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N O R T H W E S T

S C I E N C E E D U C A T I O N A D V O C A C Y

Fish Use within the Maxwelton Creek Watershed, Island County, Washington – A baseline for monitoring fish passage improvements at the Maxwelton tidegates. July 27, 2007

Background

During summer 2006, Diking District #2 and the Whidbey Island Conservation District will be implementing fish passage improvements at the tidegates located where Maxwelton Creek enters Useless Bay in Island County. Wild Fish Conservancy was contracted to evaluate the fish passage effectiveness of the tidegate modifications by summarizing baseline anadromous fish use data collected within the watershed, and by performing salmon spawning surveys during fall 2006 to test two main hypotheses:

Hypothesis 1: The proposed modification of the existing tidegate facility at the Maxwelton estuary (anticipated summer 2006) will improve returning adult coho and chum salmon access to Maxwelton Creek.

Hypothesis 2: The proposed modification of the existing tidegate facility at the Maxwelton estuary will, over time, increase the abundance of salmon smolts emigrating from the watershed.

The data presented in this report are from six distinct sources:

Section 1: Wild Fish Conservancy's 2003-2004 Maxwelton Creek Inventory;

Section 2: Other (non-Wild Fish Conservancy) salmon observations in Maxwelton Creek;

Section 3: Wild Fish Conservancy nearshore beach seining efforts in Useless Bay;

Section 4: 2005, 2006, and 2007 Outmigrant juvenile salmon data collected by Whidbey Watershed Stewards (formerly Maxwelton Salmon Adventure);

Section 5: Wild Fish Conservancy fall 2006 Maxwelton Creek spawning surveys; and

Section 6: Wild Fish Conservancy fall 2006 Maxwelton Creek Tidegate observations.



Figure 1. The mouth of the Maxwellton Watershed in Useless Bay. WA State Dept. of Ecology.

Section 1: Wild Fish Conservancy's 2003-2004 Maxwellton Creek Inventory

In 2003, Wild Fish Conservancy was contracted by Island County to perform a comprehensive watershed assessment on Maxwellton Creek on Whidbey Island, and to identify opportunities to improve conditions for salmonids in the watershed. Funding for the project was provided by the Salmon Recovery Funding Board, through Island County.

Through this project, Wild Fish Conservancy documented fish distribution and species composition; inventoried and assessed instream habitat, fish passage at culverts, and water quality; and determined the distribution of spawning salmon. These parameters, along with historical information for the watershed, were examined to identify and prioritize restoration and protection opportunities that will a) protect, maintain, and/or restore watershed processes that create habitat characteristics favorable to salmonids; and b) protect, maintain, and/or restore habitats required by salmonids during all life stages and maintain functional corridors linking these habitats.

Field surveys were performed only where property owners had granted access to Wild Fish Conservancy crews. Where permission was not granted, information from past surveys, aerial photographs, public access points like County roads, and topographic maps was used.

Wild Fish Conservancy has compiled the data collected during this study in an interactive internet-based geographic information system (GIS), which is available at:

<http://www.washingtontrout.org/islandco/index.shtml>

Specifically, with regards to monitoring the effectiveness of the fish passage improvements made at the tidegates located where Maxwellton Creek enters Useless Bay, the data presented in the interactive web page provide an excellent overview of the watershed, the fish species utilizing it, as well as exact locations where fish and redd observations have been made. These data are summarized below:

Maxwelton Salmon Spawning Survey Summary – Fall 2004

Wild Fish Conservancy performed surveys on index reaches that had characteristics favorable to salmon spawning, and were located on parcels where crews had been granted permission to access. The spawning survey index reaches were identified based on the characteristics (flow, substrate, channel morphology) observed during the habitat reconnaissance. Surveys were conducted between October 23, 2004, and December 16, 2004. As is often the case, there are many man-made barriers to fish passage in Maxwellton Creek that abbreviate the distribution of the fish throughout the watershed.

Maxwelton Creek fall 2004 adult salmon observations:

- One live male coho was observed on Parcel# R32933-052-0810 on October 23, 2003.
- Four or five chum heads and four chum carcasses without heads were located at the Maxwellton Outdoor Classroom on November 25th (the carcasses were filleted and were likely from a different stream origin).
- One coho carcass was found on Parcel# R32933-323-1000 on November 25th (Figure 2).
- Two salmonid remnants (unknown species) were found on Parcel# R32804-412-0310 property on December 2, 2003.
- A total of 10 redds was observed in the index reach extending from the Outdoor Classroom to Parcel# R32933-323-1000; no other redds were observed in Maxwellton Creek or its tributaries during the salmon spawning surveys.



Figure 2. Coho carcass found adjacent to two redds in mainstem Maxwellton Creek, approximately 1200 feet upstream from the confluence with Quade Cr.

Maxwelton Juvenile and Resident Fish Survey Summary – 2003-2004

Juvenile coho salmon (*Oncorhynchus kisutch*), sculpin (*Cottidae*), and three-spine stickleback (*Gasterosteus aculeatus*), and juvenile steelhead or coastal cutthroat trout (*O. mykiss* or *O. clarki*, respectively) were observed in Maxwelton Creek. Salmonid observations are presented in Figures 3 through 6.

