

FINAL

FISH PASSAGE BARRIERS PRIORITIZATION

City of Bellingham Culvert Inventory, Prioritization, and Implementation Plan Development

Prepared for
Nooksack Indian Tribe
City of Bellingham
Lummi Nation
Washington Department of Fish and Wildlife

September 2024



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FISH PASSAGE BARRIERS PRIORITIZATION

Introduction

The City of Bellingham (City) is committed to being a responsible steward of natural resources and watersheds. The City has and will continue to take measures to improve fish habitat by removing City-owned fish passage barriers and improving instream conditions to restore salmon runs and address historic treaty rights violations. As part of this commitment, in 2003 the City of Bellingham formally began a fish passage improvement program and has maintained a list of high priority barrier improvement projects for planning and implementation. To expand these efforts, the City and fisheries co-managers, i.e., Nooksack Indian Tribe, Lummi Nation, and the Washington Department of Fish and Wildlife (WDFW) signed a voluntary Memorandum of Agreement in 2022 to work together “*to prioritize and create a schedule for remediating culverts owned by the City of Bellingham that block or that partially block anadromous and resident fish passage.*” The Memorandum of Agreement (Appendix A) outlines the shared roles and responsibilities of the parties, including supporting the technical work involved, expanded coordination, jointly securing funding, and supporting obtaining necessary regulatory permissions for remediation construction.

The City, Nooksack Indian Tribe, Lummi Nation, and WDFW, herein referred to as Project Leads, hired Environmental Science Associates (ESA) to support their work on the assessment, prioritization, and implementation planning per the Memorandum of Agreement. This work is funded by a grant awarded to the Nooksack Indian Tribe from NOAA’s Restoring Tribal Priority Fish Passage through Barrier Removal funding opportunity under the Bipartisan Infrastructure Law and Inflation Reduction Act.

Work commenced in January 2023. Project Leads created a database of all City-owned water crossings that partially or fully block fish passage. The database includes culverts assessed as part of this project to determine fish passability at crossings that had not previously been assessed, as well as previously assessed crossings which are included in WDFW’s Fish Passage and Diversion Screening Inventory (FPDSI) database¹. Fisheries co-managers also developed a higher resolution fish distribution layer based on field-verified hydrography provided by the City of Bellingham’s Public Works Department. This data was used to evaluate species use (resident and anadromous) and upstream extent of habitat for each fish passage site.

This report describes the methods and results of a prioritization for remediation of all City-owned water crossings that partially or fully block fish passage. This prioritization is intended to build upon and replace earlier fish passage prioritizations prepared by the City including a 2022 version. The following sections include a summary of current fish passage conditions at City-owned crossings, the goals and values guiding the prioritization, methods, and results.

¹ Data for the crossings assessed in this project will be submitted to WDFW for inclusion in the FPDSI database so that the WDFW database will be complete for City-owned crossings.

Fish Passage Conditions at City-owned Crossings

The Project Leads conducted an update to the inventory of City-owned crossings from January 2023 through August 2024. The City owns 174 water crossings on fish-bearing streams. Most of the crossings are round culverts (pipes), but there are also square (box) culverts, bridges, weirs, gates, and fishways. Among the culvert crossings, most include a single culvert to convey flow, however a subset includes multiple culverts to increase the capacity for conveying water during higher flow events. Crossings comprised of multiple culverts are evaluated collectively as one crossing for determining fish passability.

Of the 174 City-owned water crossings, 127 partially or fully block fish passage according to the WDFW (2019) guidelines for assessing fish passage. **Table 1** summarizes the fish passage assessment results for the City-owned water crossings.

TABLE 1
SUMMARY OF FISH PASSAGE AT CITY-OWNED WATER CROSSINGS

Percent Passable According to WDFW (2019) Guidelines	Number of Sites
100% Passable (not a barrier)	47
67% Passable	35
33% Passable	38
Barriers of Unknown Passability	7
0% Passable (total barrier)	47
Total Number of City-owned Water Crossings	174
Total Number of City-owned Water Crossings that are not 100% Passable	127

Goals and Values Guiding the Prioritization

The Memorandum of Agreement was established “to address remediation of fish passage that may be blocked or partially blocked by culverts owned by the City of Bellingham.” The goal of this work is to remediate City-owned water crossings that currently prevent anadromous and/or resident salmonids (salmon and trout) access to the natural extent of their habitats.

To gain perspective and guidance on goals, priorities, and implementation, the Project Leads conducted outreach to vested interest communities. The vested interest communities are those groups that may be directly impacted by the prioritization project or have interests in the project area. The vested interest communities consisted of various department representatives, outreach experts, and elected officials from the Nooksack Indian Tribe, Lummi Nation, WDFW, City of Bellingham, and NOAA to understand more of the cultural considerations of the tribes and agency interests. Two meetings were conducted with the vested interest communities during the development of the prioritization. The meetings were conducted during the early development of a prioritization approach and when near-final results were available. This engagement with vested interest communities focused on sharing information, receiving guidance on

what is important for them, and involving participants in approval of prioritization developed. The vested interest communities dialogue identified the following values regarding priorities:

- A priority is placed on populations that contribute to tribal fisheries
- All historically accessible habitat is important
- An emphasis is placed on restoring passage to the most productive and resilient habitats

Prioritization Method

The prioritization method was developed through an iterative process working with Project Leads. The prioritization method focused on characterizing the potential benefits to anadromous and resident fish species of remediating water crossings that partially or fully block fish passage. The prioritization method incorporates the values identified by vested interest communities.

The development of a prioritization method started with a review of other fish passage prioritization frameworks being used in the Pacific Northwest. The review focused on identifying the parameters being included in other frameworks and pros, cons, and lessons learned described in the documentation for each framework. The other frameworks reviewed are listed below.

- City of Bellingham (City of Bellingham 2022)
- King County (King County 2022)
- Chehalis River Watershed (WDFW 2020)
- Upper Columbia Salmon Recovery Region (Upper Columbia Regional Technical Team 2020)
- Washington State Priority Index (WDFW 2019)

During the development of a prioritization method, Washington State began the development of a comprehensive statewide strategy outlining an approach for prioritizing the removal of small-scale fish passage barriers. Due to City's efforts preceding the State's work, WDFW's role as one of the Project Lead's included consistency and eventual State acceptance of the City's approach.

To begin to develop a prioritization for the City, framework components in other prioritizations were considered for alignment with the values, fit to the watersheds in the City, and the availability of data in the City watersheds, and uniformity of data across watersheds. **Table 2** summarizes the parameters included in those frameworks.

The prioritization framework was developed through iterative testing and adjustment. Components were tested in multiple individual calculations and combinations for contributing to the differentiation among water crossings. A points-based scoring system was developed. Points were assigned to each component based on conditions. The maximum number of points varied among the components which served to emphasize or de-emphasize the relative contribution of individual components in the overall formula.

TABLE 2
PRIORITIZATION COMPONENTS INCLUDED IN OTHER PRIORITIZATIONS

Component	City of Bellingham	King County	Chehalis River Watershed	Upper Columbia Region	Washington State Priority Index
Quantity of Upstream Habitats	Yes	Yes	Yes	Yes	Yes
Quality of Upstream Habitats	Yes	Yes	Yes	Yes	
Barriers Upstream	---	Yes	Yes	---	---
Barriers Downstream	---	Yes	Yes	Yes	---
Barrier Severity	Yes	---	Yes	Yes	Yes
Species Benefitting	Yes	Yes	Yes	Yes	Yes
Core Salmon Population Area	---	---	---	Yes	---
Climate Change Effects	---	---	Yes	Yes	---
Colonization Potential	---	---	---	Yes	---

Following is the final prioritization formula used. The following sections describe the scoring of each component.

$$\begin{aligned}
 \text{Prioritization Score} = & (\text{Quantity of Upstream Habitats}) * (\text{Barrier Severity}) \\
 & + \\
 & (\text{Downstream Barriers}) \\
 & + \\
 & (\text{Core Salmon Production Area}) \\
 & + \\
 & (\text{Quality of Upstream Habitat})
 \end{aligned}$$

Upstream Habitat Quantity

Upstream habitat quantity was calculated based on stream lengths and fish distributions. More quantitative information on habitat area upstream, such as is used in the WDFW Priority Index calculation (WDFW 2019), would have been preferred, but there are no available datasets to provide that information for all City-owned crossings and it is a very time-intensive dataset to collect. Stream lengths were calculated based on the City's Waterbody Monitoring Stream Network and the Statewide Integrated Fish Distribution watercourse and fish distribution database and modified by Project Leads (SWIFD; NWIFC and WDFW 2024). Project Leads applied their familiarity with the stream networks to refine the endpoints of fish-bearing streams for the subset of streams in the City.

Four elements of upstream habitat quantity were included in the scoring and added together:

1. Total length of anadromous salmon accessible habitat upstream (5 points per miles)
2. Length of anadromous salmon accessible habitat upstream to next human-made barrier (incremental gain length) (2 points per mile)

3. At resident-accessible only sites, total length of resident fish accessible habitat upstream (1 point per miles)
4. At resident-accessible only sites, length of resident fish accessible habitat upstream to next human-made barrier (incremental gain length) (0.5 points per mile)

These elements factored in the total potential habitat length and incremental gain associated with remediating a fish passage barrier. In doing so, both the immediate gains and longer-term potential were factored in. The incremental gain lengths were to the next barrier upstream, regardless of ownership. Also, the elements credit anadromous salmon habitat gains higher than resident fish-only habitat gains. Anadromous salmon accessible habitats are those portions of the stream where anadromous salmon could access if no human-made barriers limited their ability to reach the sites. The upstream end of anadromous salmon accessible habitat is based on SWIFD or Project Lead-informed distributions of the uppermost extent of anadromous salmon distribution among the Pacific salmon and steelhead species. Anadromous accessible habitats can be used by resident and anadromous fish species. Resident fish accessible habitats are located upstream of anadromous habitats. These areas tend to be upstream of a natural barrier (e.g., waterfall) blocking anadromous salmon access or in parts of the watershed where a stream is too small to support anadromous salmon. The upstream end of resident fish distribution was based on SWIFD or Project Lead-informed distributions for the uppermost extent of resident accessible habitats.

The upstream habitat quantity score is the sum of the four elements identified above. There is no limit to the maximum score other than what is calculated; therefore, this component was the largest contributing component for many of the water crossings evaluated. Detailed prioritization methodology is provided in **Appendix B**.

Barrier Severity

Different scores were assigned based on whether a water crossing created a partial barrier or a total barrier to fish access. Partial barriers and unknown barriers were scored the same because for some sites there is no method to determine severity (e.g., tidal sites) and because the percent passability assignments can be arbitrary. Barrier severity information is in the fish passage database of City-owned barriers and is established based on the guidelines in WDFW (2019).

