Piercy Creek Arden Road Fish Ladder – Assessment and Review

Prepared for:

Fisheries and Oceans Canada
South Coast Area, RCoE
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January 13th, 2025

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1 INTRODUCTION

1.1 Hanging Culverts and Fish Passage

Hanging or perched culverts, where the downstream outlet is elevated above the stream surface, often prevent upstream-migrating fish from entering the structure and accessing upstream habitat (MOTI, 2013) [1]. This decreased connectivity leads to habitat fragmentation within stream systems, which has numerous well-documented effects on fish populations and is recognized as a leading cause of declining freshwater diversity (Lehrter *et al.*, 2024)[2]. When fish cannot move between different habitats to access thermal refugia, spawning areas, or feeding opportunities, populations may begin to lose their ability to respond to seasonal changes and environmental variation across generations.

Piercy Creek is a regionally significant salmon-bearing stream in the Comox Valley that supports coho, chum, and pink salmon, as well as cutthroat trout (Fleenor and Silvester, 2018)[3]. Development pressure continues to increase in the 938-hectare watershed, with impervious surfaces comprising approximately 31% of the urban area as of 2000[4]. Within the Millard-Piercy watershed, 15 fish passage structures have been identified and assessed for restoration feasibility and priority; 6 are high/moderate priority for restoration. One such culvert is located on Arden Road and exemplifies infrastructure that creates barriers to fish passage in the system (Image 1). It is a corrugated steel hanging culvert with a small outlet pool (Image 2,3) that was scored as a full barrier to fish passage in 2018 (Fleenor & Silvester, 2018). In the fall of 2022 and 2023, Millard Piercy Watershed Stewards (MPWS) volunteers observed Coho salmon upstream of the hanging culvert, but were only able to enter the culvert at extremely high water levels. This culvert has large impacts on fish passage; 4.9km of upstream habitat is restricted and 114.6% of the stream is barred*. Although the Arden Road culvert is an impactful blockage, its feasibility for restoration has been marked as difficult due to ease of work and costs associated with restoration; it therefore requires an out-of-the-box solution.

[1] [MOTI] Ministry of Transportation and Infrastructure. 2013. Culverts and Fish Passage. Environmental Management branch.

[2] Lehrter, R.J., T.K. Rutherford, J. B. Dunham, A. N. Johnston, D.J.A. Wood, T.S. Haby, and S.K. Carter. 2024. Effects of culverts on habitat connectivity in streams—A science synthesis to inform National Environmental Policy Act analyses: U.S. Geological Survey Scientific Investigations Report 2023. 21p. Fort Collins, CO.

[3] Fleenor, W., and D. Silvester. 2018. Millard and Piercy Creeks and Tributaries – Culvert Fish Passage Inspection. 12p. Courtenay, BC.

[4] Fleenor, W., and A. Smailes. 2000. Millard/Piercy Watershed Stewards Assessment and Monitoring Program. Pg. 28. Courtenay, BC.

*% stream barred: the stream length gained divided by the total fish bearing mainstem length of system on which culvert exists

1.2 FishCulvert

One such out-of-the-box solution is the FishCulvert, a proprietary fishway designed to facilitate fish passage at road culverts or small dams. Velocity is slowed using a series of Hannaford baffles, creating resting pockets that aid in the upstream movement of various sizes of fish. The FishCulvert is assembled in sections, each fabricated from a 1.2 m long x 1.5 m diameter section of steel highway culvert and baffles are welded onto each section 0.6 m apart. The sections are then polymer coated. All materials meet CSA G401 standards and are designed for a 100-year life. This product is designed and fabricated in Ontario and have been installed in eastern Canada, Alaska, and the United States, but until the summer of 2025 have not been installed in western Canada. During installation, sections are bolted together to form the required fish ladder length, at a maximum recommended slope of 25%. Using a polymer coated steel mounting bracket, the FishCulvert is bolted to a wood end dam which is fitted and bolted through the existing road culvert.

