hydrologically separated from other high priority barriers and cross under Gales Creek Road. The group numbers are not based on barrier priority, i.e. Group 1 is not necessarily a higher priority than Group 5.

Road	Milepost	Barrier Type	Potential Upstream	Score	Rank
			Habitat (mi)		
	Gro	up 1 – White Creek	Subwatershed		
Gales Creek Rd	8.543	Barrier	0.077	10.99	2
Thornburg Rd	0.929	Partial Barrier	2.416	8.96	8
	Gro	up 2 – Clear Creek	Subwatershed		
Soda Springs Rd	1.565	Barrier	0.1	8.99	6
Soda Springs Rd	1.348	Barrier	0.1	7.99	13
	Grou	ıp 3 – Beaver Creek	x Subwatershed		
Timber Rd	3.525	Barrier	1.267	11.93	1
Timber Rd	1.939	Barrier	3.954	10.98	3
Timber Rd	1.653	Barrier	0.438	8.99	7
Timber Rd	2.863	Barrier	0.1	8.95	9
Timber Rd	3.297	Barrier	0.1	7.99	14
	Group 4	4 – Little Beaver Cr	eek Subwatershed		
Parson Rd	3.112	Barrier	2.719	9.26	4
Timmerman Rd	0.878	Barrier	0.1	8.11	12
	Group S	5 – Lower Gales Cr	eek Subwatershed		
Gales Creek Rd	1.527	Barrier	1.025	9.24	5
Gales Creek Rd	2.102	Partial Barrier	0.679	8.90	10
Gales Creek Rd	6.588	Partial Barrier	2.798	8.80	11
Gales Creek Rd	3.946	Barrier	0.1	7.99	15

Table 4.Culvert Groupings



Figure 4. High Priority Culverts

Group 1: White Creek Subwatershed

Two high-ranking culverts comprise Group 1 in the White Creek subwatershed. Gales Creek Road milepost 8.543 and Thornburg Road milepost 0.929 culverts, scoring second and eighth overall, block access to White Creek at the confluence with Gales Creek. These two culverts were grouped together due to their hydrologic and geographic connection. In December 2009, adult coho were witnessed attempting to pass through the Gales Creek Road culvert at milepost 8.543. Due to the shape and configuration of the culvert, upstream passage for the coho was blocked. The culvert on Thornburg Road immediately upstream is considered a partial barrier; blocking juvenile cutthroat passage during higher flows. By replacing the culverts, access to 2.5 miles of high quality habitat would be restored for all migratory fish.

Table 5. White Creek Subwatershed Group

Road	Milepost	Score	Rank	Barrier Type	Upstream Habitat (mi)
Gales Creek Rd	8.543	11.99	2	Barrier	0.077
Thornburg Rd 0.929		9.96	8	Potential Barrier	2.416
				Total:	2.493

Figure 5: Group 1 – White Creek



Culvert	Location	Culvert Key #	340015FFF4	Group 1
Road Name	Gales Creek Rd			
Milepost	8.543			
Watershed	Gales Creek	7 924	Contraction of the	Contraction of
Stream Name	White Creek		E SP SA	
Latitude	45° 36.519' N	108		
Longitude	123° 14.413' W	Constant of the	4	
Culvert Key #	340015FFF4	1. 1.		1
County Asset #	1886	1	-	2
Culvert In	nformation			
Shape	Arch	1 1-		and the second
Material	Cast-in-place Concrete	1 1 1 mg	1 and a	
Length (ft)	37	A CONTRACTOR	1.	SA.
Width (ft)	6			
Height (ft)	5			
Outlet Perch (ft)	1.5		Culvert Interio	r
Slope	3.00%			
Structural Condition	5			
Channel I	nformation			
Stream Gradient	4.75%			
Bankfull width (ft)	7			
Prioritizati	on Analysis		ANT THAT IS	ALL ALL AVE
Habitat Length (mi)	2.493		Martin Mar	
Habitat Quality	5.5	20	A	
Barrier Severity	3			THE AN
Distance to ESH (mi)	0.032	36		the second second
Distance to CH (mi)	0.032			A and a
Habitat Length Points	4			Alla
Habitat Quality Points	3			
Barrier Points	3	Se Prese	and the second second second	a fait was and
ESH Points	0.993	A State of the second sec	A End	
CH Points	0.993	Do	wnstream Hab	itat
Barrier Type	Barrier			
Barrier Rank	2			
Total Points	11.986			