Barrier severity was included in the scoring formula as a multiplier of Quantity of Upstream Habitat. Full barriers received full credit as a 1.0 multiplier. Partial barriers were included with a 0.8 multiplier. This way, the partial access provided by partial barriers is accounted for in the quantity calculation.

Downstream Barriers

The number and severity of barriers downstream affect the likelihood of fish ever reaching a crossing, especially anadromous salmon. Since anadromous salmon migrate upstream upon their re-entry to freshwater for spawning, the number of barriers blocking access affects the quantity of fish impacted by an upstream barrier. The scoring of this component considers the relative location of a barrier compared to other downstream barriers as a factor in prioritization.

The scoring assignments for downstream barriers considered whether the site is in the anadromous accessible zone or resident fish only, the number of barriers, and the severity of the downstream barriers.

All human-made downstream barriers were included in the scoring, not only City-owned barriers. Information from WDFW FPDSI (WDFW 2024) was used to characterize this component. Following are the scores assigned with a maximum of 5 points:

- Anadromous accessible culvert with no downstream barriers = 5
- Anadromous accessible culvert with one partial downstream barrier = 4
- Anadromous accessible culvert with multiple partial downstream barriers = 2.5
- Anadromous accessible culvert with one total downstream barrier = 1.5
- Anadromous accessible culvert with one total downstream barrier and one or more partial barriers = 0.5
- Anadromous accessible culvert with multiple total downstream barriers = 0
- Resident-only accessible culvert with no downstream barriers = 1
- Resident-only accessible culvert with one or more partial barriers downstream = 0.5
- Resident-only accessible culvert with one or more total barriers downstream = 0

Core Salmon Production Area

This component was included to assign more points to sites within or downstream of the portion of watersheds that have the most documentation of salmon use, including spawning, with the understanding that restoring fish passage to those areas will especially benefit the population. Salmon and trout habitat use from SWIFD (NWIFC and WDFW 2024) (e.g., documented spawning) and WDFW information on significant reach upstream (660 linear feet) informed the scoring. WDFW data forms indicating no, blank, or unknown for “significant reach” were considered to not have a significant reach upstream. Following are the scores assigned with a maximum of 5 points:

- Barrier is located downstream of or in documented spawning habitat for anadromous salmon or steelhead = 5
- Barrier is located downstream of or in either: 1) documented habitat for anadromous salmon or steelhead or 2) a “significant reach” per WDFW = 3.5
- Barrier is located downstream of or in presumed or gradient accessible habitat for anadromous salmon or steelhead = 2
- Barrier is located downstream of or in documented habitat for only resident fish = 1
- Barrier is located downstream of or in presumed or gradient accessible habitat for only resident fish = 0.5

Upstream Habitat Quality

This component was included to assign more points to sites within or downstream of habitat considered more resilient and with higher restoration potential. Points were assigned based on whether the barrier was in a tidally influenced area and based on the City’s Habitat Restoration Technical Assessment (ESA 2015). Tidally influenced barriers are documented to affect fish originating in the stream, as well as juvenile salmon, most notably juvenile Chinook salmon, originating from other stream systems. Research

shows that some juvenile Chinook salmon outmigrate from their natal stream, migrate along the nearshore of Puget Sound, and move into non-natal estuaries for feeding and refuge (e.g., Beamer et al. 2013, Beamer et al. 2016, Lambert and Chamberlin 2023). In addition, the City's Habitat Restoration Technical Assessment included a comprehensive restoration prioritization of subwatersheds in the City and assigned each to Tier 1, 2, or 3 based on habitat resilience and general likelihood of habitat restoration success. Tier 1 sub-watersheds are identified as having the highest habitat resilience and likelihood of restoration success. Following are the scores assigned with a maximum of 5 points:

- Barrier is tidally influenced (regardless of Tiers) = 5
- Barrier is located downstream of or in Tier 1 subwatershed = 3
- Barrier is located downstream of or in Tier 2 subwatershed = 2
- Barrier is located downstream of or in Tier 3 subwatershed = 0

Components and Formula Calculations Not Included

Additional components were tested for inclusion in the framework as removed based on an issue with contribution to scoring and input from Project Leads. Multiple formula combinations were also tested. These additional components and formula calculations that were not included are described below.

- **Species Benefitting** – Versions of a metric were tested that assigned scores based on the presence of Endangered Species Act-listed salmon, the number of anadromous salmonid species, whether presence is documented or presumed, and whether resident trout were present. The City contains habitat used by Endangered Species Act-listed Puget Sound Chinook, Puget Sound steelhead, and Coastal-Puget Sound bull trout, but does not include designated critical habitat for their recovery. This metric was not included in subsequent iterations in part because, although the City's watersheds contain Endangered Species Act-listed Chinook salmon, the Chinook salmon using freshwater habitat within the City are primarily hatchery-origin fish released as juveniles for harvest upon their return as adults. The exception to this is the use of estuaries by juvenile Chinook salmon from the Nooksack River and other river systems. Furthermore, the distribution of anadromous species in the City's watersheds were so similar that the metric did not meaningfully differentiate between sites. Other components include scoring differences for anadromous accessible versus resident-only accessible, so a separate metric was not deemed necessary.
- **Climate Vulnerability** – Versions of a metric were tested that assigned scores based on projected changes to stream temperatures and flows. The available stream temperature data from the U.S. Forest Service Northwest Stream Temperature Database (NorWeST) and stream flow data from the University of Washington Climate Impact Group provided some projections of differences among the City's watersheds. The climate vulnerability metric was found to not meaningfully add to the Upstream Habitat Quality metric which indicates resilience and excluded too many other important factors affecting site vulnerability. In addition, vested interest communities expressed the desire to incorporate a climate resilience strategy of retaining a broad range of potential habitats rather than reduce priority habitat areas based on projected climate changes.
- **Upstream Barriers** – Versions of a metric based on the count and severity of upstream barriers were tested using data from the WDFW FPDSI database (WDFW 2024). The versions tested greatly influenced the overall scores of many sites. It was concluded that the metric had a stronger influence

on the total score than desired and did not produce results that aligned with general expectations of priorities. One part of the challenge was that watersheds, particularly Squalicum and Whatcom Creeks, extended far upstream of the City borders and culverts in those upper portions of the watershed substantially altered scores.

- Multiple iterations of the scoring formula were run during framework development and were discussed with Project Leads. After the components to include in the prioritization were identified, another 21 scoring combinations were tested. These combinations tried different weighting of the components and different formula structure as entirely additive or including some multiplicative parts. The later iterations began to show consistency among them in the highest scoring sites and the lowest scoring sites. That is, the highest scoring sites were consistently scoring among the highest even as the formula was adjusted. The greatest variations occurred in the middle scoring sites. The consistency among the highest and lowest scoring sites is considered a positive finding that the final formula properly characterizes priorities based on the selected components included in the framework.

Prioritization Results

Prioritization scores among the 127 sites evaluated ranged from 2.99 to 174.49. The highest scores were due to exceptionally long distances of upstream habitat that would be more accessible to anadromous salmon. Only four sites scored higher than 100 points. The mean score was 19.27 and the median score was 8.13. To account for the emphasis on salmon recovery and tribal fisheries, all anadromous accessible sites were ranked higher than resident fish access only sites. **Figure 1** displays the scoring distribution among the sites in ranked order from high to low. The scoring assignments for each component and the total score are provided for each site in **Appendix C**.

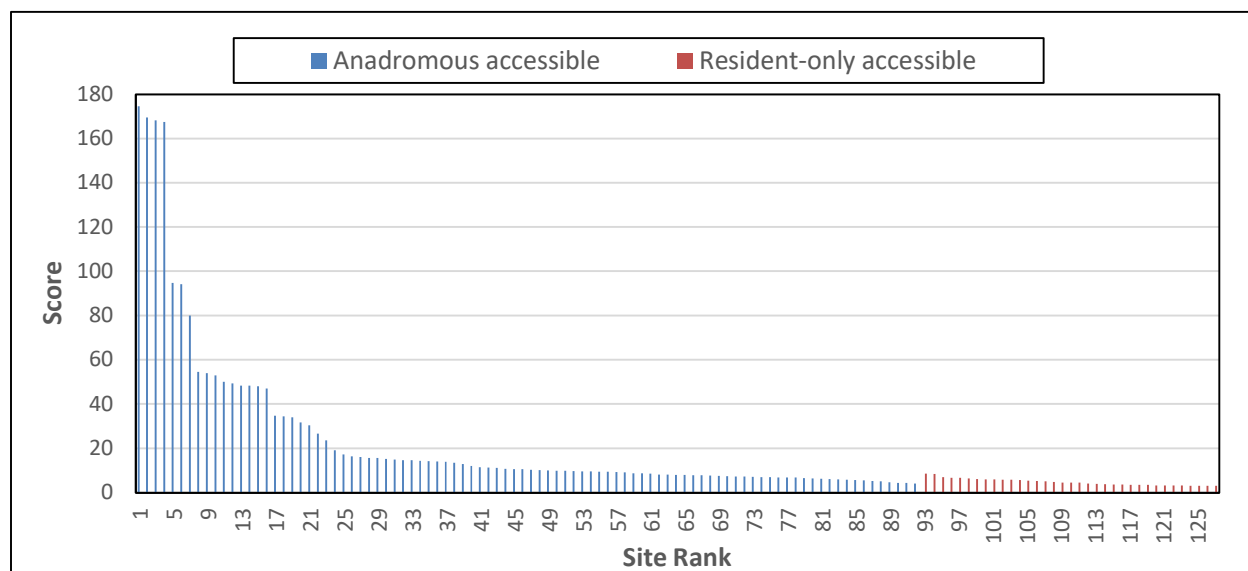


Figure 1 Distribution of Prioritization Scores

The seven highest scoring sites were in Squalicum Creek or Baker Creek, a tributary in the Squalicum Creek watershed. The top 20 sites were in the Squalicum, Whatcom, and Padden Creek watersheds.

Table 3 lists the top 20 sites with their WDFW Site Identification Number from WDFW FPDSI (WDFW 2024). **Figure 2** shows a ranking label for the location of the top 20 sites. **Figures 3, 4, and 5** are maps of the Squalicum, Whatcom, and Padden Creek sites, respectively, among the top 20 sites in the City.