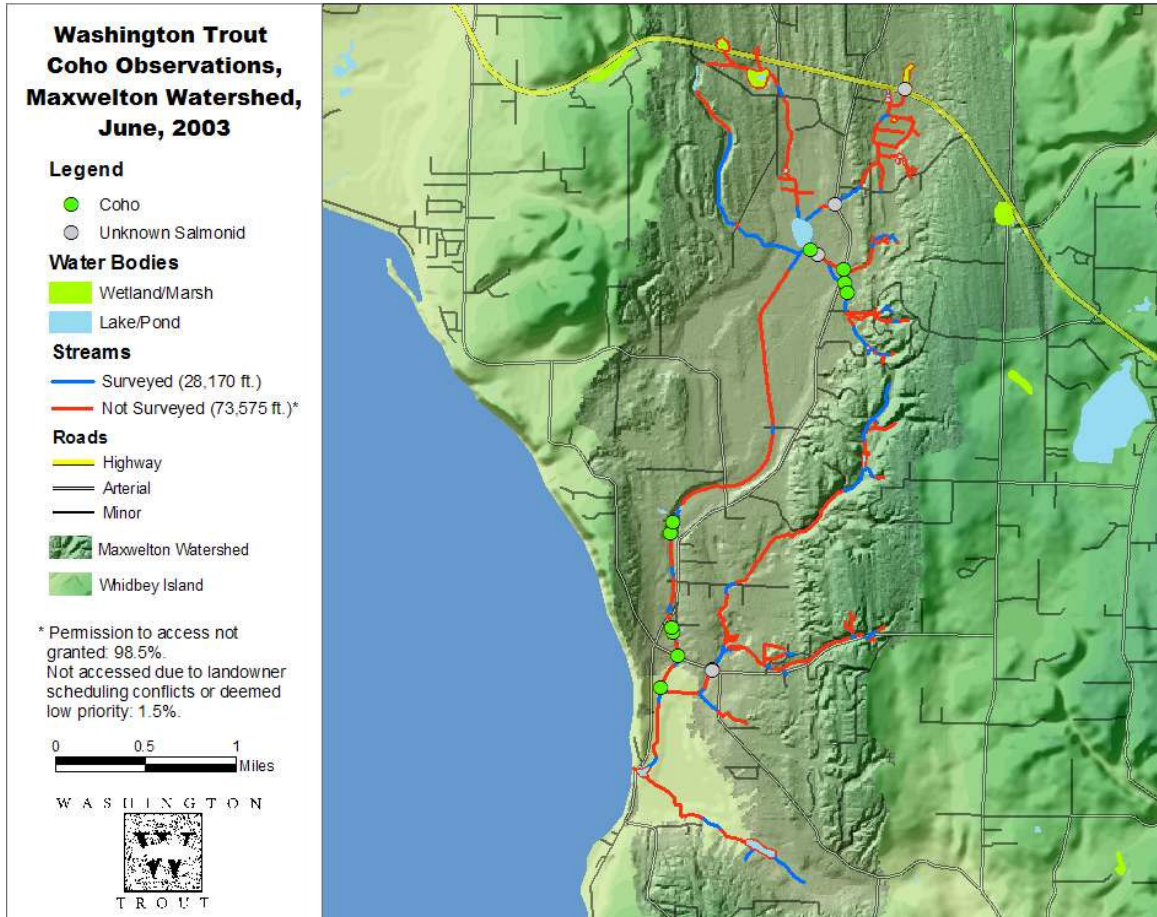


Figure 3. Wild Fish Conservancy’s juvenile coho salmon observations within the Maxwelton watershed – June 2003. Portions of the watershed were not surveyed due to lack of landowner permission.



Figure 4. 170mm coho (*O. kisutch*) smolt brought to hand at the culvert outlet pool of the French Road crossing on Maxwellton Creek. Wild Fish Conservancy, 5/21/2003.

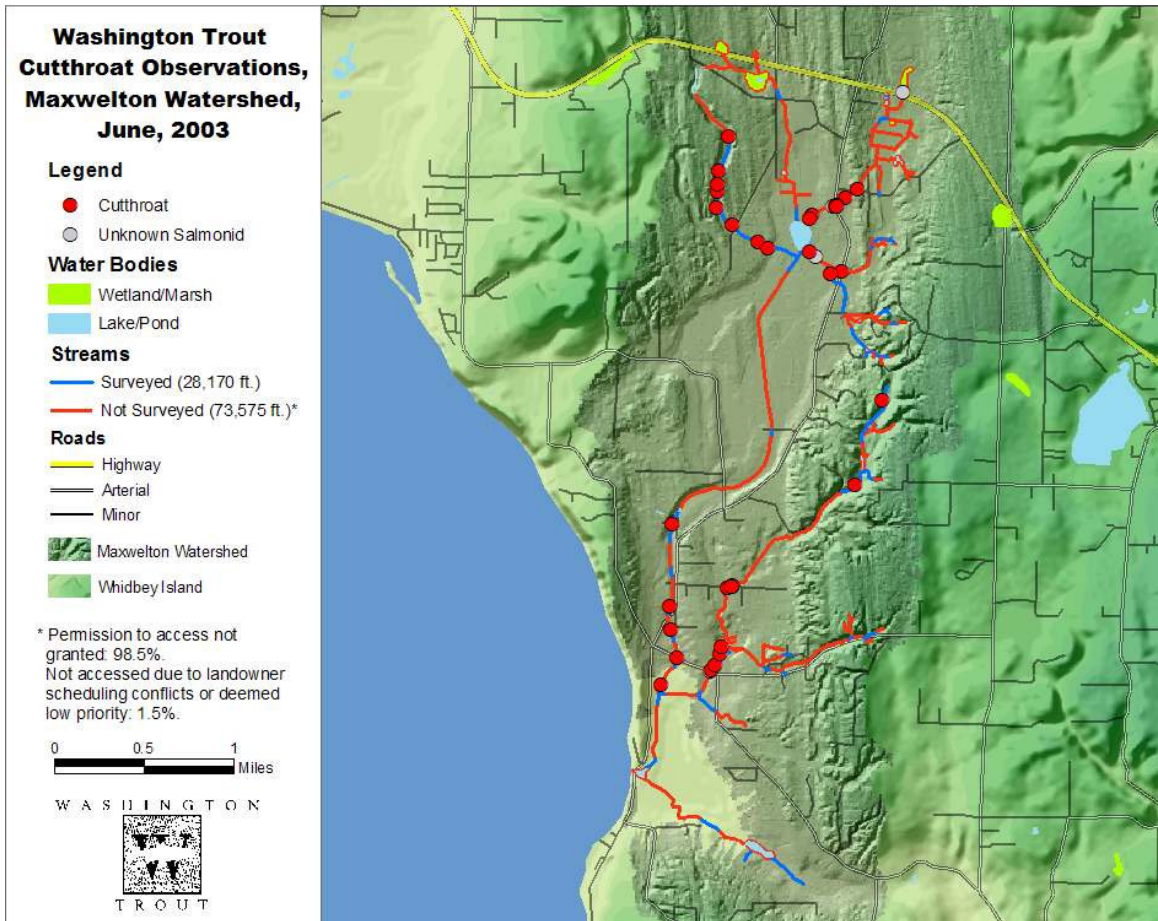


Figure 5. Wild Fish Conservancy’s juvenile and adult cutthroat trout observations within the Maxwellton watershed – June 2003. Cutthroat may represent either or both resident or anadromous life history strategies. Portions of the watershed were not surveyed due to lack of landowner permission.



