Habitat

The purpose of the Habitat Analysis study was to assess fish habitat in lower Vasa Creek (downstream of I-90) and to evaluate the capacity of the stream to support kokanee salmon spawning.

Kokanee salmon were once numerous in Lake Sammamish but today spawn only in a few streams. Kokanee do not go out to the ocean but spend their entire lifecycle in fresh water. While kokanee have been observed in Vasa Creek, their presence has been periodic and in low numbers.

Key Findings

Lower Vasa Creek has channel dimensions and sediment composition very similar to other major kokanee creeks draining Lake Sammamish, so should be considered potential habitat for kokanee. If kokanee can access the stream, it is likely they can spawn successfully.

There is potential for habitat improvement:

- **Shade the Stream:** Shading from trees and shrubs helps keep water cold and stabilizes stream banks. Excellent shade (greater than 90% coverage) was found in 9 of the 12 reaches. Stream areas with lawns to the stream edge could be improved by planting trees and shrubs.
- **Reduce impact of barriers:** Several potential fish passage barriers were discovered within the lower reaches.

Habitat

One private and two city-owned culverts were identified as potentially slowing migration unless there is adequate rain to increase the stream depth, thereby giving fish more space to jump.

Five grade control weirs (small waterfalls, see photo) need deeper pools to allow fish to jump over logs or rocks installed to stabilize the stream bed. The barriers are located on private property between 137th Ave SE and 164th Pl SE.

- **Increase Wood:** Lower Vasa Creek needs more large pieces of wood in the stream to create complex habitat, especially deep pools. Lack of pools limits the ability for kokanee to rest, find cover from predators, and jump over barriers.
- **Improve the first point of access:** The lowest portion of Vasa Creek, near Lake Sammamish, could benefit the most from improvements. There is development close to the stream, limited shade, rock armoring (riprap), lack of wood in the channel, and few pools. Because all kokanee and other salmon need to pass through this section to spawn, the whole system would benefit from improvements in this area.

Fish Studies

- Lack of pool habitat may be limiting fish diversity and the number of older trout residing in Vasa Creek. Only cutthroat trout were observed in a 151 foot survey area of lower Vasa Creek. Most (95%) of the 86 trout captured were less than 3 inches long, indicating they were less than one year old. Only two fish were more than one year old.

Habitat

What will Bellevue Utilities do with this information?

- Fix fish passage at public culverts through the Bellevue Utilities Fish Passage Improvement Capital Program, D-81.
- Provide or coordinate technical assistance to property owners wanting to improve habitat.

What can you do to help?

- Plant native trees and shrubs near the stream to provide shade and habitat.
- Place wood to create pools. Construct better fish passage over grade control weirs. This will require local and state permits.

  Contact Angie Peace, Washington Department of Fish and Wildlife, Regional Habitat Biologist *Angie.Peace@dfw.wa.gov*, 425-427-0570 for technical assistance.

  Contact Mark Taylor, Trout Unlimited, for volunteer help and assistance. Personal Cell (206) 200-2840. Email emtbckt@msn.com. Trout unlimited web information www.tu-bi.org/kokaneeproject.htm
- If you see kokanee, call or email Bellevue Stream Team at 425-452-5200 or *streamteam@bellevuewa.gov*.

