

Island County Fish Passage Barrier Inventory: Priority Area 2

Water Resource Inventory Area 6



Final Report December 2022

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Abstract

Recent research has found that coastal streams in Island County provide quality rearing habitat for juvenile salmonids during critical rearing periods in spring. Lack of delta and pocket estuary rearing habitat is identified as a limiting factor or critical issue throughout the Puget Sound, especially in the Skagit, Stillaguamish and Island County watersheds. With inadequate rearing habitat in the delta, small streams entering the Whidbey Basin can provide rearing habitat for fry migrant Chinook salmon originating from the Skagit, Snohomish and Stillaguamish (Beamer, 2013). Local recent research shows ESA listed Puget Sound Chinook (and other salmonids) rear for a significant periods of time in small stream habitats (Beamer et al 2013; Beamer et al 2006). Fish densities can be up to 20 times higher in pocket estuary habitat than adjacent nearshore areas (Beamer et al 2006). Undersized culverts on these streams feeding pocket estuaries have been found to be detrimental to the quality of this habitat type and cause lower juvenile salmonid densities (Beamer et al. 2013). The process of inventorying these barrier culverts began in 2014 and is ongoing. A previous study completed by Island County Public Works analyzed fish passage at publicly owned culverts within Island County's WRIA 6 Salmon Recovery Plan's highest priority geographic area for salmon recovery (Geographic Area 1). This project is a continuation of that previous Island County work.

The WRIA 6 Salmon Recovery Plan specifies three priority Geographic Areas. In this project, Skagit Fisheries Enhancement Group (SFEG) partnered with Island County Public Works and Sound Salmon Solutions (SSS) to locate and inventory private fish passage barriers in Island County's Geographic Area 1 and both public and private fish passage barriers in Geographic Area 2. The project team completed habitat surveys on streams that were identified as the highest priority for restoration by knowledgeable local stakeholders. These results will be used to make decisions about funding and prioritization for future culvert replacement projects.

Introduction

WRIA 6 is a water resources inventory area which includes Whidbey and Camano Islands. It is located near the mouths of three salmon bearing rivers, the Stillaguamish, Snohomish, and Skagit rivers, and lies in the migration corridor between these rivers and the sea. Delta and estuary habitat provide a mixture of salty and freshwater micro habitats important for osmoregulation during the smoltification process, shelter, and other critical resources to juvenile salmonids leaving their natal streams and rivers and migrating to oceanic habitats (Beamer et al, 2000; Beamer et al, 2005). It is well established that the highest rates of mortality in the salmon life cycle typically occur during the juvenile stage. This can be compounded by a critical lack of adequate rearing habitat throughout the river, delta and nearshore due to apomorphic impacts. Fish densities can be up to 20 times higher in pocket estuary habitat than adjacent nearshore areas (Beamer et al 2006).

Lack of rearing habitat is a known limiting factor for Skagit Chinook recovery. The 2005 Skagit Chinook Recovery Plan identifies this as a top priority for restoration efforts. Loss of this rearing habitat type is also an issue in the Snohomish system where “the loss of rearing habitat quantity and quality along mainstems, within the estuary, and in the nearshore environment is thought to be one key reason for the decline of Snohomish River basin Chinook salmon.” (Snohomish River Basin Salmon Conservation Plan, 2005). Furthermore, according to the Stillaguamish Watershed Chinook Salmon Recovery Plan, a lack of estuary rearing habitat is a limiting factor for Stillaguamish Chinook Recovery, “In addition to the salt marsh estuarine habitat connected to the Stillaguamish River, nearshore areas in Port Susan and Skagit Bay historically included a number of “pocket estuaries” that provided additional estuary rearing habitat for juvenile salmon...The loss of pocket estuary habitat throughout Puget Sound has likely had a significant impact on the fry migrant life history type of Chinook salmon...Many factors have contributed to the loss of estuarine and nearshore habitat, including: construction of dikes and the associated loss of salt marsh habitat and blind tidal channels; installation of tide-gates, flood-gates, pump-stations, weirs, and culverts.” Removing fish passage barriers which block access to rearing habitat and prevent fully functioning pocket estuary habitat is a critical action for Chinook recovery for Chinook stocks for all of these systems.

WRIA 6 is home to all 5 Pacific salmon species, as well as steelhead including ESA listed salmonid stocks such as Puget Sound Chinook, Puget Sound Steelhead, Puget Sound bull trout, and Hood Canal summer chum. (WRIA 6 Multi Species Salmon Recovery Plan, 2005). Until recently, the importance of these non-natal pocket estuary habitats to juvenile salmonids was not well understood. Recent sampling in pocket estuaries found juvenile Chinook rearing in over half of all coastal streams sampled in Island and Snohomish counties (Beamer et al, 2013). This study notes that at that time, streams and potential fish passage barriers were not well mapped. This led the Island County Lead Entity Salmon Technical Advisory Group to identify barrier analysis and water typing on streams potentially suitable for salmon habitat as a high priority for salmon recovery in WRIA 6.

After a lack of Skagit Delta Habitat was identified as a limiting factor for Skagit Chinook Salmon recovery in 2003 (Beamer et al, 2003), researchers turned to pocket estuaries throughout Island County to determine if pocket estuaries were of similar importance to juvenile salmonids. In studies examining Harrington Lagoon (Kagley et al. 2007a), Elger Bay (Kagley et al. 2007b), Race Lagoon (Henderson et al. 2007), Cornet Bay (Keystone Ecological 2009; Schmidt 2010; Schmidt 2012), and Dugwalla Heights Lagoon (Beamer et al. 2011; Beamer et al. 2012), salmonid fishes made up

substantial proportions of total fish encountered. Salmonids found to be utilizing these habitats included Chinook (age 0 and age 1), coho (ages reported as “All”), chum (age 0), pink (age 0), and cutthroat trout (age unknown). Further research has shown that pocket estuaries provide a faster growing environment than other near shore areas and are safer for fry sized Chinook than adjacent nearshore or offshore areas early in the year (Beamer et al 2003). The presence of barrier culverts on a pocket estuary or nearshore Island County stream is associated with lower Chinook and salmonid presence (Beamer et al 2013)

In 2005 the WRIA 6 Salmon Technical Advisory Group completed a multi species recovery plan which identified actions within WRIA 6 necessary for salmon recovery. This document identified large sections of shoreline in WRIA 6 as critical habitat for Puget Sound Chinook and bull trout. Chinook were highlighted as the most prevalent ESA listed species utilizing WRIA 6 habitats. The WRIA 6 Salmon Recovery Plan established the priority areas for salmon recovery (WRIA 6 Technical Advisory Group, 2005). This recovery plan was updated in 2019 to include a renewed commitment to restoring and preserving pocket estuaries and lagoons based on new research. In the updated 2019 plan, identification and removal of fish passage barriers, reconnecting creek mouths to estuaries and nearshore habitats, and protection and restoration of natural marine shorelines and processes were all identified as tier 1 salmon recovery strategies moving forward (Multi Species Recovery Plan, 2019).

Salmon recovery priority areas

According to the 2005 and updated 2019 WRIA 6 Salmon Recovery Plans, there are three designated salmon recovery priority Geographic Areas in WRIA 6 (Figure 1). Prioritization of these Geographic Areas was based on multiple characteristics of the sub-basins and associated shorelines which have been found to be associated with salmon habitat suitability. These factors included the distance of the sub-basins’ shoreline from the three rivers that terminate into the Whidbey Basin and the priority of the adjacent salmon recovery priority geographic area (WRIA 6 Technical Advisory Group, 2005). The inventory process of salmon passage barriers in Island County began in 2014 in Geographic Area 1, the highest priority area for salmon recovery. The Washington Department of Fish and Wildlife (WDFW) partnered with Island County Public Works to survey publicly owned culverts and complete habitat surveys on streams associated with them.

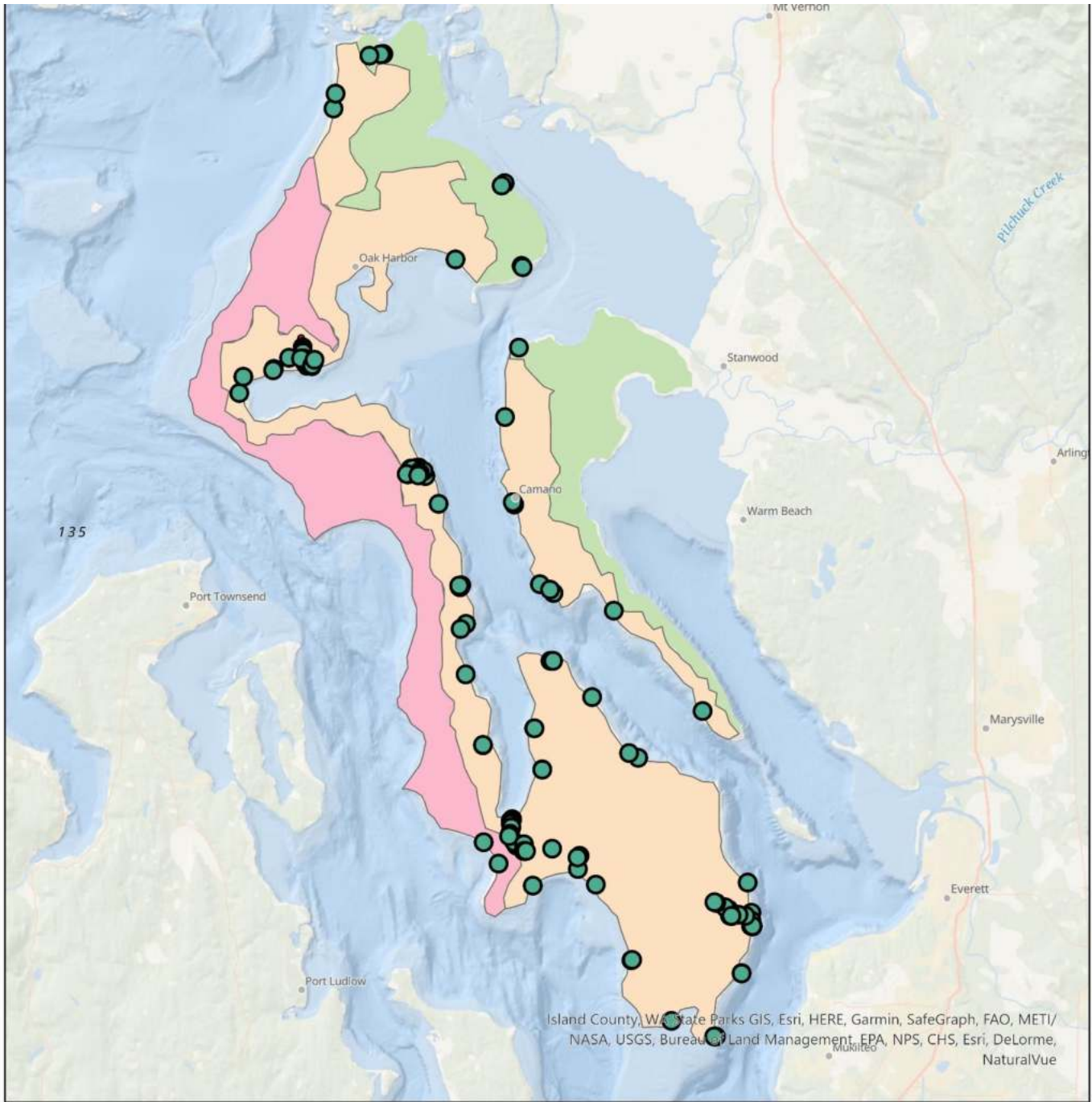
Recent studies have shown that Whidbey Island has important rearing habitat for all 5 species of juvenile Pacific salmon, especially Chinook (Beamer et al. 2013). In a 2013 study, researchers found juvenile salmon in small streams throughout the Whidbey Basin from each of the three source rivers (Skagit, Stillaguamish, and Snohomish) for Chinook salmon populations (Beamer et al. 2013). This study also found that four factors influenced juvenile Chinook salmon presence within these small streams: 1) distance to nearest Chinook salmon bearing river, 2) stream channel slope, 3) watershed area, and 4) presence and condition of culverts at the mouth of a stream. In the 2013 small streams study, researchers surveyed streams either 200 meters from the shoreline or to the first fish barrier (Zackey presentation 2016); this project also focuses on culverts within 200 meters of the shore on mapped streams because these are the rearing habitats that are vital to juvenile Puget Sound Chinook.

Geographic Area 1 is the highest priority area for salmon recovery efforts. All shorelines within this Geographic Area are within 5 miles of the mouths of a salmon bearing river. These areas are the

most utilized areas for the 47 salmon and trout stocks that originate from the Skagit, Stillaguamish, and Snohomish rivers including juvenile Chinook salmon and bull trout (Island County, 2015). Geographic Area 2 is the focus of this study and where most surveys in this phase of the project are located. Geographic Area 2 is a medium priority for salmon recovery within Island County. This area includes the WRIA 6 sub basins and shorelines of Saratoga Passage, Possession Sound, Southeast Admiralty Inlet (Double Bluff to Possession Point), and Northwest Whidbey (Deception Pass to the north end of West Beach). Northwest Whidbey adjacent to Geographic Area 1 was identified as especially important for bull trout due to critical bull trout habitat (Island County, 2015).

Geographic Area 3 is the lowest priority area for salmon recovery within Island County. These shorelines on the west side of Whidbey Island are the furthest from natal rivers and therefore the hardest for out-migrating juvenile salmonids to reach. Geological processes including high wave and ocean current action are also thought to impact the quality of these habitats for juveniles, including facilitating the formation of steep slopes in streams in Geographic Area 3. Although Geographic Area 3 is likely migration corridors for larger juvenile and returning adults (Island County, 2015). Streams and culverts in Geographic Area 3 were not evaluated in this study.

Figure 1: Map of 3 WRIA 6 Salmon Recovery Plan Priority Geographic Areas and culverts of interest for this project phase



Legend

- Phase 2 culverts
- Habitat Surveys
- Geo_Area_3_projected
- Geo_Area_2_projected
- Geo_Area_1_reprojected

0 1.5 3 6 9 12 Miles

N

Seattle

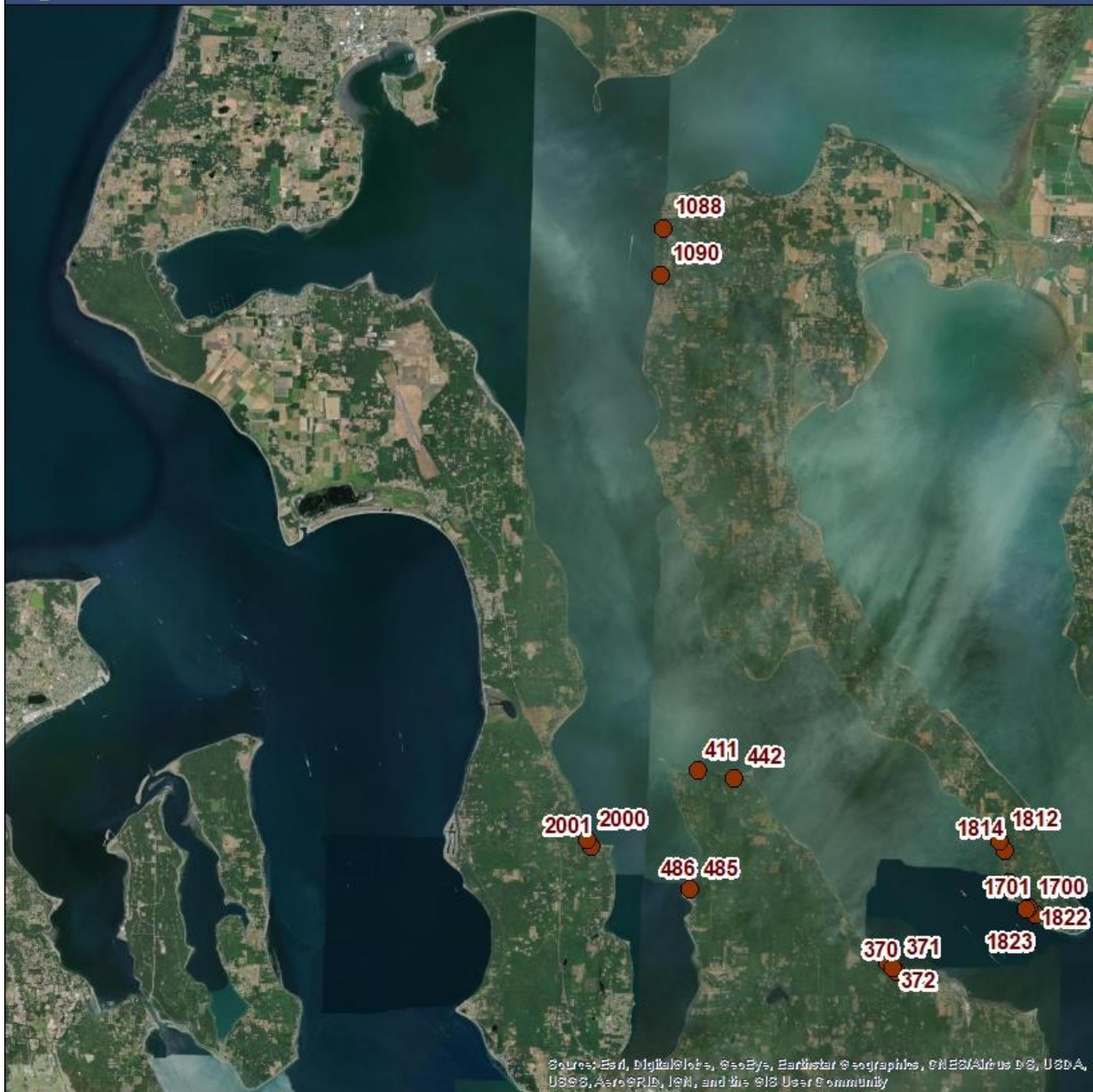
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

WDFW's Fish Passage Inventory, Assessment, and Prioritization Manual has multiple criteria for determining fish use. In the absence of biological evidence of fish use or reliable fish distribution maps for a reach, physical fish use criteria can be used. In Western Washington this criterion is a scour line width of at least 0.61 meters and a sustained gradient that does not exceed 20% for a distance greater than 160 meters. (Barrett & Zweifel, 2019). Although a 2013 study on Whidbey Island found that a slope of 6.5% or less was required for there to be potential for juvenile Chinook to utilize the stream, SFEG only eliminated 20 county owned culverts and 13 "RFEGXX" points where a mapped road/driveway/other structure potentially crossed a mapped stream (Beamer et al. 2013) from the survey list of streams with an average slope greater than 20% over the entire lower 200 meters of each stream. This is based on the WDFW protocol for determining fish use potential during a culvert survey when biological or mapped data cannot be found (Barrett & Zweifel, 2019). SFEG used GIS and a topographic contour map layer from Island County Public Works to estimate slope of the streams associated with culverts of interest. Table 1 below lists the 37 culverts (21 county owned culverts and 16 private sites with possible private stream crossings) that were removed from the survey list and their estimated slope. Figure 2 shows a map of the county culvert locations. The potential private crossings whose existence is uncertain are not mapped. There were no known and mapped private culverts at this stage, only potential private sites based of road and stream maps that had limited accuracy at the individual parcel scale. Slope analysis eliminated these potential stream crossings from the survey list in this project. We did not include them on the map since their existence is very uncertain.

After high gradient streams were eliminated, 80 private and publicly owned potential stream crossings remained on the list (Figure 3). Though field work, mainly habitat surveys, we identified an additional 30 stream crossing sites for a total of 110 sites.

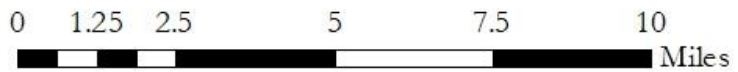
Whidbey Island				Camano Island			
Culvert ID	Owner Type	Road Name	estimated slope	Culvert ID	Owner Type	Road Name	estimated slope
370	County	Saratoga Road	31%	1088	County	North Sunset Drive	23%
371	County	Saratoga Road	38%	1090	County	North Sunset Drive	30%
372	County	Saratoga Road	42%	1700	County	Wilkes Gary Hts	28%
411	County	Saratoga Road	21%	1701	County	Wilkes Gary Hts	33%
442	County	Fox Spit Road	44%	1812	County	South Camano Drive	30%
485	County	Beach Road	25%	1814	County	South Camano Drive	22%
486	County		25%	1820	County	South Camano Drive; almost Wilkes Gary Ht	33%
573	County	Wilkinson Road	34%	1821	County	South Camano Drive; almost Wilkes Gary Ht	33%
2000	County	Resort Road	26%	1822	County	South Camano Drive; almost Wilkes Gary Ht	31%
RFEG005	Private Potential crossing	End of Handy Road	26%	1823	County	South Camano Drive	37%
RFEG007	Private Potential crossing	Private Drive Hastings/Campers Row	20%	2735	County	Green Road	20%
RFEG008	Private Potential crossing	Edgecliff Drive 1	29%	3744	County	South Camano Drive	54%
RFEG009	Private Potential crossing	Edgecliff Drive 2	20%	RFEG017	Private Potential crossing	Wildrose Lane	38%
RFEG010	Private Potential crossing	Saratoga Road	34%	RFEG018	Private Potential crossing	Hansen Street	22%
RFEG011	Private Potential crossing	Saratoga Road	27%	RFEG021	Private Potential crossing	Camano Island State Park Road	28%
RFEG014	Private Potential crossing	Surfside Lane	20%	RFEG023	Private Potential crossing	South Camano Drive	29%
#NAME?	Private Potential crossing	East Pioneer Way	34%	RFEG024	Private Potential crossing	South Camano Drive	27%
				RFEG025	Private Potential crossing	Utopian Way	29%
				RFEG026	Private Potential crossing	Utopian Way	30%
				RFEG027	Private Potential crossing	Maple Grove Road	44%

Table 1. Stream crossings that were removed from survey list due to location on a stream that had a >20% gradient based on GIS stream slope analysis



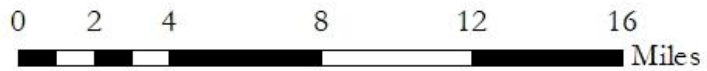
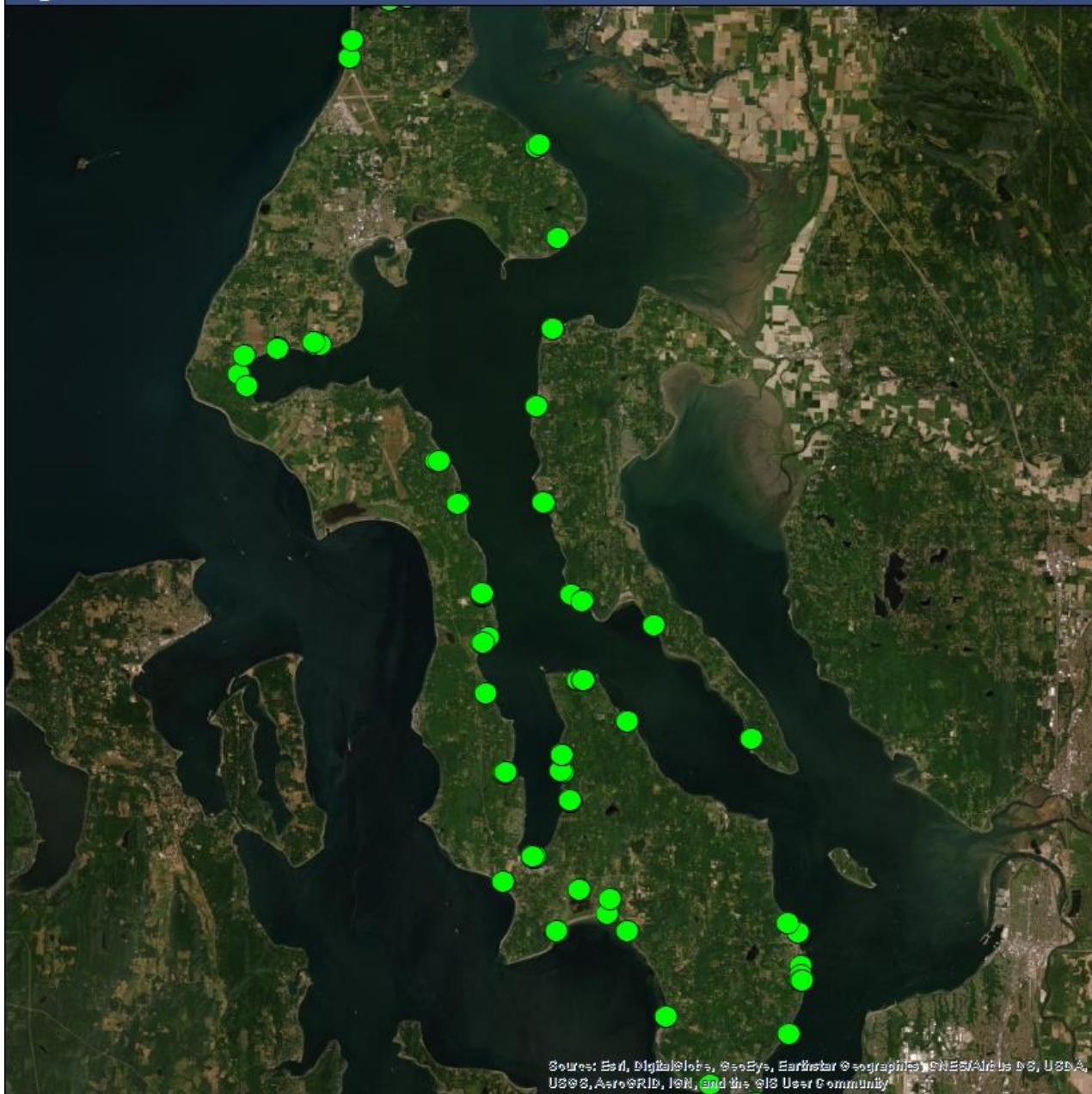
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- Steep_Culverts_Phase2



SFEG makes no claim to the completeness or accuracy of the material included herein. Locations are approximate as no survey of record was conducted.