TABLE 3
TOP 20 SITES BY PRIORITIZATION SCORE

Rank	WDFW Site ID	Watershed
1	991104	Squalicum Creek
2	991105	Squalicum Creek
3	811121	Squalicum Creek
4	920646	Squalicum Creek
5	01.0552 2.00	Squalicum Creek
6	920649	Squalicum Creek
7	602273	Baker Creek (tributary to Squalicum Creek)
8	920625	Whatcom Creek
9	994375	Padden Creek
10	994390	Padden Creek
11	370647	Whatcom Creek
12	01.0555 0.00	Baker Creek (tributary to Squalicum Creek)
13	01.0622 0.30	Padden Creek
14	01.0622 0.80	Padden Creek
15	01.0622 0.50	Padden Creek
16	01.0622 0.70	Padden Creek
17	994370	Padden Creek
18	991599	Padden Creek
19	991600	Padden Creek
20	992981	Spring Creek (tributary to Squalicum Creek)

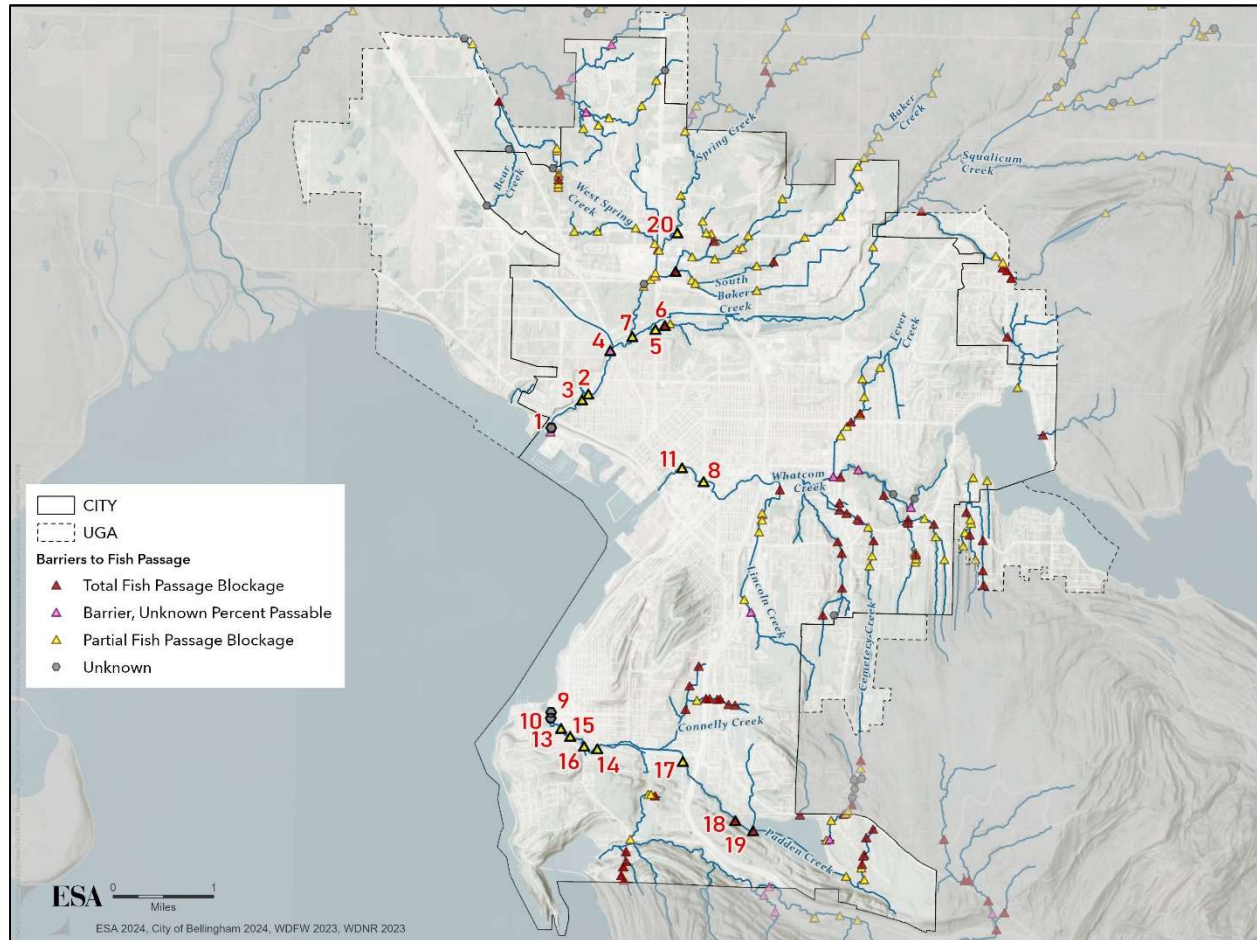


Figure 2 Map of Top 20 Sites By Prioritization Score

Note: Top 20 rankings shown in red labels.

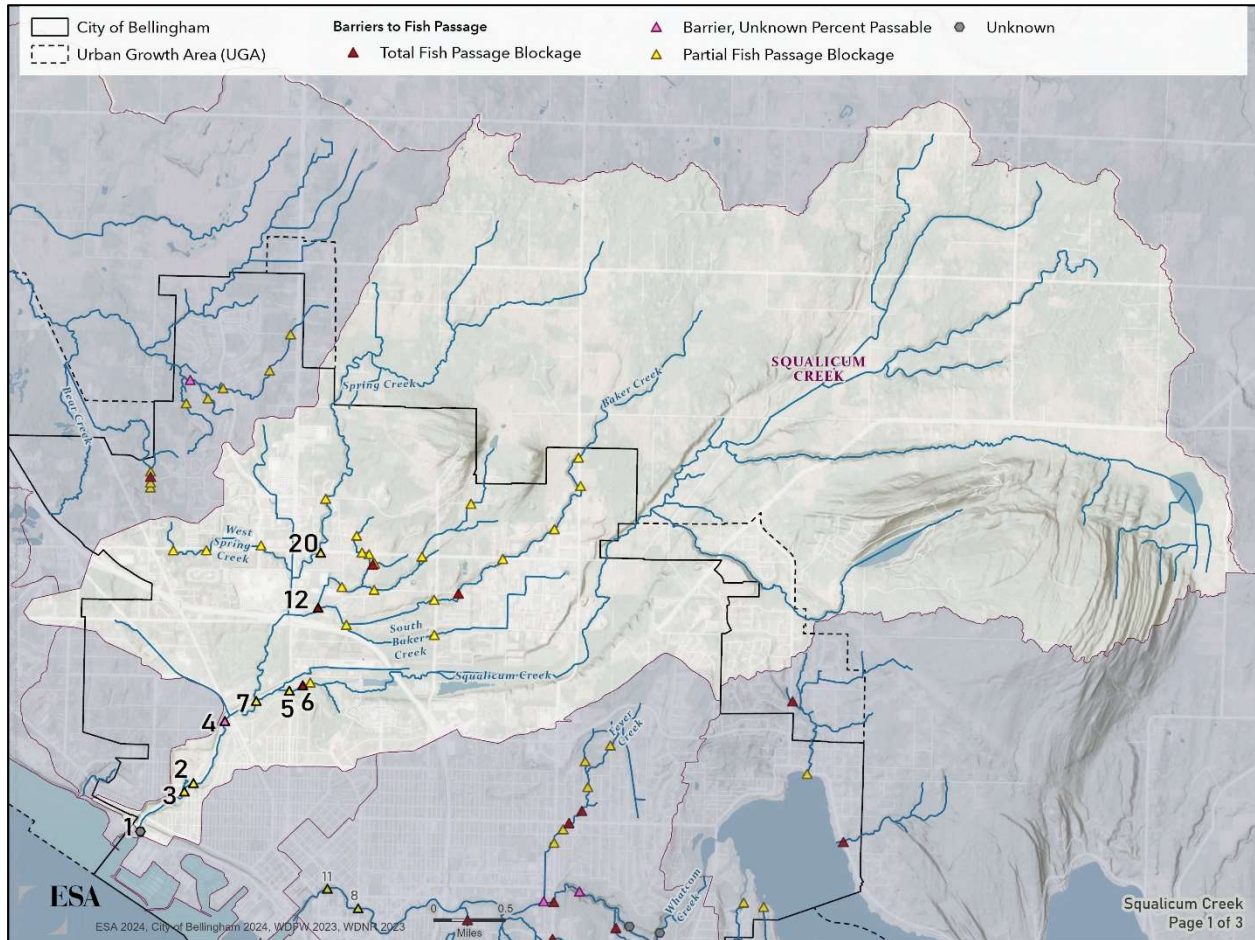


Figure 3 Map of Squalicum Creek Sites Among the Top 20 Sites By Prioritization Score

Note: Top 20 rankings shown in black labels.

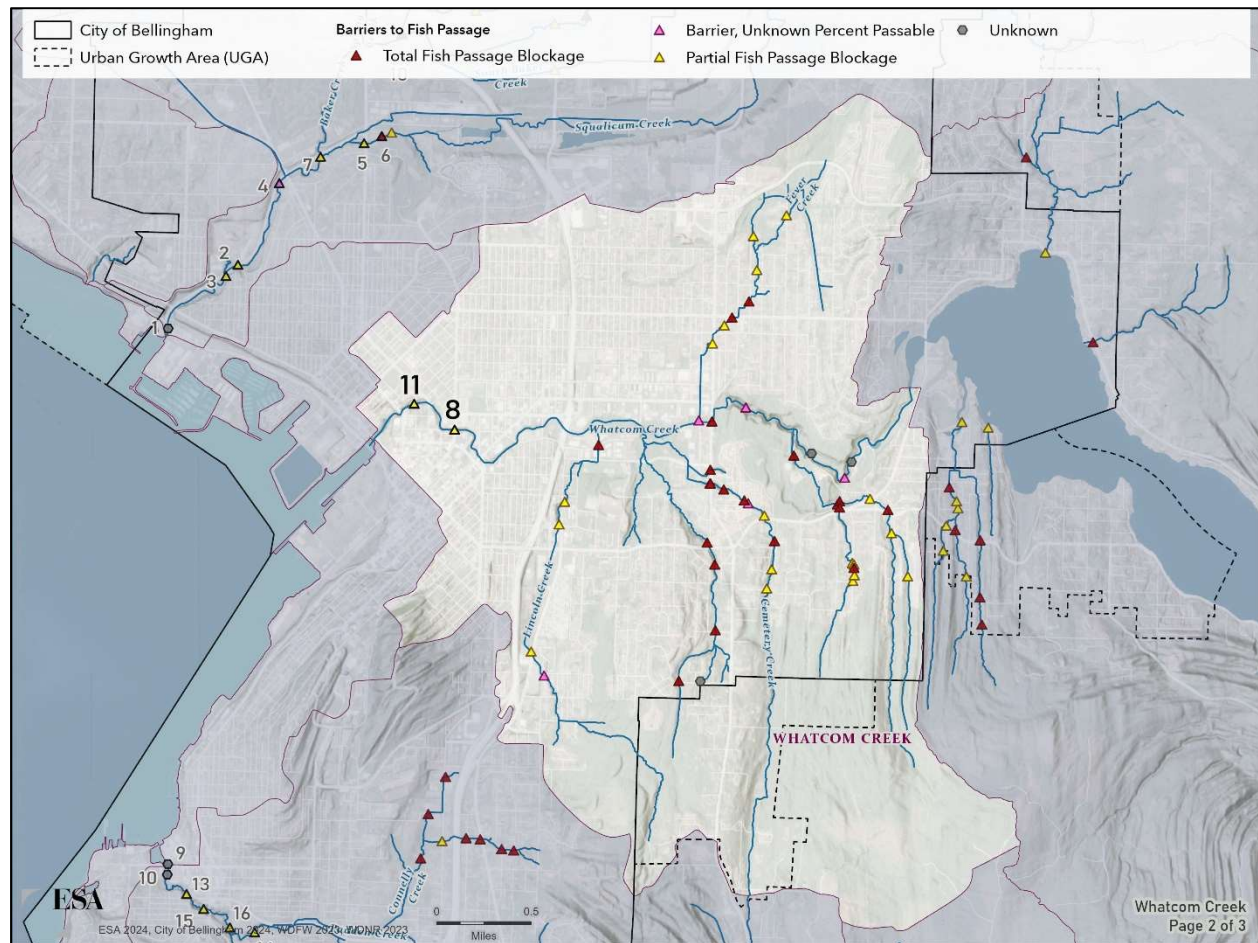


Figure 4 Map of Whatcom Creek Sites Among the Top 20 Sites By Prioritization Score