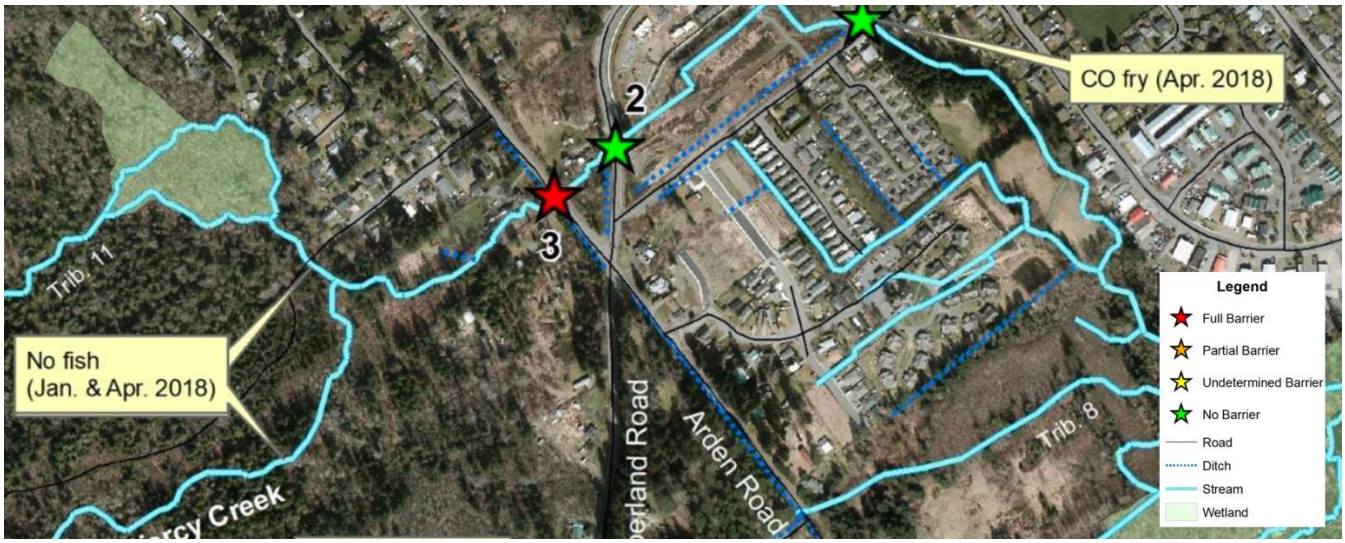

Image 1. Map of 2018 assessed culverts along Piercy Creek main channel, including Arden Road culvert (site #3). Map derived from Fleenor and Silvester, 2018.

Image 2. Arden Road hanging culvert "before"

Image 3. Arden Road culvert outlet pool

1.3 FishCulvert for Arden Road: Feasibility, Permitting, and Installation

The FishCulvert was deemed a possible solution for fish passage at the Arden Road culvert in 2024[5]. A makeshift FishCulvert was installed on a similar system in Morrison Creek following communication between Leon Fisher (Morrison Creek and MPWS volunteer) and Dave Penny, the inventor of the FishCulvert. Fisheries and Oceans Canada (DFO) purchased six sections of FishCulvert in the spring of 2025, with plans to install 2 sections at the Arden Road culvert. Permitting and authorization for installation was organized between DFO and the City of Courtenay.

The FishCulvert installation occurred on August 6th, 2025, which is inside of the general reduced risk in-stream work window for Vancouver Island (MFLNRO, 2011)[6]. At the time of installation, water levels were very low, with all flow (approx. 0.5 l/sec) coming from the stormwater system that drains Copperfield Ridge and Cumberland Road. The installation was contracted to Dave Key who along with his partner and two DFO employees completed the installation in approximately 4 hours. MPWS volunteers assisted in seine netting the outlet pool to remove and relocate fish prior to installation; fish observations were not recorded (Image 4). The components requiring installation includes an end dam, mounting bracket, and 2

[5] L. Fisher, Personal Communication with Dave Penny and DFO, 2024.

[6] [MFLNRO] Ministry of Forests, Lands, and Natural Resource Operations. 2011. Terms and Conditions For Changes In And About A Stream Specified By Ministry of Forests, Lands and Natural Resource Operations Habitat Officer, West Coast Region (Vancouver Island & Gulf Islands). p.1. Nanaimo, BC.

sections of FishCulvert (Image 5). The FishCulvert was installed at a slope of approximately 35% (vs. the maximum recommended slope of 25%), due to the shorth length of the outlet pool below the culvert.

Image 4. Seining at installation

Image 5. FishCulvert mounting bracket; hanging culvert and outlet pool

2 OBSERVATIONS

2.1 Flow Observations

The FishCulvert was installed during August low flows, where typically, the hanging culvert would be a complete barrier to fish passage (Image 6). During the first significant rain events of the season (October 1st and October 18th), all of the flow through the culvert was from the Copperfield Ridge subdivision and Cumberland Road (Image 7&8) and flow was considered moderate. After a heavy rain on October 23, a significant volume of water from Piercy Creek began flowing from above Arden Road and through the culvert and FishCulvert (Image 9).