Group 1: White Creek Subwatershed

Culvert	Location	Culvert Key #	340015F956	Group	1
Road Name	Thornburg Rd				
Milepost	0.929			11111	200
Watershed	Gales Creek				111
Stream Name	White Creek				
Latitude	45° 36.506' N	El alla and			
Longitude	123° 14.484' W	1 Michael	A STA		1111
Culvert Key #	340015F956	in an and the second		With a la	lin
County Asset #	1778	A PARTINE WAR	12 Martin State		136.4
Culvert Ir	nformation				
Shape	Circular	AR SKA			///
Material	Structural Steel Plate				11
Length (ft)	35			and the second	11
Width (ft)	4	and a second			11
Height (ft)	4				
Outlet Perch (ft)	0		Culvert Interior		
Slope	0.00%				
Structural Condition	4				
Channel I	nformation				
Stream Gradient	2.00%		CARNA STREAM	Marine Caller	Constant -
Bankfull width (ft)	5.4	A Star No.	CALL ANT	E Maria	
Prioritizati	on Analysis	1 Star	Name S.	Jo-KANER -	
Habitat Length (mi)	2.416			Nev	ST.
Habitat Quality	5.1		MONT		No.
Barrier Severity	1				N.
Distance to ESH (mi)	0.095		ST PREST	Nor.	
Distance to CH (mi)	0.095	Thorat			
Habitat Length Points	4	1 0929 Sc 1778	11 Alexandre		
Habitat Quality Points	3	To to	C"	CER AZ	
Barrier Points	1	and the second	and the second	N AV	
ESH Points	0.979				
CH Points	0.979		Culvert Outlet		
Barrier Type	Partial Barrier				
Barrier Rank	8				
Total Points	9.957				

Group 1: White Creek Subwatershed

Group 2: Clear Creek Subwatershed

Two barriers on Soda Springs Road block access to 0.2 miles of upstream habitat. The culverts at milepost 1.565 and 1.348 carry small unnamed tributaries of Clear Creek. Both barriers are located within 250' of the confluence, blocking high quality fish habitat. The barrier at milepost 1.565 is ranked sixth and the culvert at milepost 1.348 is ranked 13th. The survey identified another top priority barrier within the Clear Creek watershed. This barrier is located on Thomas Creek and was ranked as the top priority barrier within the Gales Creek watershed. Additional investigations and discussions with ODFW determined that the topography in the surrounding area would be a natural migration barrier, even if the culvert were removed or replaced. Due to this finding, the Thomas Creek barrier was removed from the prioritization list.

Road	Milepost	Score	Rank	Barrier Type	Upstream Habitat (mi)
Soda Springs Rd	1.565	8.99	6	Barrier	0.1
Soda Springs Rd	1.348	7.99	13	Barrier	0.1
				Total:	0.2

Table 6. Clear Creek Subwatershed Group

Figure 6. Group 2: Clear Creek Barriers



Culvert	Location	Culvert Key #	340015F976	Group 2
Road Name	Soda Springs Rd			
Milepost	1.565			
Watershed	Gales Creek			
Stream Name	Tributary of Clear Creek			and the second
Latitude	45° 34.247' N	1		N IAU
Longitude	123° 14.008' W			
Culvert Key #	340015F976		States 1	1 Par
County Asset #	N/A		50 Y-	1
Culvert I	nformation	Turrenting		
Shape	Circular	Sode Spring 1.5%	1.	34
Material	PVC	SC 10/20/08	19 - 20-14	
Length (ft)	32	- Outlet		A star st
Width (ft)	2			and the second
Height (ft)	2			
Outlet Perch (ft)	1.1		Culvert Outlet	
Slope	2.34%			
Structural Condition	9			
Channel	Information			
Stream Gradient	8.25%	and the second		A COL
Bankfull width (ft)	7.125	and the state		and a the state
Prioritizati	ion Analysis			A THE STREET
Habitat Length (mi)	0.1			
Habitat Quality	5.9			and the second
Barrier Severity	3	the states		
Distance to ESH (mi)	0.019	the car		11
Distance to CH (mi)	0.019	and for		and the second
Habitat Length Points	1	* 117		
Habitat Quality Points	3	1 111		
Barrier Points	3	1 1 1 1		1
ESH Points	0.996			
CH Points	0.996		Culvert Interior	
Barrier Type	Barrier			
Barrier Rank	6			
Total Points	8.991			