Figure 6. Two coastal cutthroat trout (*O. clarki*) brought to hand downstream from the French Road crossing on Maxwellton Creek. Wild Fish Conservancy, 5/21/2003.

The Maxwelton watershed historically received outplants of juvenile coho and chum salmon from the Whidbey Watershed Stewards and Salmon in the Classroom projects. January 2003 was the last time Whidbey Watershed Stewards put 40,000 fertilized coho eggs in the stream as part of the Outdoor Classroom project. Coho from this effort would have, most likely, returned to Maxwelton as adults during fall/winter 2005. The local school put 500 coho fry in Maxwelton watershed as part of a classroom project for the last time in January 2005 – survivors from this effort will emigrate as smolts during spring 2006 and may return in the fall of 2007. There were no eggs or fry put in the stream late 2005 or early 2006, and no more outplants are planned for the watershed. WDFW does not stock fish in the Maxwelton Creek watershed. Puget Sound Anglers released 17,000 coho smolts near Possession Point on May 18th (The Record, May 23rd).

As is often the case, there are locations in the watershed where man-made barriers to fish passage abbreviate the distribution of the fish in the watershed – see: <http://www.washingtontrout.org/islandco/fishpassage.html> for more information on fish passage barriers within the Maxwelton Creek watershed.

Section 2: Other (non Wild Fish Conservancy) salmon observations made in Maxwelton Creek prior to 2006

Volunteers for the Whidbey Watershed Stewards (specifically, Nathaniel Scholz, a toxicologist for NOAA Fisheries) performed informal spawning surveys in November and December 2004 and 2005. Surveying within the vicinity of the Whidbey Watershed Stewards Outdoor Classroom, Dr. Scholz enumerated approximately twelve adult coho in 2004, each apparently with intact adipose fins. Dr. Scholz also noted evidence of coho redd construction in the survey reach in 2004. Conversely, in 2005 Dr. Scholz did not observe any adult salmon nor redds, despite similar survey intensity.

In 2006, Ron Kerrigan (watershed resident) observed an adult salmon in Quade Creek upstream from French Road n November 6.

Section 3: Wild Fish Conservancy nearshore beach seining efforts in Useless Bay

Since spring of 2005, Wild Fish Conservancy has been studying juvenile salmonid use of nearshore habitat on the west coast of Whidbey Island. This is the first comprehensive study of nearshore habitat on the west shore of the island. For more background on this project please see “*Juvenile Salmon and Puget Sound Nearshore – West Whidbey Juvenile Fish-Use Assessment*” in the 2005 edition of The Washington Trout Report (<http://www.washingtontrout.org/Spring2005Newsletter.pdf>)

Methodology

In its West Whidbey Nearshore Fish Use Assessment, Wild Fish Conservancy used a fish sampling methodology that parallels sampling efforts conducted in the Skagit Bay on the eastern shore of Whidbey Island by the Skagit River System Cooperative (Skagit River System Cooperative 2003). Sampling was conducted using fine meshed beach seines which were deployed using a motorized skiff, or set by hand.

The large set net has 1/8” mesh, and is 120’ long and 12’ deep in the middle of the net. The wing of the net that was tied to the beach tapered to 6’, while the other wing had no taper. The small set net has 1/8” mesh, and is 80’ long, with no taper. This smaller net was rigged with 90’ of net along 80’ of lead and float line, creating a pucker, or pocket, in the net for holding fish.

Intertidal/subtidal habitats are sampled using the large-net protocol. At each large-net sample site three consecutive seine hauls are conducted using the large net, with the net anchored to the same spot for each of the sample hauls. The net is pulled off the beach behind a 17’ aluminum skiff with a fifty horsepower four-stroke engine. At half the net length from the beach, the net is hooked to form a pocket, facing the current flow, and held in place for four minutes. The open end of the net is then brought to the beach to close off the semi-circle and the net is hauled to shore. To determine if the species assemblages caught are segregating within the range of habitats sampled by the large net, three successive small-net sets are conducted in the same location immediately following the large-net sets. The small net is loaded in a plastic floating dump tub, and the net is walked around in a semi-circle off the beach.

Shallow water intertidal habitats are sampled using the small-net protocol. At each small-net site consecutive hauls are conducted moving along the shore so that the same habitat is not sampled twice in one effort. The small net is loaded in a plastic floating dump tub, and the net was walked around in a semi-circle off the beach. Once the net was closed it was brought into shore for catch processing.

For each beach-seine set the following data re collected:

- Time and date of set
- Tidal stage (ebb, flood, high tide slack, low tide slack)
- Length of time the set is held open (large net only)
- Surface and bottom water temperature of area seined using a YSI meter
- Maximum depth of area seined
- Average surface water velocity using a Swoffer flow meter

- Substrate of area seined.
- Vegetation of area seined.
- Complete fish catch records by species.
- Individual juvenile chinook fork lengths (FL) and weights for the first forty fish sampled.
- Individual fork lengths (FL) on all other fish species for the first twenty individuals of each species.

All juvenile chinook captured were wanded with a Washington Department of Fish and Wildlife coded wire tag (CWT) detector. Fish that tested positive for a CWT were sacrificed in order to determine stock origin for a subsample of hatchery chinook encountered. All CWT reading was conducted by technicians from the Skagit River System Cooperative.

Useless Bay / Maxwellton Creek Mouth Data

All data were originally recorded on a standard data form that was entered in the field; subsequently data from the field forms were entered into spreadsheets for analysis. Data were summarized and analyzed for temporal, spatial, and biological trends. Data were summarized into catch per unit effort (CPUE) tables organized by sample site and date. CPUE was defined as:

$$\text{CPUE} = \text{number of target species caught/units of effort (net sets)}$$

CPUE was used to account for biases created by unequal sampling efforts across space or time. Monthly, daily, and instantaneous CPUE's were calculated for all juvenile salmon and forage fish at all sites.

Table 1. Juvenile salmon data that were collected near the mouth of Maxwellton Creek at the Dave Mackie County Park beach during six sampling efforts in winter and spring 2006.