Note: Top 20 rankings shown in black labels.

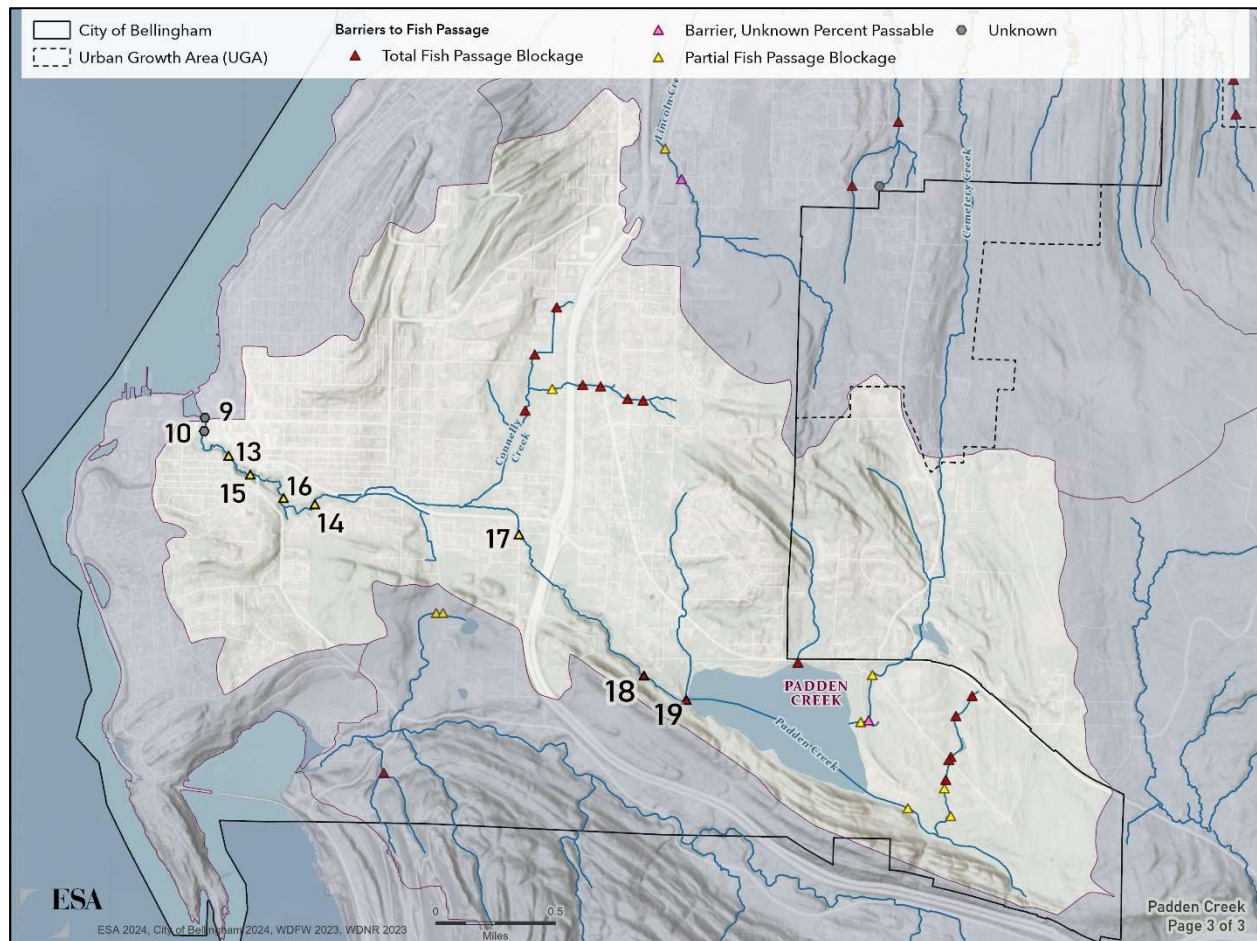


Figure 5 Map of Padden Creek Sites Among the Top 20 Sites By Prioritization Score

Note: Top 20 rankings shown in black labels.

Summary and Next Steps

This prioritization of City-owned fish passage barriers was developed with input from Project Leads and was supported by the vested interest communities. This prioritization is an important step identified in the Memorandum of Agreement. The next step is to develop an implementation plan that establishes how the prioritization will inform the schedule for remediation and how Project Leads will work together on decision-making and collaborative participation for remediating City-owned fish passage barriers.

References

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Appendix A
**Fish Barrier Culvert Remediation
Project
Memorandum of Agreement**

FISH BARRIER CULVERT REMEDIATION PROJECT MEMORANDUM OF AGREEMENT

Between
Lummi Natural Resources Department, Nooksack Indian Tribe Natural Resources
Department,
City of Bellingham, and the Washington Department of Fish and Wildlife

PREAMBLE:

The City of Bellingham has the legal right and legal obligation to design, to construct, and to maintain a road network, including culverts and other passageways over streams, for its residents. The Nooksack Indian Tribe and the Lummi Nation assert that they have federal reserved water rights in the Nooksack River basin, including the right to instream flows for fisheries purposes. This Memorandum of Agreement is intended solely to address remediation of fish passage that may be blocked or partially blocked by culverts owned by the City of Bellingham.

PURPOSE:

The purpose of this Memorandum of Agreement is to prioritize and create a schedule for remediating culverts owned by the City of Bellingham that block or that partially block anadromous and resident fish passage.

PARTIES TO THE AGREEMENT:

The parties to this agreement are the Lummi Natural Resources Department, the City of Bellingham, the Nooksack Tribe Natural Resources Department, and the Washington Department of Fish and Wildlife.

OBJECTIVES:

The objectives of this Memorandum of Agreement are:

1. To use best available information to compile an inventory of those culverts owned by the City of Bellingham that may block fish passage, pursuant to the Washington State Department of Fish and Wildlife's database, as updated from time to time. For the purposes of this Memorandum of Agreement, the term, "culvert," is used to mean any structure, including dams, weirs, tidegates and floodgates, other than a full-span bridge, that is constructed to convey water beneath a roadway, footpath or railway, and shall also include associated fishways;

2. To develop the priority of remediation efforts in the case of those culverts as defined above that block or partially block fish passage using a habitat-based goal;
3. To determine a schedule for those remediation efforts. The parties to this Memorandum of Agreement recognize that the schedule may be impacted by available resources; and
4. The foregoing objectives are not intended to and do not create any legal rights or liabilities for or against any party to this Memorandum of Agreement.

ROLES AND RESPONSIBILITIES:

The parties to this Memorandum of Agreement commit, to the best of their abilities, to:

1. Provide support as needed to compile an inventory of culverts owned by the City of Bellingham and to share all relevant information of that inventory with the parties to this Memorandum of Agreement in a timely manner.
2. Provide support as needed to develop a priority list for remediation efforts at culverts identified through this Memorandum of Agreement
3. Provide support as needed to evaluate possible remediation designs and associated costs.
4. Confer and agree on a proposed schedule for remediation efforts.
5. Provide support as needed and as available to obtain necessary regulatory permissions for any remediation efforts agreed upon by the parties to this Memorandum of Agreement.
6. Provide support as needed and as available to obtain necessary funding for remediation efforts as agreed upon by the parties to this Memorandum of Agreement.

It is the intent of the parties to secure funding for remediation efforts jointly and severally and upon doing so one of the parties may be selected as the financial lead for receipt and disbursement of funds.

Once the parties agree on an inventory of culverts as defined above owned by the City of Bellingham, the parties will enter into a separate agreement that will govern the substance and priority of remediation efforts.

DECISION MAKING:

1. Decisions shall be based on the best available information.
2. Decisions shall be made by consensus of all parties to this Memorandum of Agreement.

TERMINATION:

Any party to this Memorandum of Agreement may terminate its participation with 30 days written notice of intent to terminate to all other parties to this Memorandum of Agreement.

No amendment or alteration of this Memorandum of Agreement shall arise by implication, course of conduct, or change in state law, tribal or federal law. This Memorandum of Agreement may be altered only by a subsequent written agreement signed by all parties, expressly stating the parties' intention to amend this Memorandum of Agreement.

LIABILITIES/RIGHTS:

Nothing in this Memorandum of Agreement shall be interpreted in any manner to create any rights or liabilities for or against any party hereto. This Agreement is entered into by the parties in a good faith effort to work cooperatively to improve and to maintain fish passage through culverts owned by the City of Bellingham and is not entered into in order to create any legal rights or liabilities.

CITY OF BELLINGHAM

By: see attached
Authorized Representative

Date

LUMMI NATION

By: 
Authorized Representative

4/7/22
Date

NOOKSACK INDIAN TRIBE

By: 
Authorized Representative

10-5-22
Date

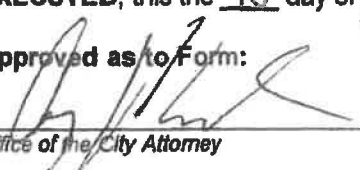
**STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE**

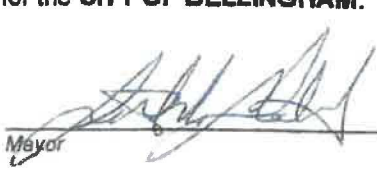
By: 
Authorized Representative

08/12/2022
Date

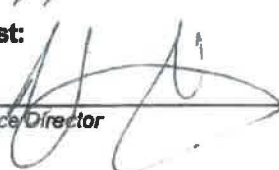
EXECUTED, this the 10 day of June, 2022, for the CITY OF BELLINGHAM:

Approved as to Form:


Office of the City Attorney


Mayor

Attest:


Finance Director

 
Department Head

Appendix B

GIS Methods for Prioritization Inputs

GIS METHODS FOR PRIORITIZATION INPUTS

Purpose and use

This document outlines the methodology employed for quantifying potential fish habitat gain related to fish passage barriers in the City of Bellingham.