Group 2: Clear Creek Subwatershed

Culvert	Location	Culvert Key #	340015F973	Group	2
Road Name	Soda Springs Rd				
Milepost	1.348				RA.
Watershed	Gales Creek	· har and the second	Col 2 Col	ALL A	
Stream Name	Tributary of Clear Creek		ENTRA CONTRACTOR	the work of	
Latitude	45° 34.375' N	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		the feature	
Longitude	123° 13.826' W		M. S. CAN		
Culvert Key #	340015F973				Carlos-
County Asset #	N/A				
Culvert I	nformation	and a state of the second s	3.5		
Shape	Circular	Sode Springs 1.3	48	ALL ST.	19
Material	Corrugated Steel	cc 11/14/08	A CONTRACTOR	and and a	
Length (ft)	51	I' Dutle	+	1.25	
Width (ft)	2			- Alter	
Height (ft)	2		Culvert Outlet		
Outlet Perch (ft)	0				
Slope	4.86%				
Structural Condition	8	1 1 55		-	1
Channel I	Information	1110	C-E-	100	
Stream Gradient	12.00%	5 1 15 1 2			
Bankfull width (ft)	4.25	11/1/1	1. (3.)		
Prioritizati	ion Analysis	STATIGA.		1411	120
Habitat Length (mi)	0.1	13ACHANS		1. 1. 1. 2004	1.1
Habitat Quality	6.56	(1 Prise and		S. K. M. K. K.	
Barrier Severity	2				33
Distance to ESH (mi)	0.024	1 1 1 Superster	and the		11
Distance to CH (mi)	0.024	LISTER S.			13
Habitat Length Points	1			A BARRIE	1
Habitat Quality Points	3		Nº 24 A	Sec. A polit	1
Barrier Points	2		Culvert Interio	r	
ESH Points	0.995				
CH Points	0.995				
Barrier Type	Barrier				
Barrier Rank	13				
Total Points	7.99				

Group 2: Clear Creek Subwatershed

Group 3 is comprised of five barriers that inhibit migration in tributaries of Beaver Creek, blocking access to 5.86 miles of upstream habitat. The barriers are located along Timber Road, the main thoroughfare between Highway 6 and Highway 26. Between the completion of the assessment and publishing this report, Washington County replaced a high priority barrier at milepost 3.989 on Timber Road. The barrier removal opened 1.2 miles of upstream habitat in the upper main stem Beaver Creek. Replacing the remaining high priority barriers in the Beaver Creek watershed will improve fish access to high quality, minimally disturbed habitat.

Road	Milepost	Score	Rank	Barrier Type	Upstream Habitat (mi)
Timber Rd	3.525	11.93	1	Barrier	1.267
Timber Rd	1.939	10.98	3	Barrier	3.954
Timber Rd	1.653	8.99	7	Barrier	0.438
Timber Rd	2.863	8.95	9	Barrier	0.1
Timber Rd	3.297	7.99	14	Barrier	0.1
				Total:	5.859

|--|

Figure 7. Group 3: Beaver Creek Barriers



Culver	Culvert Location		340015FD10	Group	3
Road Name	Timber Rd				
Milepost	3.525				
Watershed	Gales Creek				134
Stream Name	Trib to Beaver Creek	Contraction of the	The and it		
Latitude	45° 41.495' N			S. Sarange	200
Longitude	123° 17.501' W		NASE N	- ALA	-
Culvert Key #	340015FD10	CARA A	KVIN	and the second second	
County Asset #	1661			A TAA	
Culvert	Information	Contraction of the			$-\frac{\hbar}{2}$
Shape	Circular			2 H	
Material	Precast Concrete		Alter Pa		
Length (ft)	48			the fact	
Width (ft)	4				Sec.
Height (ft)	4		Ken In XA	CINC IN	
Outlet Perch (ft)	5		Culvert Inlet		
Slope	2.42%				
Structural Condition	8				
Channel	Information				
Stream Gradient	2.75%	Section Sugar	Service and	and the second	5.
Bankfull width (ft)	8.875				
Prioritizat	ion Analysis	AL A		THE COL	
Habitat Length (mi)	1.267			A States	e.
Habitat Quality	6.6			A DAMA SE	
Barrier Severity	4			11 de	
Distance to ESH (mi)	0.148		addiri		
Distance to CH (mi)	0.148				
Habitat Length Points	3	1 - ·	Small Land	1 All	S.A.
Habitat Quality Points	3		Carel Martin	in all	1 and
Barrier Points	4			Chill Not a	1
ESH Points	0.967				
CH Points	0.967		Culvert Outlet		
Barrier Type	Barrier				
Barrier Rank	1				
Total Points	11.933				