<u>Date</u>	<u>Species</u>	<u>Total Count: large net</u>	<u>Large net CPUE</u>	<u>Total Count: small net</u>	<u>Small net CPUE</u>
2/15/2006	Pink	3	1	0	0
	Chum	0	0	0	0
2/23/2006	Pink	67	22.3	71	23.7
	Chum	1	0.3	1	0.3
	Coho	1@345mm (sub-adult, see Figure X)	0.3	0	0
3/20/2006	Pink	384	128	0	0
	Chum	11	3.7	0	0
4/3/2006	Pink	651	217	8	2.7
	Chum	78	26	1	0.3
4/20/2006	Pink	607	202.3	98	32.7
	Chum	183	61	53	17.7
5/25/2006	Pink	0	0	0	0
	Chum	0	0	0	0
	Coho	3	3	0	0

At each date there were three large net sets and three small net sets, except for 5/25/2006 when there was one large net set and three small net sets. We document a strong pattern of juvenile pink salmon use near the mouth of Maxwellton, with juvenile chum and coho salmon were present to a lesser extent (Figure 7).



Figure 7. Sub-adult coho salmon collected and released by Wild Fish Conservancy in Useless Bay near the mouth of Maxwellton Creek on February 23, 2006.

Section 4: Outmigrant juvenile salmon data collected by Whidbey Watershed Stewards (WWS, formerly Maxwelton Salmon Adventure)

The Whidbey Watershed Stewards (<http://www.whidbeywatersheds.com/>) has been trapping outmigrating fish during the spring at the French Rd. crossing for several years (Figure 8).



Figure 8. Whidbey Watershed Stewards smolt trap installed at the outlet of the French Rd. culvert on lower Maxwelton Creek. May 21, 2003.

Fish observations at the trap typically include coho smolts, juvenile and adult cutthroat, and fry (most likely young-of-year coho or young of year cutthroat). 2005, 2006, and 2007 data (Figures 9, 10, and 11) are presented below; data from the earlier years of the Whidbey Watershed Stewards outmigrant assessment are presented in Table 2. During the first week in May of 2000 and 2001, MSA measured the lengths of a subsample of coho. In 2000, the average length of the coho smolts was 11.5 cm. (n=46; minimum=9.3; maximum=18.0). In 2001, the average length of the coho smolts was 12.5 cm. (n=36; minimum=8.5; maximum=18.0). The average length of the cutthroats in 2000 was 11.0 cm. (n=12; minimum=8.0; maximum=14.5). In 2001 the average length of the cutthroats was 14.1 cm. (n=14; minimum=10.4; maximum=19.0.)

Table 2. Outmigrant fish data collected by Whidbey Watershed Stewards during the springs of 2000-2003.

Year	Coho	Cutthroat
2000	296	67
2001	369	102
2002	75	4
2003	169	12

Distribution of Fish by Day

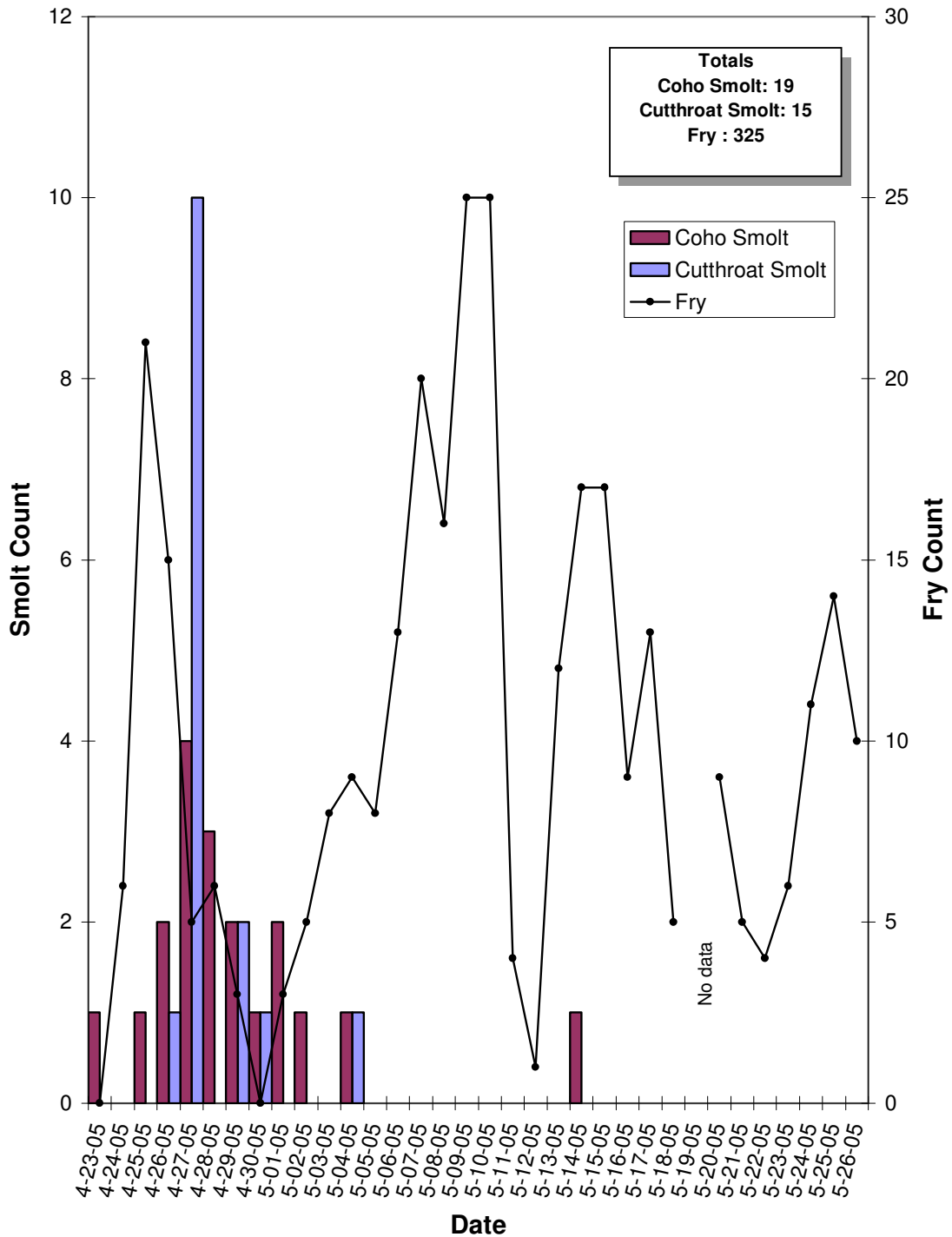


Figure 9. 2005 outmigrant data collected by the Whidbey Watershed Stewards, on mainstem Maxwellton Creek at French Road.