The purpose of this analysis was to calculate potential anadromous and resident fish habitat gain upstream of City-owned fish passage barriers. Components of the analysis included compiling a database of City-owned fish passage barriers, consolidating information on known and presumed fish distribution, identifying a specific stream course network to use for habitat length calculations, and finally completing calculations of total and incremental potential anadromous and/or resident habitat gain above City-managed barriers.

Data Inputs

Data was sourced from City of Bellingham, Washington Department of Fish and Wildlife, and the Nooksack Indian Tribe (Mike Maudlin). Selections and modifications of data inputs are described in **Table B-1**.

TABLE B-1
DATA INPUTS – ANALYSIS LAYERS

Feature Class	Description	Source	Queries Applied
Env_Waterbody MonitoringRoutes_021424.shp	Stream Routes layer; aligns with City utility network.	City of Bellingham	none
SWIFD	SWIFD watercourse, used for reference	WDFW	DISTTYPE_DESC IN ('Artificial - Documented', 'Documented', 'Gradient Accessible', 'Presumed', 'Transported - Documented', 'Artificial - Presumed', 'Transported - Presumed')
Env_Watersheds	Watershed boundaries	City of Bellingham	none
Env_SubWatersheds	Subwatersheds with tier designations	City of Bellingham	none
Bham_FishPassageBarriers_forReview_20240123	All fish passage barriers identified by WDFW as “City” owned within Bellingham city limits or on City-owned property. Features identified as not barriers were ignored. Features on non-fish bearing streams were not prioritized. Prioritized barriers are marked as “Y” under the field “Prioritize” (127).	City of Bellingham	Cartograph <> 'No barrier'
Wdfw_watershed_2023	Downloaded copy of the WDFW Fish Passage Barrier database, limited to the watersheds around City of Bellingham (707 features). Query applied for purpose of fish habitat calculations to select only features plausibly aligned to waterbody monitoring stream courses (based on proximity and discretion), features not classified as “not barriers” or “NA” meaning non-fish, and barriers not otherwise identified in the Bham barriers layer.	WDFW	Siteld_copy NOT IN (...[duplicates of bham*]...) And FishPassageBarrierStatusCode NOT IN (20, 0) And ESA_nearwc IN ('y', 'm') *see below
FishDistributionPoints_20240311	Modified copy of BellinghamFishDistribution_022024. Consolidated fish distribution points snapped to the waterbody monitoring stream courses. Includes distribution points from SWIFD, WDFW, and Nooksack (as compiled by Mike Maudlin). Edited 9 points to snap with stream courses, moved one point based on WDFW input, created points for Squalicum Creek where missing. Modified version of fish distribution points retained as 'fish_dist_copy'	Mike Maudlin (Nooksack)	none

Methodology for Quantifying Potential Lineal Habitat Gain

Components of the analysis included compiling a database of City-managed fish passage barriers, consolidating information on known and presumed fish distribution, identifying a specific stream course network to use for habitat length calculations, and quantifying total and incremental anadromous and/or resident habitat gain above City-managed barriers.

Desktop analysis was performed in GIS software that enabled data visualization, data manipulation, data querying, and export of data to tabular formats. Exported data was incorporated into the prioritization scheme calculated in tabular format.

Step 1. Create a database of City-managed Fish Passage Barriers

An initial step was to compile a database of City-managed potential Fish Passage Barriers with input from the City and other Project Leads. Of those City Fish Passage Barriers, Project Leads identified barriers to prioritize for remediation. All crossings on fish-bearing streams were included in prioritization.

- Completely passable crossings (i.e. not barriers) were removed from the City’s Fish Passage Barriers feature class.
- Any barriers erroneously identified as City-managed were removed.
- Site-specific information from Project Leads was recorded as pertaining to barrier status, fish-bearing nature of associated stream, and any other relevant information.
- To facilitate geoprocessing, each City Fish Passage Barrier was snapped to a Waterbody Monitoring stream course. Any crossing not snapped to a stream course was individually reviewed.
- From the City’s Fish Passage Barriers feature class, barriers were identified for inclusion in prioritization. All barriers on fish-bearing streams were included in the prioritization.

Step 2. Identify a single source of stream course information

High resolution field-verified hydrography, the Waterbody Monitoring stream course layer, was created by the City of Bellingham’s Public Works Department and subsequently provided to Project Leads for analytic purposes. To facilitate efficient calculation of potential fish habitat gain, the Waterbody Monitoring stream courses were split at intersections with tributaries, barriers, and fish distribution points.

- All habitat length calculations referenced the City’s water course layer.

Step 3. Create a database of relevant Fish Passage Barriers not managed by the City

To consider non-City-managed barriers on streams of interest to the City, fish passage barrier data was downloaded from the WDFW’s FDPSI database. Potential fish passage barriers not otherwise in the City Fish Passage Barriers layer that occurred near the City’s stream network (Waterbody Monitoring stream course) were reviewed. Each WDFW barrier was individually reviewed for plausibility of aligning with water courses of interest to the City. Inclusion of such a barrier in the habitat length calculations was reviewed on a case-by-case basis. Features identified as “not a barrier” were excluded.

- Fish Passage Barriers sourced from WDFW’s FDPSI were downloaded for the following watersheds: Silver Creek, Squalicum Creek, Whatcom Creek, Lake Whatcom, Padden Creek, and Chuckanut Creek.
- Non-City-managed barriers were included in the potential habitat gain calculations if they were associated with a water course of interest (Waterbody Monitoring water course).
- Features identified as “not a barrier” were excluded.

Step 4. Consolidate fish distribution information

A point layer representing end points of documented or presumed anadromous or resident fish distributions was prepared by Nooksack Tribe (c/o Mike Maudlin) that consolidated fish distribution information from SWIFD, WDFW, and Project Leads in relation to the City’s high-resolution hydrography. Fish distribution point hierarchy followed: WDFW non-fish determination, natural barrier, SWIFD projected distribution (End of Presumed), Based on WDFW culvert survey length. If no Fish Distribution point was identified for a particular stream segment, it implied that the measurement extended to the upstream end of the City’s Waterbody Monitoring stream course. Any discrepancies in fish distribution information across entities were resolved by Project Leads.

- Fish distribution information was consolidated using the following hierarchy: WDFW non-fish determination, natural barrier, SWIFD projected distribution (End of Presumed), Based on WDFW culvert survey length.
- Habitat lengths were calculated referencing the Fish Distribution points in relation to the City’s Waterbody Monitoring stream course layer.

Step 5. Calculate Potential Lineal Habitat Gain

Total and incremental potential anadromous and/or resident upstream habitat length were calculated for each prioritized City Fish Passage Barrier.

The following ‘rules’ guided the analysis:

- Incremental upstream habitat potential was measured from a City Fish Passage Barrier to the next barrier regardless of if the next barrier was partial or complete.
- Incremental upstream habitat potential was measured from a City Fish Passage Barrier to the next natural or man-made barrier regardless of ownership of that next barrier.
- Incremental upstream habitat potential up to ‘next barrier’ may have included multiple barriers if there existed a fork in a stream course upstream of the City Fish Passage Barrier.
- Anadromous incremental potential habitat assumed anadromous + resident, however, is reported as ‘anadromous’ henceforth.
- Resident incremental potential habitat assumed resident-only.
- Each stream segment was classified as either documented or presumed, not double counted.
- For tributaries directly to Lake Whatcom, upstream potential resident habitat was measured from the confluence with the lake.

- For barriers above complete natural barriers, resident fish habitat is included in the incremental and total potential habitat gain.
- For barriers downstream of complete natural barriers, resident fish habitat above the natural barriers is not included in the incremental and total potential habitat gain.

Additional Quantified Attributes

The following data fields were collected in a tabular format and later incorporated into the prioritization scheme.

- SiteID (barrier identifier as listed in WDFW)
- Sum, all potential upstream habitat
- Sum potential upstream length anadromous - documented
- Sum potential upstream length anadromous - presumed
- Sum potential upstream length below natural barrier, resident only
- Sum potential upstream length above natural barrier, resident only
- Incremental to next barrier, anadromous - documented
- Incremental to next barrier, anadromous - presumed
- Incremental to next barrier below natural barrier, resident only
- Incremental to next barrier above natural barrier, resident only
- Count of upstream barriers, total
- Count of upstream barriers – City
- Count of upstream barriers – Non-city
- Count of downstream barriers, total - City
- Count of downstream barriers, unknown - City
- Count of downstream barriers, any - City
- Count of downstream barriers, partial - City
- Count of downstream barriers, full - City
- Count of downstream barriers, total - Non-city
- Count of downstream barriers, unknown - Non-city
- Count of downstream barriers, any - Non-city
- Count of downstream barriers, partial - Non-city
- Count of downstream barriers, full - Non-city