Culver	t Location	Culvert Key #	340015FD08	Group 3
Road Name	Timber Rd			
Milepost	1.939			
Watershed	Gales Creek	Contraction of the	1 2 2 2 17	
Stream Name	West Fork Beaver Creek	1 A 10	LANT I	
Latitude	45° 40.228' N			1 AM
Longitude	123° 17.465' W		San Lee al	
Culvert Key #	340015FD08			Note the second
County Asset #	1677		A CONCENTRAL	122 34
Culvert	Information	The second of the		145 100
Shape	Arch Pipe	A	S AV	
Material	Structural Steel Plate	Sand a		The little
Length (ft)	52.5			
Width (ft)	6			- H
Height (ft)	3.5			State Carto
Outlet Perch (ft)	0.67		Culvert Outlet	
Slope	1.41%			
Structural Condition	3			
Channel	Information			
Stream Gradient	1.25%	Children of Co		
Bankfull width (ft)	7.75	and the set of the	Carlow Martin	Caller and
Prioritizat	tion Analysis	States and the States	AFRICA	and the second
Habitat Length (mi)	3.954		to Annit	
Habitat Quality	6.7			Links or
Barrier Severity	4		A A A A A A	
Distance to ESH (mi)	0.055	A ASTA	ALLED COL	
Distance to CH (mi)	0.055	A Reality of the second second	Sector States	
Habitat Length Points	4	Timber (and	to fair the	
Habitat Quality Points	3	1 Asset# 1671		
Barrier Points	2	SC HATERON		
ESH Points	0.988	takt		STATISTICS.
CH Points	0.988		Culvert Inlet	
Barrier Type	Barrier			
Barrier Rank	3			
Total Points	10.975			

Culvert L	ocation	Culvert Key #	34003BB571	Group 3
Road Name	Timber Rd			
Milepost	1.653			
Watershed	Gales Creek			
Stream Name	Trib to Beaver Creek			labort
Latitude	45° 39.992' N		A REAL PROPERTY AND INCOMENT	
Longitude	123° 17.557' W		141 5	CARDON SEL
Culvert Key #	34003BB571			N7SAV
County Asset #	N/A	ALC ALC ALC		-A
Culvert Inf	ormation		194	12 2/2
Shape	Circular			
Material	Precast Concrete	Con R	1.3.1.1.1.1.2.3	
Length (ft)	61.5	Timber		Contraction of the second
Width (ft)	2	5 SC 10/9/08	A Plank	
Height (ft)	2	Outlet	ALL POST OF	Star Star
Outlet Perch (ft)	0.83		Culvert Outlet	
Slope	7.14%			
Structural Condition	Unknown			
Channel In	formation			
Stream Gradient	5.25%		and the second	and a second stands
Bankfull width (ft)	2.25		ATTA NOA	and and a state
Prioritizatio	n Analysis		1/ Barres	all and a set of
Habitat Length (mi)	0.438	MARTIN		
Habitat Quality	5.9			
Barrier Severity	3		N. C. Martin	
Distance to ESH (mi)	0.031	State & State B		
Distance to CH (mi)	0.031			
Habitat Length Points	1		an contractor	
Habitat Quality Points	3		Holes Hard St.	
Barrier Points	4	ALL EDATES		
ESH Points	0.993	A CONTRACTOR OF	10 AN 10 AN 10	
CH Points	0.993		Culvert Interior	
Barrier Type	Barrier			
Barrier Rank	7			
Total Points	8.986			

Culvert L	ocation	Culvert Key # 340015FD0E Group 3
Road Name	Timber Rd	
Milepost	2.863	
Watershed	Gales Creek	
Stream Name	Trib to Beaver Creek	
Latitude	45° 40.968' N	
Longitude	123° 17.330' W	
Culvert Key #	340015FD0E	
County Asset #	1678	
Culvert Inf	ormation	
Shape	Circular	
Material	Precast Concrete	
Length (ft)	62	
Width (ft)	3	
Height (ft)	3	
Outlet Perch (ft)	2.08	Culvert Interior
Slope	3.34%	
Structural Condition	6	
Channel In	formation	
Stream Gradient	2.50%	
Bankfull width (ft)	5	
Prioritizatio	n Analysis	
Habitat Length (mi)	0.1	
Habitat Quality	7.5	10 A 10 A 10
Barrier Severity	2	
Distance to ESH (mi)	0.112	and the second second
Distance to CH (mi)	0.112	
Habitat Length Points	1	* Timber 280x
Habitat Quality Points	4	SC MARTINE
Barrier Points	3	C Dala Analis
ESH Points	0.975	
CH Points	0.975	Culvert Outlet
Barrier Type	Barrier	
Barrier Rank	9	
Total Points	8.949	