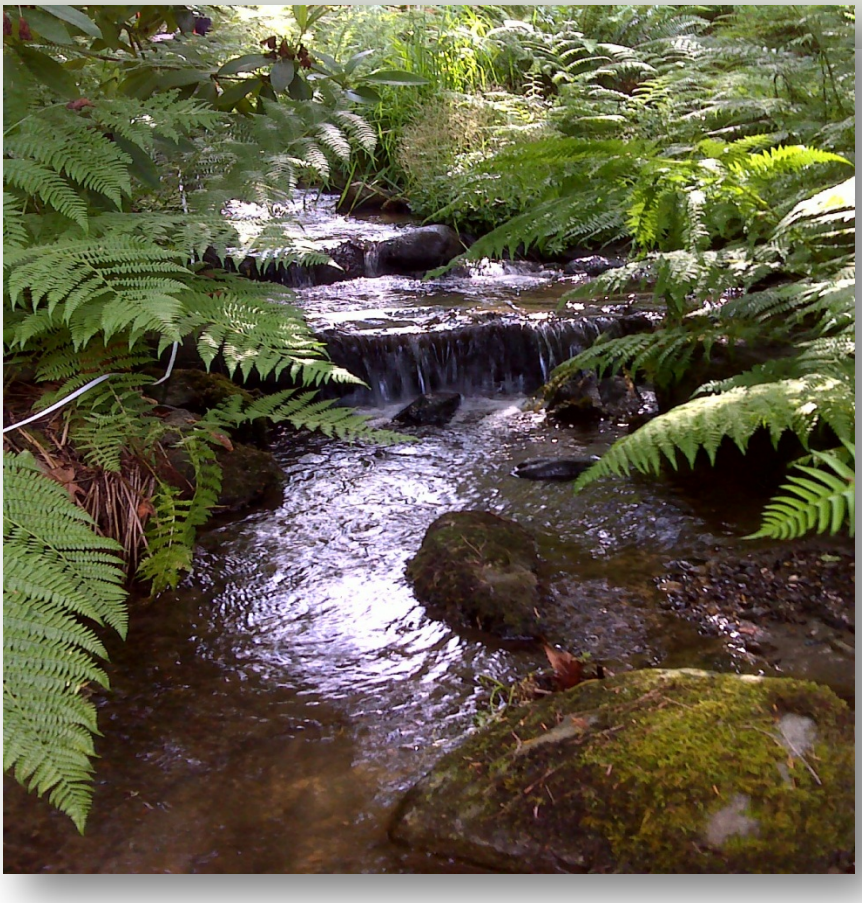
For Additional Information

Questions? Kit Paulsen, Bellevue Utilities, 425-452-4861

Technical reports are available at: http://bellevuewa.gov/pdf/Utilities/Vasa_Creek_Final_Habitat_Memo.pdf

Kokanee Workgroup Information: www.kingcounty.gov/environment/animalsAndPlants/salmon-and-trout/kokanee.aspx

Vasa Creek Fish Habitat Assessment



Prepared for:

City of Bellevue
450 110th Ave. NE
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19803 North Creek Parkway
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August 2014

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August 2014

Contents

Attachments

List of Tables

List of Figures

1. Introduction

1.1 Background Information

Vasa Creek is a 1,085-acre basin located in the Puget Lowland that drains into the southwestern end of Lake Sammamish. The watershed is highly developed with a mixture of predominately residential, commercial and institutional development. Forty percent of the land cover is classified as impervious surface. The basin elevation ranges from 31 to 1,195 feet (City of Bellevue 2009).

The portion of Vasa Creek (lower Vasa Creek) downstream of Interstate 90 (I-90) is migratory fish bearing, with occasional rainbow trout, cutthroat trout, coho salmon, and late-run kokanee salmon present. The presence of I-90 is a complete fish passage barrier, preventing upstream access beyond this point. Furthermore, kokanee spawning habitat within the tributary creeks to Lake Sammamish is relatively limited. Suitable spawning habitat in most Lake Sammamish tributaries occurs in short reaches due to migration barriers or poor channel conditions upstream (Connor et al. 2000).

Recent results from the Lake Sammamish Kokanee Technical Work Group (LSKTWG) highlight the importance of the Lake Sammamish tributaries for kokanee salmon. The LSKTWG (2013) report results have shown a major spike in escapement estimates from 2013 demonstrating the success of the supplementation program that began in 2010-2011 and underscoring the need for evaluating kokanee habitat and restoration potential in Lake Sammamish tributaries.

1.2 Project Overview

Tetra Tech was contracted by the City to assist with ongoing efforts to study fish habitat and slope stability in the Vasa Creek (State Stream #08-0156) and the East Tributary to Vasa Creek stream corridors. The objective of this project is to evaluate kokanee salmon habitat in the accessible portions of lower reach of Vasa Creek (downstream of I-90) and slope stability concerns upstream that may negatively impact habitat quality and/or restoration potential. This work builds on the technical report (master's thesis) by Britton (2013) that examined Vasa Creek channel conditions and slope stability in a stream segment upstream of the I-90 crossing, which is a complete barrier to fish passage.

This project has two discrete components; a landslide assessment, and a fish habitat assessment. The landslide assessment component of the field work occurred in May of 2014. The results from that effort are available in the *Vasa Creek Landslide Inventory and Slope Stability Reconnaissance* technical memo (Tetra Tech 2014). The fish habitat assessment field work was completed in June of 2014. During the habitat assessment survey, Tetra Tech staff surveyed

lower Vasa Creek assessing habitat conditions using the assessment protocols of the Washington Department of Ecology for Status and Trends Monitoring (WADOE 1999). In addition to the habitat data collected, Outfall Reconnaissance Inventory/Sample Collection forms were completed for observed discharges.