Appendix C

Prioritization Scoring Results for City-owned Fish Passage Barriers

WDFW Site ID	Creek	Anadromous- Accessible or Resident-Only	Upstream Habitat Quantity Score	Barrier Severity Score	Upstream Quantity * Barrier Severity	Downstream Barriers Score	Core Salmon Production Area Score	Upstream Habitat Quality Score	Prioritization Total Score	Rank
991104	Squalicum Creek	Anadromous	202.49	0.8	161.99	2.5	5.0	5.0	174.49	1
991105	Squalicum Creek	Anadromous	198.67	0.8	158.93	2.5	5.0	3.0	169.43	2
811121	Squalicum Creek	Anadromous	199.53	0.8	159.63	0.5	5.0	3.0	168.13	3
920646	Squalicum Creek	Anadromous	196.13	0.8	156.90	2.5	5.0	3.0	167.40	4
01.0552 2.00	Squalicum Creek	Anadromous	105.19	0.8	84.15	2.5	5.0	3.0	94.65	5
920649	Squalicum Creek	Anadromous	104.57	0.8	83.66	2.5	5.0	3.0	94.16	6
602273	Baker Creek	Anadromous	86.91	0.8	69.53	2.5	5.0	3.0	80.03	7
920625	Whatcom Creek	Anadromous	54.41	0.8	43.53	4.0	5.0	2.0	54.53	8
994375	Padden Creek	Anadromous	48.63	0.8	38.91	5.0	5.0	5.0	53.91	9
994390	Padden Creek	Anadromous	48.70	0.8	38.96	4.0	5.0	5.0	52.96	10
370647	Whatcom Creek	Anadromous	48.78	0.8	39.03	4.0	5.0	2.0	50.03	11
01.0555 0.00	Baker Creek	Anadromous	40.31	1.0	40.31	2.5	3.5	3.0	49.31	12
01.0622 0.30	Padden Creek	Anadromous	47.33	0.8	37.86	2.5	5.0	3.0	48.36	13
01.0622 0.80	Padden Creek	Anadromous	47.22	0.8	37.78	2.5	5.0	3.0	48.28	14
01.0622 0.50	Padden Creek	Anadromous	46.83	0.8	37.46	2.5	5.0	3.0	47.96	15
01.0622 0.70	Padden Creek	Anadromous	45.65	0.8	36.52	2.5	5.0	3.0	47.02	16
994370	Padden Creek	Anadromous	32.23	0.8	25.79	2.5	3.5	3.0	34.79	17
991599	Padden Creek	Anadromous	26.39	1.0	26.39	2.5	3.5	2.0	34.39	18
991600	Padden Creek	Anadromous	28.48	1.0	28.48	0.0	3.5	2.0	33.98	19
992981	Spring Creek	Anadromous	28.27	0.8	22.62	2.5	3.5	3.0	31.62	20
992984	Spring Creek	Anadromous	26.69	0.8	21.35	2.5	3.5	3.0	30.35	21
993038	Baker Creek	Anadromous	17.58	1.0	17.58	2.5	3.5	3.0	26.58	22
993006	Baker Creek	Anadromous	18.28	0.8	14.63	2.5	3.5	3.0	23.63	23
993040	Baker Creek	Anadromous	15.18	0.8	12.14	0.5	3.5	3.0	19.14	24
993093	Baker Creek	Anadromous	12.75	0.8	10.20	0.5	3.5	3.0	17.20	25
993821	Baker Creek	Anadromous	11.68	0.8	9.34	0.5	3.5	3.0	16.34	26
370683	West Cemetery Creek	Anadromous	9.05	1.0	9.05	0.5	3.5	3.0	16.05	27
1280163	East Bear Creek	Anadromous	10.87	0.8	8.69	0.5	3.5	3.0	15.69	28
370658	West Cemetery Creek	Anadromous	9.19	1.0	9.19	0.0	3.5	3.0	15.69	29
993443	Baker Creek	Anadromous	10.29	0.8	8.23	0.5	3.5	3.0	15.23	30
370673	Lincoln Creek	Anadromous	8.89	1.0	8.89	0.5	3.5	2.0	14.89	31
370648	West Cemetery Creek	Anadromous	8.18	1.0	8.18	0.0	3.5	3.0	14.68	32
993883	North Baker Creek	Anadromous	9.54	0.8	7.63	0.5	3.5	3.0	14.63	33
992656	Connelly Creek	Anadromous	6.29	1.0	6.29	2.5	3.5	2.0	14.29	34
993886	North Baker Creek	Anadromous	8.90	0.8	7.12	0.5	3.5	3.0	14.12	35
993880	Baker Creek	Anadromous	6.25	0.8	5.00	2.5	3.5	3.0	14.00	36
920647	Fever Creek	Anadromous	9.33	0.8	7.46	2.5	2.0	2.0	13.96	37

WDFW Site ID	Creek	Anadromous- Accessible or Resident-Only	Upstream Habitat Quantity Score	Barrier Severity Score	Upstream Quantity * Barrier Severity	Downstream Barriers Score	Core Salmon Production Area Score	Upstream Habitat Quality Score	Prioritization Total Score	Rank
932767	Padden Creek	Anadromous	6.79	0.8	5.43	2.5	3.5	2.0	13.43	38
935975	East Bear Creek	Anadromous	7.33	0.8	5.87	0.5	3.5	3.0	12.87	39
370661	Fever Creek	Anadromous	5.44	1.0	5.44	2.5	2.0	2.0	11.94	40
609981	West Spring Creek	Anadromous	4.91	0.8	3.93	2.5	2.0	3.0	11.43	41
370663	Fever Creek	Anadromous	4.80	1.0	4.80	2.5	2.0	2.0	11.30	42
920634	Whatcom Creek	Anadromous	2.17	1.0	2.17	2.5	3.5	3.0	11.17	43
920635	Lincoln Creek	Anadromous	5.90	0.8	4.72	0.5	3.5	2.0	10.72	44
992059	Our Lake Creek	Anadromous	5.73	0.8	4.59	0.5	3.5	2.0	10.59	45
996048	California St Creek	Anadromous	1.51	1.0	1.51	2.5	3.5	3.0	10.51	46
920652	East Bear Creek	Anadromous	4.18	0.8	3.34	0.5	3.5	3.0	10.34	47
991609	Our Lake Creek	Anadromous	7.02	0.8	5.61	0.5	2.0	2.0	10.11	48
370664	Fever Creek	Anadromous	4.30	0.8	3.44	2.5	2.0	2.0	9.94	49
932760	Our Lake Creek	Anadromous	6.76	0.8	5.40	0.5	2.0	2.0	9.90	50
370678	Lincoln Creek	Anadromous	5.39	0.8	4.31	0.0	3.5	2.0	9.81	51
934428	North Baker Creek	Anadromous	3.46	0.8	2.77	0.5	3.5	3.0	9.77	52
993483	Hoags Creek	Anadromous	0.71	0.8	0.57	2.5	3.5	3.0	9.57	53
932757	Governor Creek	Anadromous	3.50	1.0	3.50	0.5	3.5	2.0	9.50	54
993482	Hoags Creek	Anadromous	0.60	0.8	0.48	2.5	3.5	3.0	9.48	55
609982	West Spring Creek	Anadromous	2.31	0.8	1.85	2.5	2.0	3.0	9.35	56
993884	North Baker Creek	Anadromous	2.88	0.8	2.31	0.5	3.5	3.0	9.31	57
370660	Fever Creek	Anadromous	6.42	0.8	5.13	0.0	2.0	2.0	9.13	58
936083	East Bear Creek	Anadromous	2.19	0.8	1.75	0.5	3.5	3.0	8.75	59
609961	East Bear Creek Trib #2	Anadromous	3.90	0.8	3.12	0.5	2.0	3.0	8.62	60
370659	Fever Creek	Anadromous	5.64	0.8	4.51	0.0	2.0	2.0	8.51	61
932746	Golf Course Creek	Anadromous	3.28	0.8	2.63	0.0	3.5	2.0	8.13	62
992659	Connelly Creek	Anadromous	2.59	0.8	2.07	0.5	3.5	2.0	8.07	63
370679	Magnolia Creek	Anadromous	0.53	1.0	0.53	2.5	2.0	3.0	8.03	64
932748	Golf Course Creek	Anadromous	2.42	1.0	2.42	0.0	3.5	2.0	7.92	65
370649	West Cemetery Creek	Anadromous	2.88	1.0	2.88	0.0	2.0	3.0	7.88	66
609983	West Spring Creek	Anadromous	0.32	0.8	0.26	2.5	2.0	3.0	7.76	67
932750	Golf Course Creek	Anadromous	2.15	1.0	2.15	0.0	3.5	2.0	7.65	68
932747	Golf Course Creek	Anadromous	2.51	0.8	2.01	0.0	3.5	2.0	7.51	69
932749	Golf Course Creek	Anadromous	1.86	1.0	1.86	0.0	3.5	2.0	7.36	70
609966	Landon Creek	Anadromous	2.21	0.8	1.77	0.5	2.0	3.0	7.27	71
609967	Landon Creek	Anadromous	2.13	0.8	1.70	0.5	2.0	3.0	7.20	72
609962	East Bear Creek Trib #3	Anadromous	2.02	0.8	1.62	0.5	2.0	3.0	7.12	73
993881	South Baker Creek	Anadromous	1.80	0.8	1.44	0.5	2.0	3.0	6.94	74

WDFW Site ID	Creek	Anadromous- Accessible or Resident-Only	Upstream Habitat Quantity Score	Barrier Severity Score	Upstream Quantity * Barrier Severity	Downstream Barriers Score	Core Salmon Production Area Score	Upstream Habitat Quality Score	Prioritization Total Score	Rank
609964	Cammack Creek	Anadromous	1.78	0.8	1.43	0.5	2.0	3.0	6.93	75
609965	Cammack Creek	Anadromous	1.38	1.0	1.38	0.5	2.0	3.0	6.88	76
920636	Lincoln Creek	Anadromous	1.06	0.8	0.85	0.5	3.5	2.0	6.85	77
992657	30th St Creek	Anadromous	2.28	1.0	2.28	0.5	2.0	2.0	6.78	78
609993	Landon Creek	Anadromous	1.34	0.8	1.07	0.5	2.0	3.0	6.57	79
932752	Golf Course Creek	Anadromous	0.93	1.0	0.93	0.0	3.5	2.0	6.43	80
920640	St Clair Creek	Anadromous	0.83	0.8	0.67	0.0	3.5	2.0	6.17	81
936155	Bear Creek Trib #2	Anadromous	0.65	0.8	0.52	0.5	2.0	3.0	6.02	82
936156	Bear Creek Trib #2	Anadromous	0.47	1.0	0.47	0.5	2.0	3.0	5.97	83
996054	Connelly Creek	Anadromous	1.76	1.0	1.76	0.0	2.0	2.0	5.76	84
932753	Golf Course Creek	Anadromous	0.21	1.0	0.21	0.0	3.5	2.0	5.71	85
992662	Connelly Creek	Anadromous	1.53	1.0	1.53	0.0	2.0	2.0	5.53	86
936157	Bear Creek Trib #2	Anadromous	0.26	0.8	0.21	0.0	2.0	3.0	5.21	87
936159	Bear Creek Trib #2	Anadromous	0.03	0.8	0.03	0.0	2.0	3.0	5.03	88
992664	Connelly Creek	Anadromous	0.59	1.0	0.59	0.0	2.0	2.0	4.59	89
920644	30th St Creek	Anadromous	0.38	1.0	0.38	0.0	2.0	2.0	4.38	90
920641	Fever Creek	Anadromous	0.45	0.8	0.36	0.0	2.0	2.0	4.36	91
992665	Connelly Creek	Anadromous	0.13	1.0	0.13	0.0	2.0	2.0	4.13	92
609969	Mill Wheel Creek	Resident	4.38	0.8	3.50	1.0	1.0	3.0	8.50	93
370670	Hanna Creek	Resident	4.40	1.0	4.40	0.0	1.0	3.0	8.40	94
370680	Cemetery Creek	Resident	2.43	1.0	2.43	0.5	1.0	3.0	6.93	95
370650	Cemetery Creek	Resident	2.12	0.8	1.70	1.0	1.0	3.0	6.70	96
370681	Cemetery Creek	Resident	2.19	1.0	2.19	0.5	1.0	3.0	6.69	97
370682	Cemetery Creek	Resident	2.37	1.0	2.37	0.0	1.0	3.0	6.37	98
370672	Hanna Creek	Resident	3.08	1.0	3.08	0.0	1.0	2.0	6.08	99
370652	Cemetery Creek	Resident	1.94	1.0	1.94	0.0	1.0	3.0	5.94	100
609980	Cemetery Creek	Resident	2.41	0.8	1.93	0.0	1.0	3.0	5.93	101
370666	Hanna Creek	Resident	2.75	1.0	2.75	0.0	1.0	2.0	5.75	102
370155	Mill Wheel Creek	Resident	2.24	1.0	2.24	0.5	1.0	2.0	5.74	103
370601	Mill Wheel Creek	Resident	2.13	0.8	1.70	1.0	1.0	2.0	5.70	104
370653	Cemetery Creek	Resident	1.77	0.8	1.42	0.0	1.0	3.0	5.42	105
609991	Lakside Creek	Resident	0.87	0.8	0.70	1.0	0.5	3.0	5.20	106
370665	Hanna Creek	Resident	2.53	0.8	2.03	0.0	1.0	2.0	5.03	107
370236	Mill Wheel Creek	Resident	2.16	0.8	1.73	0.0	1.0	2.0	4.73	108
609989	Silver Beach Creek	Resident	0.67	0.8	0.53	1.0	1.0	2.0	4.53	109
609990	Academy Creek	Resident	0.53	1.0	0.53	1.0	1.0	2.0	4.53	110
370335	Mill Wheel Creek	Resident	0.98	1.0	0.98	0.5	1.0	2.0	4.48	111