Distribution of Fish by Day

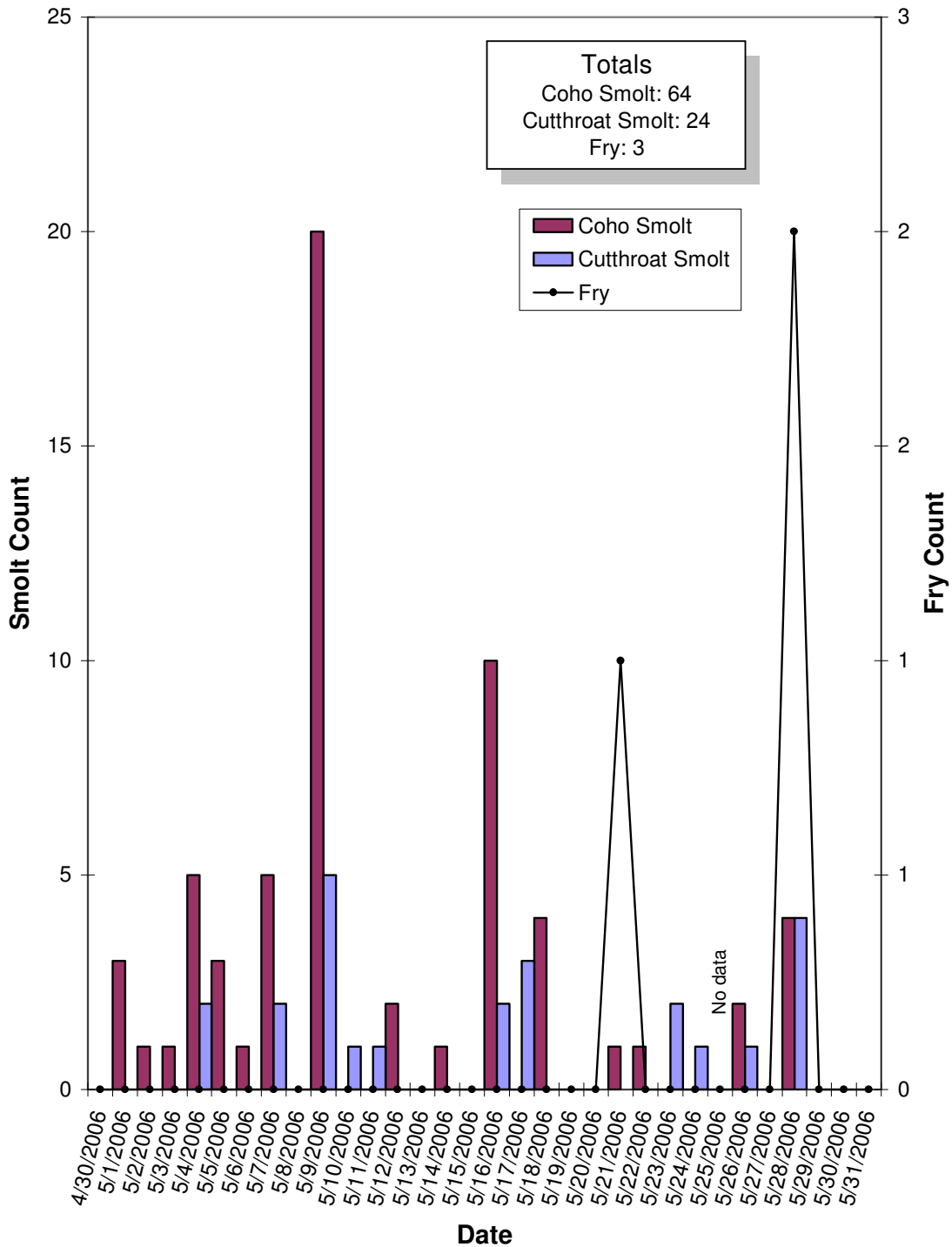


Figure 10. 2006 outmigrant data collected by the Whidbey Watershed Stewards (formerly Whidbey Watershed Stewards), on mainstem Maxwellton Creek at French Road.