Culvert L	ocation	Culvert Key # 3400204C47	Group 3
Road Name	Timber Rd		
Milepost	3.297		
Watershed	Gales Creek		
Stream Name	Trib to Beaver Creek		
Latitude	45° 41.311' N		and the second
Longitude	123° 17.390' W		
Culvert Key #	3400204C47		MILLON STATISTICS
County Asset #			
Culvert Inf	ormation		
Shape	Circular		
Material	Corrugated Steel		
Length (ft)	50		
Width (ft)	2.5		
Height (ft)	2.5		
Outlet Perch (ft)	0.75		
Slope	2.24%	Culvert Inlet	
Structural Condition	7		
Channel In	formation		
Stream Gradient	6.00%		
Bankfull width (ft)	5	S STRUCT	1//////
Prioritizatio	n Analysis	1911/1	11111999
Habitat Length (mi)	0.1	STATE AND	141111122
Habitat Quality	6.7	11110	
Barrier Severity	4		
Distance to ESH (mi)	0.03	P.C. MARKED	
Distance to CH (mi)	0.03		
Habitat Length Points	1		41198304
Habitat Quality Points	3		1111 11
Barrier Points	2		81111
ESH Points	0.993		2111 61
CH Points	0.993	A REAL AND A DECEMBER OF A	
Barrier Type	Barrier	Culvert Interio	r
Barrier Rank	14		
Total Points	7.986		

Group 4: Little Beaver Creek Subwatershed

Two high priority culverts are located in the Little Beaver Creek subwatershed. The culvert on Parson Road is ranked fourth with 2.7 miles of upstream habitat potentially available. The upper reaches of the stream are used for forestry, providing limited human disturbance to the stream corridor. The second barrier is ranked twelfth, located on an unmarked stream. Beaver activity in the surrounding area has created ponds, increasing the habitat complexity.

Table 8. Little Beaver Creek Subwatershed Group

				Barrier	Upstream
Road	Milepost	Score	Rank	Туре	Habitat (mi)
Parson Rd	3.112	9.26	4	Barrier	2.719
Timmerman Rd	0.878	8.11	12	Barrier	0.1
				Total:	2.819

Figure 8. Group 4: Little Beaver Creek Barriers



Culver	rt Location	Culvert Key # 340015FD7C Group 4
Road Name	Parson Rd	
Milepost	3.112	
Watershed	Gales Creek	
Stream Name	Trib to Little Beaver Creek	
Latitude	45° 38.038' N	· · · · · · ·
Longitude	123° 14.251' W	think with a start with a start
Culvert Key #	340015FD7C	
County Asset #	1855	
Culvert	Information	
Shape	Circular	
Material	Structural Steel Plate	
Length (ft)	32	
Width (ft)	3	
Height (ft)	3	
Outlet Perch (ft)	0.58	Culvert Interior
Slope	1.00%	
Structural Condition	7	
Channel	Information	
Stream Gradient	1.25%	
Bankfull width (ft)	4.25	
Prioritiza	tion Analysis	
Habitat Length (mi)	2.719	
Habitat Quality	6.1	
Barrier Severity	2	
Distance to ESH (mi)	3.846	
Distance to CH (mi)	3.846	A-14-1555
Habitat Length Points	4	
Habitat Quality Points	3	
Barrier Points	2	
ESH Points	0.131	Culvert Outlet
CH Points	0.131	
Barrier Type	Barrier	
Barrier Rank	4	
Total Points	9.262	

Group 4: Little Beaver Creek Subwatershed

Culve	rt Location	Culvert Key # 340015FDB1 Group 4
Road Name	Timmerman Rd	
Milepost	0.878	
Watershed	Gales Creek	
Stream Name	Trib to Little Beaver Creek	
Latitude	45° 37.156' N	As Contraction
Longitude	123° 13.054' W	CALL TO A
Culvert Key #	340015FDB1	
County Asset #	N/A	
Culvert	Information	
Shape	Circular	A REAL PROVIDENCE AND A
Material	Precast Concrete	prome U. off
Length (ft)	73	SC 10/10/08
Width (ft)	1.5	Inlet
Height (ft)	1.5	
Outlet Perch (ft)	1	Culvert Inlet
Slope	5.88%	
Structural Condition	N/A	
Channe	Information	
Stream Gradient	6.50%	
Bankfull width (ft)	4.875	
Prioritiza	tion Analysis	
Habitat Length (mi)	0.1	
Habitat Quality	7.4	
Barrier Severity	2	
Distance to ESH (mi)	1.96	
Distance to CH (mi)	1.96	Timeraco, SA
Habitat Length Points	1	SC 10/10/01
Habitat Quality Points	3	
Barrier Points	3	
ESH Points	0.557	Culvert Outlet
CH Points	0.557	
Barrier Type	Barrier	
Barrier Rank	12	
Total Points	8.115	