Figure 2: Map of county-owned stream crossings that were excluded from survey list due to a stream gradient >20% where the stream entered Puget Sound



Legend

● Phase 2 Culverts



SFEG makes no claim to the completeness or accuracy of the material included herein. Locations are approximate as no survey of record was conducted.

Figure 3. Map of 80 culverts on survey list to visit and survey during this project.

Culvert evaluation methods

Culverts in this study were evaluated using the same methods as in the previous study of the public salmon recovery geographic area 1 culverts. These methodologies and protocols are specified in Washington Department of Fish and Wildlife Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual (Barrett & Zweifel, 2019). SFEG provided the culvert and stream evaluation data collected in this report to the Washington Department of Fish and Wildlife for incorporation into their fish passage barrier database.

Skagit Fisheries Enhancement Group and Sound Salmon Solution survey teams received training on WDFW barrier assessment survey methods from WDFW staff member, Daniel Barrett, in February 2020. Stream crossings were surveyed using either Level A/Level B methods for non-tidally influenced culverts (i.e., culverts whose invert has a higher elevation than the high tide line). If the crossing was partially inundated at high tide, it was assessed using WDFW's preliminary Level "T" method for tidally influenced culverts. The Level T methods are still under development, and SFEG and SSS are working closely with WDFW to test and refine this method which were first published in 2019 (Barrett & Zweifel, 2019).

Level A

The purpose of the Level A culvert assessment is to collect basic information about culverts in potentially fish bearing waters (e.g., structural dimensions), and to make a barrier determination on culverts that are obviously barriers or the most obvious non-barriers (Barrett & Zweifel, 2019).

The majority of culverts can be classified as barriers or non-barriers using just the Level A culvert assessment. If culvert hydraulics are affected by tidal activity the Level A flow chart and Level B hydraulic analysis are not applicable (Barrett & Zweifel, 2019).

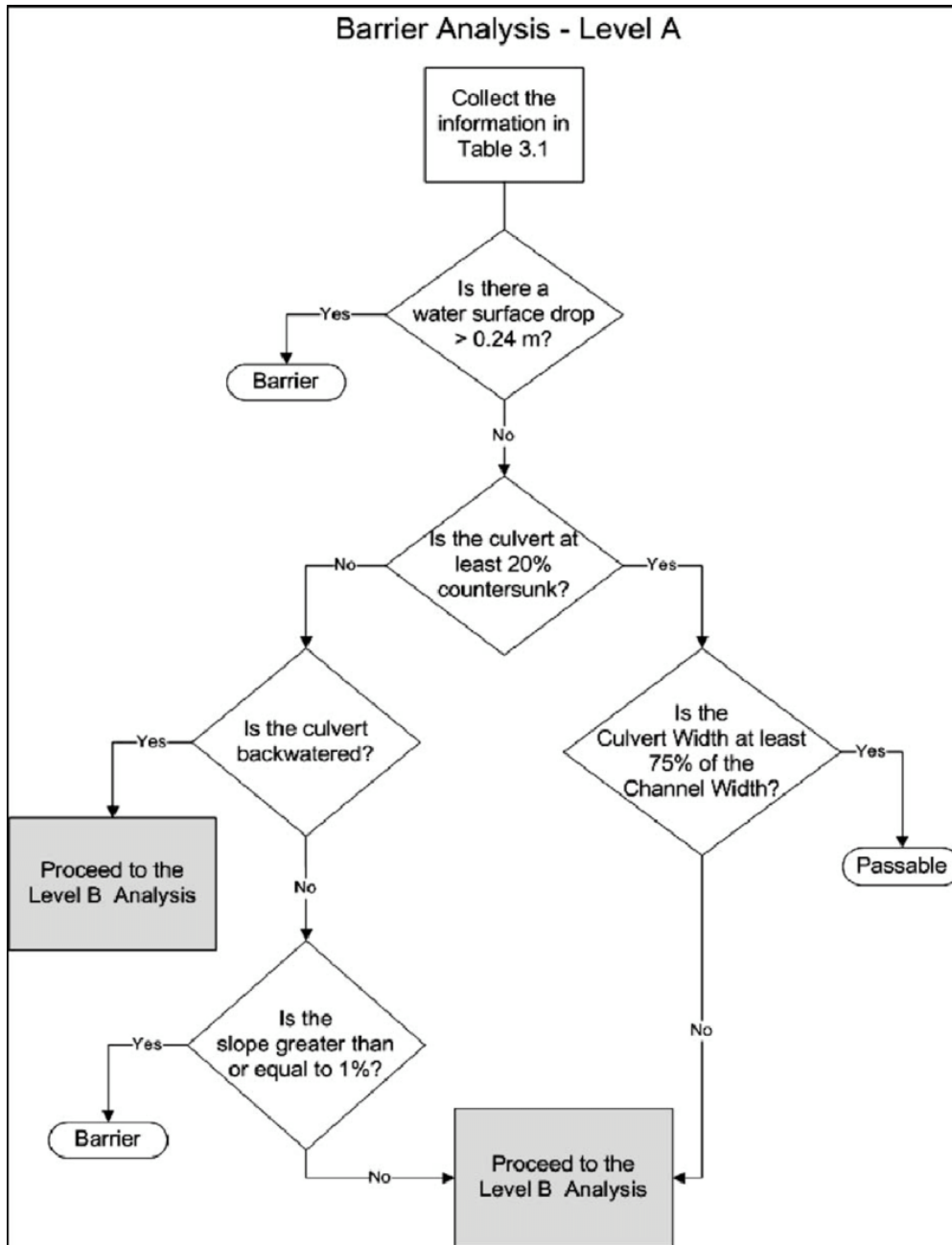
Figures 4 and 5 show Level A flow charts used to determine passability of non-tidal culverts. When a Level A survey is inconclusive, a Level B survey must be completed. The Level B assessment uses hydrologic modeling to determine how frequently that water velocity exceeds fish passage criteria; if the velocity is greater than 4 feet per second (fps) more than 10% of the time fish passage is impaired. Model outputs provide the estimated velocity. WDFW's velocity criteria of 4 fps focuses on adult fish; since the species/life stage of primary concern for this project is juvenile Chinook, SFEG also evaluated each crossing where a Level B assessment was completed based on NOAA-Fisheries recommended fish passage criteria for juvenile salmon which is 0.5 fps.

The WDFW manual states that if there is only one culvert at the crossing, and more than one barrier criterion apply, then assign the lowest percent passability. For example, a 10-meter long culvert with a water surface drop of 0.30 meters and a slope of 2.5% would be assigned a percent passability value of 33% because the barrier severity of the slope is greater than that of the water surface drop. If there is more than one non-overflow culvert at the crossing, then the entire site will be assigned the percent passability of the most passable culvert. This is based on the assumption that fish will migrate through the most passable culvert (Barrett & Zweifel, 2019).

Figure 4. A WDFW criteria for assigning passability of culvert assessed as barriers using Level A assessment methods

Parameter	Value	Range	Passability								
Water Surface Drop	≥0.24 meters	≥0.24 m & <0.5 m	0.67								
		≥0.5 m & <1.0 m	0.33								
		≥1.0 m	0								
Slope (Culverts ≤18.3 meters length)	≥1.0%	≥1.0% & <2.0%	0.67								
		≥2.0% & <4.0%	0.33								
		≥4.0%	0								
Slope (Culvert >18.3 meters length)	≥1.0%	≥1.0% & <2.0%	0.33								
		≥2.0%	0								
Velocity (Level B Result)	Exceeds WAC 220-110-070 velocity criterion for 15 cm (6 inch) trout		0.67								
	<0.61 mps over criterion for 15 cm trout										
	<table border="0"> <tr> <td><u>Culvert Length (m)</u></td> <td><u>Velocity (mps)</u></td> </tr> <tr> <td><30.5</td> <td>≤1.22</td> </tr> <tr> <td>30.5-61.0</td> <td>≤0.91</td> </tr> <tr> <td>>61.0</td> <td>≤0.61</td> </tr> </table>		<u>Culvert Length (m)</u>	<u>Velocity (mps)</u>	<30.5	≤1.22	30.5-61.0	≤0.91	>61.0	≤0.61	≥0.61 mps over criterion for 15 cm trout
<u>Culvert Length (m)</u>	<u>Velocity (mps)</u>										
<30.5	≤1.22										
30.5-61.0	≤0.91										
>61.0	≤0.61										
Depth (Level B Result)	<0.30 meters	≥0.15 m & <0.30 m	0.67								
		≥0.05 m & <0.15 m	0.33								
		<0.05 m	0								
Tidegate or Floodgate	Gate Style	Flap gate	0								
		Self-regulating	0.33								

Figure 5: Level A WDFW culvert assessment flowchart.



Level B

In some cases when evaluating a non-tidally influenced culvert, the results of a Level A assessment will be to “proceed to a Level B Analysis.” The Level B method is an advanced analysis used to determine if a culvert meets the velocity and depth requirements for fish passage between low and high fish passage flows (Barrett & Zweifel, 2019). There are a number of conditions that impede the ability to determine barrier status using the Level B hydraulic analysis. These conditions often require an engineer review, leaving the barrier status as ‘unknown’ until the review is complete. Examples of these situations include:

- When a significant amount of the flow at the downstream control did not pass through the culvert. If >30% of the total flow at the downstream control was not conveyed through the entire length of the culvert, then the Level B is not applicable.
- The culvert discharges into a waterbody that lacks an accessible control. This is common in lakes, reservoirs, and some wetlands.
- The size or shape of the culvert varies significantly from one end to the other. The Level B works on the assumption that the culvert has a similar shape and uniform volumetric capacity through the entire length of the pipe.
- Inverts are partially missing or water is flowing beneath the culvert structure. The Level B works on the assumption that the same volume of water entering the culvert inlet is exiting through the culvert outlet. If there is a loss of >30% of flow from the culvert inlet to outlet, the Level B is not applicable.
- Another culvert is functioning as the downstream control. If there is a culvert immediately downstream, contact WDFW for assistance with the hydraulic analysis.
- The presence of a flow control structure obstructing any part of the culvert inlet or outlet, e.g., a closed or partially open gate.
- An enclosed culvert with a grade break. Note: this does not apply to bottomless arch culverts.

According to the WDFW manual, any commercially available software capable of culvert hydraulic computations can be used with the Level A and B data to complete the Level B analysis. For this project SFEG utilized HY8 software instead of the WDFW ‘Hydraulic Analysis Spreadsheet’ due to the capabilities of HY8 software to analyze crossings with multiple side by side pipes.

Once the Level B field assessment and software analysis is complete, we compared the calculated velocity and depth values from the hydraulic analysis results to the WDFW Level B chart (Figure 6).

Figure 6: Assignment of percent passability to culverts determined to be barriers using the Level B hydraulic analysis

Criterion	Culvert Length	Value	Range	% Passability
Velocity	≤ 30.4 m	≥ 1.22 mps	1.22 mps – 1.82 mps	67
			≥ 1.83 mps	33
Velocity	30.5 – 61 m	> 0.91 mps	0.92 mps – 1.52 mps	67
			≥ 1.53 mps	33
Velocity	> 61 m	≥ 0.61 mps	0.61 mps – 1.21 mps	67
			≥ 1.22 mps	33
Water Depth	N/A	≤ 0.30 m	0.15 m – 0.30 m	67
			0.05 m – 0.14 m	33
			≤ 0.04 m	0

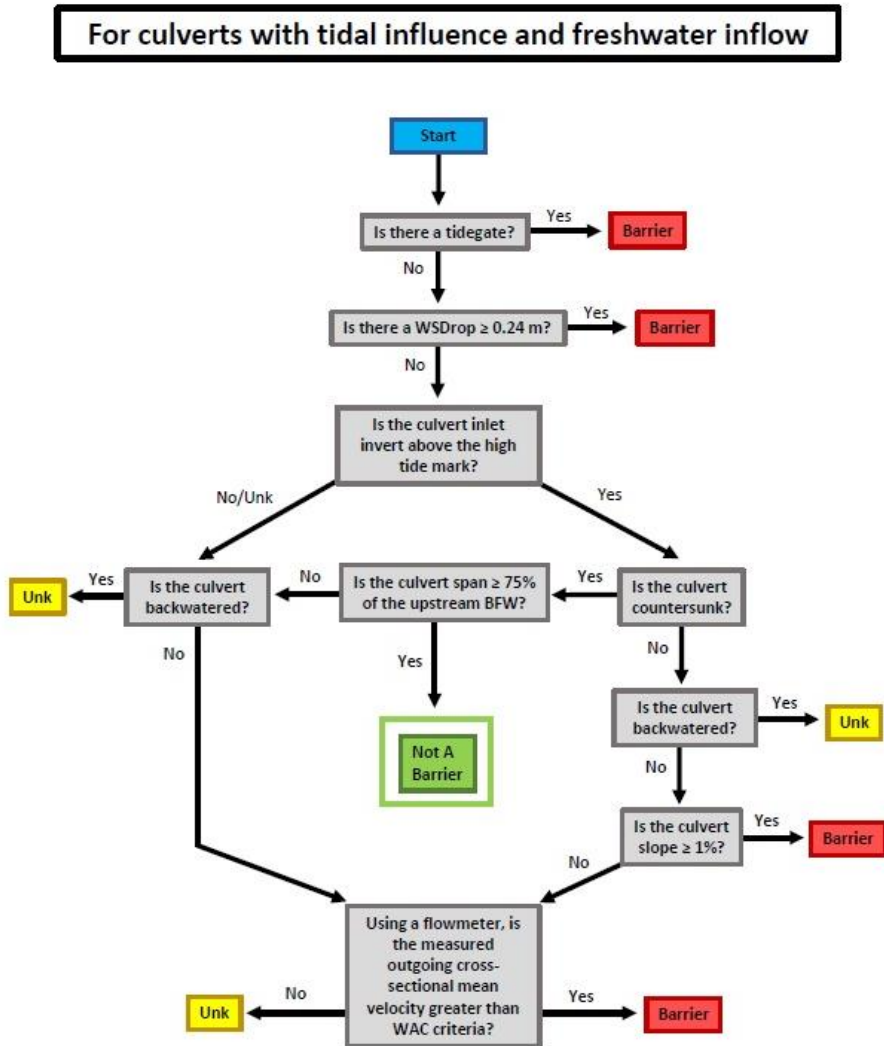
Level T

If culvert hydraulics are affected by tidal activity, defined as the culvert outlet invert is below the high tide mark and the culvert has freshwater input. If there are no signs of tidal fluctuations in water level, surveyors use the standard Level A.

Surveyors can complete Level A data collection, however the Level A flowchart and Level B hydraulic analysis are not applicable. Level A data can be interpreted using the Level T flowchart, similar to the Level A flowchart, the purpose of the Level T flowchart is to identify obvious barrier or obviously passable culverts based on the swimming and leaping abilities of an adult 6” (152 mm) trout. Culverts may be assigned a barrier status of “Yes” or “No”, but the percent passability of barriers (i.e., 67%, 33%, or 0%), representing the barrier severity, cannot be assigned to culverts when using the Level T flowchart (Barrett & Zweifel, 2019).

WDFW is still developing methods to assess tidally influenced culverts. Before 2019 WDFW simply recommended gathering Level A data and photos. In March 2019 WDFW released Draft Guidance for Evaluating Fish Passage at Tidally Influenced Culverts. These Level T methods were used to assess tidally influenced culverts. Figure 7 below is the flow chart used to determine tidal culvert passability. Due to the complex nature of tidally influenced habitats, there are more situations than with Level A and Level B methods where a barrier assessment will result in an unknown barrier status.

Figure 7: Temporary WDFW guidance for tidally influenced culvert assessment flow chart



Please contact WDFW with any questions:
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 or
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(version date: 2/19/2019)

Tidal culvert barrier status designations in this report are specified to the fullest extent possible given these methods based on the best science currently available. The barrier status of many culverts will remain 'unknown' and will require additional site visits during different tidal conditions and/or may require a more thorough tidal hydraulic analysis. The Level T does not address depth issues as more research is required to determine the appropriate water depth for fish passage through tidally influenced culverts (Barrett & Zweifel, 2019).

Future tidal culvert evaluation methods will likely be able to determine barrier status of human made structures with an unknown barrier status at this time.

Stream habitat survey site selection

After we completed the majority of the culvert assessments on our list, stakeholders, including SFEG, Island County Public Works, and local tribal biologists met to evaluate the barrier culverts and prioritize reaches for habitat surveys and Culvert Assessment Forms (CAFs). The ultimate goal of this data collection effort is to inform restoration projects. Successful restoration projects must not only be beneficial to salmon, they must also be feasible politically, financially and socially. Given this context, local stakeholders and experienced restoration specialists considered both biological and human factors as a part of this prioritization process. Sites with known political, legal, or landowner permission problems that would prevent a restoration project in the foreseeable future were excluded for further stream typing evaluation in order for restoration practitioners and the lead entity to best utilize both time and funding.

The criteria used to evaluate potential project sites originated from the 2013 small streams study (Beamer et al 2013). This study found that Chinook abundance was positively associated with watershed area. Watersheds below 45 hectares were not associated with Chinook use, with larger watersheds tended to have more salmonid rearing. In the same study, stream slope was negatively associated with salmonid rearing. Salmonids were not found in streams with a gradient greater than 6.2% and lower gradient streams were preferred. Salmonid abundance was negatively associated with distance from a large river mouth (Skagit, Stillaguamish, and Snohomish Rivers), this was a leading factor in designating salmon recovery priority areas for WRIA 6, this project is in Geographic Area 2 which is a "medium" priority for salmon recovery.

The remaining known barrier culverts with no known political, legal, or landowner barriers to restorations were prioritized for further data collection based on the potential quality and quantity of potential habitat gain/improvement. Streams with fish passage barriers on them were evaluated based on research criteria including: documented juvenile Chinook presence, watershed area, low stream gradient, distance from natal river mouths, and presence or absence of a pocket estuary.

Sixteen (16) coastal watersheds within WRIA 6 Salmon Priority Geographic Area 2 were evaluated by stakeholders. Six streams were designated as highest priority for further surveys due to high project potential and habitat gains (including two Race Lagoon streams, two Penn Cove streams, Carp/Freeland Creek, and Deer/Orr Creek), three streams were designated as medium priority for habitat surveys to be surveyed if time and funded allowed (Maxwelton Creek, an unnamed stream associated with county culvert number 1092, Chapmen Creek, and West Lobe Deer Lagoon), two streams were designated as lowest priority for surveying during this phase (West Lobe Deer Creek

and an unnamed stream associated with county culver number 3352), and five streams were eliminated from consideration for further surveys due to low habitat gains and/or low chance of successful restoration in the foreseeable future (Goss Lake outfall, and three unnamed streams associated with county culverts numbers 318, 3509 & 319, and 2033 & 2031).

In this phase we completed habitat surveys on all of the priority streams identified above. Future phases could collect habitat survey data on the remaining coastal streams. A summary of the habitat survey priorities can be found in Appendix C

Habitat survey field methods

Methods for habitat assessment are detailed in the WDFW Fish Passage Inventory, Assessment, and Prioritization Manual, Chapter 10. The physical habitat survey protocol includes a survey of the downstream channel and a habitat assessment of all upstream, potentially fish-bearing channels. The resulting data can be used to help prioritize barrier corrections based on the potential benefits to the salmonid species that are affected by the barrier (Barrett & Zweifel, 2019). The manual gives two options for stream assessment. All streams were surveyed using the more rigorous of the two, the Physical Habitat Survey method, because it is suitable to determine a priority index score for each reach. Assessments begin at the lowest point in the watershed and physical and habitat data are collected including:

- Fish use observations.
- Periodic gradient and bankfull measurements.
- Observations of salmonid spawning and rearing habitat quality, and riparian condition (instream cover, canopy cover, etc.).
- Partial natural barriers, which may limit the potential for certain species to utilize the habitat upstream.
- Land use observations, including potential sources of pollution, stormwater input, etc.
- Noteworthy stream morphology.
- The coordinates of any tributary confluences, an estimated percentage of contributing flow, and the potential fish use of those tributaries. Do not survey downstream
- tributaries.
- Inventory and assessments of all downstream fish passage features.
- Landowner denials.
- Representative habitat photos, and any noteworthy conditions.
- Distance to the end of the FAC, from the outlet of the target barrier, as measured on the hip chain.

Habitat survey analysis methods:

WDFW developed a customized “Physical Habitat Survey” Excel workbook to process and record stream survey field data collected using the 2019 habitat assessment methods. All reach data are entered into this analysis sheets including mainstem and tributary portions. We used the Streamstats database to calculate watershed areas entered into these analysis sheets that were checked against other watershed maps and by surveyors with local watershed knowledge. When delineating the boundaries of the basin area, we included all upstream areas that would contribute water to the point at the outlet of each reach (Barrett & Zweifel, 2019).

When using the WDFW methods, the physical habitat survey data is used to estimate habitat gains in terms of fish production potential. Habitat gain is expressed as meters squared of spawning habitat and rearing habitat (Barrett & Zweifel, 2019). Rearing habitat gain estimates are most important for those species whose recovery is currently limited by inadequate access to rearing habitat, such as ESA listed Chinook. We are not aware of any perineal spawning of adult salmon in the seasonal island watersheds surveyed in this project phase, however multiple studies and monitoring projects have shown the importance of pocket estuaries and island streams for rearing.