2007 Distribution of Fish by Day

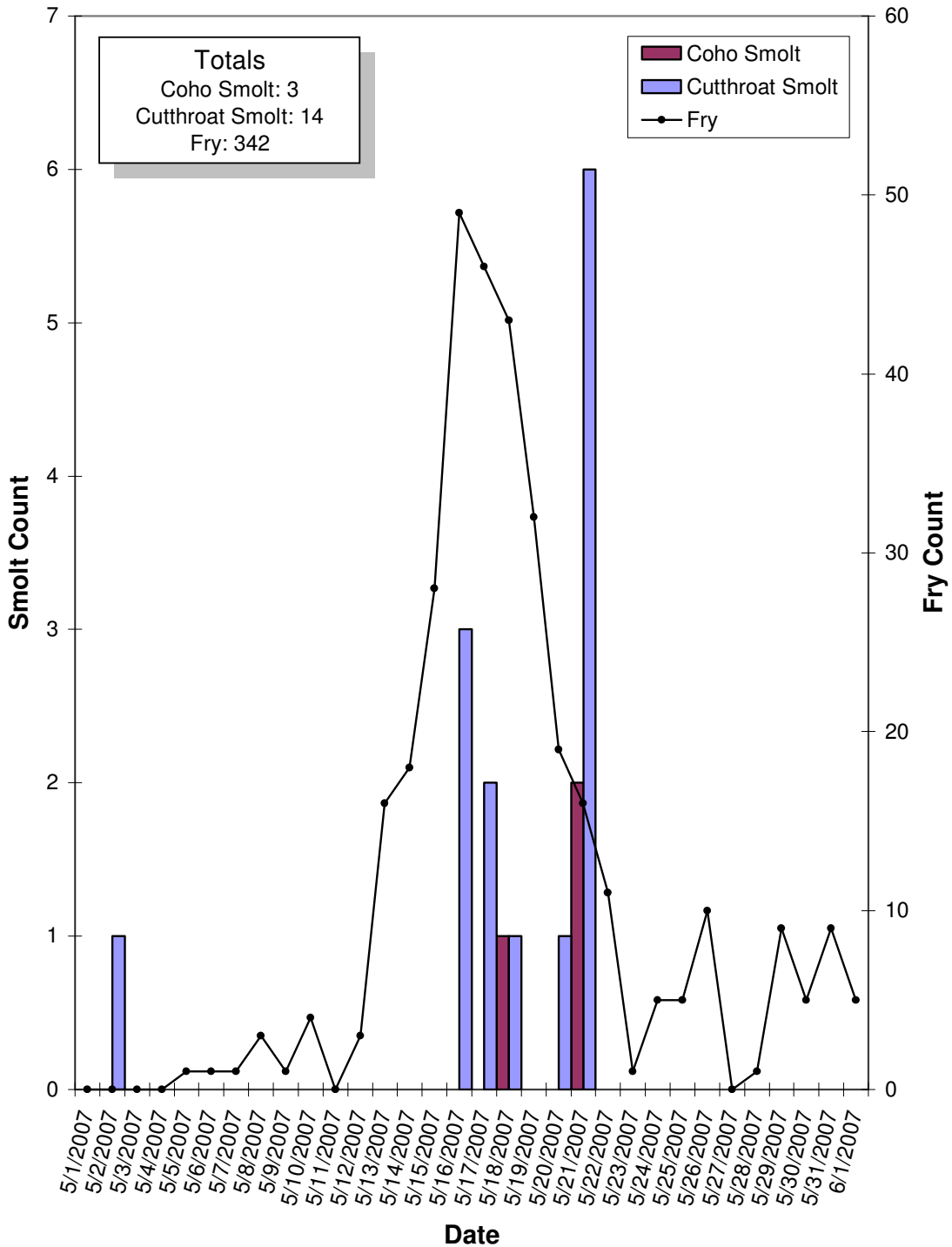


Figure 11. 2007 outmigrant data collected by the Whidbey Watershed Stewards (formerly Whidbey Watershed Stewards), on mainstem Maxwellton Creek at French Road.

Section 5: Wild Fish Conservancy 2006 Maxwellton Creek fall spawning surveys

Maxwelton Spawning Surveys

Washington Trout conducted salmon spawning surveys weekly between October 20, 2006 and January 2, 2007. Surveys targeted index reaches that had characteristics favorable for salmon spawning, and were located on parcels where Washington Trout had been granted permission to access. The spawning survey index reaches (stream segments designated for spawning surveys) were identified based on characteristics (flow, substrate, channel morphology) observed during habitat reconnaissance surveys conducted in 2004. With exception to two parcels which abut primary spawning reaches, supplementary secondary index reaches where spawning seemed less likely were surveyed only once during the 2006 spawning surveys due to the lack of live fish and redd observations in the primary spawning reaches. Table 1. lists the parcel numbers, survey date and observations (carcasses, redds, and live fish) for each spawning survey conducted in 2006. Observations of live salmonids, redds or carcasses made by the general public have not been included Table 1.

Spawning Survey Results

Carcass counts and redd sites in primary index reaches surveyed are summarized in Table 3 by date and location. In total, one live fish and two redds were observed in Reach A (mainstem Maxwellton) on the Outdoor Classroom property. The live fish was observed approximately 15 ft. upstream of the uppermost bridge crossing. One redd was located approximately 40ft downstream of the Erickson culvert outlet and the other redd was observed approximately 30ft from the survey starting point. Additionally, fish eggs and remnant fish fragments (unidentified species) were observed within the Maxwellton Road right-of-way upstream of the Maxwellton tide-gate. No other live fish redds or carcass were observed in the mainstem of Maxwellton Creek. Two redds were observed in Quade Creek, reach C on parcel R32933-168-297. One live fish and one potential carcass were reported by Quade Creek landowners.

Table 3. Spawning survey reaches and dates.

High Priority Primary Spawning Reaches	Spawner Survey Dates (X in box indicates parcel was surveyed on this date).										
	10/25/06	11/9/06	11/14/06	11/24/06	12/1/06	12/4/06	12/13/06	12/20/06	12/27/06	1/2/07	
<i>Trib A - mainstem Maxwellton</i>											
R32804-412-0310 ¹	X	X ²	X	X	X	X	X	X	X	X	X
R32910-374-0850	X	X	X ³	X	X	X	X	X ⁵	X	X	X
R32933-289-0730	*	*	*	*	X	X	X	X	-	X	X
<i>Trib C - Quade Creek</i>											
R32933-168-2970	X	*	X	*	*	X ⁴	X	X ⁶	-	X	X
<i>Trib G - Unnamed tributary</i>											
S8193-00-00006-0	*	*	*	X	X	X	X	X	-	X	X
<i>Trib H - Unnamed tributary</i>											
R32922-229-021	*	*	*	X	X	X	X	X	-	X	X
<i>Trib HH - Unnamed tributary</i>											
R32922-325-063	*	*	-	*	*	X	X	X	-	X	X
Moderate Priority Secondary Spawning Reaches	Spawner Survey Dates (X in box indicates parcel was surveyed on this date).										
	10/25/06	11/9/06	11/14/06	11/21/06	12/1/06	12/4/06	12/13/06	12/20/06	12/27/06	1/2/06	
<i>Trib A - mainstem Maxwellton</i>											
R32933-323-1000	*	X	X	X	X	X	X	X	-	X	X
<i>Trib C - Quade Creek</i>											
S8443-00-00006-0	-	-	-	-	-	-	-	X	-	-	-
S8443-00-00004-0	-	-	-	-	-	-	-	X	-	-	-
Low Priority Secondary Spawning Reaches	Spawner Survey Dates (X in box indicates parcel was surveyed on this date).										
	10/25/06	11/9/06	11/14/06	11/21/06	12/1/06	12/4/06	12/13/06	12/20/06	12/27/06	1/2/06	
<i>Trib A - mainstem Maxwellton</i>											
R32933-018-0780	-	-	-	-	-	-	-	X	-	-	-
R32933-145-1700	X	X	X	X	X	X	X	X	-	X	X
R32928-072-0970	-	-	-	-	-	-	-	X	-	-	-
<i>Trib H - Unnamed tributary</i>											
R32922-245-0950	-	X	-	-	-	-	-	-	-	-	-

* Access was not secured on this date.