Initial observations indicated that at medium to high flows, water moving through the FishCulvert was very turbulent and appeared likely to impede fish passage. During these flow conditions, observers noted several fish attempting to enter the FishCulvert that instead landed on the structure's edge or in turbulent flows and were flushed back into the outlet pool (Image 10). Juvenile fish were unsuccessful at entering the FishCulvert during these flow conditions as turbulent flows washed them back into the outlet pool (Image 11).

Water flow inside the culvert itself was much slower and deeper than prior to the installation of the FishCulvert, likely due to the 6" high end dam that is bolted to the discharge end of the road culvert. Upon further observation, adult Coho were able to navigate the FishCulvert and enter the road culvert flow

refugia, allowing them to move slowly upstream past the culvert; juvenile fish were not observed in the road culvert.

Image 6. FishCulvert at August low flows

Image 7. FishCulvert at early-October moderate flows

Image 8. Flow upstream of culvert in early-October

Image 9. FishCulvert at mid-October high flows

Image 10. Fish flushed back into outlet pool

Image 11. Juvenile fish unable to enter FishCulvert

2.2 Spawner Enumeration

MPWS volunteers began spawner observations at sites upstream, downstream, and at FishCulvert (Image 12) on October 8th, 2025 and continued regularly until December 3rd, 2025 (Table 1). The first observation of fish using the FishCulvert was on October 24th, 2025, after a period of heavy rainfall the day prior. Throughout the observation period, fish were observed using the FishCulvert and one successful attempt was observed. Additionally, no fish were observed trapped in the outlet pool below Arden Road and less fish were observed in downstream spawning areas than in 2024, indicating upstream migration. Although Coho salmon have been observed to move within the freshwater habitat in search of adequate spawning habitat, spawning adults generally do not move back downstream once through an identified barrier (Anderson & Quinn, 2007; Baker, 2022)[7][8]. Research on salmon migration behavior has demonstrated that fish exhibit predominantly nocturnal movement patterns to avoid visual predators[9], suggesting that Coho salmon are using the FishCulvert for migration, but are primarily doing so at dawn and dusk.

Although there was only one observed success, there were few repeat attempts recorded. Previous assessments of salmon migration note that successful fish passages are those in which repeat attempts are not observed, as this indicates successful upstream migration on the first attempt (Sheng *et al.,*

[7] Anderson, J.H., and T.P. Quinn. 2007. Movements of adult coho salmon (*Oncorhynchus kisutch*) during colonization of newly accessible habitat. *Canadian Journal of Fisheries and Aquatic Sciences*. **64**(8): 1143-1154.

[8] Baker, C. 2022. Coho Salmon's Upstream Battle Against Climate Change. National Park Service, Point Reyes National Seashore Association.

[9] Fraser, F.J., E.A. Perry, and D.T. Lightly. 1983. Big Qualicum River salmon development project. Volume 1: a biological assessment 1959-1972. Can. Tech. Rep. Fish. Aquat. Sci. **1189**. 198p.

2024)[10]. In previous years, there were dozens of observations by MPWS volunteers of fish attempting to jump into the perched culvert, with many of these observations likely being of repeat attempts by the same fish. This statement is corroborated by notable differences in fish coloration: in previous years, fish jumping at the culvert outlet pool were observed to be quite dark, which is characteristic of extended freshwater residence, whereas fish attempting to enter the FishCulvert this year remained predominantly silver, indicating recent arrival from saltwater.

Throughout November, observations occurred every few days under various flow conditions, from medium to very high. No adult Coho were observed to be jumping into the FishCulvert. Using an underwater video camera starting the 2nd week in November, one live and one dead adult Coho and several Cutthroat trout and juvenile Coho were observed in the holding pool below Arden Road. One dead Jack coho was observed lodged between the rocks in the riffle crest below the pool. At this time, approximately 20 adult and jack Coho were observed in several areas between Arden Road and Comox Logging Road, upstream of the FishCulvert. Approximately twelve adult Coho and three jack Coho were observed above Comox Logging Road. The greatest numbers of fish were observed in areas that have not been historically monitored for spawning activity, and very few fish were observed in the four usual monitoring locations (Image 12), likely due to high pedestrian and animal foot traffic.