Group 4: Little Beaver Creek Subwatershed

Four high priority culverts are included in the Lower Gales Creek subwatershed group. The culverts comprising Group Five are hydrologically separated from other priority barriers and are located along Gales Creek Road. Three barriers are on unnamed tributaries of Gales Creek and the fourth is at Milepost 6.588, located on Fir Creek. The highest ranking barrier at Milepost 1.527 blocks access to 1.03 miles of upstream habitat. The other two barriers on unnamed tributaries block access to a combined 0.78 miles of upstream habitat. The barrier on Fir Creek is a partial barrier, blocking access to 2.80 miles of upstream habitat during high migration flows. Combined, the four barriers block a total of 4.6 miles of upstream habitat on Gales Creek tributaries. Because Gales Creek Road is a main thoroughfare and the four culverts are not hydrologically connected, it is unlikely that more than one barrier will be addressed within a construction season.

Road	Milepost	Score	Rank	Barrier Type	Upstream Habitat (mi)
Gales Creek Rd	1.527	9.24	5	Barrier	1.025
Gales Creek Rd	2.102	8.9	10	Partial Barrier	0.679
Gales Creek Rd	6.588	8.8	11	Partial Barrier	2.798
Gales Creek Rd	3.946	7.99	15	Barrier	0.1
				Total:	4.602

Table 9. Lower Gales Creek Subwatershed Group





Culve	rt Location	Culvert Key # 340015FFC9 Group 5
Road Name	Gales Creek Rd	
Milepost	1.527	
Watershed	Gales Creek	
Stream Name	Trib to Gales Creek	
Latitude	45° 32.010' N	
Longitude	123° 09.241' W	
Culvert Key #	340015FFC9	
County Asset #	1883	A A A A A A A A A A A A A A A A A A A
Culvert	Information	
Shape	Circular	
Material	Precast Concrete	COMPANY REAL PROPERTY
Length (ft)	54	
Width (ft)	3	All the state
Height (ft)	3	
Outlet Perch (ft)	1.92	Culvert Outlet
Slope	1.87%	
Structural Condition	8	
Channe	I Information	
Stream Gradient	0.90%	A CONTRACTOR OF THE OWNER OWNER OF THE OWNER OWNE
Bankfull width (ft)	4.25	
Prioritiza	tion Analysis	
Habitat Length (mi)	1.025	
Habitat Quality	5.3	
Barrier Severity	2	
Distance to ESH (mi)	1.675	
Distance to CH (mi)	1.675	
Habitat Length Points	3	
Habitat Quality Points	3	
Barrier Points	2	
ESH Points	0.622	Culvert Interior Looking Upstream
CH Points	0.622	Private double culverts located upstream
Barrier Type	Barrier	of County barrier
Barrier Rank	5	
Total Points	9.243	

Culver	rt Location	Culvert Key # 340015FFCD Group 5
Road Name	Gales Creek Rd	
Milepost	2.102	
Watershed	Gales Creek	
Stream Name	Trib to Gales Creek	
Latitude	45° 32.344' N	
Longitude	123° 09.654' W	
Culvert Key #	340015FFCD	
County Asset #	N/A	
Culvert	Information	
Shape	Circular	
Material	Precast Concrete	Galestreek Z.102
Length (ft)	49	sc Il/18/08
Width (ft)	2	Out A
Height (ft)	2	
Outlet Perch (ft)	0	Culvert Outlet
Slope	3.69%	
Structural Condition	8	
Channel	Information	
Stream Gradient	2.75%	(HIII)
Bankfull width (ft)	5.625	
Prioritiza	tion Analysis	
Habitat Length (mi)	0.679	
Habitat Quality	6.3	
Barrier Severity	2	
Distance to ESH (mi)	0.225	
Distance to CH (mi)	0.225	
Habitat Length Points	2	
Habitat Quality Points	3	
Barrier Points	2	
ESH Points	0.949	Culvert Interior
CH Points	0.949	
Barrier Type	Partial Barrier	
Barrier Rank	10	
Total Points	8.898	