The WDFW excel workbook uses projected 60-day low flow, or wetted with, whichever is lower, when calculating rearing area. 60-day low flow is calculating in the sheet using basin area, spring influence (recorded during survey) and a constant assigned to the region where the stream is located (Barrett & Zweifel, 2019). Pond habitat is included in rearing habitat summations. According to the WDFW manual “When large ponds and lakes are present in a watershed, the calculated rearing areas are extremely large, yielding unreasonably high production values. To adjust this, a lake adjustment factor was developed that reduces the rearing area for lakes and ponds larger than 4,000 square meters through the formula: $((\text{Area} - 2,000)/2,000)^{1/2} \times 2,000$. This reduces the rearing area to a number that approximates the littoral area, which more accurately describes the rearing potential for a large pond or lake” (Barrett & Zweifel, 2019). This was applied to the survey of the unnamed stream that flows into Penn Cove associated with county culvert number 3346 under Penn Cove Road. The first reach of this stream is a large pond rearing areas for this reach were corrected using the lake adjustment factor.

The WDFW sheet produces “adjusted production area calculations” to account for competition between species with similar freshwater life histories, which tends to reduce the production rate below single species production values. Competition is modeled using a species complex factor (see the WDFW manual chapter 11 for the equations). In addition to these adjusted production areas the sheet calculates and summarizes the sum of several useful habitat measures for each reach and in total including habitat length, culverted length, spawning habitat and rearing (Barrett & Zweifel, 2019). A summary of the habitat survey results can be found in the next section, detailed data is included in appendices D and E.

County Public Works Culvert Condition Inspections

Publicly owned stream crossings are not only structures that either support or impede natural process such as fish passage, they are also important infrastructure that supports public roads. This factor is inseparable from restoration work. When working with the county to identify and plan stream crossing projects, culvert function and condition are relevant to urgency, opportunities for matching funds, public works capacity and public works priorities. In support of this fish passage project Island County Public Works staff attended the midway strategy meeting where priority reaches were selected for habitat surveys. In this meeting stakeholders also identified county crossings where an examination of culvert condition was needed to inform priorities. In this meeting we identified 5 priority culverts for county engineer review including video scoping throughout pipe. Stakeholder selected culverts 1893 and 1894 on Race Road, culverts 3345 and 3346 on W Scenic Heights Road, and culvert 1417 associated with the ongoing Chapmen Creek Fish Passage Project. 3352 and 3508 were identified as alternate crossings to scope but were not scoped in this phase. Including these 5 culverts, a total of 22 culverts were visited by county crews and the pipe condition was accessed by Island County Public Works in support of this inventory effort. All of these culverts were first identified as fish passage issues and then examined by the county. Regularly scheduled county infrastructure evaluation information is not included in this report.

Results

Culvert survey results:

We started the culvert survey portion of this project with a list of 80 culverts to survey. Through the culvert survey and habitat survey process we identified another 30 stream crossings for a total of 110 stream crossings. A completed list of all of these crossings can be found in appendix A and detailed data from these crossings can be found in appendix B.

We assessed 31 publicly owned crossings including 30 county owned stream crossings and 2 WA State Parks owned culverts. Three of these crossings were passable: culverts number 305 and 304 on Glendale Road and culvert number 312 on Columbia Beach Drive. These were the only passable culverts found during this project phase. Twenty-three of the public culverts surveyed were barriers to fish passage (Table 2). Only one culvert, 1894, required a level B survey, most crossings were level A slope barriers.

Owner Type	Culvert ID	wdfw name	Location	Level A Status	Level B status	Tidal Eval Status	Overall Barrier status	Barrier main issue
Parks	RFEG049	NA	Cornet Bay Learning Center Lawn	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Parks	RFEG052	NA	trail next to Cornet Bay road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	395	NA	East Harbor Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	396	NA	East Harbor Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	1092	NA	North Sunset Drive	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	1438	NA	Breezy Point Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	1995	NA	Greenbank Drive	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop & Slope
County	2031	932576	Honeymoon Bay Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
County	2033	932576	Honeymoon Bay Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
County	2726	NA	Polnell Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	3352	NA	Penn Cove Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	3508	NA	Columbia Beach Drive	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
County	22	NA	Millman Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
County	1815	NA	South Camano Drive, Near Bayside Drive	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Drop
County	1893	NA	Race Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
County	1951	NA	North Bluff Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
County	2734	NA	Green Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
County	1936	NA	North Bluff Road	BARRIER: 67% passable	Not Needed	Not Needed	Barrier	Drop
County	642	NA	parking lot freeland park	Not Needed	Not Needed	BARRIER: % Unknown	Barrier	tide gate
County	1894	NA	Race Road	Level B Required	BARRIER	Not Needed	Barrier	Velocity
County	3346	NA	Penn Cove Road	Not Needed	Not Needed	BARRIER: % unknown	Barrier	gate
County	3731	NA	Stewart Road	Not Needed	Not Needed	BARRIER: % unknown	Barrier	gate
County	3345	NA	Scenic Heights Road	Not Needed	Not Needed	BARRIER: % unknown	Barrier	slope

Table 2. Publicly owned barrier culverts

With Level A and Level B methods it is possible to determine if a crossing is a partial barrier or a complete barrier to salmon passage. For tidally influenced culverts this level of detail is not possible using WDFW survey methods. We determined that county culvert numbers 642, 3346, 3731, and 3345 were tidally influenced and did not meet the criteria to be considered passable for adult salmon (Table 2). It is unknown if these crossings are partial or complete barriers.

Our crews completed surveys on an additional five county owned culverts but were unable to determine barrier status due to limitations in the current WDFW culvert assessment methods. Three of the culverts, 3821, 1417, and 1862 were tidally influenced but the result of the survey and current tidally influenced culvert flowchart resulted in a “barrier status unknown” outcome. Future improvements in culvert analysis methods may allow us to determine the barrier status of these crossings in the future (Table 3).

The other two surveyed but unknown culverts were 2135 and 393. We completed surveys of these crossings. The results of a Level A analysis were “proceed to Level B” however a Level B analysis of these crossings was not possible. To complete a Level B survey, a downstream control point is needed, however culvert number 2135 flowed directly into an artificially shaped pond so there was no place for a cross section survey necessary for a Level B analysis. Crossing number 393 had two side by side culverts and one was too buried to access for a Level B survey (Table 3).

Owner Type	Culvert ID	wdfw name	Location	Level A Status	Level B status	Tidal Eval Status	Overall Barrier status	Survey main issue
County	3821	NA	North Bluff Road	Not Needed	Not Needed	Needs Engineer Review	Unknown	result of level T surevy is barrier status not possible to determine.
County	1417	NA	Sandy Beach Drive	Not Needed	Not Needed	Needs Engineer Review	Unknown	result of level T surevy is barrier status not possible to determine. Needs flow meter assesments or engineer review
County	1862	NA	Madrona Way	Not Needed	Not Needed	Needs Engineer Review	Unknown	result of level T surevy is barrier status not possible to determine.
County	2135	NA	Mutiny Bay Road	Not Needed	Needs Engineer Review	Unknown	Unknown	Level B required , but not possible to do culvert outlets into pond. Channel width upstream effected by pond BFW not accurate
County	393	NA	East Harbor Road	BARRIER: % Unknown	Needs Engineer Review	Unknown	Unknown	Level B needed but not possible because this crossing has two pipes and one is partially underground (see 394 survey data for notes)

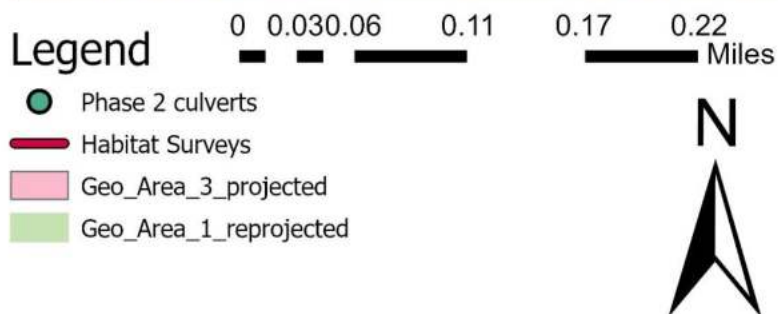
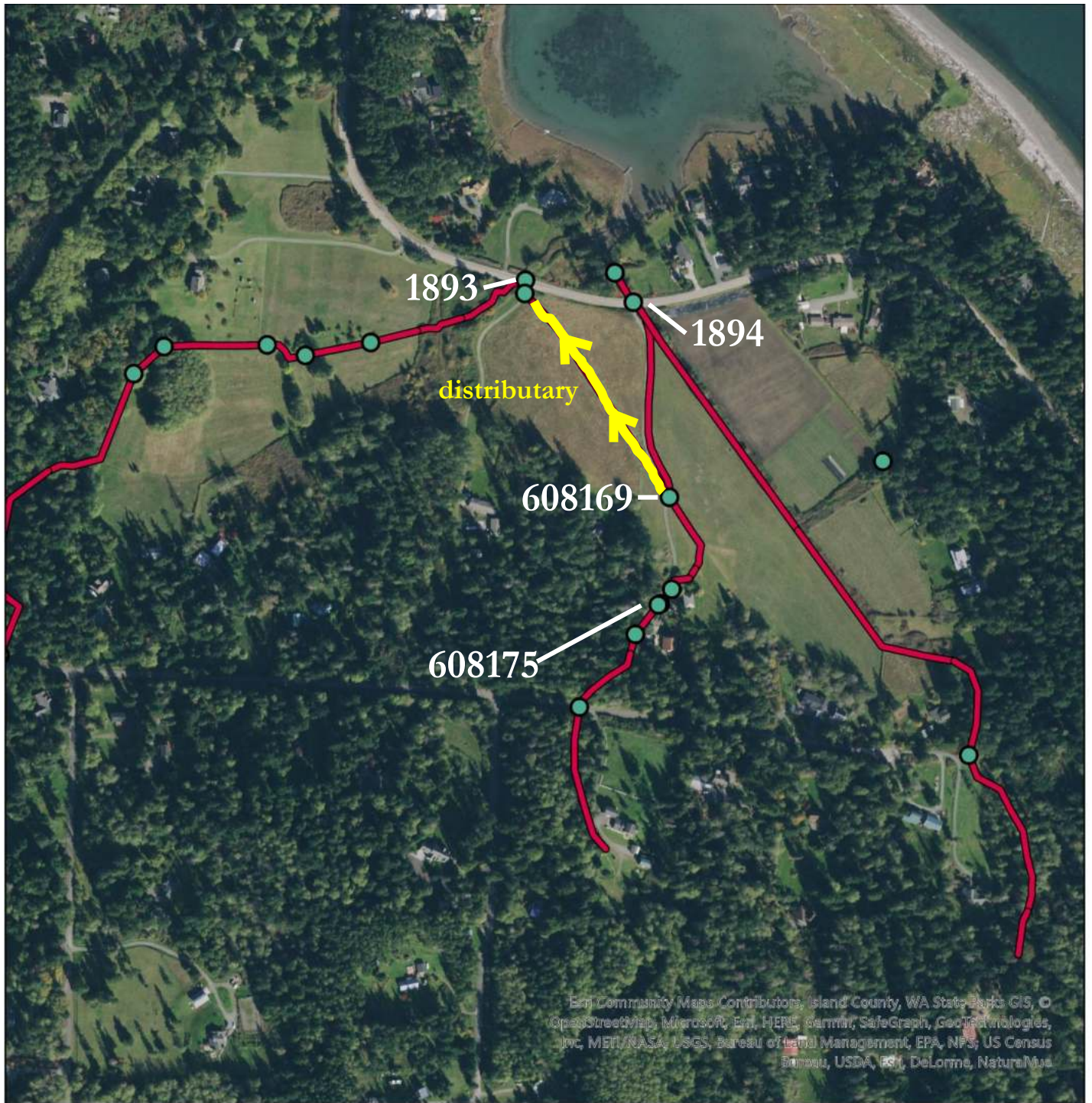
Table 3. Publicly owned culverts surveyed but barrier status could not be determined

Our crews completed surveys on fourteen privately owned culverts. All but two were at least partial barriers to salmon passage. Similar to the publicly owned culverts, most culverts had slopes exceeding current standards for fish passage. Many of these culverts were also in poor shape.

The two crossings where the barrier status was not determined were crossings in the stream associated with an unnamed tributary to Race Lagoon associated with county culvert number 1894 under Race Road. Culvert number 608169 was located on a distributary from this stream. This channel is only wetted seasonally (Figure 8 map of 608169 channel). When water in the largest tributary to 1894 creek is overwhelmed with water, it flows under the driveway from house number 516 Race Road, Coupeville. This water spreads out into the wetland/field and during high flows some of the water makes it to the unnamed stream associated with county culvert 1893. Field crews completed a survey of this culvert, the result of the Level A analysis was “proceed to a Level B.” A Level B analysis was not possible because one of the assumptions of Level B analysis hydrologic software is that there is a discrete, definable watershed upstream of the crossing being examined. With this culvert being a distributary, this assumption did not apply and a barrier status could not be determined (Table 4).

Survey crews could not determine the barrier status of crossing number 608175, a privately owned culvert associated with a driveway to the main house at 516 Race Road, Coupeville. This culvert was long and likely undersized for the stream. This pipe was one in a series of culverts along this driveway. The results of a Level A analysis were “proceed to Level B” but a Level B was not possible due to another barrier culvert being located too close to collect a channel cross section at a downstream control point. Due to the small size of the pipe and the slope of the stream in that reach this crossing is very likely a barrier to salmon passage (Table 4).

Figure 8: Temporary WDFW guidance for tidally influenced culvert assessment flow chart



Owner Type	Temp RFEG Name	WDFW name	Location	Level A Status	Level B status	Tidal Eval Status	Overall Barrier status	Barrier main issue
Private	NA	608168	48.187729, -122.598931	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Private	NA	608167	48.187549, -122.598952	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Private	RFEG028	NA	Private Driveway US of 3346	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
Private	RFEG076	NA	48.189914, -122.604412	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Private	RFEG080	NA	48.187302, -122.599538	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Private	RFEG051	NA	North Bultman Ln	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
Private	RFEG053	NA	Private Yard DS of county culvert 1894	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
Private	RFEG057	NA	48.1897167, -122.6060333	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Drop
Private	RFEG074	608173	48.189971, -122.602972	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
Private	RFEG001	932069	Private, Lone Lake outlet creek to Useless Bay	BARRIER: 67% passable	Not Needed	Not Needed	Barrier	Drop
Private	RFEG075	608174	48.1898074, -122.6039014	BARRIER: 67% passable	Not Needed	Not Needed	Barrier	Drop
Private	NA	608166	Behind water treatment facility	BARRIER: Unknown	Not Needed	Not Needed	Barrier	Slope
Private	NA	608169	48.188849, -122.596032	Unknown	needs a level B	Not Needed	unknown	UK
Private	NA	608175	48.18758 -122.599085	Unknown	needs a level B	Not Needed	unknown	UK

Table 4. Privately owned culverts surveyed

During the culvert survey portion of this project SFEG and SSS field staff frequently found that culverts on this list were located underground. Inlets and/or outlets were frequently found under storm drain grates. In the majority of these cases, it was not possible to survey these crossings. Level A, Level B, and Level T methods assume one continuous pipe, when underground catch basins connected multiple pipes it was impossible to determine the barrier status with the methods currently available. It is unlikely any of these crossings are 100% passible.

There were 13 county owned stream crossings that our crews were able to locate but we were not able to survey because one or both ends were underground. Most of these were covered in storm drain covers so the inlets and outlets were visible but not accessible for survey. These pipes were often small in diameter, many of them are likely fish passage issues but their true barrier status is unknown due to lack of access (Table 5).

Owner Type	County Culvert ID	Temp RFEG Name	WDFW name	Location	Barrier Status
County	318	NA	NA	Brighton Road	CANNOT SURVEY - underground
County	372	NA	NA	Saratoga Road	CANNOT SURVEY - underground
County	394	NA	NA	East Harbor Road	CANNOT SURVEY - underground
County	641	NA	NA	Stewart Road	CANNOT SURVEY - underground
County	692	NA	NA	Marshal Road	CANNOT SURVEY - underground
County	693	NA	NA	Marshal Road	CANNOT SURVEY - underground
County	694	NA	NA	Marshal Road	CANNOT SURVEY - underground
County	695	NA	NA	Marshal Road	CANNOT SURVEY - underground
County	696	NA	NA	Marshal Road	CANNOT SURVEY - underground
County	697	NA	NA	Marshal Road	CANNOT SURVEY - underground
County	1041	NA	NA	Maple Grove Road	CANNOT SURVEY - underground
County	1341	NA	NA	West Camano Drive	CANNOT SURVEY - underground
County	3011	NA	NA	Cornet Bay Road	CANNOT SURVEY - underground

Table 5. Underground culverts

In the beginning of this project, we used GIS analysis to identify locations where there were potential crossings between driveways, farm roads, private roads or trails and streams but there were no culvert, bridge or other crossing data available. Our crews were able to visit seven of these locations and determine that no crossing existed (Table 6). Three county culverts, numbers 21, 2001 and 3207 on Shore Ave Resort Road and Cove Road respectively were not possible to locate or survey. In the midway stake holder meeting where habitat survey streams were located, we asked the project partners for more information that could be used to locate these crossings. We confirmed that tribal biologists and WDFW crews were unable to locate crossing number 21. 3207 and 2001 are likely underground but our crews could not confirm (Table 6).

Owner Type	Culvert ID	Temp RFEG Name	WDFW name	Location	Level A Status	Overall Barrier status
County	21	NA	NA	Shore Ave	Could Not locate	Unknown
County	2001	NA	NA	Resort Road	Could Not locate	Unknown
County	3207	NA	NA	Cove Road	Could Not locate	Unknown
Parks	NA	RFEG004	NA	Franklin Road	Crossing does not exist	NA
Parks	NA	RFEG020	NA	Lowell Road, Camano Island State Park	Crossing does not exist	NA
Parks	NA	RFEG050	NA	Lowell Road, Camano Island State Park	Crossing does not exist	NA
Private	NA	RFEG005	NA	Franklin Road	Crossing does not exist	NA
Private	NA	RFEG012	NA	Bells Beach Road	Crossing does not exist	NA
Private	NA	RFEG029	NA	4665 Surfcrest Dr Oak Harbor WA 98277	Crossing does not exist	NA
Unknown	NA	RFEG022	NA	Cougar Lane	Crossing does not exist	NA

Table 6. Stream crossings that could not be located, public and private

There were 10 private potential stream crossings that were identified using road, stream, and aerial maps. Skagit Fisheries Enhancement Group and Sound Salmon Solutions reached out to these landowners multiple times via letters to the site address and other addresses if available in public parcel data. We were unable to obtain permission to check if these crossings existed and to survey them if they did (Table 7). There was one military owned potential stream on our list that we were not able to obtain permission to survey located on East Pioneer Way. Finally there were two county owned culverts that were not possible to survey due to lack of private landowner permission. In these two cases due to road prism sideslopes and road shoulder characteristics, our crews needed private landowner permission to stand outside of the public right of way and on private property to complete a survey. We attempted to contact these landowners but were unable to get a hold of them via mail or knocking on doors (Table 7).

Owner Type	Culvert ID	Temp RFEG Name	WDFW name	Location	Level A Status	Overall Barrier status
Private	NA	RFEG002	NA	Driftwood Drive	Unknown - landowner did not respond	Unknown
Private	NA	RFEG006	NA	Brighton Board Walk	Unknown - landowner did not respond	Unknown
Private	NA	RFEG019	NA	3402 Green Road Oak Harbor	Unknown - landowner did not respond	Unknown
Private	NA	RFEG032	NA	Riepma Ave Oak Harbor	Unknown - landowner did not respond	Unknown
Private	NA	RFEG035	NA	1036 Susan ST Coupeville	Unknown - landowner did not respond	Unknown
Private	NA	RFEG037	NA	2181 North Bluff Road Greenbank	Unknown - landowner did not respond	Unknown
Private	NA	RFEG038	NA	2169 North Bluff Road Greenbank	Unknown - landowner did not respond	Unknown
Private	NA	RFEG039	NA	North Bluff Road Greenbank WA	Unknown - landowner did not respond	Unknown
Private	NA	RFEG054	NA	2072 CAPTAIN WHIDBEY INN RD	Unknown - landowner did not respond	Unknown
Private	NA	RFEG055	NA	655 Zylstra Road Coupeville W	Unknown - landowner did not respond	Unknown
County	3749	NA	NA	Sunlight Beach Road	CANNOT SURVEY - no access	Unknown
Military	NA	RFEG031	NA	E Pioneer Way, on base	CANNOT SURVEY - no access	Unknown
County	375	NA	NA	Saratoga Road	CANNOT SURVEY - no access	Unknown

Table 7. Stream crossings on our list that could not be surveyed due to lack of landowner permission

During this grant period WDFW was also conducting stream crossing surveys around Island County. WDFW did not have funding to partner on this barrier assessment, however they generously provided multiple survey trainings and ongoing technical support for SSS and SFEG field staff. It was not always possible to coordinate in advance which culverts were going to be assessed. Every attempt was made to not duplicate work. SSS and SFEG often checked the WDFW culvert fish passage database and did not survey culverts that were assessed by WDFW from 2017 to present. We are including their findings in this table and in our overall stream crossing barrier status table in appendix A. SFEG submitted all culvert assessment and location to WDFW for inclusion into their database. WDFW staff reviewed it and entered it into their public database and those individual culvert assessment forms can be found in appendix B of this report.

There were seven stream crossings that we would have surveyed during habitat surveys or from our list of culverts generated in the beginning of this project, but we did not survey them again because WDFW had recent survey data from them collected between 2017 and 2022 (Table 8).

Owner Type	Culvert ID	Temp RFEG Name	WDFW name	Location	Level A Status	Level B status	Tidal Eval Status	Overall Barrier status	Barrier main issue
County	None	NA	934524	Beauregard Ave	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Private	NA	NA	934523	driveway; Murtyl Ave	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Private	NA	RFEG064	132171061	47.96985, -122.36718	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
County	665	NA	934522	Stewart Road	Level B Required	Unknown	Not Needed	Unknown	UK
County	94	NA	932017	Maxwelton Road	Not Needed	Not Needed	BARRIER	Unknown	UK
Private	NA	NA	934525	Yard of private property off of Beauregard Ave	Level A not possible	Unknown	Unknown	Barrier: Professional Judgement	Pipe condition
Private	NA	NA	934526	private; Dutch Hollow Dr	Level A not possible	Unknown	Unknown	Barrier: Professional Judgement	Pipe length

Table 8. Stream crossings on our list surveyed by WDFW between 2017-2022

Out of the original list of culverts of interest in this project phase, two privately owned culverts were not surveyed because when crews visited the site, they confirmed that these culverts were not located on a fish bearing stream, they were part of the stormwater management system. These were located on a driveway off of Arnold Road in Oak Harbor and alongside Race Road in a stormwater ditch in Oak Harbor. Our crews also visited a structure located at the Lone Lake outlet creek to Useless Bay. We confirmed this privately owned structure is a diversion surveyed by WDFW in 2011 with site ID 932070.

Habitat survey results

SFEG and SSS staff completed stream habitat surveys of all six of the reaches with barrier culverts near the mouths of streams that were identified as high priority to survey during this project. This included two unnamed tributary streams to Race Lagoon, two unnamed tributary streams to Penn Cove and Monroe's Landing, Freeland Creek, and Orr Creek. All of these creeks have publicly owned fish passage barrier culverts at or near the stream mouth. Table 9 shows a summary of the habitat survey findings produced using the customized WDFW Physical Habitat Survey excel workbook.