WDFW Site ID	Creek	Anadromous- Accessible or Resident-Only	Upstream Habitat Quantity Score	Barrier Severity Score	Upstream Quantity * Barrier Severity	Downstream Barriers Score	Core Salmon Production Area Score	Upstream Habitat Quality Score	Prioritization Total Score	Rank
370668	Park Creek	Resident	1.05	1.0	1.05	0.0	1.0	2.0	4.05	112
370334	Mill Wheel Creek Trib West	Resident	1.10	0.8	0.88	0.0	1.0	2.0	3.88	113
609972	Hanna Creek	Resident	1.03	0.8	0.82	0.0	1.0	2.0	3.82	114
370669	Park Creek	Resident	1.20	1.0	1.20	0.0	0.5	2.0	3.70	115
370143	Silver Breach Creek Trib	Resident	0.16	1.0	0.16	0.5	1.0	2.0	3.66	116
609971	Mill Wheel Creek Trib West	Resident	1.30	0.8	1.04	0.0	0.5	2.0	3.54	117
370154	Mill Wheel Creek Trib East	Resident	0.54	1.0	0.54	0.0	1.0	2.0	3.54	118
370336	Mill Wheel Creek Trib East	Resident	0.97	1.0	0.97	0.0	0.5	2.0	3.47	119
609974	Ella Creek	Resident	0.94	0.8	0.75	0.0	0.5	2.0	3.25	120
609975	Park Creek	Resident	0.85	0.8	0.68	0.0	0.5	2.0	3.18	121
609970	Mill Wheel Creek	Resident	0.85	0.8	0.68	0.0	0.5	2.0	3.18	122
609977	Park Creek	Resident	0.66	1.0	0.66	0.0	0.5	2.0	3.16	123
370469	Mill Wheel Creek Trib East	Resident	0.58	1.0	0.58	0.0	0.5	2.0	3.08	124
609979	Park Creek	Resident	0.68	0.8	0.54	0.0	0.5	2.0	3.04	125
609978	Park Creek	Resident	0.67	0.8	0.53	0.0	0.5	2.0	3.03	126
609976	Park Creek	Resident	0.62	0.8	0.49	0.0	0.5	2.0	2.99	127

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991104	Squalicum Creek	1	Anadromous	40.30	0.50	10.53	0.00	Unknown	---	multiple	Documented anadromous fish spawning and significant reach	Tidal
991105	Squalicum Creek	2	Anadromous	39.51	0.55	10.53	0.00	33	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
811121	Squalicum Creek	3	Anadromous	39.79	0.28	10.53	0.00	67	1	multiple	Documented anadromous fish spawning and significant reach	Tier 1
920646	Squalicum Creek	4	Anadromous	38.96	0.66	10.53	1.08	Unknown	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
01.0552 2.00	Squalicum Creek	5	Anadromous	21.00	0.11	4.67	0.00	67	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
920649	Squalicum Creek	6	Anadromous	20.89	0.06	4.67	0.00	67	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
602273	Baker Creek	7	Anadromous	17.31	0.18	3.82	0.00	33	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
920625	Whatcom Creek	8	Anadromous	9.32	3.90	2.68	0.00	67	---	1	Documented anadromous fish spawning and significant reach	Tier 2
994375	Padden Creek	9	Anadromous	9.70	0.06	2.50	0.00	Unknown	---	---	Documented anadromous fish spawning and significant reach	Tidal
994390	Padden Creek	10	Anadromous	9.65	0.23	2.50	0.00	Unknown	---	1	Documented anadromous fish spawning and significant reach	Tidal
370647	Whatcom Creek	11	Anadromous	9.63	0.31	2.68	0.00	33	---	1	Documented anadromous fish spawning and significant reach	Tier 2
01.0555 0.00	Baker Creek	12	Anadromous	7.54	1.31	1.30	0.00	0	---	multiple	Documented anadromous fish and significant reach	Tier 1
01.0622 0.30	Padden Creek	13	Anadromous	9.41	0.14	2.50	0.00	33	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
01.0622 0.80	Padden Creek	14	Anadromous	8.82	1.55	2.50	0.88	67	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
01.0622 0.50	Padden Creek	15	Anadromous	9.27	0.23	2.50	0.00	33	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
01.0622 0.70	Padden Creek	16	Anadromous	9.04	0.22	2.50	0.05	33	---	multiple	Documented anadromous fish spawning and significant reach	Tier 1
994370	Padden Creek	17	Anadromous	6.09	0.90	1.24	0.00	33	---	multiple	Documented anadromous fish and significant reach	Tier 1
991599	Padden Creek	18	Anadromous	5.19	0.22	1.24	0.00	0	---	multiple	Accessible for anadromous fish and significant reach	Tier 2
991600	Padden Creek	19	Anadromous	4.98	1.80	1.24	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
992981	Spring Creek	20	Anadromous	5.46	0.48	1.12	0.00	67	---	multiple	Documented anadromous fish and significant reach	Tier 1
992984	Spring Creek	21	Anadromous	4.98	0.89	1.12	0.00	67	---	multiple	Documented anadromous fish and significant reach	Tier 1
993038	Baker Creek	22	Anadromous	3.32	0.48	0.00	0.00	0	---	multiple	Accessible for anadromous fish and significant reach	Tier 1
993006	Baker Creek	23	Anadromous	3.56	0.24	0.00	0.00	67	---	multiple	Accessible for anadromous fish and significant reach	Tier 1
993040	Baker Creek	24	Anadromous	2.85	0.47	0.00	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
993093	Baker Creek	25	Anadromous	2.38	0.43	0.00	0.00	67	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
993821	Baker Creek	26	Anadromous	1.67	1.67	0.00	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
370683	West Cemetery Creek	27	Anadromous	1.66	0.37	0.05	0.00	0	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
1280163	East Bear Creek	28	Anadromous	1.99	0.45	0.00	0.00	Unknown	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
370658	West Cemetery Creek	29	Anadromous	1.79	0.13	0.05	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 1
993443	Baker Creek	30	Anadromous	1.95	0.28	0.00	0.00	67	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
370673	Lincoln Creek	31	Anadromous	1.56	0.54	1.67	0.00	0	1	multiple	Documented anadromous fish and significant reach	Tier 2
370648	West Cemetery Creek	32	Anadromous	1.29	0.87	0.05	0.05	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 1
993883	North Baker Creek	33	Anadromous	1.69	0.54	0.18	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
992656	Connelly Creek	34	Anadromous	1.18	0.20	0.26	0.00	0	---	multiple	Accessible for anadromous fish and significant reach	Tier 2
993886	North Baker Creek	35	Anadromous	1.41	0.92	0.00	0.00	33	1	multiple	Documented anadromous fish and significant reach	Tier 1
993880	Baker Creek	36	Anadromous	0.97	0.71	1.12	0.00	67	---	multiple	Documented anadromous fish and significant reach	Tier 1
920647	Fever Creek	37	Anadromous	1.68	0.45	1.48	0.00	Unknown	---	multiple	Accessible for anadromous fish	Tier 2
932767	Padden Creek	38	Anadromous	1.30	0.13	0.11	0.11	67	---	multiple	Accessible for anadromous fish and significant reach	Tier 2
935975	East Bear Creek	39	Anadromous	1.25	0.54	0.00	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
370661	Fever Creek	40	Anadromous	1.03	0.14	1.48	0.00	0	---	multiple	Accessible for anadromous fish and significant reach	Tier 2
609981	West Spring Creek	41	Anadromous	0.80	0.46	0.18	0.00	67	---	multiple	Accessible for anadromous fish	Tier 1
370663	Fever Creek	42	Anadromous	0.88	0.21	1.48	0.07	0	---	multiple	Accessible for anadromous fish and significant reach	Tier 2
920634	Whatcom Creek	43	Anadromous	0.31	0.31	0.00	0.00	0	---	multiple	Documented anadromous fish and significant reach	Tier 1
920635	Lincoln Creek	44	Anadromous	0.89	0.73	0.00	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 2
992059	Our Lake Creek	45	Anadromous	1.08	0.16	0.65	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 2
996048	California St Creek	46	Anadromous	0.27	0.08	0.53	0.38	0	---	multiple	Accessible for anadromous fish and significant reach	Tier 1
920652	East Bear Creek	47	Anadromous	0.71	0.32	0.00	0.00	67	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
991609	Our Lake Creek	49	Anadromous	1.37	0.09	0.65	0.00	67	1	multiple	Accessible for anadromous fish	Tier 2
370664	Fever Creek	50	Anadromous	0.67	0.48	1.41	0.00	67	---	multiple	Accessible for anadromous fish	Tier 2