[10] Sheng, M., E. Guimond, N. Nahirnick, J. Sutherst, A. Bass, K. Miller-Saunders, and T. Sweeten. 2024. Puntledge River Summer Chinook Habitat Status Report. Can. Contract. Rep. Hydrogr. Ocean Sci. p.125

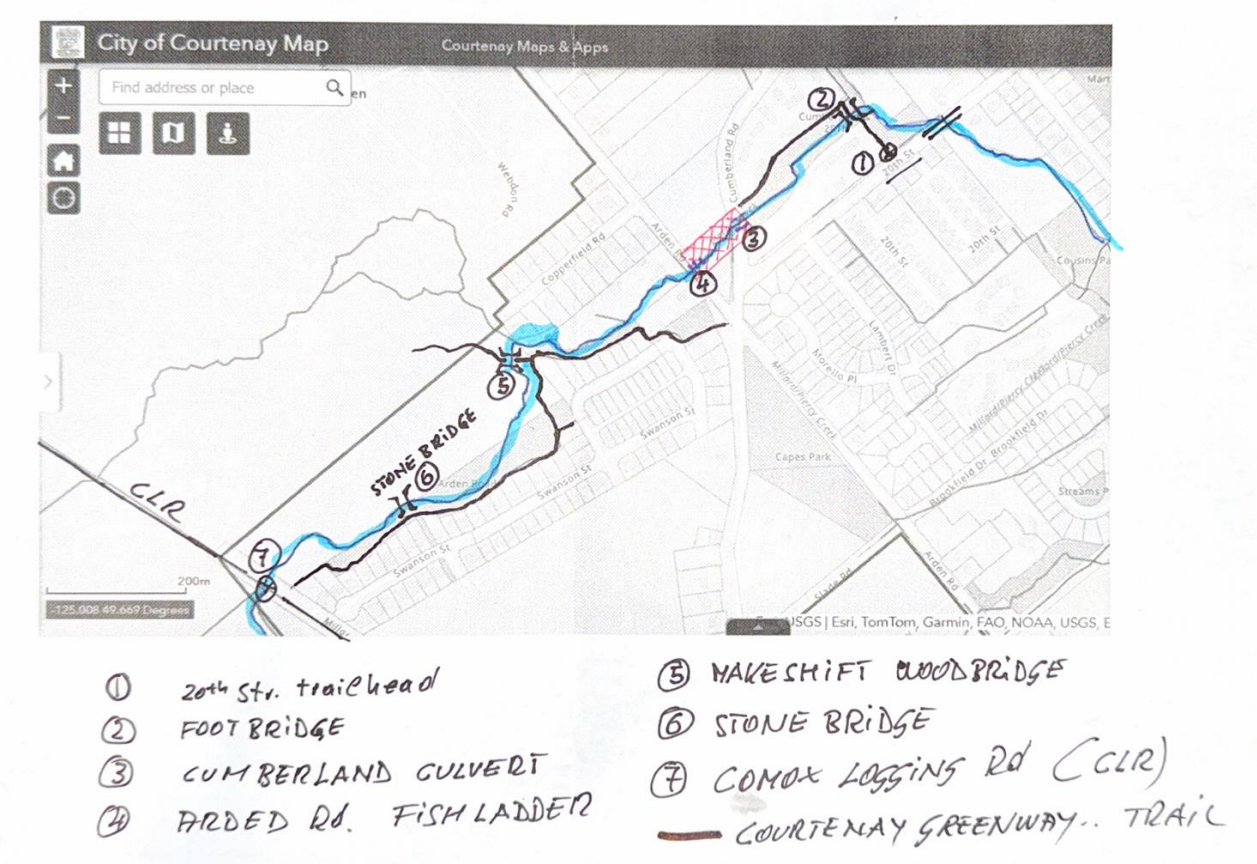

Image 12. Map of MPWS 2025 Spawner Survey locations for the Arden Road FishCulvert assessment. Downstream sites are numbered 1-3, the FishCulvert is site 4, and upstream sites are numbered 5-7. Red hatching indicates poor spawning habitat downstream of Arden Road. Image courtesy of Helmut Novak.

Table 1. MPWS 2025 Spawner Survey[11] at Arden Road FishCulvert, beginning on October 8th, 2025 and ending on December 3rd, 2025. Downstream visual observations were recorded from sites 1-3, and upstream visual observations were recorded from sites 5-7, as indicated on the survey map (Image 10).

			NUMBER OF FISH (est.) T = trout, otherwise Coho. Juveniles not recorded 0 = No fish observed						
Date (mm-dd)	Time	Observer	DOWNSTREAM	AT FISH LADDER			UPSTREAM	Water flow	Video / Photo
				Attempts	Fails	Successes			

[11] Other MPWS volunteers, Susan and Greg Brown and Bill Kippan collected daily observations of the site but did not observe any fish using the FishCulvert and did not provide data for this table.