Unnamed Tributary associated with county culvert 3346

The unnamed stream associated with county culvert 3346 had the most potential habitat of the six streams surveyed. The most downstream reach, beginning at the inlet of the county culvert, consists of a large wetland and potential rearing area directly upstream. This perennial wetland was occupied by cattails and other wetland plants. Little to no connection exists currently between this nearshore wetland and Pean Cove due to the perched county culvert number 3346 and its tide gate.

Unnamed Tributary associated with county culvert 3345

The mouth of this stream is a pocket estuary that connects nearly daily to Penn Cove during high tides. This pocket estuary is a public park with some riparian cover and plentiful large woody debris brought in during high high tides that would offer cover for small fish. The county culvert number 3345 under West Scenic Heights Road is a barrier to salmon passage. Upstream of the culvert is a low gradient wetland located next to the Penn Cove Park Sewer District facility. There is only one additional culvert in the first 270 meters of this stream located under a footpath behind the sewer district building. These lower reaches were low gradient, flanked by riparian buffers, and full of willow and skunk cabbage. This site should be further examined for future restoration projects due to the low gradient, wetland rearing habitat and riparian cover.

Due to the pocket estuary habitat located at the mouth of this stream and the low gradient quality wetland above the county culvert this stream was identified as a high priority for restoration efforts. The undersized county culvert number, 3345, was a contributing factor in a 2018 spill from the sewer district facility when the stream backed up into the plant and prevented discharge of treated water and caused a spill of untreated water that impacted the estuary and broader shoreline.

Freeland Creek

This watershed was the largest surveyed in this project phase but had little area suitable for spawning or rearing. This watershed mouth is extremely impacted by human infrastructure with 538 meters out of the total 3424 meters (~16%) of the stream habitat currently lying within public and private culverts. The mouth of the stream meets the ocean through a series of pipes, catch basins, and a tide gate under the parking lot of Freeland Park. Restoration of this stream would require significant modifications to Freeland Park in order to be fish accessible.

Orr Creek

This stream connects Deer Lake to the Salish Sea, due to gradient issues only the lower half of this stream would be productive areas for salmonids. Multiple long culverts are serious barrier to salmon passage. The two lowest reaches would have abundant rearing areas without the infrastructure around it. The mouth of the stream is restricted between two houses. Restoration of the portion of this stream most valuable to salmonids, the lowest 300 meters, would be very difficult and affect multiple private waterfront homes.

Unnamed Tributary associated with county culvert 1893

This stream is the larger of the two unnamed tributary streams to Race Lagoon. During surveys of this stream our crews found, photographed and relocated a Chinook yearling near the inlet of culvert number 1893 that had likely entered the stream during high tide, seeking rearing habitat in the stream and become stranded when the tide receded. The current channel during habitat surveys was narrow and impacted, however unlike other island streams this one was flanked by grassy fields and not homes or other hardened infrastructure. The upper portions of this watershed were well forested and water temperatures were low.

Due to landowner interest from almost every property owner in the lower portions of this stream in a wetland restoration project, the lack of valuable infrastructure over or adjacent to the stream, and the verified high habitat value of Race Lagoon for seasonal juvenile salmonid rearing, this small watershed was identified as the most valuable site in Geographic Region 2 for restoration.

Unnamed Tributary associated with county culvert 1894

This stream had the least amount of rearing area out of the six priority streams surveyed. The lower reaches were low gradient. Both the main channel and the largest tributary have been artificially straightened. The tributary stays wetted later in the season than most Island County streams of that size due to overflow from a French well on the hillside. Upstream of the field the tributary had a series of culverts under driveways all close together. These were fish passage barriers but would be low priority for fixing due to the natural gradient of the stream being <2% in the first 220 meters and then suddenly increasing to >10% upstream on the hillside. Downstream of the county owned fish passage barrier, number 1894 under Race Road, is a private lawn mower crossing that is also a fish passage barrier, number RFEG053.

Due to landowner interest from almost every property owner in the lower portions of this stream in a wetland restoration project, the lack of valuable infrastructure over or adjacent to the stream, and the verified high habitat value of Race Lagoon for seasonal juvenile salmonid rearing, this small watershed was identified as the second most valuable site in Geographic Region 2 for restoration.

Figures 9-12 show overall reach locations and culverts for the six streams habitat surveyed in this project phase, more detailed maps can be found in Appendix E of this report.

Habitat Summary (meters)

Habitat Survey Location	Length (meters)	Culverted Length (meters)	Spawning Area (meters ²)	Rearing Area (meters ²)
Unnamed Tributary associated with county culvert 3346	1420	55.1	6183.56554	47736.57
Freeland Creek	3424.4	538.5	8.6491057	6599.405
Orr Creek	2479.6	181.1	447.777813	6274.767
Unnamed Tributary associated with county culvert 1893	1419	32.1	6.04488696	1196.142
Unnamed Tributary associated with county culvert 1894	1303.3	80.6	35.133395	433.4268
Unnamed Tributary associated with county culvert 3345	730.2	61.5	106.002709	382.0987

Table 9. Summary of Results of Habitat Surveys on 6 Island County Streams

Data collection for this project occurred in 2020 and 2021. Our crews had significant difficulties getting a hold of private landowners to obtain permission to survey the streams and stream crossings on their properties. In several cases we were able to get permission to walk the creek, but due to the COVID-19 emergency landowners were not comfortable with a crew lingering on the property to complete a culvert survey. We focused our outreach efforts on crossings in lower reaches and surveyed the crossings that we could. Table 10 includes a list of crossings we were able to map but were not able to determine a barrier status in this project phase.

Owner Type	Culvert ID	Temp RFEG Name	WDFW name	Location	Barrier Status
Private	NA	NA	608180	48.18625, -122.5944667	Unknown
Private	NA	RFEG059	NA	48.24282, -122.6783032	Unknown
Private	NA	NA	608177	48.244673, -122.685934	Unknown
Private	NA	RFEG058	NA	48.1871667, -122.608467	Unknown
Private	NA	RFEG060	608176	48.24240, -122.6846833	Unknown
Private	NA	RFEG061	NA	48.247579, -122.686548	Unknown
Private	NA	RFEG062	NA	48.2486491, -122.6867383	Unknown
Private	NA	RFEG063	NA	48.2501371, -122.6869445	Unknown
Private	NA	RFEG067	NA	48.002505, -122.525609	Unknown
Private	NA	RFEG068	NA	48.003128, -122.523378	Unknown
Private	NA	RFEG069	NA	48.003127, -122.623190	Unknown
Private	NA	RFEG070	NA	48.003320, -122.521128	Unknown
Private	NA	RFEG071	NA	48.002925, -122.520120	Unknown
Private	NA	RFEG072	NA	48.18625, -122.5944667	Unknown
Private	NA	RFEG077	NA	48.1872333, -122.6079833	Unknown
Private	NA	RFEG078	NA	48.1900, -122.6056667	Unknown
Private	NA	RFEG079	NA	48.188860, -122.596145	Unknown
Private	NA	RFEG081	NA	48.186657, -122.600050	Unknown
County	3405	NA	NA	48.244012, -122.678099	Unknown

Table 10. Culverts located on Habitat surveys but not surveyed this phase



- Legend**
- Phase 2 culverts
 - Habitat Surveys
 - Roads

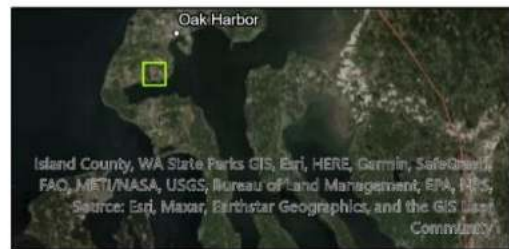
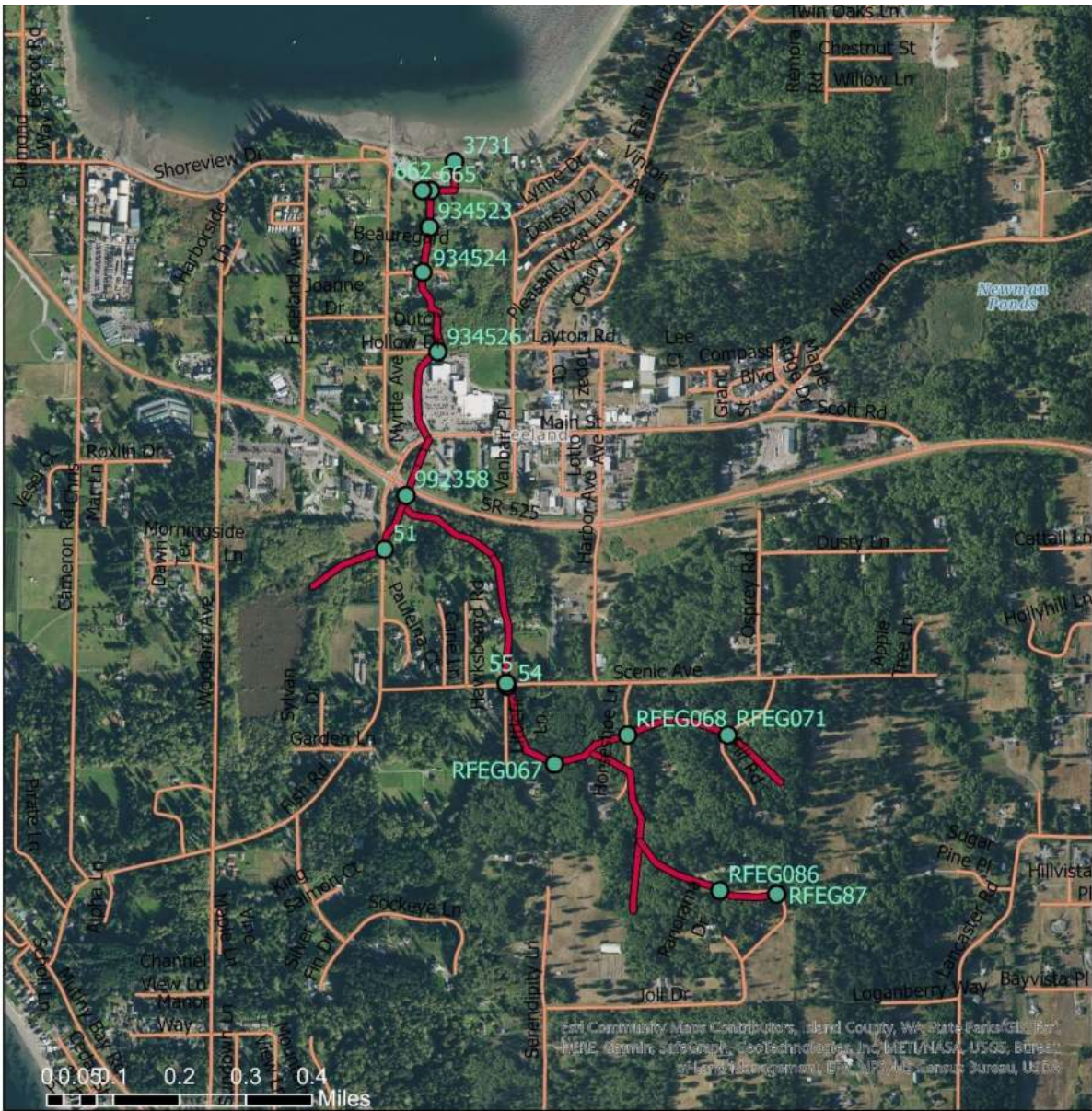


Figure 9: Monroe’s Landing Habitat Surveys overall. Eastern stream is an unnamed tributary to Penn Cove associated with county culvert number 3346. The western stream is an unnamed tributary to Penn Cove associated with county culvert number 3345.



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads

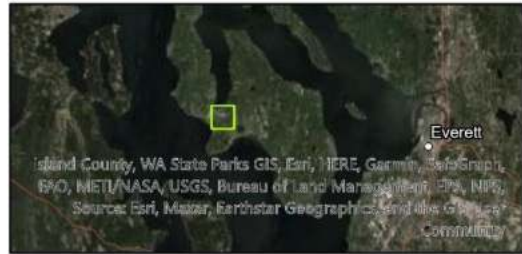
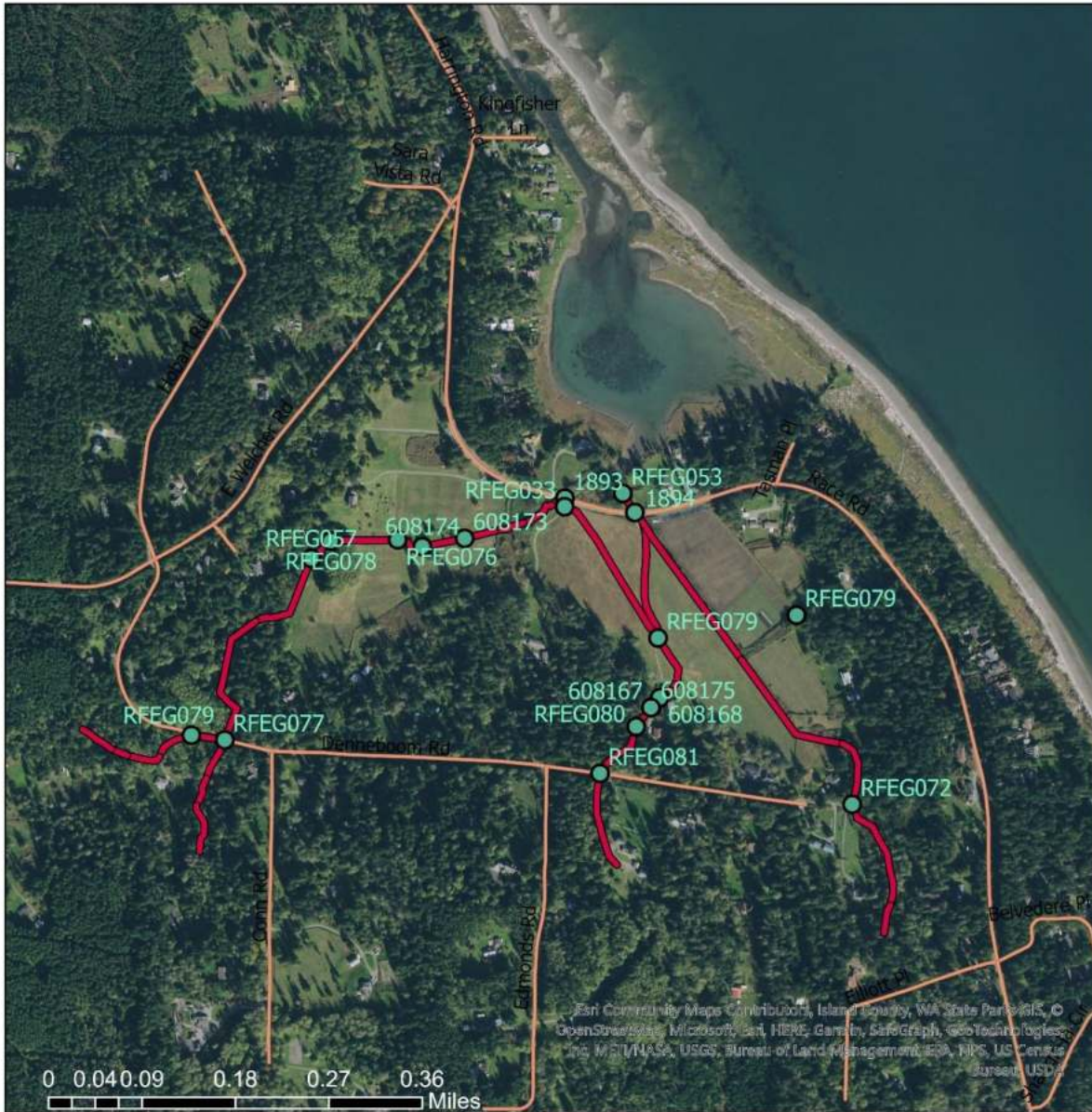


Figure 10: Freeland Creek habitat survey overall map.



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads

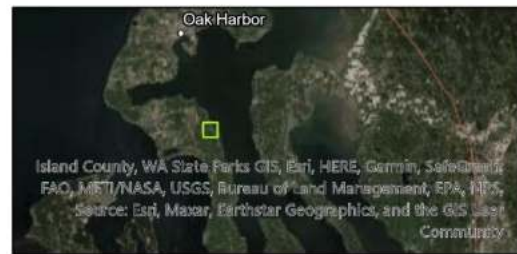


Figure 12: Two Race Road stream Surveys overall. Eastern stream is an unnamed tributary to Race Lagoon associated with county culvert number 1893. The western stream is an unnamed tributary to Race Lagoon associated with county culvert number 1894.

Glossary

Backwatered Culvert – Condition within a culvert where a pool with little or no current exists throughout the entire length of the culvert.

Ephemeral stream – An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Habitat – The physical, chemical, and biological features

Intermittent stream – A stream which ceases to flow during dry periods.

Natal – The stream where a salmon was spawned.

Nearshore – The estuarine/delta, marine shoreline and areas of shallow water from the top of the coastal bank or bluffs to the water at a depth of about 10 meters relative to Mean Lower Low Water.

Perched culvert – A vertical drop at the outfall of a culvert usually due to erosion of the stream channel downstream of the drainage structure.

Perennial stream – A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Pocket Estuary – Non-natal, small lagoons and coastal stream mouths which provide critical habitat for rearing, predator refugia, and physiological transition. These habitats have very low energy regimes, high productivity, and seasonally diluted salinity regimes.

Reach – A section of a stream having similar physical and biological characteristics.

Salmonid – Any member of the taxonomic family Salmonidae, which includes all species of salmon, trout, char, whitefish and grayling.

SFEG – Skagit Fisheries Enhancement Group, one of the regional fisheries enhancement groups. WRIA 6 is partially in SFEG's work area

SSS – Sound Salmon Solutions, one of the regional fisheries enhancement groups. WRIA 6 is partially in SFEG's work area

Significant reach – A significant reach is defined as a section of stream having at least 200 linear meters of usable habitat without a gradient or natural point barrier.

Tributary – A stream that feeds into a larger stream. Also called a feeder stream.

Water Resources Inventory Area (WRIA) – 62 areas designated by the State of Washington to delineate watershed boundaries within the state for management purposes. Island County is all in WRIA 6

Watershed – The area of land that water flows across or under on its way to a river, lake or ocean. Includes all surface water and adjacent estuaries and marine areas. A legal framework for watershed boundaries is provided through Washington’s designation of Water Resource Inventory Areas.

Whidbey Basin – The marine waters between the east side of Whidbey Island and the Puget Sound mainland. This area includes Skagit Bay, Port Susan and Saratoga Passage.

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Appendix A -Summary of all culverts

Eliminated Due to Slope	Owner Type	Culvert ID	Temp RFEG Name	WDFW name	Location	Level A Status	Level B status	Tidal Eval Status	Overall Barrier status	Barrier main issue
No	County	21	NA	NA	Shore Ave	Could Not locate	Unknown	Unknown	Unknown	UK
No	County	22	NA	NA	Millman Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
No	County	94	County	932017	Maxwelton Road	Not Needed	Not Needed	BARRIER: 0% passable	Unknown	UK
No	County	304	NA	NA	Glendale Road	Passable	Not Needed	Not Needed	Passable	None
No	County	305	NA	NA	Glendale Road	Passable	Not Needed	Not Needed	Passable	None
No	County	312	NA	NA	Columbia Beach Drive	Passable	Not Needed	Not Needed	Passable	None
No	County	318	NA	NA	Brighton Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
Yes	County	370	NA	NA	Saratoga Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	371	NA	NA	Saratoga Road	not surveyed	not surveyed	not surveyed	unknown	UK

No	County	372	NA	NA	Saratoga Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
Yes	County	372	NA	NA	Saratoga Road	not surveyed	not surveyed	not surveyed	unknown	UK
No		375		NA	Saratoga Road	CANNOT SURVEY unfriendly landowner	Unknown	Unknown	Unknown	UK
No	County	393	NA	NA	East Harbor Road	BARRIER: Unknown	Needs Engineer Review	Unknown	Unknown	UK
No	County	394	NA	NA	East Harbor Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	395	NA	NA	East Harbor Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	County	396	NA	NA	East Harbor Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Yes	County	411	NA	NA	Saratoga Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	442	NA	NA	Fox Spit Road	not surveyed	not surveyed	not surveyed	unknown	UK

Yes	County	485	NA	NA	Beach Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	486	NA	NA	Brainers Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	573	NA	NA	Wilkinson Road	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	641	NA	NA	Stewart Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	642	NA	934521	parking lot Freeland Park	Not Needed	Not Needed	BARRIER: % Unknown	Barrier	tide gate
No	County	665	NA	934522	Stewart Road	Level B Required	Unknown	Not Needed	Unknown	UK
No	County	692	NA	NA	Marshal Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	693	NA	NA	Marshal Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	694	NA	NA	Marshal Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK

No	County	695	NA	NA	Marshal Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	696	NA	NA	Marshal Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	697	NA	NA	Marshal Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	1041	NA	NA	Maple Grove Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
Yes	County	1088	NA	NA	North Sunset Drive	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	1090	NA	NA	North Sunset Drive	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	1092	NA	933251	North Sunset Drive	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	County	1341	NA	NA	West Camano Drive	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK

No	County	1417	NA	NA	Sandy Beach Drive	Not Needed	Not Needed	Needs Engineer Review	Unknown	UK
No	County	1438	NA	NA	Breezy Point Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
Yes	County	1700	NA	NA	Wilkes Gary Heights	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	1701	NA	NA	Wilkes Gary Heights	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	1812	NA	NA	South Camano Drive	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	1814	NA	NA	South Camano Drive	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	1815	NA	NA	South Camano Drive, Near Bayside Drive	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Drop
Yes	County	1820	NA	NA	South Camano Drive near Wilkes Gary Ht	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	1821	NA	NA	South Camano Drive near Wilkes Gary Ht	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	County	1822	NA	NA	South Camano Drive near Wilkes Gary Ht	not surveyed	not surveyed	not surveyed	unknown	UK

Yes	County	1823	NA	NA	South Camano Drive	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	1862	NA	NA	Madrona Way	Not Needed	Not Needed	Needs Engineer Review	Unknown	UK
No	County	1893	NA	NA	Race Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
No	County	1894	NA	NA	Race Road	Level B Required	BARRIE R	Not Needed	Barrier	Velocity
No	County	1936	RFEG03 6	NA	North Bluff Road	BARRIER: 67% passable	Not Needed	Not Needed	Barrier	Drop
No	County	1951	NA	NA	North Bluff Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
No	County	1995	NA	NA	Greenbank Drive	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop & Slope
Yes	County	2000	NA	NA	Resort Road	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	2001	NA	NA	Resort Road	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	2031	NA	932576	Honeymoon Bay Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop

No	County	2033	NA	932576	Honeymoon Bay Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
No	County	2135	NA	NA	Mutiny Bay Road	Not Needed	Needs Engineer Review	Unknown	Unknown	UK
No	County	2726	NA	NA	Polnell Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	County	2734	RFEG030	NA	Green Road	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
yes	County	2735	NA	NA	ADDDATA	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	3011	NA	NA	Cornet Bay Road	CANNOT SURVEY - underground	Unknown	Unknown	Unknown	UK
No	County	3207	NA	NA	Cove Road	Could Not locate	Unknown	Unknown	Unknown	UK
No	County	3345	NA	NA	Scenic Heights Road	Not Needed	Not Needed	BARRIER: unknown	Barrier	slope
No	County	3346	NA	NA	Penn Cove Road	Not Needed	Not Needed	BARRIER: % unknown	Barrier	gate