- No survey was attempted

¹This property does not have spawning gravels, but is located at the mouth.

²Eggs and fish fragments were observed on road right-of-way.

³Live fish and redd observed

⁴One redd observed

⁵One redd observed.

⁶One redd observed

Section 6: Wild Fish Conservancy fall 2006 Maxwellton Creek Tidegate observations

Three new light-weight side hinge tidegate were installed by the Maxwellton Diking District #2 in September 2006; the gates were designed to be completely closed when tidal elevations exceed the elevation of the water surface elevation in the vault's upstream bay. This situation occurs when the tide level in Useless Bay rises above the pool elevation in the Maxwellton Tidegate pond. The pond's pool elevation is estimate to range from about 5 to 9 feet above MLLW, depending on flow conditions within Maxwellton Creek. Typical spring and fall pool elevations are approx. 6' to 8' above MLLW. Adult salmon passage at the site is further confounded by the water depth in the outfall culvert and the water depth in the meandering outlet channel across the Useless Bay beach and sand flats. For a thorough description of the new tidegate design considerations as they relate to tidal conditions, streamflow conditions, and fish passage, see the Technical Memorandum prepared by the Whidbey Island Conservation District, April 2006 (Appendix A), which was included with the Joint Aquatic Resources Permit Application (JARPA) for the tidegate construction project.

The northern-most tidegate was set at an elevation slightly lower than the other two gates so that at low flow, all flow would concentrate at the north gate instead of being dispersed across all three gates. The design allows one or more of the gates to be open for fish passage when the tidal elevation is less than the elevation of the pond water surface area immediately upstream from the gate structure. This design was intended to increase the number of hours each week that fish would be able to migrate into and out of Maxwellton Creek.

Wild Fish Conservancy evaluated the tide-gates during the 2006 fall spawning surveys, however, due to fall and winter tide heights crews were never able to observe the tide-gates open. Tom Slocum, PE, Washington Conservation Districts Northwest Region Engineer, observed the gates on June 25 2007. During a low tide, the minimal outflow from the pond held the northernmost of the three gates half-way open, sufficient for upstream and downstream fish migration. At the time, the other two gates were closed.

Discussion

This document represents an overview and synthesis of all available, contemporary fish-use data for the Maxwellton watershed; as such it provides an important baseline against which future comparisons can be made to evaluate the effectiveness of efforts made to improve conditions for fish (and presumably increase the abundance of fish) in the watershed. These efforts include modifications made at the tidegate facility (including the Diking District's efforts in summer 2006), instream habitat enhancement projects, fish passage improvements at culverts, and others.

Because of the number and extent of variables affecting fish abundance, evaluating the impacts of fish habitat improvement actions is a long process; in most cases, effectiveness monitoring projects require not years, but decades. Data need not be collected each year, but time is needed to bear out the affects of the habitat improvements. With time, enough generations of fish reap the benefits (or not) of the actions so that changes in fish abundance are measurable above and beyond the extensive natural (background) variability in abundance.

With the presence of effective local organizations present, including the Maxwellton Watershed Stewards and the Whidbey Island Conservation District, it is our hope that this compilation of Maxwellton fish data will form the foundation of a long-term fish abundance and species composition monitoring effort in the Maxwellton watershed.

APPENDIX A

Technical Memorandum prepared by the Whidbey Island Conservation District, April 2006

**Technical Memorandum
Whidbey Island Diking District No. 2 Maxwelton Tidegate Replacement Project
Salmonid Habitat Issues Associate with the Proposed Project**

Prepared by: Whidbey Island Conservation District, April 2006

Purpose

This memo discusses technical issues related to fish passage and salmonid habitat at Whidbey Island Dike District No. 2's (DD2) tidegate system located at the mouth of Maxwelton Creek in Clinton, Washington. The discussion is provided to assist Washington Department of Fish and Wildlife in reviewing DD2's and Whidbey Island Conservation District's (WICD) application for a Hydraulic Project Approval to replace the existing tidegates during summer 2006.

Background

During the past five years considerable effort has been expended in evaluating fish passage conditions at the Maxwelton tidegates. In 2001 the Maxwelton Salmon Adventure (MSA) organization received a Washington SRFB grant to evaluate the feasibility of restoring salmonid habitat in the former Maxwelton Creek estuary. MSA hired Northwest Hydraulic Consultants, Inc. and Jones and Stokes Inc. to complete this study, titled *Maxwelton Lower Reach and Fish Passage Feasibility Study* (NHC, 2002). In 2005, Island County contracted R2 Resource Consultants and Washington Trout to prepare a technical memorandum titled *Fish Passage Review for Maxwelton Creek and Glendale Creek Mouths* (R2, 2005). Pertinent findings and conclusions from these studies, as well as from data developed by WICD in winter 2006 for the design of the current proposal, are included in the discussion below.

Existing Tidegate Conditions

Sheet Nos. 2, 3, and 4 of the JARPA show elevations, cross sections, and other relevant measurements of the existing tidegate system. In brief, the system consists of a 5-foot diameter concrete outfall pipe, a concrete vault in which there are three tidegates, and a 5-foot diameter concrete inlet pipe. The three gates are attached to a concrete wall that divides the vault into two equal-sized bays. The center gate is a round, 36"-diameter side-hinged aluminum flap gate. On each side of the center gate is a rectangular, top-hinged heavy steel flap gate. The hinges on all three gates are deteriorating and need to be replaced. Currently the hinges on the rectangular gate on the north side of the vault are so corroded that DD2 has sealed this gate closed with a 4"x 4" timber. The south side rectangular gate is operating, but because of its heavy weight, higher invert elevation, and position off-set from the center line of the inlet culvert, relatively little flow passes through it under normal flow conditions. The lighter-weight center gate, with its lower invert elevation, side-hinged design, and orientation directly in-line with the inlet culvert, currently passes the majority of the flow.