The habitat assessment surveys were conducted on the extent of lower Vasa Creek between the outlet of the I-90 crossing and the mouth of Vasa Creek at Lake Sammamish (approximately 1,270 meters). Within this reach, a series of relatively evenly spaced representational stream transects were identified starting at Transect A (near the mouth) and ending at Transect K (at the fish passage barrier). Section 2 describes the layout of transects and data collection methods in greater detail. Figure 1 contains the habitat assessment area surveyed and the habitat survey transect locations. The gaps in the survey area downstream of Transect A and between Transect B and West Lake Sammamish Parkway were not surveyed due to access being denied by landowners for those parcels (Figure 1). Data were also collected to characterize a left bank (facing downstream) tributary to Vasa Creek following the same methods described in Section 2.

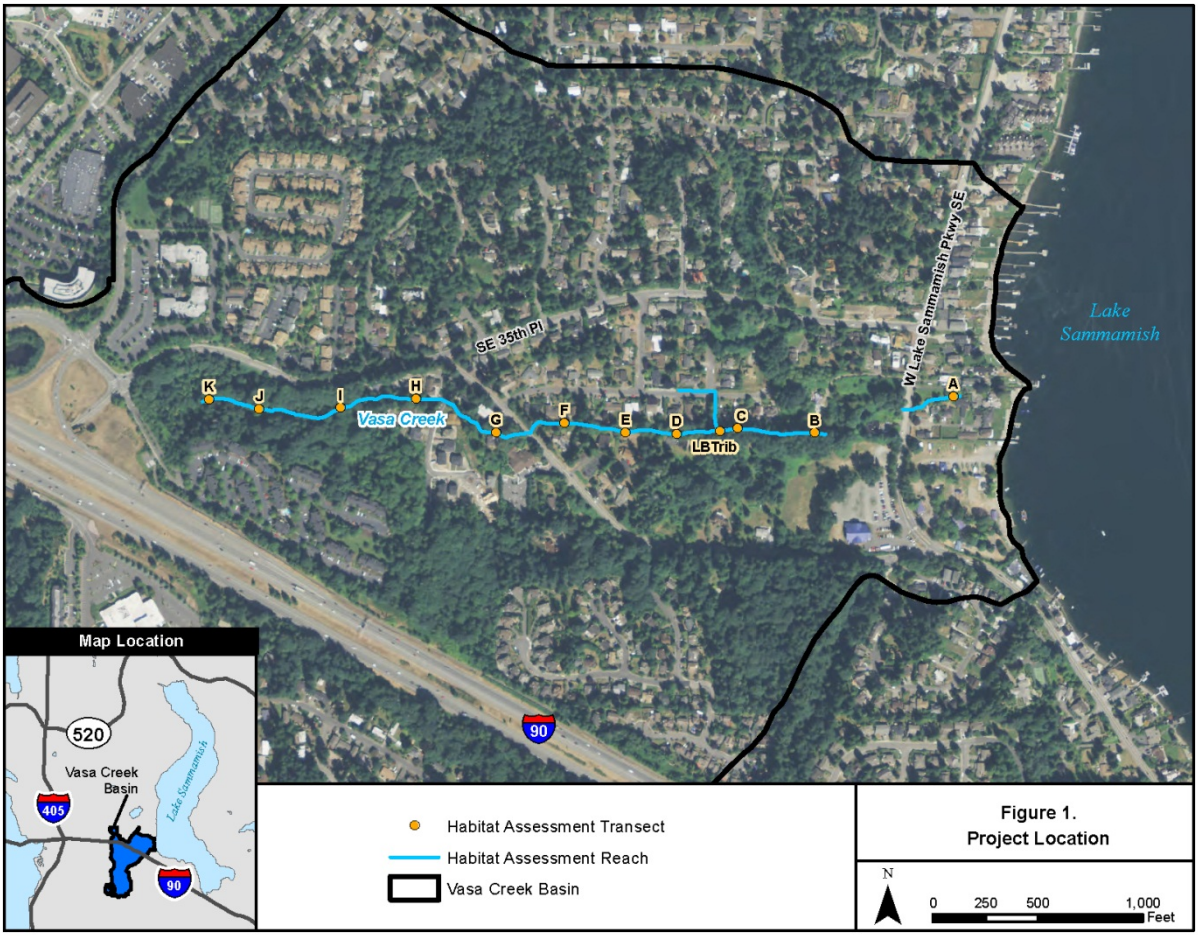

Figure 1. Location Map of Lower Vasa Creek Basin and Fish Habitat Assessment Transects

The remainder of this document will describe the results of the fish habitat assessment as follows:

- Section 2 contains a description of the field data collection and reporting methods, and a summary of methodology limitations;
- Section 3 contains a summary of the fish habitat assessment findings;
- Section 4 contains a summary of results from macroinvertabrate sampling from Rithron (2011);
- Section 5 contains a summary of recent electrofishing results from City of Bellevue (2014);
- Section 6 contains a discussion of results and a list of recommendations based on the fish habitat assessment work that was conducted; and
- Section 7 lists references cited in the document.