No	County	3352	NA	NA	Penn Cove Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	County	3405	NA	NA	48.244012, -122.678099					
No	County	3508	NA	NA	Columbia Beach Drive	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
No	County	3731	NA	934521	Stewart Road	Not Needed	Not Needed	BARRIER: % unknown	Barrier	gate
Yes	County	3744	NA	NA	South Camano Drive	not surveyed	not surveyed	not surveyed	unknown	UK
No	County	3749	NA	NA	Sunlight Beach Road	CANNOT SURVEY - no access	Unknown	Unknown	Unknown	UK
No	County	3821	NA	NA	North Bluff Road	Not Needed	Not Needed	Needs Engineer Review	Unknown	UK
No	Military	NA	RFEG031	NA	E Pioneer Way, on base	CANNOT SURVEY - no access	Unknown	Unknown	Unknown	UK
No	Parks	NA	RFEG004	NA	Franklin Road	Crossing does not exist	NA	NA	NA	NA
No	Parks	NA	RFEG020	NA	Lowell Road, Camano Island State Park	Crossing does not exist	Unknown	Unknown	Unknown	UK

No	Parks	NA	RFEG049	NA	Cornet Bay Learning Center Lawn	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Parks	NA	RFEG050	NA	Lowell Road, Camano Island State Park	Crossing does not exist	NA	NA	NA	NA
No	Parks	NA	RFEG052	NA	trail next to Cornet Bay Road	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	NA	934523	driveway; Myrtle Ave	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG001	932069	Private, Lone Lake outlet creek to Useless Bay	BARRIER: 67% passable	Not Needed	Not Needed	Barrier	drop
No	Private	NA	RFEG002	NA	Driftwood Drive	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK
No	Private	NA	RFEG005	NA	Franklin Road	Crossing does not exist	NA	NA	NA	NA
No	Private	NA	RFEG006	NA	Brighton Board Walk	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK

No	Private	NA	RFEG01 2	NA	Bells Beach Road	Crossing does not exist	NA	NA	NA	NA
No	Private	NA	RFEG01 9	NA	3402 Green Road Oak Harbor	Unknown - landowner did not respond	Unknow n	Unknown	Unknown	UK
No	Private	NA	RFEG02 8	NA	Private Driveway US of 3346	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Drop
No	Private	NA	RFEG02 9	NA	4665 Surfcrest Dr Oak Harbor WA 98277	Crossing does not exist	NA	NA	NA	NA
No	Private	NA	RFEG03 2	NA	Riepma Ave Oak Harbor, WA 98277	Unknown - landowner did not respond	Unknow n	Unknown	Unknown	UK
No	Private	NA	RFEG03 3	NA	512 Race Road Coupeville WA 98239	Did not survey - not on stream	Unknow n	Unknown	Unknown	UK
No	Private	NA	RFEG03 4	NA	1462 Arnold Road Oak Harbor WA 98277	Unknown - not on a stream	Unknow n	Unknown	Unknown	UK
No	Private	NA	RFEG03 5	NA	1036 Susan ST Coupeville WA 98239	Unknown - landowner did not respond	Unknow n	Unknown	Unknown	UK

No	Private	NA	RFEG03 7	NA	2181 North Bluff Road Greenbank WA98253	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK
No	Private	NA	RFEG03 8	NA	2169 North Bluff Road Greenbank WA98253	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK
No	Private	NA	RFEG03 9	NA	North Bluff Road Greenbank WA 98253	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK
No	Private	NA	RFEG05 1	NA	North Bultman Ln	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG05 3	NA	Private Yard DS of 1894	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG05 4	NA	2072 CAPTAIN WHIDBEY INN RD	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK
No	Private	NA	RFEG05 5	NA	655 Zylstra Road Coupeville WA 98239	Unknown - landowner did not respond	Unknown	Unknown	Unknown	UK
Yes	Private	NA	RFEG00 5	NA	End of Handy Road	not surveyed	not surveyed	not surveyed	unknown	UK

Yes	Private	NA	RFEG007	NA	Private Drive Hastings/Campers Row	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG008	NA	Edgecliff Drive	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG009	NA	Edgecliff Drive	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG010	NA	Saratoga Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG011	NA	Saratoga Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG014	NA	Surfside Lane	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG016	NA	East Pioneer Way	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG017	NA	Wildrose Lane	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG018	NA	Hansen Street	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG021	NA	Camano Island State Park Road	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG023	NA	South Camano Drive	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG024	NA	South Camano Drive	not surveyed	not surveyed	not surveyed	unknown	UK

Yes	Private	NA	RFEG02 5	NA	Utopian Way	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG02 6	NA	Utopian Way	not surveyed	not surveyed	not surveyed	unknown	UK
Yes	Private	NA	RFEG02 7	NA	Maple Grove Road	not surveyed	not surveyed	not surveyed	unknown	UK
No	Private	NA	NA	608166	Behind water treatment facility(needs site form)	BARRIER Unknown	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG05 7	NA	48.1897167, - 122.6060333 1893	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Drop
No	Private	NA	RFEG05 8	NA	48.1871667, - 122.6084667	Unknown	Not Needed	Not Needed	unknown	UK
No	Private	NA	RFEG05 9	NA	48.24282, - 122.6783032	not surveyed	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG06 0	608176	48.24240, -122. 6846833	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG06 1	NA	48.247579, - 122.686548	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG06 2	NA	48.24864908, - 122.68673831	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG06 3	NA	48.25013705, - 122.68694454	Unknown	not surveyed	not surveyed	unknown	UK

No	Private	NA	RFEG06 4	13217106 1	47.96985, - 122.36718	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG06 7	NA	48.002505, - 122.525609	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG06 8	NA	48.003128,- 122.523378	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG06 9	NA	48.003127,- 122.623190	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG07 0	NA	48.003320,- 122.521128	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG07 1	NA	48.002925,- 122.520120	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG07 2	NA	48.18625, - 122.5944667	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG07 4	608173	48.189971,- 122.602972	BARRIER: 33% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG07 5	608174	48.1898074, - 122.6039014	BARRIER: 67% passable	Not Needed	Not Needed	Barrier	Drop
No	Private	NA	RFEG07 6	NA	48.189914, - 122.604412	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG07 8	NA	48.1900, - 122.6056667	Unknown	not surveyed	not surveyed	unknown	UK

No	Private	NA	RFEG07 7	NA	48.1872333, - 122.6079833	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	RFEG07 9	NA	48.188860, - 122.596145	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	NA	608169	48.188849, - 122.596032	Unknown	needs a level B	Not Needed	unknown	UK
No	Private	NA	NA	608175	48.18758 - 122.599085	Unknown	needs a level B	Not Needed	unknown	UK
No	Private	NA	NA	608168	48.187729, - 122.598931	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	NA	608180	48.18625, - 122.5944667	not surveyed	not surveyed	not surveyed	unknown	UK
No	Private	NA	NA	608167	48.187549, - 122.598952	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG08 0	NA	48.187302, - 122.599538	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private	NA	RFEG08 1	NA	48.186657, - 122.600050	Unknown	not surveyed	not surveyed	unknown	UK
No	Private	NA	NA	608177						
No	Unknow n	NA	RFEG02 2	NA	Cougar Lane	Crossing does not exist	Unknow n	Unknown	Unknown	UK

No	County	None	NA	934524	Beauregard Ave	BARRIER: 0% passable	Not Needed	Not Needed	Barrier	Slope
No	Private		NA	934525	Yard of private property off of Beauregard Ave	Level A not possible	Unknow n	Unknown	Barrier: Profession al Judgement	pipe conditio n
No	Private		NA	934526	private; Dutch Hollow Dr	Level A not possible	Unknow n	Unknown	Barrier: Profession al Judgement	pipe length
No	Private		RFEG04 4	932070	Private, Lone Lake outlet creek to Useless Bay most downstream	Unknown - non culvert	Unknow n	Unknown	Unknown	UK

Appendix B

Culvert evaluation reports and photos

Full fish passage reports, and photos of the water crossing structures will be available on the Washington Department of Fish and Wildlife web app after February 2023.

Link: <https://geodataservices.wdfw.wa.gov/hp/fishpassage/index.html>

Appendix C Summary of habitat survey priorities

Priority for habitat surveys	Stream Name	county owned barrier culvert #	Notes
Highest priority for survey	unnamed tributary to Race Lagoon	1893	low gradient stream upstream of Race Lagoon, a known high density area for rearing juvenile salmonids, upstream landowners interested in restoration
Highest priority for survey	unnamed tributary to Race Lagoon	1894	low gradient stream upstream of Race Lagoon, a known high density area for rearing juvenile salmonids, upstream landowners interested in restoration
Highest priority for survey	Unnamed tributary to Penn Cove	3346	Large pond near mouth likely once was excellent rearing habitat, removal/restoration of 3346 culverts would be challenging/costly due to access issues
Highest priority for survey	Unnamed tributary to Penn Cove	3345	Mouth is publicly owned by Department of game, road construction nearby already planned, near water treatment plant, restoration would have water quality benefits (plugged culvert caused water treatment spill in 2018)
Highest priority for survey	Freeland Creek/ Carp Creek	665, 662, 641	Tide gate at mouth, road floods, lower stream behind dike could be good habitat, potential restoration site but complex fix would be needed due to so many culverts present in Freeland Park
Highest priority for survey	Orr Creek/ Deer Creek	3508	Previous restoration projects on this creek include FFFPP barrier removal. Creek is restricted between two houses near mouth
Medium priority for survey	Maxwelton Creek	94 & 95	Unless tide gate at mouth could be fixed local exports expect low fish potential, not a known Chinook stream, sediment and shore drift would make a self-maintaining fix to barrier difficult or impossible, culvert goes under an occupied private house. Some restoration potential, survey if time and funding allows

Priority for habitat surveys	Stream Name	county owned barrier culvert #	Notes
Medium priority for survey	Unnamed	1092	Lots of potential Habitat, 1092 is the only known crossing on this creek, project to fix this culvert already in the works. High priority for restoration but medium priority for habitat surveying due to ongoing restoration
Medium priority for survey	County Chapmen Creek	1417	Active county project in preliminary design phase. High priority for restoration but medium priority for habitat surveying due to ongoing restoration. Ongoing upstream project ongoing at 1390 (County Chapmen Creek project)
Lowest priority for survey	West Lobe Deer Lagoon	21	Uncertainties about natural drainage area, steep gradient compared to other streams on this list
Lowest priority for survey	Unnamed	3352	very long pipe under lots of infrastructure. Less habitat potential than other streams on this list. Survey only if time and funding allow
no survey this phase	Goss Lake Outfall	393 & 394	Downstream portion is very steep, only suitable habitat for trout. There is a waterfall which is a natural barrier to most salmon species under most conditions downstream of these culverts. They would be low priority for restoration with that downstream barrier.
no survey this phase	Deer Lake/Useless Bay	3749	High priority for habitat survey except political and social issues would be barriers to restoration. Access to private parcels for habitat survey would not be possible, stream survey data would be incomplete
no survey this phase	Unnamed	318	Habitat surveys have been done, no potential restoration projects at this time
no survey this phase	Unnamed	3509 & 319	3509 is long, goes under a house and outlet is an exposed pipe on the beach. Pipe is so long and uncertainties if it is one continuous pipe and therefore barrier status. Due to infrastructure over this long culvert, landowner support for restoration project is not possible in foreseeable future.
no survey this phase	Unnamed	2033 & 2031	Low potential for salmon and for restoration compared to other watersheds on this list

Appendix D -Habitat Survey Results Detailed

1893

Adjusted Production Area (meters Squared)

Habitat Summary

Mainstem Reachs	Sockeye	Chum	Pink	Coho	Sea run Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	11.66049	11.66049	11.66049047	11.6604905	0	0	63.3	0	0	14.2045
2	0	0	0	0.8950437	0.8950437	0.895043688	0.89504369	0	0	41.3	0	0	1.09032
3	0	0	0	10.676728	10.676728	10.67672801	10.676728	0	0	55	5.9	1.579256	13.0061
4	0	0	0	13.479835	13.479835	13.47983472	13.4798347	0	0	65.2	3	1.796025	16.4208
5	0	0	0	6.8916197	6.8916197	6.89161968	6.89161968	0	0	46	4	0.067886	8.3952
6	0	0	0	16.136792	16.136792	16.1367925	16.1367925	0	0	87.6	0	2.60172	19.6574
7	0	0	0	309.97184	309.97184	309.97184	309.97184	0	0	31.6	0	0	377.6
8	0	0	0	57.319343	57.319343	57.3193425	57.3193425	0	0	205.7	6.2	0	69.825
9	0	0	0	38.302066	38.302066	38.30206612	38.3020661	0	0	167.3	0	0	46.6586
10	0	0	0	85.800468	85.800468	85.800468	85.800468	0	0	67	0	0	104.52
11	0	0	0	54.83612	54.83612	54.83612	54.83612	0	0	167	0	0	66.8
12	0	0	0	23.305351	23.305351	23.305351	23.305351	0	0	167	0	0	28.39
Triutary Reachs	Sockeye	Chum	Pink	Coho	SR Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	0	0	0	0	0	0	51	0	0	15.3082
2	0	0	0	0	0	0	0	0	0	59	13	0	18.795
3	0	0	0	0	0	0	0	0	0	66	0	0	31.7279
4	0	0	0	0	0	0	0	0	0	26	0	0	340.6
5	0	0	0	0	0	0	0	0	0	53	0	0	23.1433

Totals: 1419 32.1 6.044887 1196.14

1894

Adjusted Production Area (meters Squared)

Habitat Summary

Mainstem Reachs	Sockeye	Chum	Pink	Coho	Sea Run Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	46.5623	46.56227	46.56227	46.562269	56.721	0	259	0	0	56.721
2	0	0	0	64.3018	64.30179	64.30179	64.301794	0	0	228	0	0	78.33085
3	0	17.89	17.9	83.4527	83.45269	83.45269	83.452694	0	0	126	6.4	21.559395	101.66
4	0	0	0	58.366	58.36599	58.36599	58.36599	0	0	164.3	6.3	5.8223	71.1
Triutary Reachs	Sockeye	Chum	Pink	Coho	SR Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	40.1431	40.14311	39.70913	0	0	0	262	12.4	0	48.21995
2	0	0	0	15.78	15.77997	15.60938	0	0	0	91	0	0	18.95492
3	0	0	0	42.3602	42.36022	41.90227	0	0	0	7	0	0	50.88315
4	0	0	0	0	0	0	0	0	0	102	49.5	0	3.371694
5	0	0	0	0	0	0	0	0	0	64	6	7.7517	4.185285
Totals:										1303.3	80.6	35.133395	433.4268

3345

Adjusted Production Area (meters Squared)

Habitat Summary

Mainstem Reachs	Sockeye	Chum	Pink	Coho	Sea Run Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	86.21297	86.21297	86.21297	86.21297	0	0	66	13.5	0	105.0225
2	0	0	0	56.83649	56.836494	56.83649	56.836494	0	0	90.3	0	3.95012981	69.23681
3	0	0	0	0	0	0	0	0	0	60.2	0	0	5.206557
4	0	0	0	27.98926	27.989256	27.98926	27.989256	0	0	59.7	0	33.3727167	34.09582
5	0	0	0	53.20793	53.207933	53.20793	53.207933	0	0	173	28	30.3824057	64.81658
6	0	0	0	8.356385	8.3563853	8.356385	8.3563853	0	0	39	20	5.38490651	10.17954
7	0	0	0	60.5971	60.597105	60.5971	60.597105	0	0	151	0	32.91255	73.81789
8	0	0	0	0	0	0	0	0	0	91	0	0	19.72299
9	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0

Totals 730.2 61.5 106.002709 382.0987

3346

Adjusted Production Area (meters Squared)

Habitat Summary

Mainstem Reachs	Adjusted Production Area (meters Squared)									Habitat Summary			
	Sockeye	Chum	Pink	Coho	SR Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0.00	0.00	0.00	452875.49	452875.49	452875.49	452875.49	0.00	0.00	104.00	0.00	0.00	35156.65
2	0.00	0.00	0.00	8.77	8.77	8.77	8.77	0.00	0.00	62.00	9.10	0.00	10.68
3	0.00	0.00	6117.92	10019.18	10019.18	10019.18	10019.18	0.00	0.00	41.00	0.00	6117.92	12205.11
4	0.00	0.00	0.00	0.00	26.48	0.00	26.48	0.00	0.00	52.00	6.00	48.50	26.84
5	0.00	0.00	0.00	0.00	41.40	0.00	41.40	0.00	0.00	28.00	0.00	5.90	41.96
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77.00	16.00	11.24	18.39
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	362.00	6.00	0.00	75.19
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	166.00	6.00	0.00	95.04
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	168.00	12.00	0.00	31.90
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	360.00	0.00	0.00	74.81
Triutary Reachs	Sockeye	Chum	Pink	Coho	SR Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	0	0	0	0	0	0	308	4.1	0	33.91
Totals:										1420	55.1	6183.566	47736.57

Orr

Adjusted Production Area (meters Squared)

Habitat Summary

Mainstem Reaches	Sockeye	Chum	Pink	Coho	Sea Run Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	184.444	184.444	0	0	0	0	313.4	0	40.281013	206.3825
2	0	0	0	86.15333	86.15333	0	0	0	0	166.8	0	39.642088	96.40073
3	0	0	0	63.87429	63.87429	0	0	0	0	94.5	25.7	6.8706088	71.47173
4	0	0	0	277.6819	277.6819	0	0	0	0	378.6	0	62.141131	310.7104
5	0	0	0	3613.262	3613.262	0	0	0	0	122	23.7	0	4043.037
6	0	0	0	158.2936	158.2936	0	0	0	0	179.5	0	34.39579	177.1216
7	0	0	0	164.0955	164.0955	0	0	0	0	283.1	4.5	61.462811	183.6137
8	0	0	0	117.9584	117.9584	0	0	0	0	171.7	30	70.714365	131.9888
9	0	0	0	0	0	0	0	0	0	63.8	0	0	616.25
10	0	0	0	0	0	0	0	0	0	29.2	0	0	27.399
11	0	0	0	0	0	0	0	0	0	21.1	14.1	0	170.85
12	0	0	0	0	0	0	0	0	0	79.9	0	11.236378	35.35438
13	0	0	0	0	0	0	0	0	0	133.7	18	12.966586	60.61986
14	0	0	0	0	0	0	0	0	0	236.1	14.6	87.867042	122.3376
Triutary Reaches	Sockeye	Chum	Pink	Coho	SR Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	11.3	11.3	0	0	0	0	89.9	49.3	20.2	12.64
2	0	0	0	0	0	0	0	0	0	58.1	0	0	8.59
3	0	0	0	0	0	0	0	0	0	12.9	1.2	0	0
4	0	0	0	0	0	0	0	0	0	45.3	0	0	0

Totals: 2479.6 181.1 447.77781 6274.767

Freeland

Adjusted Production Area (meters Squared)

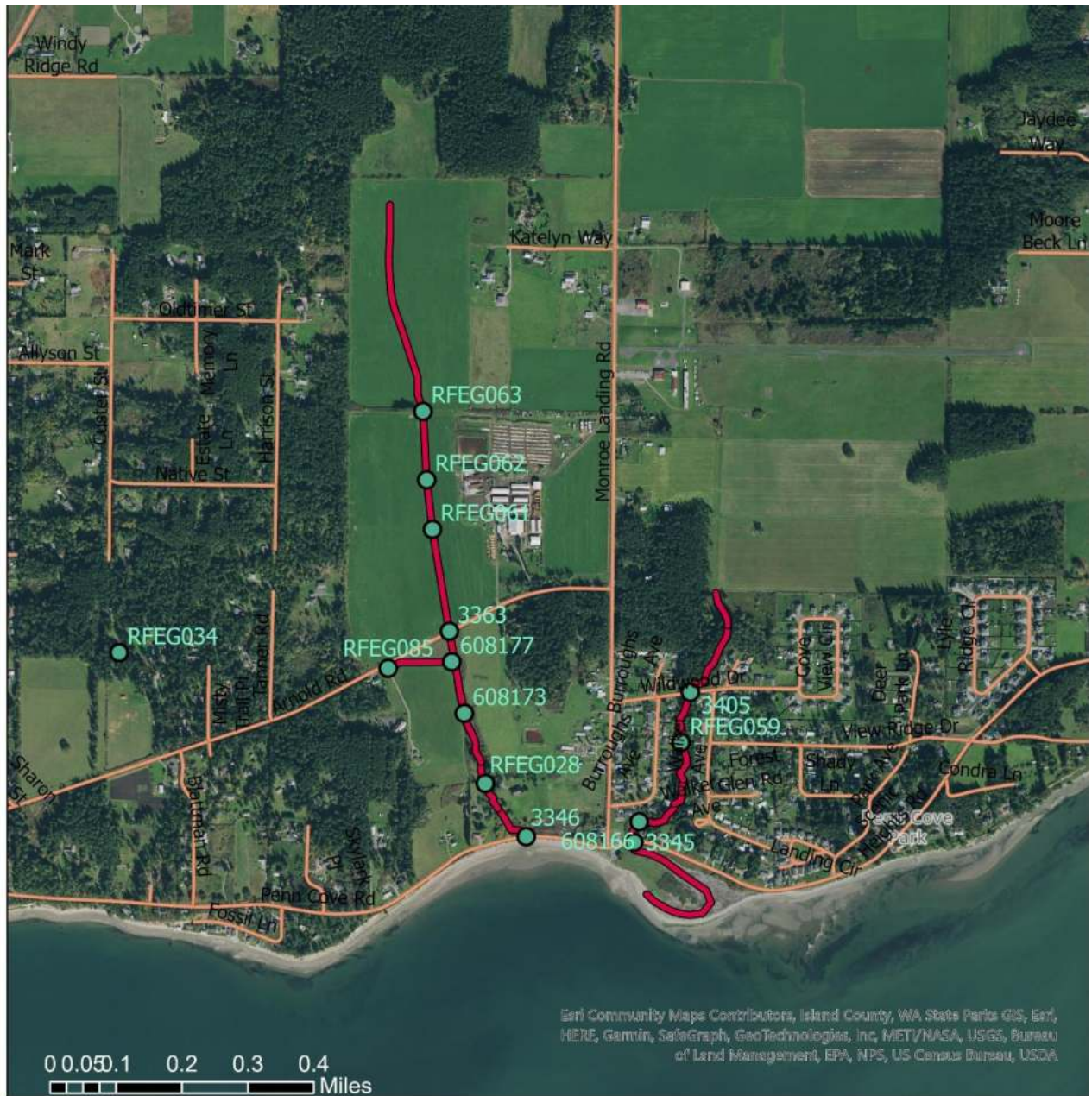
Habitat Summary

Mainstem Reachs	Sockeye	Chum	Pink	Coho	Sea Run Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	0	0	0	0	8.3391	0	58	31.4	0	8.3391
2	0	0	0	0	0	0	0	21.995	0	62	0	0	21.9945
3	0	0	0	0	0	0	0	20.761	0	84.9	18.5	0.41998	20.7610667
4	0	0	0	0	0	0	0	31.739	0	91.9	21.6	5.711988	31.7392581
5	0	0	0	0	0	0	0	7.2877	0	111.1	92.4	2.097995	7.28770167
6	0	0	0	0	0	0	0	28.594	0	269.23	223.43	0	28.5936318
7	0	0	0	0	0	0	0	10.901	0	16.5	0	0	10.9013979
8	0	0	0	0	0	0	0	115.44	0	83	0	0	115.435138
9	0	0	0	0	0	0	0	121.83	0	86.77	34.47	0	121.825877
10	0	0	0	0	0	0	0	21.857	0	15.5	0	0	21.8569633
11	0	0	0	0	0	0	0	1789.1	0	116.1	0	0	1789.101
12	0	0	0	0	0	0	0	219.12	0	300	0	0	219.118508
13	0	0	0	0	0	0	0	57.464	0	259.9	0	0	57.46389
14	0	0	0	0	0	0	0	43.555	0	319.1	16.1	0	43.5554897
15	0	0	0	0	0	0	0	196.15	0	342.6	8	0	196.152633
16	0	0	0	0	0	0	0	59.815	0	213	25.1	0	59.8152984
17	0	0	0	0	0	0	0	1.2449	0	13.3	6.3	0.419142	1.24486007
18	0	0	0	0	0	0	0	1334.5	0	130	0	0	1334.52517
19	0	0	0	0	0	0	0	2.3627	0	23	12	0	2.36266487
20	0	0	0	0	0	0	0	0	0	87	30	0	0
21	0	0	0	0	0	0	0	518.98	0	37.24	0	0	518.97664
22	0	0	0	0	0	0	0	66.335	0	339	0	0	66.3347706
Triutary Reachs	Sockeye	Chum	Pink	Coho	SR Cutthroat	Chinook	Steelhead	Res Trout	Bull	Length	Culverted Length	Spawning Area	Rearing Area
1	0	0	0	0	0	0	0	914.61	0	173	19.2	0	914.605279
2	0	0	0	0	0	0	0	1007.4	0	192.26	0	0	1007.41374