1	10-08	09:25	Helmut	0	0	0	0	0	extremely low	yes
2	10-15	09:52	Helmut	0	0	0	0	0	extremely low	yes
3	10-16	11:13	Helmut	0	0	0	0	0	extremely low	yes
4	10-18	17:29	Helmut	0	0	0	0	0	low	yes
5	10-19	14:07	Helmut	0	0	0	0	0	low	yes
6	10-20	12:02	Helmut	0	0	0	0	0	low	yes
7	10-23	10:05	Helmut	0	0	0	0	0	low	yes
8	10-24	09:44	Helmut & Leon	5 – 7	4	3	1	1	high	yes
9	0-24	15:48	Helmut	2	4	3	1(?)	0	high	yes
10	10-25	09:00	Leon	?	1	1	1	0	high	yes
11	10-26	09:00	Leon	?	1 + 2T	3	0	did not check	high	yes
12	10-27	09:00	Leon	?	2+1T	3	0	0	high	yes
13	10-28	09:48	Helmut	6	0	0	0	0	high	yes
14	10-29	14:09	Helmut	0	2	2	0	0	high	yes
15	10-29	11:00	Leon	?	3 T	3	0	0	high	yes
16	10-31	09:00	Leon	?	1	0	0	0	extremely high	?
17	11-01	14:30	Helmut	12 to 15	5 T	5	0	1	extremely high	yes
18	11-01	16:10	Leon	did not check	3 T	3	0	0	extremely high	?
19	11-03	16:45	Helmut	~10	0	0	0	did not check	high	yes
20	11-04	09:32	Helmut	~5	0	0	0	did not check	high	yes
21	11-05	09:45	Helmut & Bill	1	8	8	?	0	extremely high	yes
22	11-06	14:00	Helmut	0	0	0	0	did not check	extremely high	yes
23	11-07	10:50	Helmut	did not check	0	0	0	1	extremely high	no
24	11-08	09:10	Helmut	did not check	0	0	0	1	high	yes
25	11-10	15:07	Helmut & Leon	2	0	0	0	8	moderate	yes
26	11-11	11:00	Helmut	did not check	0	0	0	did not check	moderate	yes
27	11-12	09:30	Helmut	~35	0	0	0	did not check	moderate	yes
28	11-18	13:50	Helmut & Leon	0	0	0	0	6 – 8	moderate	yes
29	11-19	10:00	Helmut &Leon	8	0	0	0	5	moderate	yes
30	11-26		Leon	3	0	0	0	did not check		
31	12-03		Leon	0	0	0	0	0		

2.3 Recommendations

Ideas for modifications to the FishCulvert to improve fish passage include:

- Reducing the slope of the FishCulvert from approximately 35%, to below the maximum recommended slope of 25% by adding another section. In this installation, the short outlet pool and slope of downstream channel warrants further in-stream modification for the FishCulvert slope recommendations to be met. Further remediation or modification to the outlet pool would not only increase FishCulvert success, but would also increase connectivity (Fleenor & Silvester, 2018)[3]. Ideas for modifications to the outlet pool include extending the pool by removing surrounding boulders and installing a weir or second fish ladder if downstream slope is deemed a barrier to fish.
- Adding a cover to all vertical edges of the FishCulvert to reduce possible damage when jumping fish land on the sharp edges.
- Reducing baffle heights and changing configuration to reduce turbulence at high flows which coincide with peak fish movement.
- Increasing spacing between baffles to accommodate larger Coho and reduce turbulence.
- Adding a section of white plastic on top of the wood end dam to allow observation of fish swimming over the top of the FishCulvert into the road culvert.
- Widening the FishCulvert to reduce flow velocity out of the road culvert. Turbulence would be consequently lowered, which will allow fish to regain control when entering the FIshCulvert.

3 CLOSURE

CONCLUSIONS

Based on observations by MPWS volunteers, the FishCulvert acts as a successful temporary solution to fish passage at the Arden Road hanging culvert, deemed previously impassable by Fleenor and Silvester (2018)[3]. The FishCulvert supports adult Coho, Jack Coho and Cutthroat trout to migrate upstream during a variety of flows. Opportunities for design modifications exist to reduce possible damage to fish and increase passage for adult Coho and other fish. However, Millard-Piercy Watershed Stewards will pursue continue to opportunities for full culvert remediation as the outlet pool requires further work that is beyond the scope of this project's components.

We trust the information provided in this report meets your current requirements. If you have any questions or require any further information do not hesitate to contact the undersigned.

Sincerely,

Emily Toma, B.Sc. (Hons.)
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