Culver	rt Location	Culvert Key # 340015FFF0 Group 5
Road Name	Gales Creek Rd	
Milepost	6.588	
Watershed	Gales Creek	
Stream Name	Fir Creek	
Latitude	45° 35.333' N	and the second se
Longitude	123° 12.904' W	ALA
Culvert Key #	340015FFF0	
County Asset #	1741	
Culvert	Information	
Shape	Pipe Arch	
Material	Corrugated Steel	the second second second second
Length (ft)	60	
Width (ft)	7	Gales Creek 6.588 Asset # 1741
Height (ft)	5	SC 11/17/08
Outlet Perch (ft)	0	Culvert Inlet
Slope	1.00%	
Structural Condition	8	
Channel	Information	
Stream Gradient	1.38%	
Bankfull width (ft)	7.25	
Prioritiza	tion Analysis	
Habitat Length (mi)	2.798	
Habitat Quality	5.9	
Barrier Severity	1	
Distance to ESH (mi)	0.446	
Distance to CH (mi)	0.446	
Habitat Length Points	4	
Habitat Quality Points	3	
Barrier Points	1	
ESH Points	0.899	Culvert Interior
CH Points	0.899	1
Barrier Type	Partial Barrier	1
Barrier Rank	11	
Total Points	8.799	

Culver	t Location	Culvert Key # 340015FD05	Group 5
Road Name	Gales Creek Rd		
Milepost	3.946		
Watershed	Gales Creek		
Stream Name	Trib to Gales Creek		
Latitude	45° 33.417' N		VARIA PAR
Longitude	123° 11.236' W		
Culvert Key #	340015FD05		P
County Asset #	1579		t den
Culvert	Information		
Shape	Circular		
Material	Steel Bored		Contract of
Length (ft)	86	Gales Creek 3946	The second
Width (ft)	2.5	Outlet	A series
Height (ft)	2.5		
Outlet Perch (ft)	2.33	Culvert Outle	t
Slope	2.15%		
Structural Condition	8		
Channel	Information		
Stream Gradient	10.00%		A CONTRACTOR OF THE
Bankfull width (ft)	4.875		
Prioritiza	tion Analysis		
Habitat Length (mi)	0.1		
Habitat Quality	6.8		
Barrier Severity	2	and the second states	
Distance to ESH (mi)	0.032		
Distance to CH (mi)	0.032		Char
Habitat Length Points	1		
Habitat Quality Points	3		10% 日本市
Barrier Points	2		CARDA P. P. State
ESH Points	0.993	Culvert Interio	or 🛛
CH Points	0.993		
Barrier Type	Barrier		
Barrier Rank	15		
Total Points	7.986		

V. Conclusion

The fish passage assessment of Washington County owned barriers within the Gales Creek watershed is a continuation of the work established by the Dairy-McKay Fish Passage Assessment and Prioritization completed in 2006. This assessment identifies the existing barriers owned and maintained by Washington County within the Gales Creek watershed and prioritizes them based on their impact to native migratory fish. Of the 43 surveyed culverts, 38 have been identified as barriers to migratory fish passage. Many of the barriers are located on smaller tributaries at or near the confluence with the main streams within the watershed, blocking migration access to critical spawning and rearing habitat as well as protection during storm events. Due to limited County resources, replacement of all fish passage barriers owned by Washington County will take decades. Prioritizing the barriers provides a rational method for utilizing the County's resources for the greatest benefit to the public and environment. Completing the barrier assessment and prioritization for two important watersheds within the Tualatin Basin is an important step in understanding and addressing the needs of native migratory fish on a basin-wide scale. The Gales Creek fish passage assessment continues the effort to systematically approach barrier replacements for restoration purposes, and underscores the need for partnerships with other organizations to achieve greater connectivity and access key habitat within the Tualatin River watershed.