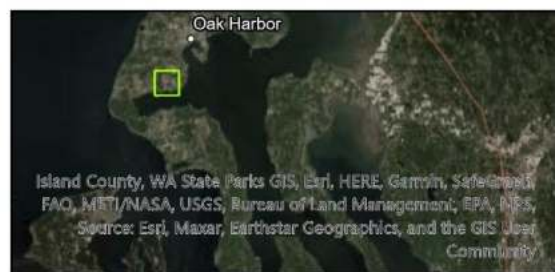
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Appendix E -Habitat survey detail maps

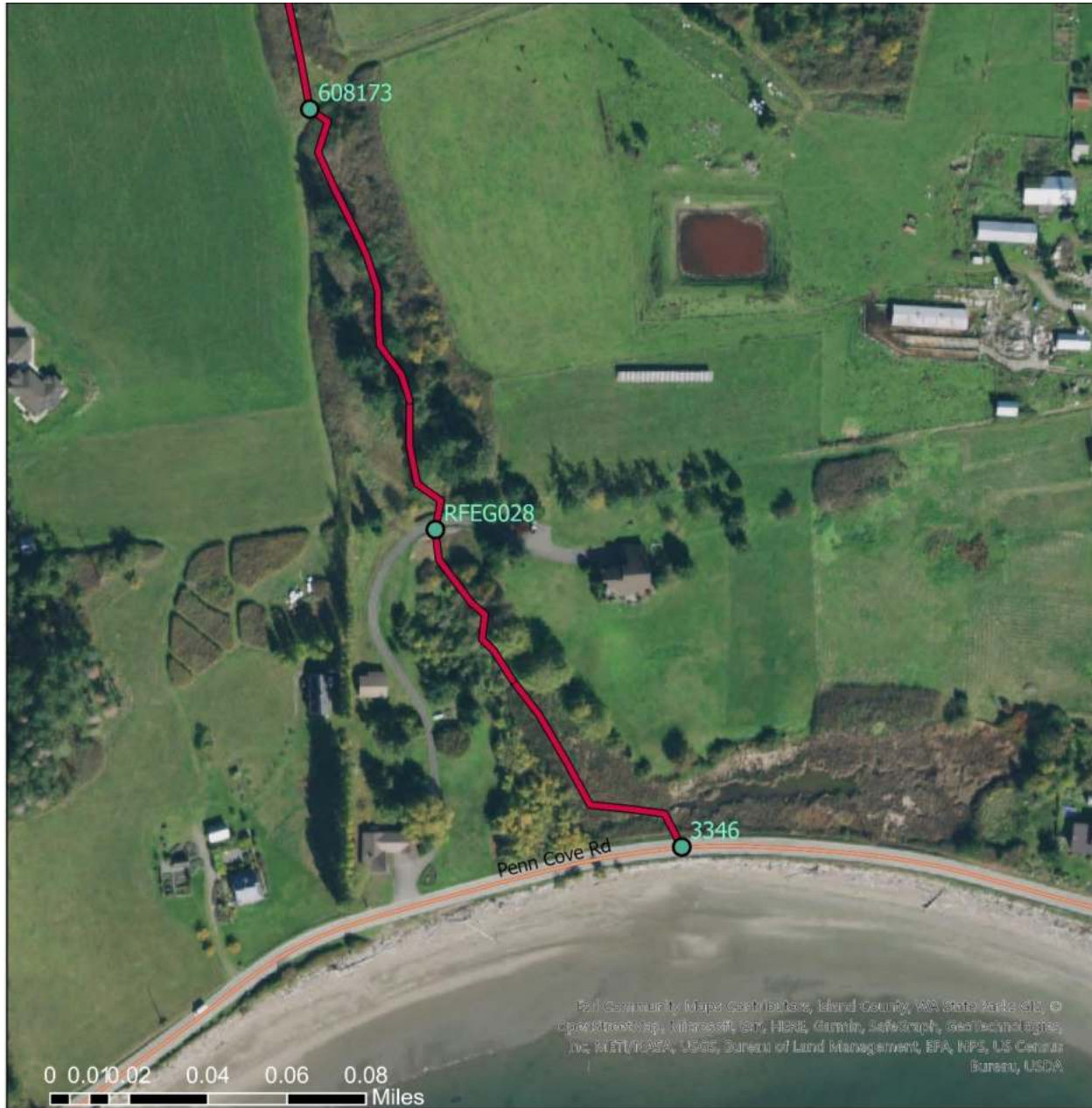
Monroe's Landing Habitat survey maps overall. 3345 stream and 3346 stream



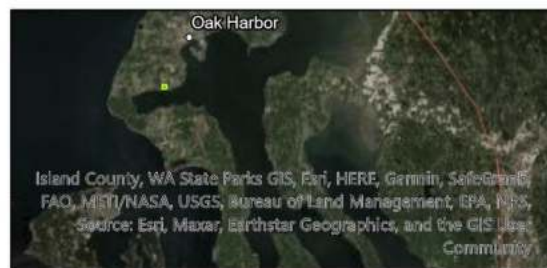
- Legend**
- Phase 2 culverts
 - Habitat Surveys
 - Roads



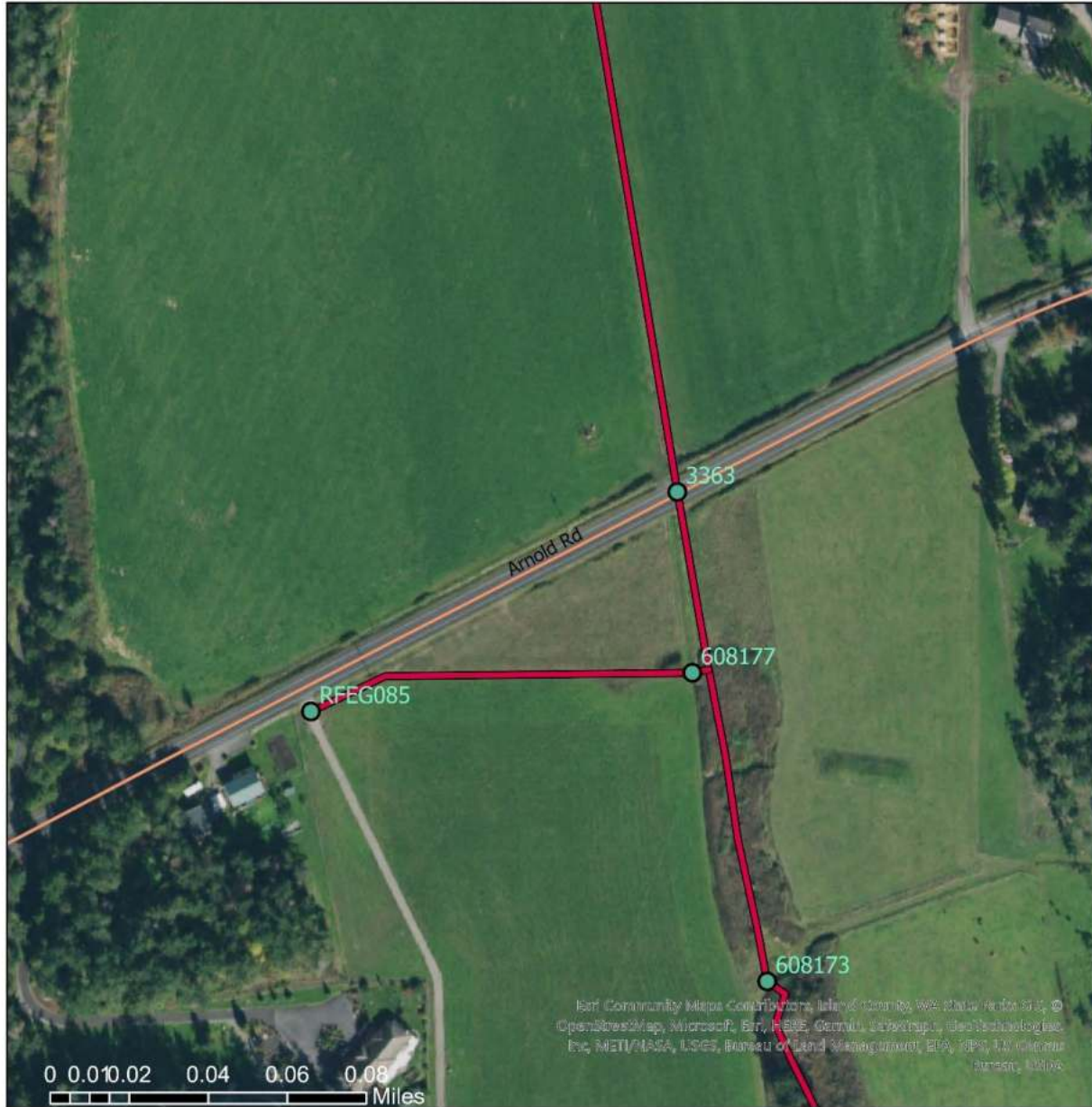
Monroe's Landing Habitat map, downstream reaches of unnamed stream associated with county culvert 3346 on North Penn Cove, Monroe's Landing



- Legend**
- Phase 2 culverts
 - Habitat Surveys
 - Roads



Monroe's Landing Habitat map, lower middle reaches of unnamed stream associated with county culvert 3346 on North Penn Cove, Monroe's Landing

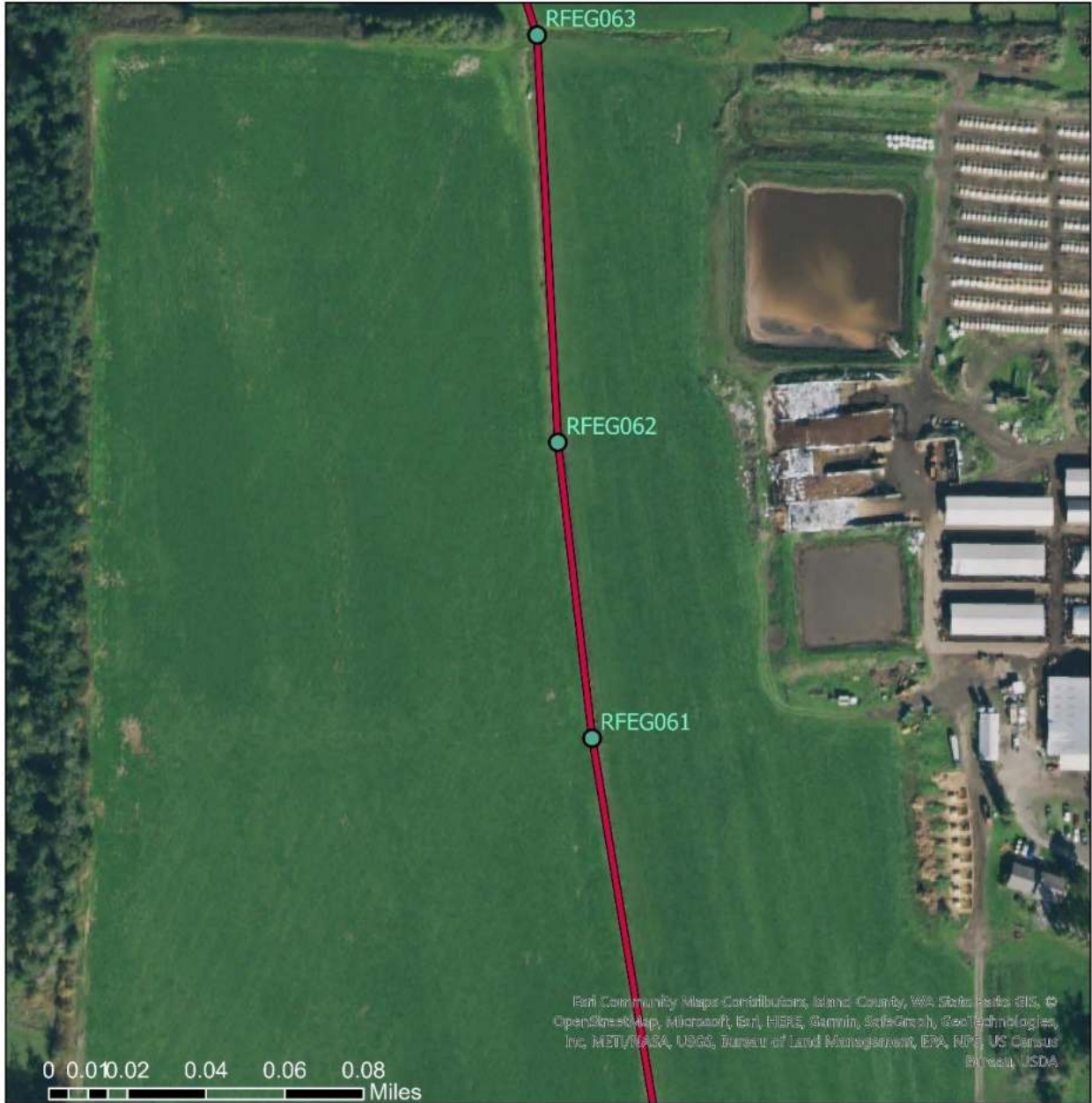


Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



Monroe's Landing Habitat map, upper middle reaches of unnamed stream associated with county culvert 3346 on North Penn Cove, Monroe's Landing



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



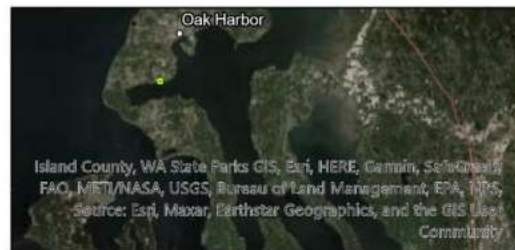
Monroe's Landing Habitat map, downstream reaches of unnamed stream associated with county culvert 3345 on North Penn Cove, Monroe's Landing

Monroe's Landing Habitat Survey



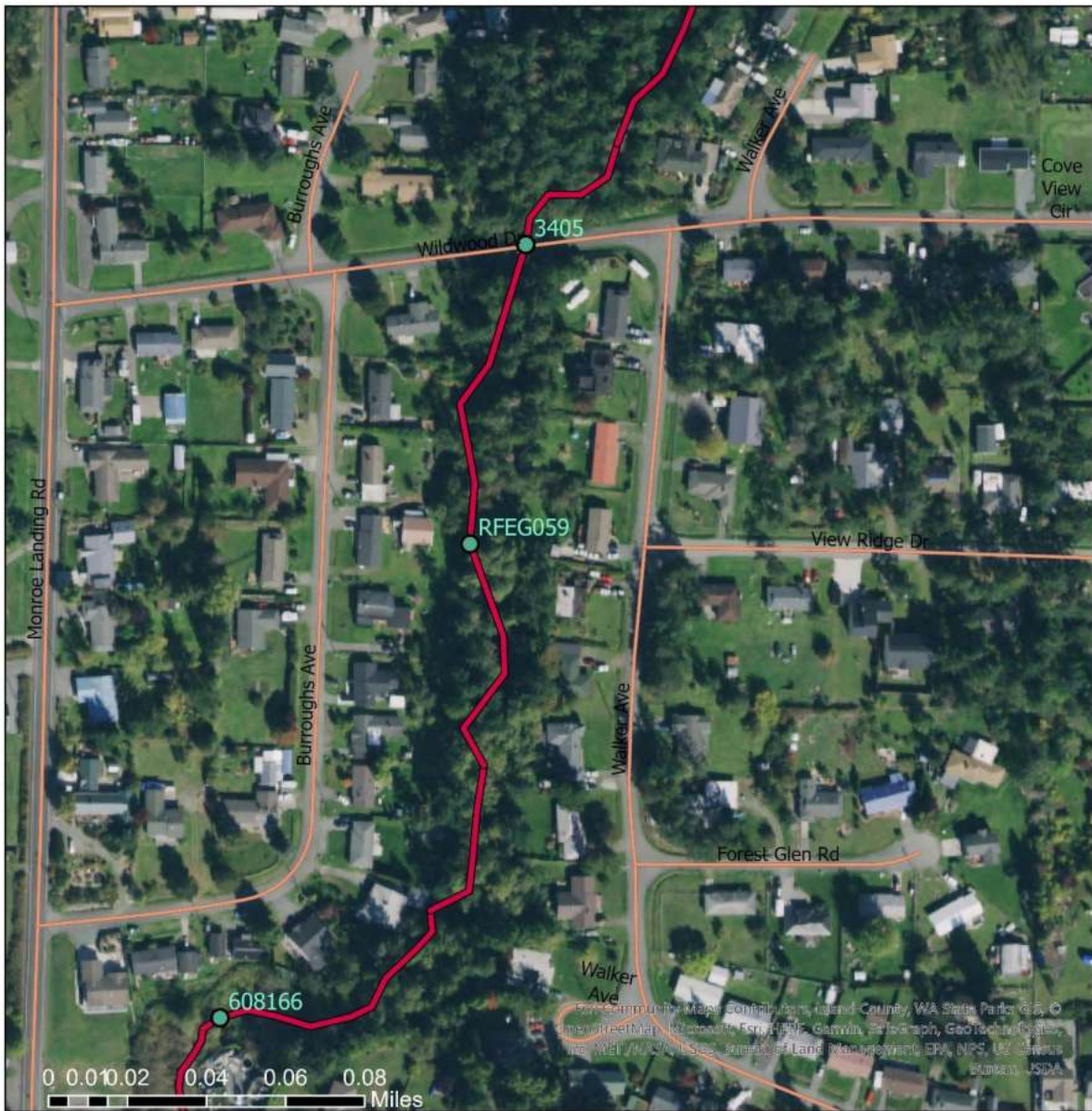
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



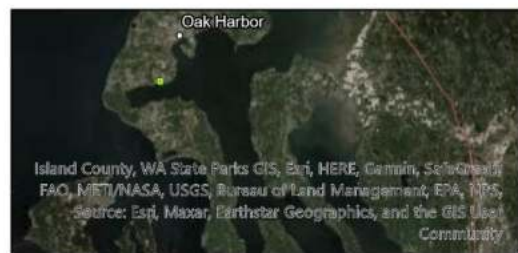
Monroe's Landing Habitat map, middle reaches of unnamed stream associated with county culvert 3345 on North Penn Cove, Monroe's Landing

Monroe's Landing Habitat Survey



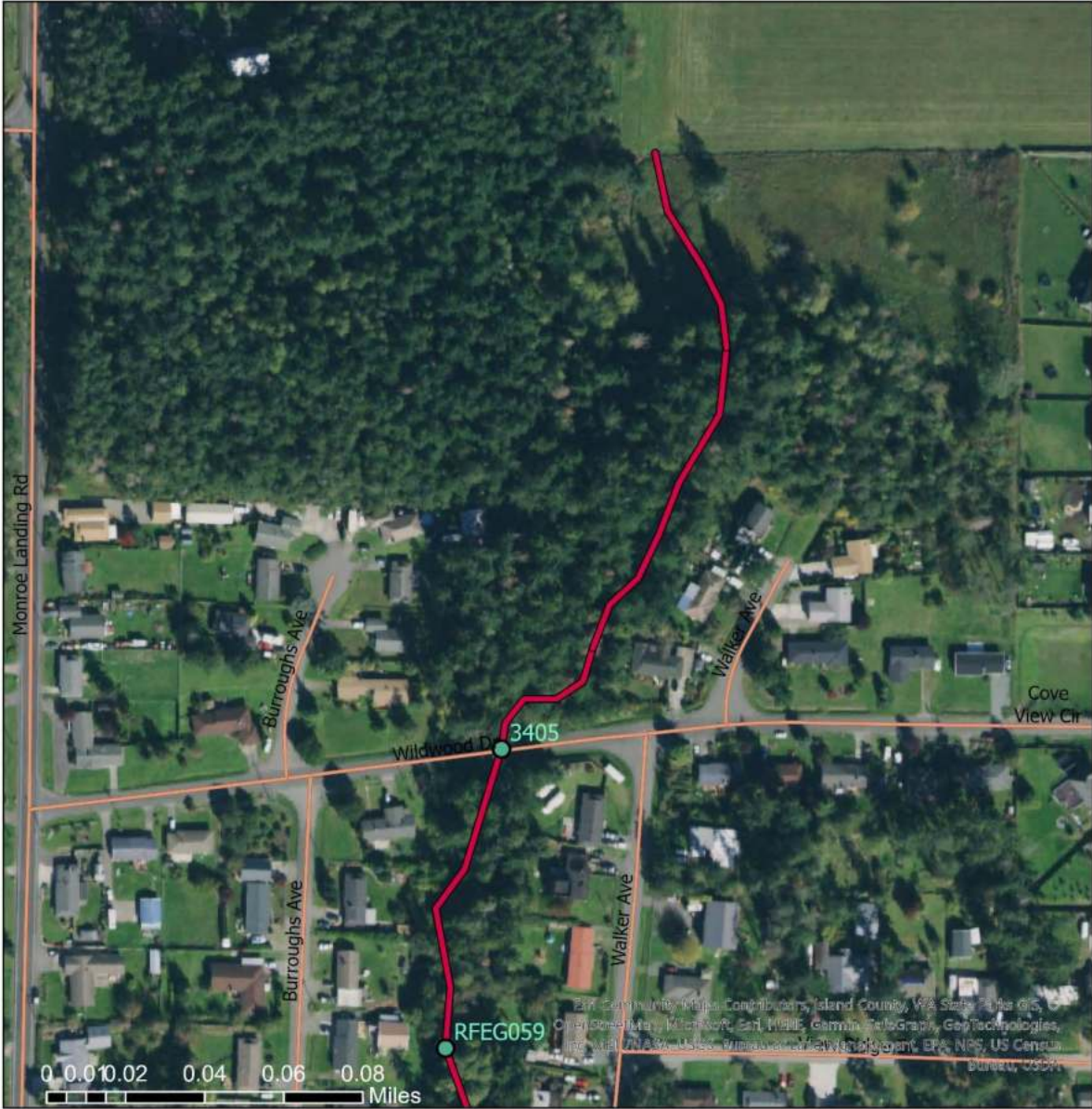
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



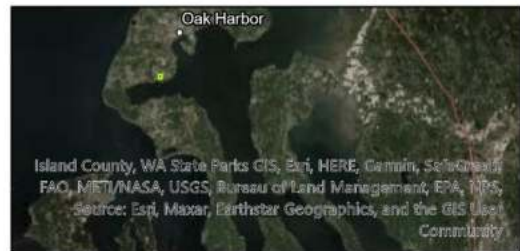
Monroe's Landing Habitat map, upstream reaches of unnamed stream associated with county culvert 3345 on North Penn Cove, Monroe's Landing