Proposed Renovations

DD2 and WICD propose to replace the three gates with new, lightweight, side-hinged gates in order to improve fish passage conditions through the vault. A schematic design of the proposed renovations is shown in Sheet 5. An analysis of tidal elevations, flow velocity, and other relevant habitat issues associated with the proposal is presented below.

Tidal Elevation Conditions

The new tidegates are designed to remain open whenever the water surface elevation (w.s.e.) in the vault's upstream bay is higher than in the downstream bay. This situation occurs when the tide level in Useless Bay drops below the pool elevation in the Maxwellton tidegate pond. The pond's pool elevation is estimated to range from about 5 to 9 feet above mean lower low water (MLLW), with the high range associated with peak runoff conditions and the low range representing summer low flow conditions. Typical spring and fall pool elevations are in the 6' to 8' range. The mean tide level at the site is estimated to be about 6.0 feet above MLLW¹. Accordingly, the tide level is below 6.0' for 50 percent of the time. Interpolations of WDFW's tide exceedance charts² estimate that the amount of time that the tide level at the site will be below the following inlet pool w.s.e. will be roughly:

Inlet pool w.s.e. (feet above MLLW)	Approx. percent of time that tide elevation is below inlet pool w.s.e.
5.0	40%
6.0	50%
7.0	60%
8.0	70%
9.0	80%

Therefore, depending on the pool level, the tidegates are designed to open between 40 to 80 percent of the time.

Even when the tidegates are open, however, below a certain tidal stage the water depth in the outfall culvert and particularly in the meandering outlet channel across the Useless Bay sand flats can block upstream adult fish passage. Based on a limited survey by WICD, it appears that the controlling elevation for water depth is a point in the outlet channel about 200 feet off shore where the thalweg elevation is about 3.2' above MLLW (see Sheet 2). Assuming that the minimum water depth for adult salmon migration is 0.8 feet (WDFW, 2003)³ it is difficult for salmonids to enter the outfall pipe when the tide level drops below $3.2' + 0.8' = 4.0'$. This situation is estimated to occur about 30 percent of the time. Accordingly, subtracting the low tide elevation barrier (i.e. shallow depth in the outlet channel) from the high tide elevation barrier (i.e. closure of the tidegates), adult fish passage into Maxwellton Creek would be possible roughly 10 percent to 50 percent of the time, depending on the inlet pool elevation.

Velocity Conditions

The existing tidegate outfall is a relatively smooth-walled, 5'-diameter concrete pipe with an effective bed slope of about 0.0043 feet/feet (i.e. 0.43 percent)⁴. The 2002 Maxwellton feasibility

¹ All tidal elevations are interpolated between the Admiralty Head and Glendale tide stations, which are the nearest two tide stations for which accurate US Army COE tide elevation data are available. All elevation data are referenced to an Island County benchmark at the intersection of Maxwellton Road and Swede Hill Road.

² Table 5-2, *Design of Road Culverts for Fish Passage*, p. 25, Table 5-2. Assumes Maxwellton's tides are most similar to the Aberdeen station.

³ For chum. The depth guideline for coho is 1.0 feet depth.

⁴ "Effective" refers to the measurement of the slope as the elevation difference between the invert at the inlet of the pipe and the elevation of the channel bed at the pipe outlet. The pipe outlet is filled to a depth of about 18" with

study estimated the flow velocity in the outfall pipe to range from 0 (when backwatered by the tide) to 3.5 feet per second (NHC, 2003).⁵ WDFW guidance identifies a maximum fish passage flow velocity of 4.0 fps for adult coho (3.0 fps for adult chum) in 100 to 200 foot long culverts. (WDFW, 2003). Accordingly, the estimated range of flow velocities in the outfall pipe does not exceed WDFW's velocity guidelines for adult coho but does exceed the guidelines for chum some portion of the time. The flow velocity in the outlet pipe is suitable for juvenile salmonids generally only when the outfall is backwatered by the tide.

Water Quality Conditions

The 2002 feasibility study presents data and analysis of the temperature and water chemistry differences between Useless Bay and the tidegate reservoir. While there appears to be a small degree of salt water influence into the tidegate pool, the gradual gradation between fresh water and salt water temperature, salinity, and other water quality parameters that is typical of estuaries is largely absent at the mouth of Maxwelton Creek. The existing water quality conditions are not expected to be effected by the proposed tidegate replacement.

Summary of Impacts on Fish Passage and Fish Habitat

Replacement of the existing tidegates with new, light-weight, side-hinged gates will result in a modest improvement in fish passage conditions by extending the duration of time when adult salmon can swim through the tidegate system, compared to the current situation. It is estimated that adult fish passage will be possible between tidal elevations of 4.0 feet above MLLW to up to 9.0 feet above MLLW, depending on the w.s.e. in the inlet pool. This is estimated to represent between 10 percent and 50 percent of the duration of the total tidal cycle. Juvenile fish passage will be possible between tidal elevations of about 3.5' MLLW to up to 9.0 feet MLLW, but only during falling tides. The project is not expected to significantly affect the existing water quality conditions at the site. In particular no significant improvement in the existing abrupt change in temperature and salinity between the bay and the tidegate reservoir is expected.

References

Northwest Hydraulic Consultants, Inc. *Maxwelton Lower Reach and Fish Passage Feasibility Study*, September 2002.

WDFW. *Design of Road Culverts for Fish Passage*. 2003

NOAA Fisheries. *Draft Anadromous Salmonid Passage Facility Guidelines and Criteria*. 2004.

R2 Resource Consultants, Inc. *Technical Memorandum: Fish Passage Review for Maxwelton Creek and Glendale Creek Mouths*. October 2005.

Charland, Jay. *Tidegate Modifications for Fish Passage and Water Quality Enhancement*. Tillamook Bay National Estuary Project. August 1998.

gravel and cobble. The pipe runs about 71 feet to a junction where it bends about 49° and continues another 45 feet to the outlet. (See Sheet 2).

⁵ No calculations or backup data are provided in the NHC report to substantiate this estimate. This figure differs substantially from velocity estimates calculated from standard Manning equation nomographs, which estimate a range from 0 to about 6.8 feet per second under the typical range of flows in the pipe.