Gales Creek Road culvert on White Creek near the confluence with Gales Creek

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Appendices

- A. Fish Passage Through Road Crossing Assessment
- B. County Fish Passage Assessment Form
- C. BLM. <u>Coarse Screen Filter—Juvenile salmonid passage evaluation criteria Version</u> 2.2.
- D. Wildlife Habitat Assessment
- E. High Priority Barrier Raw Data

Appendix A Fish Passage Through Road Crossing Assessment

Appendix B County Fish Passage Assessment Form

Appendix C

BLM Coarse Screen Filter—Juvenile salmonid passage evaluation criteria Version 2.2

Ü	oarse Screen Filter – Juvenile salmonid _k	assage evaluation criteria		V2.2
	Structure	Green	Grey	Red
1	Bottomless pipe arch or countersunk pipe arch, substrate 100% coverage through pipe and invert depth greater than 20% of culvert nse.	Culvert installed at channel grade $(+/-1%)$, culvert span to bankfull width ratio greater than 0.9, no blockage.	Culvert installed at channel grade $(+/. 1\%)$, culvert span to bankfull width ratio greater than 0.5, less than or equal to 10% blockage.	Culvert not installed at channel grade $(+/-1\%)$, culvert span to bankfull width ratio less than 0.5 , greater than 10% blockage.
7	Pipe arches (1x3 corrugation and larger). Substrate less than 100% coverage through pipe or invert depth less than 20% of culvert rise.	Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75.	Culvert gradient between 0.5 to 2.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 2.0%, greater than 4" perch, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5.
3	Circular CMP or ABS, 48 inch span and smaller, spiral or annular (CMP) corrugations, regardless of substrate coverage.	Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75	Culvert gradient 0.5 to 1.0%, perch less than 4 inches, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 1.0%, perch greater than 4 inches, blockage greater than 10%, span to bankfull width ratio less than 0.5.
4	Circular CMPs with annular corrugations larger than 1x3 and 1x3 spiral corrugations (>48" span), substrate less than 100% coverage through pipe or invert depth less than 20% culvert rise.	Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75.	Culvert gradient between 0.5 to 2.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 2.0%, greater than 4" perch, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5.
vo.	Circular CMPs with 1x3 or smaller annular corrugations (all spans) and 1x3 spiral corrugations (>48" span), 100% substrate coverage through pipe and invert depth greater than 20% of culvert rise.	Culvert gradient less than 1%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75	Culvert gradient 1.0 to 3.0%, perch less than 4 inches, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 3.0%, perch greater than 4 inches, blockage greater than 10%, culvert span to bankfull width ratio less than 0.5.
9	Circular CMPs with 2x6 annular corrugations (all spans), 100% substrate coverage through pipe and invert depth greater than 20% of culvert rise.	Culvert gradient less than 2.0%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75	Culvert gradient 2.0 to 4.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 4.0%, greater than 4 inch perch, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5.
1	Special items; log stringer or modular bridge,	No encroachment on bankfull width.	Encroachment on bankfull width (either streambank).	Structural collapse.
8	Baffied structure installations (all culvert sizes and configurations).	No perch, no blockage. Culvert span to bankfull width ratio greater than 0.75. 100% substrate in pipe but baffles protruding.	Outlet with less than 6 inch perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5. Less than 100% substrate.	Perch greater than 6 inches, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5. Less than 100% substrate.
6	Weir installations (all culvert sizes and configurations).	No perch, no blockage. Culvert span to bankfull width ratio greater than 0.75. Weirs provide 6 inch minimum pool depth and no jumps exceed 4 inches.	Outlet with less than 6 inch perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5. Weirs with pool depths less than 6 inches. Jumps over weirs greater than 4 inches.	Perch greater than 6 inches, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5. Weirs without pools, no resting areas. Weir Jumps> 4 inches
10	Concrete Box Culverts	Culvert backwatered or mostly backwatered w/100% substrate. Culvert span to bankfull width ratio greater than 0.75. No blockage.	Culvert gradient up to 2%. Outlet with less than 4 inch perch. 100% substrate in pipe. Culvert span to bankfull ratio greater than 0.5.	Perch greater than 4 inches. Culvert span to bankfull ratio less than 0.5. Laminar flow. Less than 100% substrate in pipe.
11	Circular concrete and smooth wall ABS culverts.	100% substrate in pipe. Slope less than .5%. No Perch	Less than 100% substrate in pipe. Slope .5-1%. Perch less than 4 inches	No substrate. Slope greater than 1% Perch greater than 4 inches.
Note Fish-	 1) For culverts containing baffles but are enti- Xing. 3) This CSF works well for culverts on i 	rely covered with substrate, evaluate using th oublic lands, not always well for private landc	e criteria for structures 2-8, as appropriate. 2) If culvert owner culverts due to large variations in construction mat	t does not fit well on this CSF run terials and types of installations.

This model was derived from a US Forest Service model.

Appendix D Wildlife Habitat Assessment

Appendix E High Priority Barrier Raw Data