Monroe's Landing Habitat Survey



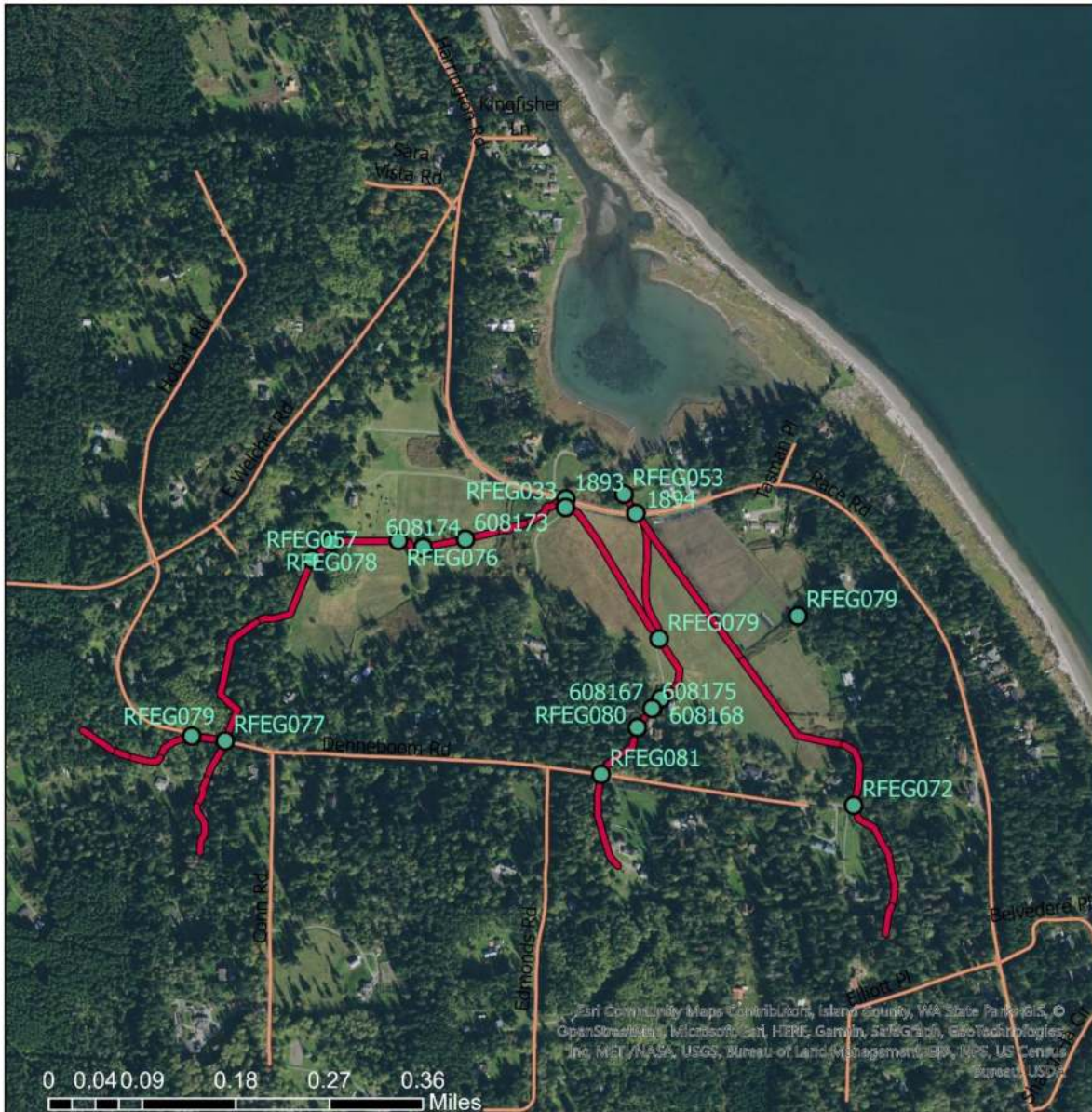
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



Race overall

Race Lagoon Habitat Survey



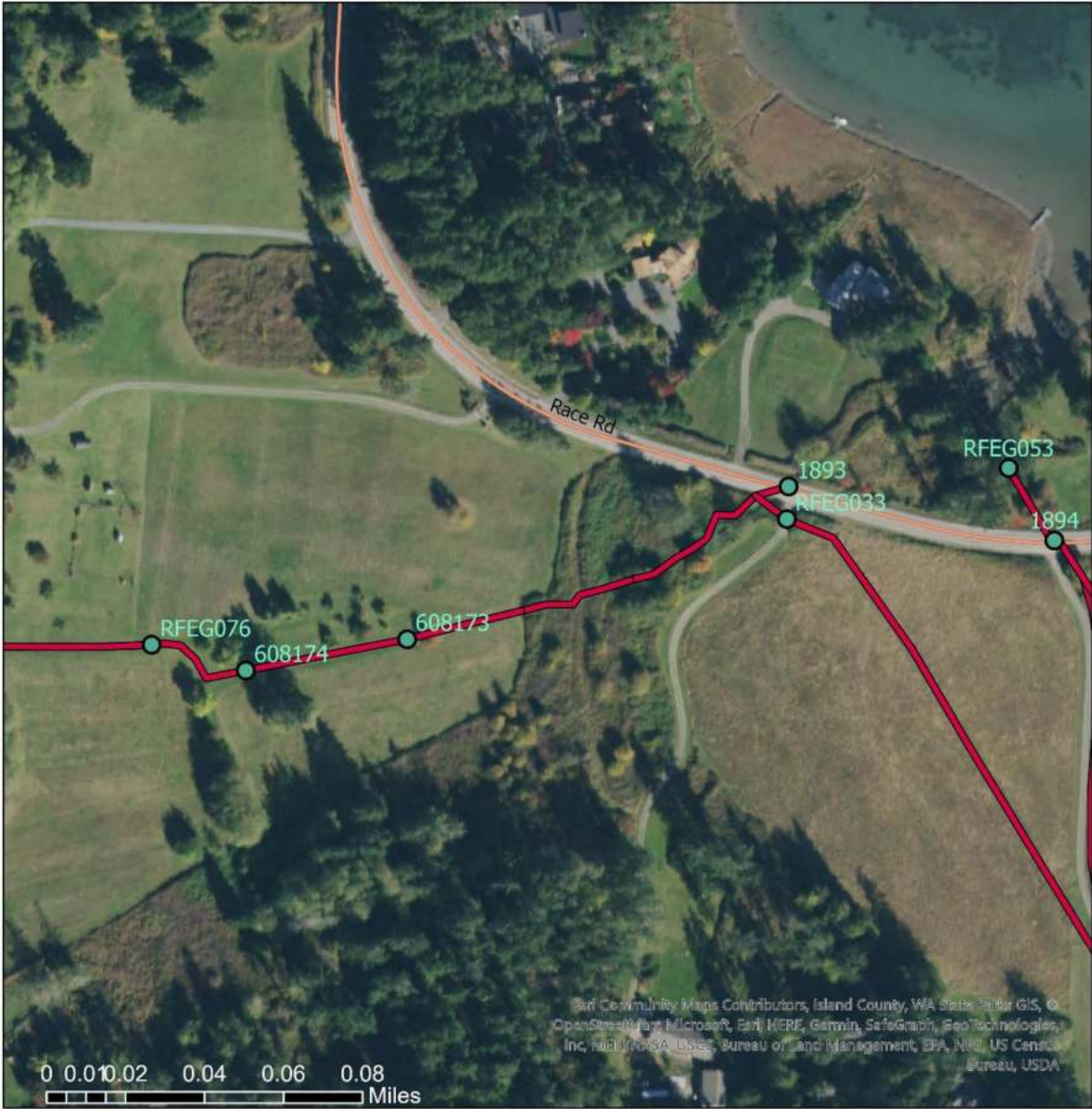
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



1893 downstream

Race Lagoon Habitat Survey



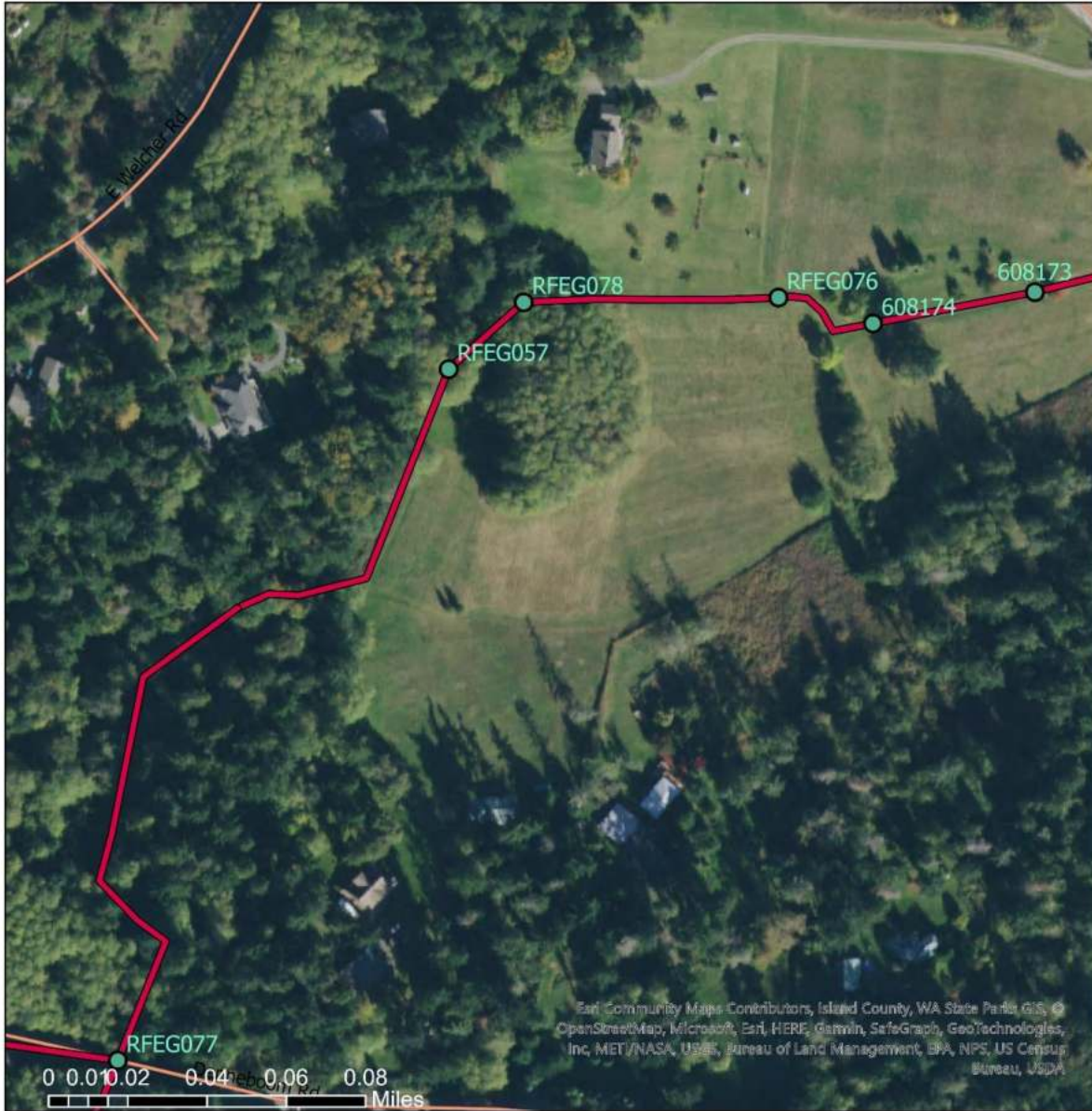
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



1893 middle

Race Lagoon Habitat Survey



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



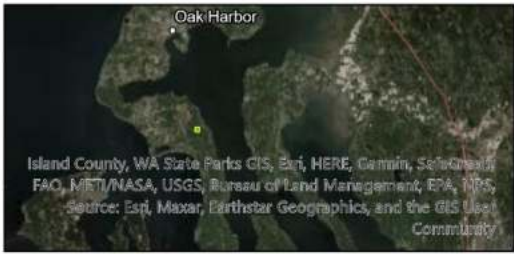
1893 upstream

Race Lagoon Habitat Survey



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



1894 downstream

Race Lagoon Habitat Survey



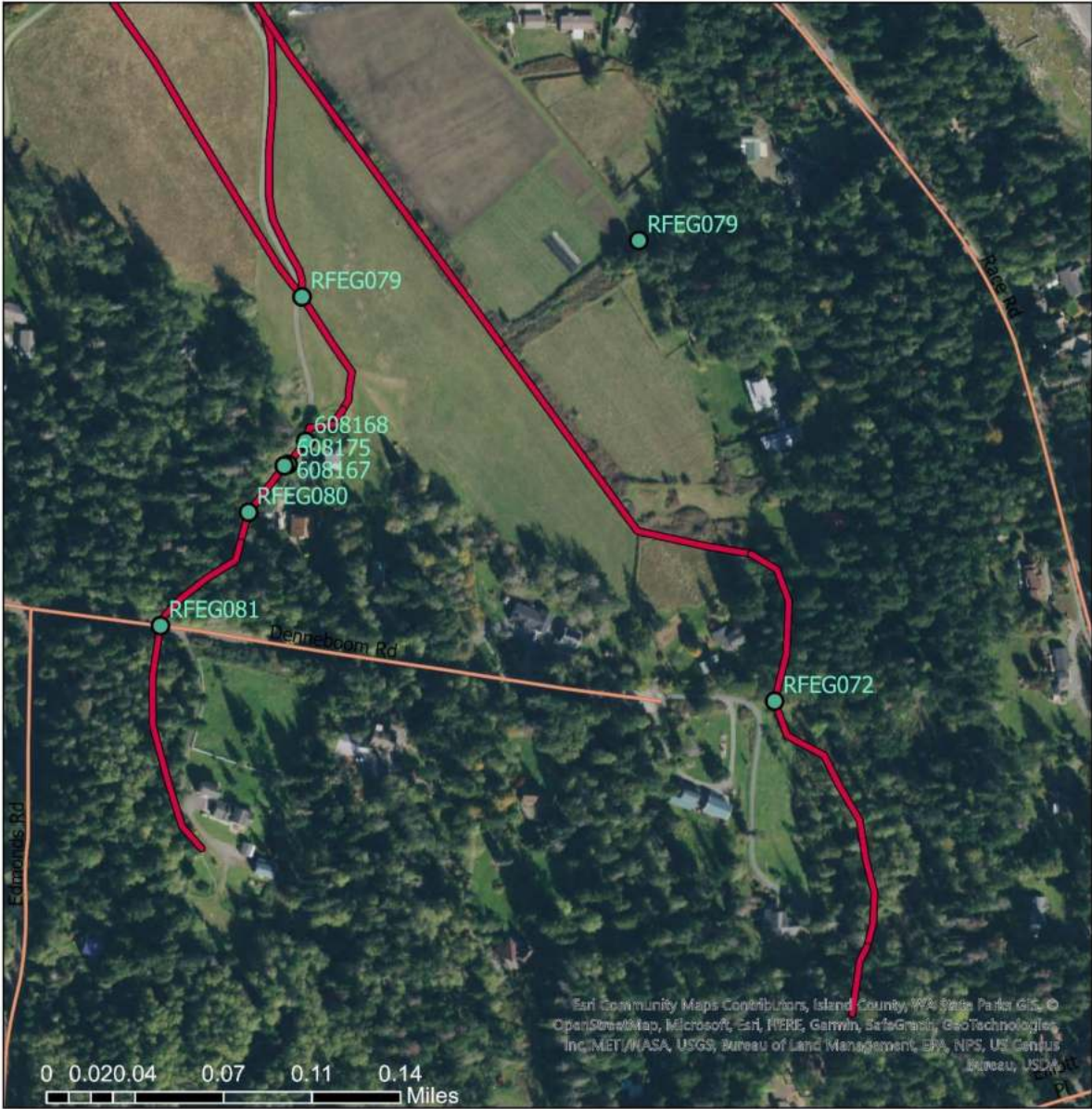
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



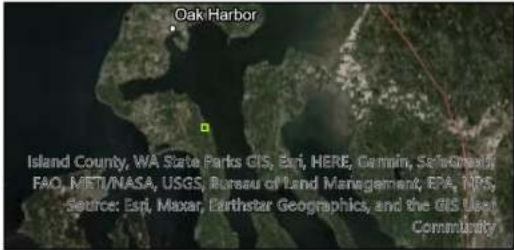
1894 upstream

Race Lagoon Habitat Survey



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



Freeland Creek downstream

Freeland Creek Habitat Survey



Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



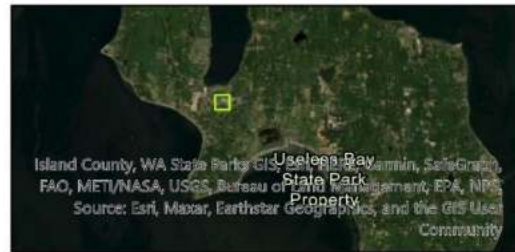
Freeland Creek lower middle

Freeland Creek Habitat Survey



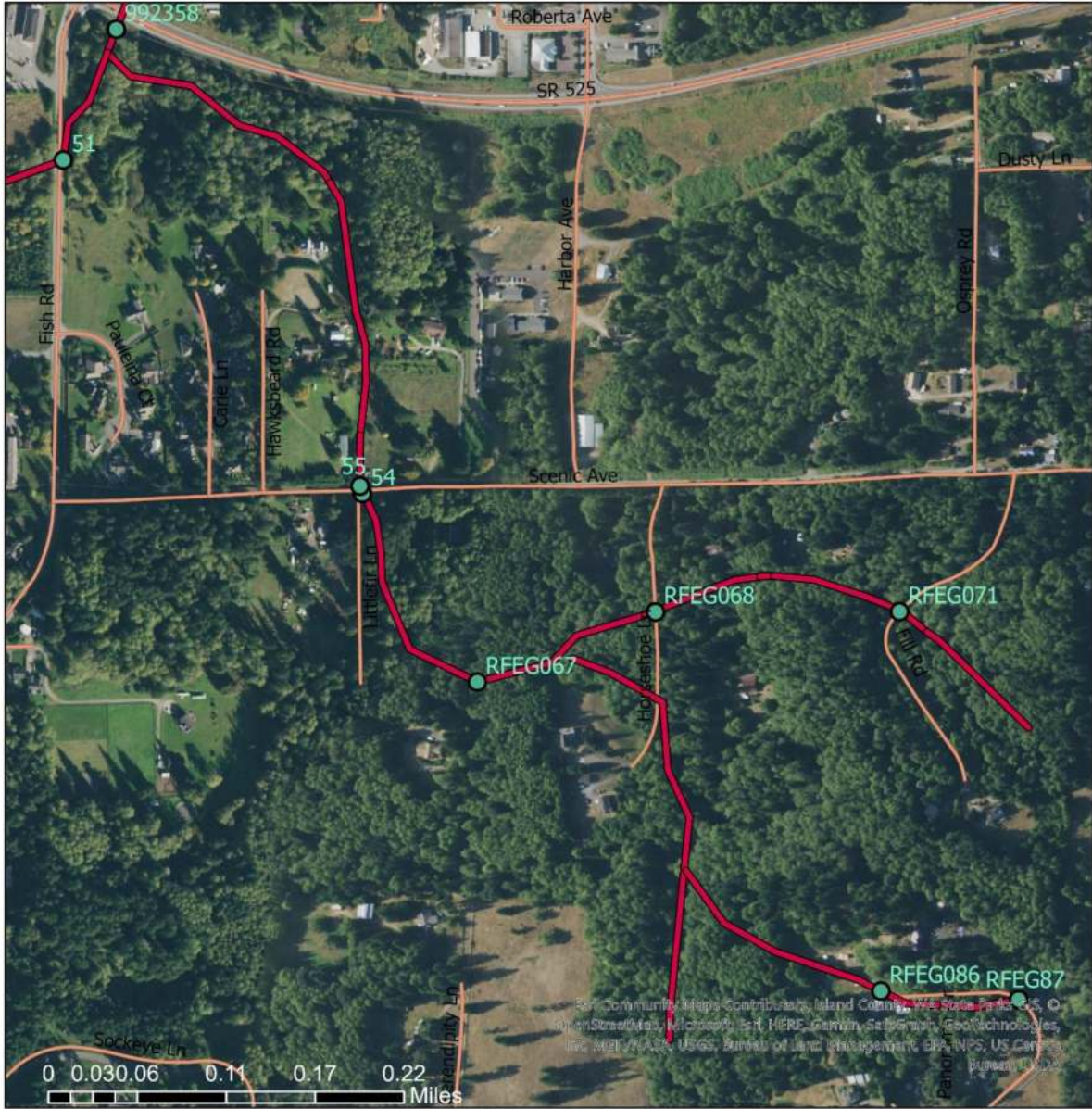
Legend

- Phase 2 culverts
- ▬ Habitat Surveys
- ▬ Roads



Freeland Creek upper middle

Freeland Creek Habitat Survey



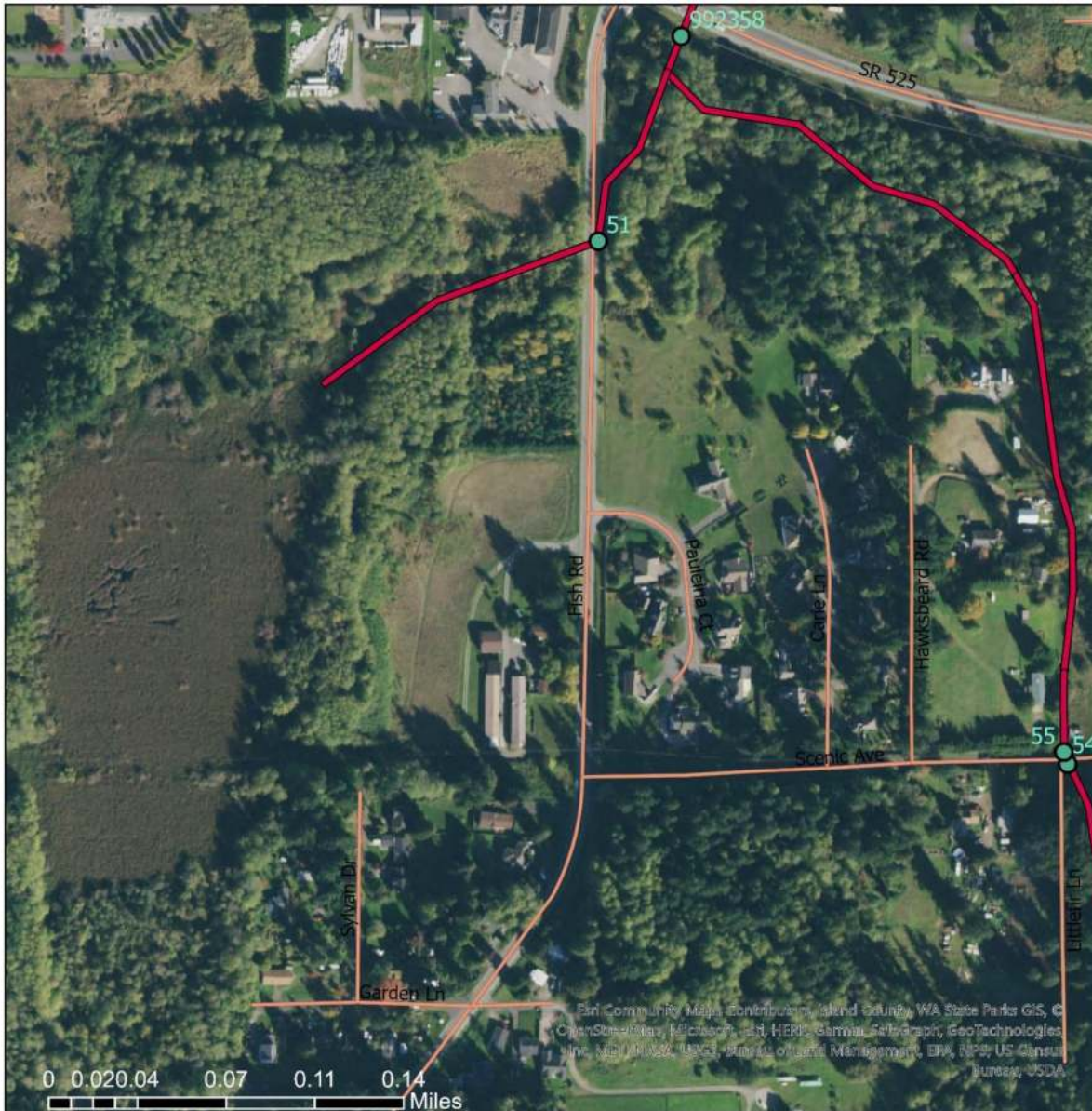
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads






Freeland upstream and tributary

Freeland Creek Habitat Survey



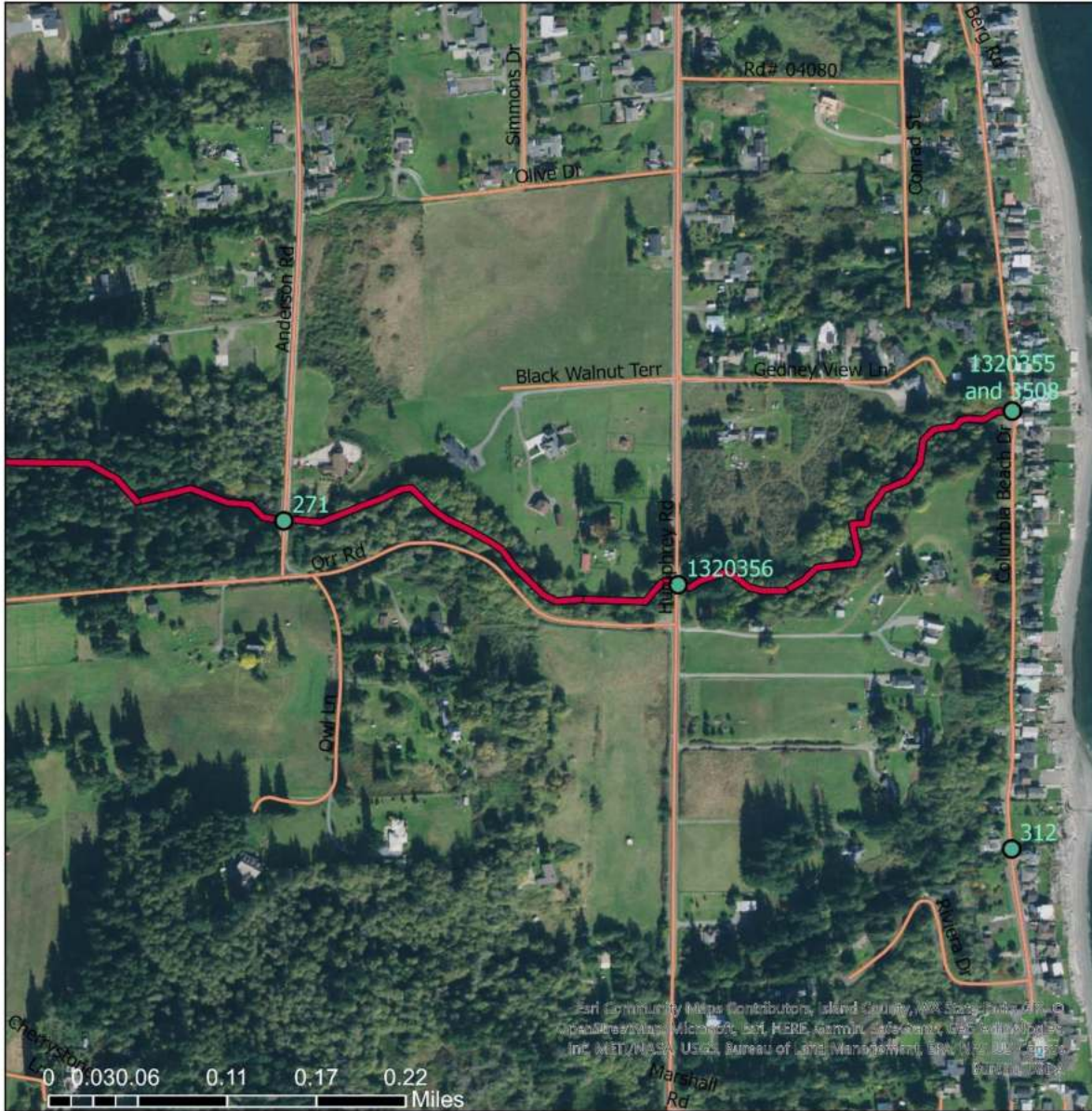
Legend

-  Phase 2 culverts
-  Habitat Surveys
-  Roads



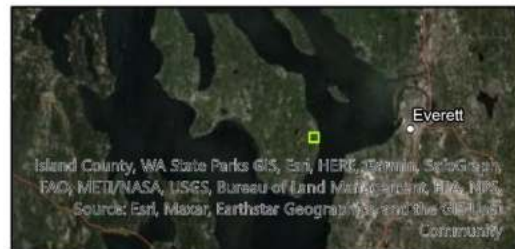
Orr Creek Downstream

Orr Creek Habitat Survey



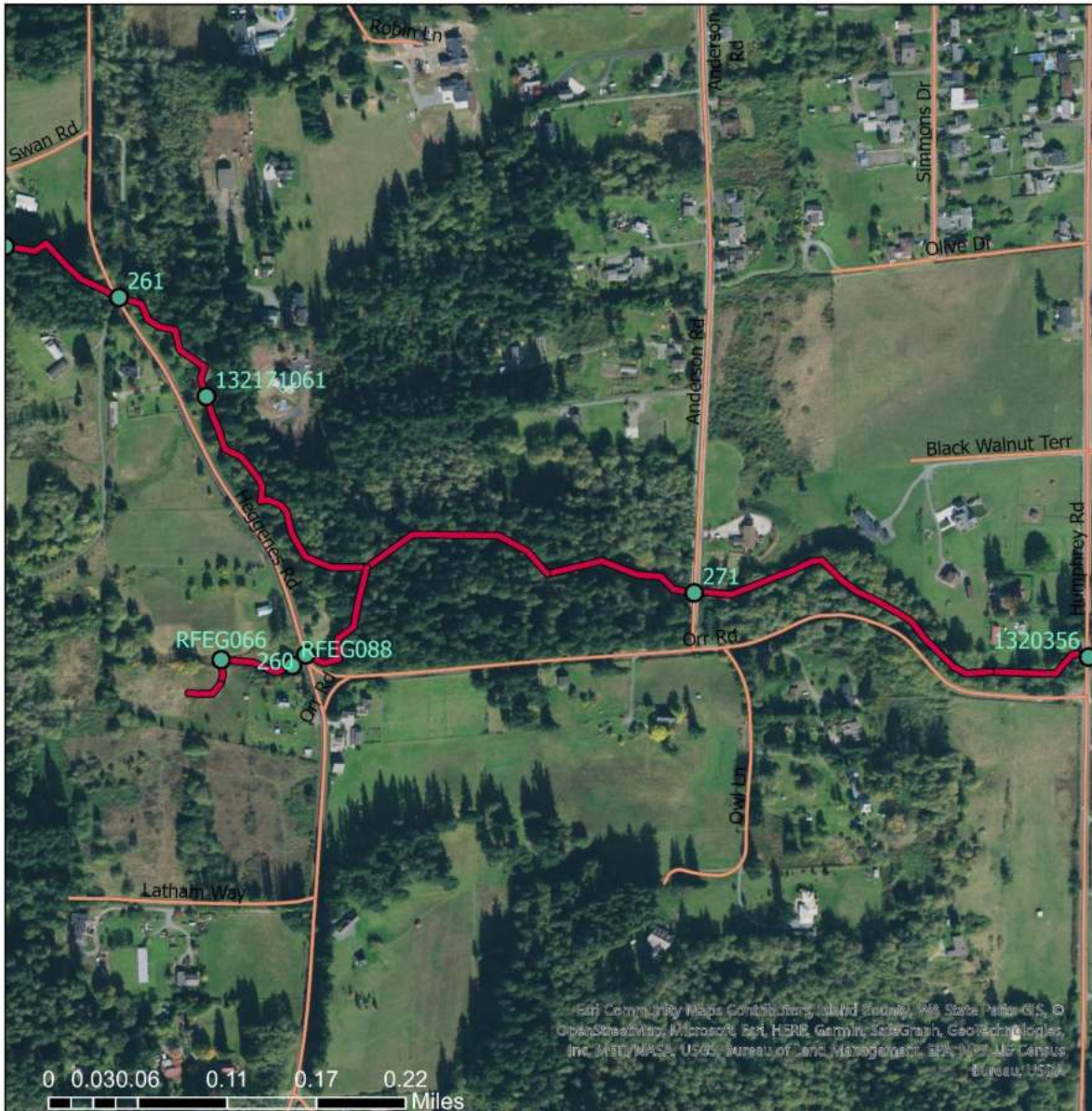
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



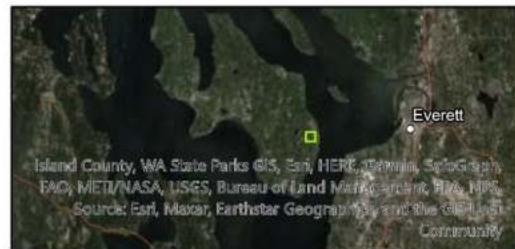
Orr Creek middle lower

Orr Creek Habitat Survey



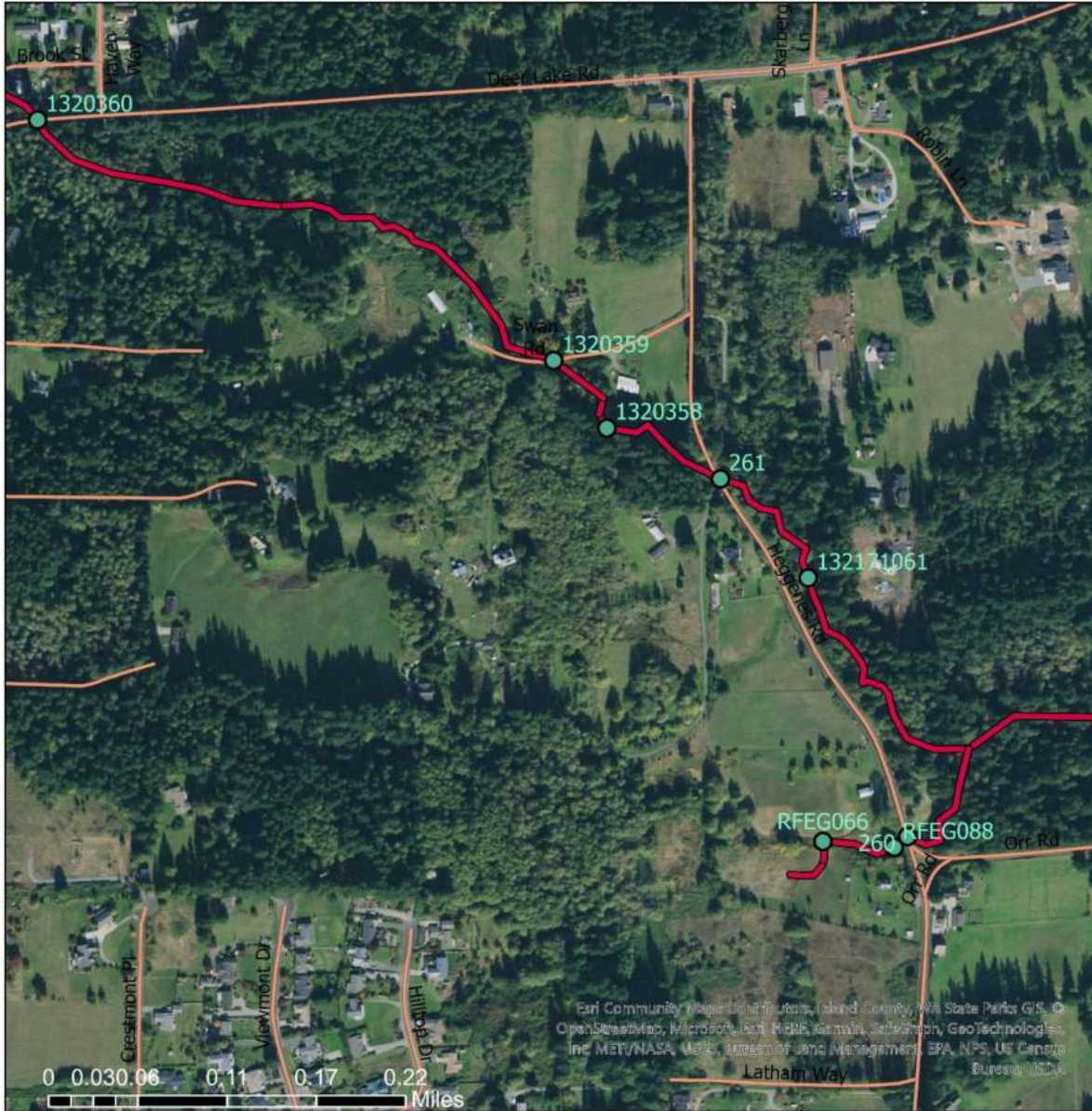
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



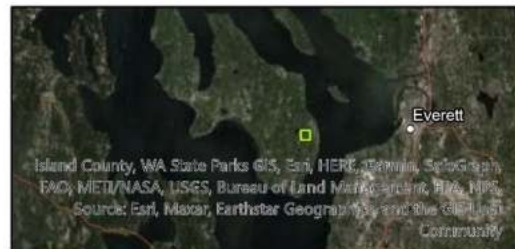
Orr Creek Middle upper

Orr Creek Habitat Survey



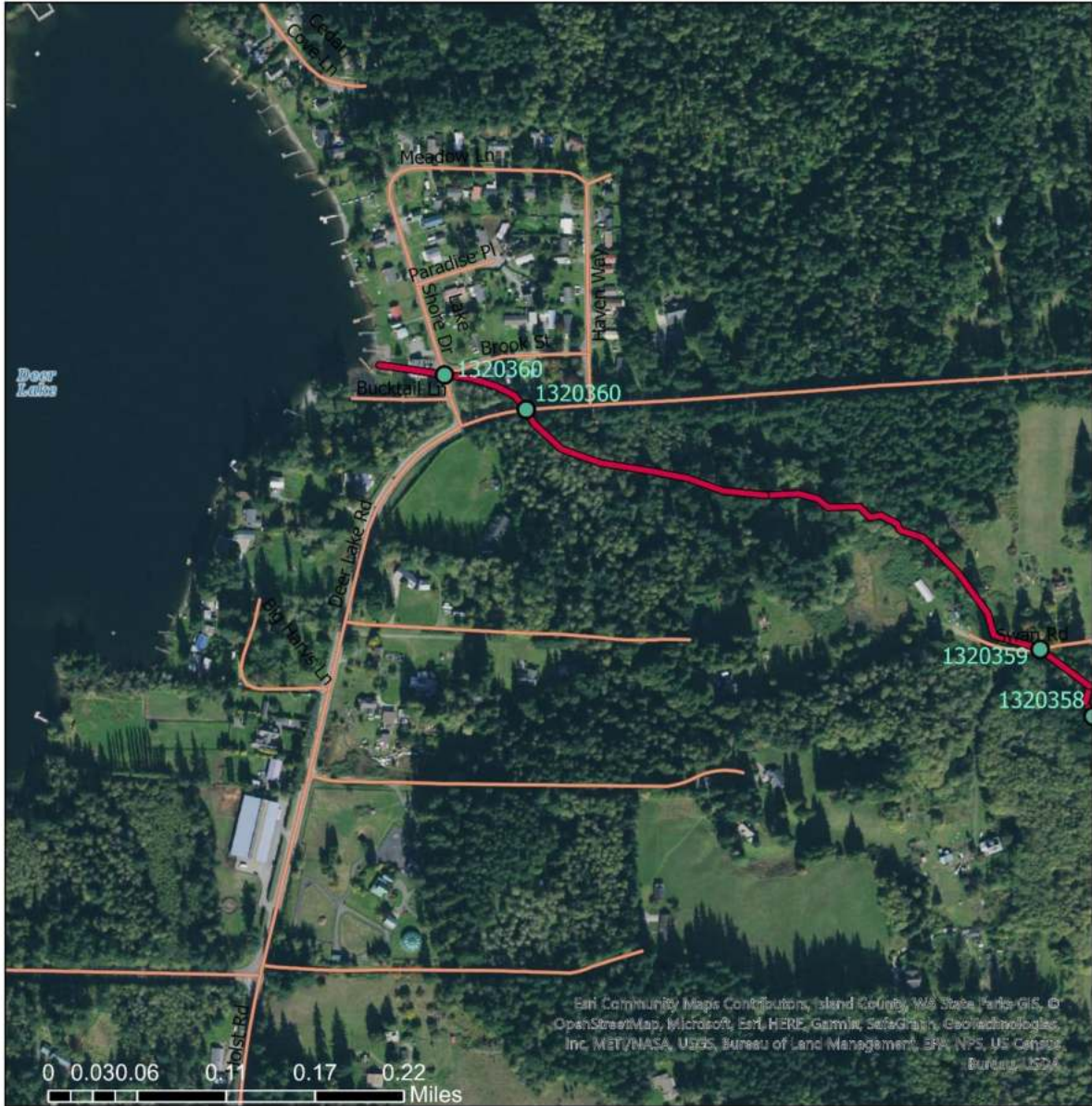
Legend

- Phase 2 culverts
- Habitat Surveys
- Roads



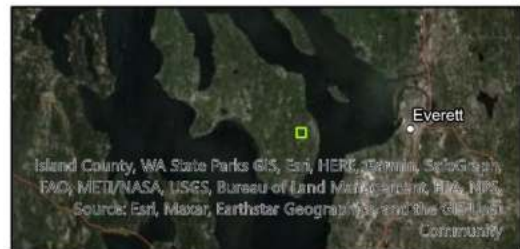
Orr Creek upstream

Orr Creek Habitat Survey



Legend






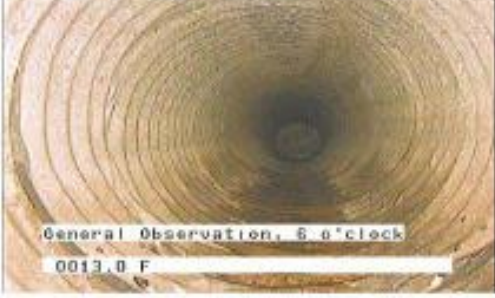



- Phase 2 culverts
- Habitat Surveys
- Roads



Appendix F – County Culvert Conditions

#	Priority Numbers	Culvert ID	Culvert Name	Culvert Location Notes
1	Island Priority	393	Goss Lake Outfall	393 and 393, Goss Lake Outfall
2	Fish Priority 1	1893	Race Lagoon	Race lagoon to the west.
3	Fish Priority 1	1894	Race Lagoon	Race lagoon to the east.
4	Fish Priority 1	3346	Penn Cove Lagoon	West of Monroe Landing
5	Island Priority	1092	Madronna Beach	Madronna Beach
6	Island Priority	1390	Chapman Creek Outfall	Chapman Creek Outfall
7	Fish Priority 1	1417	Chapman Creek Fish Passage	Chapman Creek Fish Passage also # 1328
8	District Priority	3728	Deer Lagoon Tide Gate	Deer Lagoon Tide Gate includes 3729, 3726, and 3727, along dyke.
9	District Priority	21	Double Bluff Outfall	Double Bluff Lagoon outfall
10	Fish Priority 1	3345	Monroe Landing	At Penn Cove Waste Water Treatment Plant
11	Public Buy-in	318	Randall Point stream outfall	Randall Point stream outfall under private home.
12	Public Buy-in	3509	Randall Point drainage outfall	Randall Point alternative under county road.
13	Public Buy-in	319	Brighton Beach Boardwalk	Brighton Beach
14	Island Priority	3731	Freeland Drainage	Freeland culverts and drainage at the park.
15	Public Buy-in	94	Maxwelton Beach	Maxwelton Stream and beach also includes # 96, and #102 upstream.
16	District Priority	3749	Deer Lake Tide Gate	Deer Lake Tide Gate into Deer Lake Drainage
17	Island Priority	642	Freeland Culverts	Freeland culverts include #641, 640, 639, 638, 664, 663, 662, 661.
18	Stream Flow	312	Deer Lake Stream	Stream that flows out of deer lake.
19	Fish Priority 2	3352	Penn Cove Cross Culvert	Next cross street East of the Three Sisters Market.
20	Stream Flow	5312	Honeymoon Bay Outfall	Neighborhood near wetlands off of Honeymoon Bay Road.
21	Island Priority 2	3821	North Bluff Outfall	Near Greenbank along North Bluff Road.
22	Fish Priority 2	3508	Columbia Beach Drive	South of Clinton Ferry, outfall splits the property line.

#	Priority Numbers	Culvert ID	Fish Passages Notes	Camera (y/n)
1	Island Priority	393	Only location of Chinook spotted, assume likely for all Holmes Harbor outfalls	No
2	Fish Priority 1	1893	Most promising site.	No
3	Fish Priority 1	1894	Second most promising site.	No
4	Fish Priority 1	3346	Wetlands and a private culvert behind the road culvert. Most ideal for a box culvert with minimal county funds.	No
5	Island Priority	1092	Blackburn Heights project fish passage	No
6	Island Priority	1390	Chapman Creek Project upstream. Currently an ongoing fish passage project.	No
7	Fish Priority 1	1417	Chapman Creek Project, may need access permit. Under private property.	No
8	District Priority	3728	Tide gates are currently ranked as permanent fish barriers.	No
9	District Priority	21	Does not seem to drain into or out of a habitat.	No
10	Fish Priority 1	3345	Does not appear to have fish access to water	No
11	Public Buy-in	318	Has favorable canyon habitat.	No
12	Public Buy-in	3509	Has favorable canyon habitat and near steep hill and county road.	No
13	Public Buy-in	319	Runs into another culvert and drainage ditch.	No
14	Island Priority	3731	Has potential for culvert replacements to open stream. May include in camera work from the County.	No
15	Public Buy-in	94	Community activism for revitalizing the stream but currently not a feasible project.	No
16	District Priority	3749	Not a feasible project due to upstream habitat loss.	No
17	Island Priority	642	May be suitable to replace culverts with fish passage.	No
18	Stream Flow	312	Lower on the list, but of more interest to county work.	No
19	Fish Priority 2	3352	Unlikely habitat due to being a residential neighborhood.	Yes
20	Stream Flow	5312	Not a feasible project, and was studied before.	No
21	Island Priority 2	3821	Not a feasible project, and was studied before.	No
22	Fish Priority 2	3508	Splits into outfall between two houses. Access permits may be required.	No

Client ID	Test Name	Date of Photo / Video Taken	Notes	Photo of Culvert	Photo of Culvert	Photo of Culvert
003	Soak Test	5/11/2011				
004	Soak Test	5/11/2011				
006	Flow Over Test	5/11/2011				
007	Sandy Beach Drive	Not available	From Culvert under beach house			
008	Soak High Soak	5/11/2011				



882 Penn-Cove Road 6/18/2011

888 Columbia Beach Drive Not available
Culvert inaccessible due
to private property