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932760	Our Lake Creek	51	Anadromous	1.27	0.19	0.65	0.00	Unknown	1	multiple	Accessible for anadromous fish	Tier 2
370678	Lincoln Creek	52	Anadromous	1.02	0.14	1.67	0.00	33	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
934428	North Baker Creek	53	Anadromous	0.49	0.49	0.00	0.00	67	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
993483	Hoags Creek	54	Anadromous	0.13	0.03	0.00	0.00	33	---	multiple	Accessible for anadromous fish and significant reach	Tier 1
932757	Governor Creek	55	Anadromous	0.50	0.50	0.20	0.20	0	1	multiple	Accessible for anadromous fish and significant reach	Tier 2
993482	Hoags Creek	56	Anadromous	0.10	0.05	0.00	0.00	33	---	multiple	Accessible for anadromous fish and significant reach	Tier 1
609982	West Spring Creek	57	Anadromous	0.34	0.30	0.18	0.00	67	---	multiple	Accessible for anadromous fish	Tier 1
993884	North Baker Creek	58	Anadromous	0.47	0.28	0.18	0.18	33	1	multiple	Documented anadromous fish and significant reach	Tier 1
370660	Fever Creek	59	Anadromous	1.23	0.13	1.48	0.00	33	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
936083	East Bear Creek	60	Anadromous	0.38	0.14	0.00	0.00	67	1	multiple	Accessible for anadromous fish and significant reach	Tier 1
609961	East Bear Creek Trib #2	61	Anadromous	0.56	0.56	0.03	0.03	33	1	multiple	Accessible for anadromous fish	Tier 1
370659	Fever Creek	62	Anadromous	1.10	0.07	1.48	0.00	33	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
932746	Golf Course Creek	65	Anadromous	0.61	0.12	0.00	0.00	33	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
992659	Connelly Creek	66	Anadromous	0.46	0.14	0.26	0.00	67	1	multiple	Accessible for anadromous fish and significant reach	Tier 2
370679	Magnolia Creek	67	Anadromous	0.08	0.08	0.01	0.01	0	---	multiple	Accessible for anadromous fish	Tier 1
932748	Golf Course Creek	68	Anadromous	0.45	0.08	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
370649	West Cemetery Creek	69	Anadromous	0.41	0.41	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish	Tier 1
609983	West Spring Creek	70	Anadromous	0.05	0.05	0.18	0.18	67	---	multiple	Accessible for anadromous fish	Tier 1
932750	Golf Course Creek	71	Anadromous	0.35	0.21	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
932747	Golf Course Creek	72	Anadromous	0.49	0.04	0.00	0.00	33	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
932749	Golf Course Creek	73	Anadromous	0.36	0.02	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
609966	Landon Creek	75	Anadromous	0.42	0.06	0.00	0.00	67	1	multiple	Accessible for anadromous fish	Tier 1
609967	Landon Creek	76	Anadromous	0.36	0.17	0.00	0.00	67	1	multiple	Accessible for anadromous fish	Tier 1
609962	East Bear Creek Trib #3	77	Anadromous	0.29	0.29	0.00	0.00	67	1	multiple	Accessible for anadromous fish	Tier 1
993881	South Baker Creek	78	Anadromous	0.26	0.26	1.03	1.03	33	1	multiple	Accessible for anadromous fish	Tier 1
609964	Cammack Creek	79	Anadromous	0.25	0.25	0.01	0.00	67	1	multiple	Accessible for anadromous fish	Tier 1
609965	Cammack Creek	81	Anadromous	0.27	0.01	0.01	0.00	0	1	multiple	Accessible for anadromous fish	Tier 1
920636	Lincoln Creek	82	Anadromous	0.15	0.15	0.00	0.00	33	1	multiple	Accessible for anadromous fish and significant reach	Tier 2
992657	30th St Creek	83	Anadromous	0.35	0.27	0.00	0.00	0	1	multiple	Accessible for anadromous fish	Tier 2
609993	Landon Creek	86	Anadromous	0.19	0.19	0.00	0.00	67	1	multiple	Accessible for anadromous fish	Tier 1
932752	Golf Course Creek	87	Anadromous	0.14	0.11	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
920640	St Clair Creek	88	Anadromous	0.12	0.12	0.33	0.33	67	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
936155	Bear Creek Trib #2	91	Anadromous	0.12	0.04	0.00	0.00	67	1	multiple	Accessible for anadromous fish	Tier 1
936156	Bear Creek Trib #2	92	Anadromous	0.08	0.04	0.00	0.00	0	1	multiple	Accessible for anadromous fish	Tier 1
996054	Connelly Creek	93	Anadromous	0.32	0.08	0.26	0.00	0	multiple	multiple	Accessible for anadromous fish	Tier 2
932753	Golf Course Creek	96	Anadromous	0.03	0.03	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
992662	Connelly Creek	99	Anadromous	0.24	0.15	0.26	0.00	0	multiple	multiple	Accessible for anadromous fish	Tier 2
936157	Bear Creek Trib #2	101	Anadromous	0.04	0.03	0.00	0.00	67	multiple	multiple	Accessible for anadromous fish	Tier 1
936159	Bear Creek Trib #2	103	Anadromous	0.00	0.00	0.00	0.00	33	multiple	multiple	Accessible for anadromous fish	Tier 1
992664	Connelly Creek	105	Anadromous	0.09	0.07	0.26	0.26	0	multiple	multiple	Accessible for anadromous fish	Tier 2
920644	30th St Creek	107	Anadromous	0.08	0.00	0.00	0.00	0	multiple	multiple	Accessible for anadromous fish	Tier 2
920641	Fever Creek	112	Anadromous	0.06	0.06	1.08	1.08	33	multiple	multiple	Accessible for anadromous fish and significant reach	Tier 2
992665	Connelly Creek	113	Anadromous	0.03	0.00	0.26	0.00	0	multiple	multiple	Accessible for anadromous fish	Tier 2
609969	Mill Wheel Creek	63	Resident	0.00	0.00	3.92	0.91	67	---	---	Documented resident fish	Tier 1
370670	Hanna Creek	64	Resident	0.00	0.00	4.17	0.46	0	multiple	multiple	Documented resident fish	Tier 1
370680	Cemetery Creek	80	Resident	0.00	0.00	2.39	0.08	0	---	multiple	Documented resident fish	Tier 1
370650	Cemetery Creek	84	Resident	0.00	0.00	2.04	0.17	33	---	---	Documented resident fish	Tier 1
370681	Cemetery Creek	85	Resident	0.00	0.00	2.18	0.03	0	---	multiple	Documented resident fish	Tier 1
370682	Cemetery Creek	89	Resident	0.00	0.00	2.31	0.13	0	multiple	multiple	Documented resident fish	Tier 1

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370672	Hanna Creek	90	Resident	0.00	0.00	2.35	1.46	0	multiple	multiple	Documented resident fish	Tier 2
370652	Cemetery Creek	94	Resident	0.00	0.00	1.87	0.15	0	multiple	multiple	Documented resident fish	Tier 1
609980	Cemetery Creek	95	Resident	0.00	0.00	1.61	1.61	67	multiple	multiple	Documented resident fish	Tier 1
370666	Hanna Creek	97	Resident	0.00	0.00	2.66	0.19	0	multiple	multiple	Documented resident fish	Tier 2
370155	Mill Wheel Creek	98	Resident	0.00	0.00	2.20	0.09	0	---	1	Documented resident fish	Tier 2
370601	Mill Wheel Creek	100	Resident	0.00	0.00	2.11	0.04	33	---	---	Documented resident fish	Tier 2
370653	Cemetery Creek	102	Resident	0.00	0.00	1.72	0.11	33	multiple	multiple	Documented resident fish	Tier 1
609991	Lakside Creek	104	Resident	0.00	0.00	0.58	0.58	33	---	---	Accessible for resident fish	Tier 1
370665	Hanna Creek	106	Resident	0.00	0.00	2.47	0.12	33	1	multiple	Documented resident fish	Tier 2
370236	Mill Wheel Creek	108	Resident	0.00	0.00	2.06	0.20	33	1	multiple	Documented resident fish	Tier 2
609989	Silver Beach Creek	109	Resident	0.00	0.00	0.45	0.45	67	---	---	Documented resident fish	Tier 2
609990	Academy Creek	110	Resident	0.00	0.00	0.47	0.11	0	---	---	Documented resident fish	Tier 2
370335	Mill Wheel Creek	111	Resident	0.00	0.00	0.84	0.28	0	---	1	Documented resident fish	Tier 2
370668	Park Creek	114	Resident	0.00	0.00	1.04	0.02	0	multiple	multiple	Documented resident fish	Tier 2
370334	Mill Wheel Creek Trib West	115	Resident	0.00	0.00	1.02	0.16	33	1	multiple	Documented resident fish	Tier 2
609972	Hanna Creek	116	Resident	0.00	0.00	0.90	0.27	67	multiple	multiple	Documented resident fish	Tier 2
370669	Park Creek	117	Resident	0.00	0.00	1.02	0.35	0	multiple	multiple	Accessible for resident fish	Tier 2
370143	Silver Breach Creek Trib	118	Resident	0.00	0.00	0.11	0.11	0	---	1	Documented resident fish	Tier 2
609971	Mill Wheel Creek Trib West	119	Resident	0.00	0.00	0.87	0.87	67	1	multiple	Accessible for resident fish	Tier 2
370154	Mill Wheel Creek Trib East	120	Resident	0.00	0.00	0.36	0.36	0	multiple	1	Documented resident fish	Tier 2
370336	Mill Wheel Creek Trib East	121	Resident	0.00	0.00	0.82	0.31	0	multiple	1	Accessible for resident fish	Tier 2
609974	Ella Creek	122	Resident	0.00	0.00	0.63	0.63	33	multiple	multiple	Accessible for resident fish	Tier 2
609975	Park Creek	123	Resident	0.00	0.00	0.57	0.57	67	multiple	multiple	Accessible for resident fish	Tier 2
609970	Mill Wheel Creek	124	Resident	0.00	0.00	0.56	0.56	67	multiple	multiple	Accessible for resident fish	Tier 2
609977	Park Creek	125	Resident	0.00	0.00	0.64	0.04	0	multiple	multiple	Accessible for resident fish	Tier 2
370469	Mill Wheel Creek Trib East	126	Resident	0.00	0.00	0.51	0.15	0	1	1	Accessible for resident fish	Tier 2
609979	Park Creek	127	Resident	0.00	0.00	0.67	0.01	33	multiple	multiple	Accessible for resident fish	Tier 2
609978	Park Creek	128	Resident	0.00	0.00	0.66	0.02	33	multiple	multiple	Accessible for resident fish	Tier 2
609976	Park Creek	129	Resident	0.00	0.00	0.60	0.03	33	multiple	multiple	Accessible for resident fish	Tier 2