2. Methods

2.1 Data Collection

Tetra Tech's field crew conducted a fish habitat assessment of lower Vasa Creek, downstream of the I-90 crossing, using the Status and Trends Monitoring for Watershed Health & Salmon Recovery: Field Data Collection Protocol (WADOE 1999). Only lower Vasa Creek was surveyed due to the complete fish passage barrier at I-90.

As described in Section 1, survey transects were set up to characterize the fish habitat in lower Vasa Creek from I-90 downstream to the mouth. This is a variation on the WADOE (1999) protocol in that it recommends the site length should be 20 times the average bankfull width. This is because typically these surveys are meant to be used as samples that represent much larger areas. Due to the relatively short distance of the accessible fish habitat in lower Vasa Creek, Tetra Tech modified the protocol to cover the entire reach extent instead of just sample reaches, except where landowner access was denied.

Field data were collected at major and minor transects as well along the entire channel survey length. Figure 2 contains a conceptual diagram describing the layout of major and minor transects. Minor transects (dashed line) were located midway between major transects (solid line). Continuous data collected between major transects (blue line) are described by stream segments (i.e., Segment A-B). Data collected at the various locations are described below.

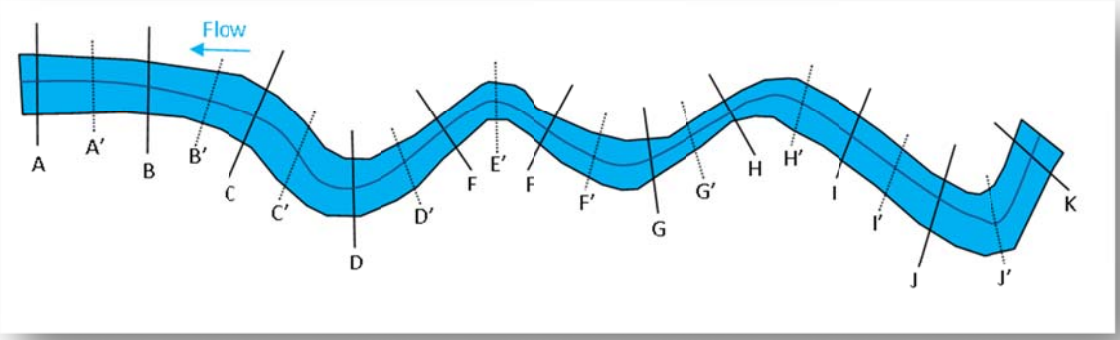

Figure 2. Field survey sampling layout of major and minor transects. Adapted from WADOE (2006).

At major transects (solid line):

- Slope and bearing
- Wetted and bankfull width
- Wetted and bankfull height
- Substrate size and embeddedness
- Water depth, bankfull depth
- Bar width
- Bank instability
- Canopy shade
- Fish cover
- Near bank human disturbance
- Riparian vegetation structure
- GPS coordinates of transects
- Photographs

At minor transects (dashed line):

- Wetted and bankfull width
- Substrate size and embeddedness
- Water depth and bankfull depth
- GPS coordinates of transects
- Photographs

Along the entire survey length:

- Habitat units
- Thalweg depth
- Presence of side channels
- Presence of bars
- Tally of Large woody Debris (LWD)
- GPS coordinates of transects
- Photographs

In total, 12 major survey transects were established: 11 on Vasa Creek (A to K), and 1 on a left bank tributary (LBTrib) located 420 meters (1,378 feet) upstream of the mouth (Figure 1). Minor transects, where less detailed data collection took place (described below), were located mid-way between each major transect. The downstream extent of the survey (Transect A) was located 90 meters (295 feet) upstream of the mouth of Vasa Creek and the upstream extent (Transect K) was near the I-90 crossing outlet (Figure 1). The distribution of habitat units and amount of LWD was collected throughout the length of the segments between major transects. Two sections, totaling 230 meters (754 feet), were not surveyed due to access to those parcels being denied. In total, 1,020 meters (3,346 feet) were surveyed on Vasa Creek as part of the fish habitat assessment. A length of 50 meters (164 feet) was surveyed on the left bank tributary before it reached the residential road network.

Habitat Units

Habitat unit type, length, and characteristics were identified throughout the length of the survey reach. Habitat units were classified into the following habitat unit types:

- Fast non-turbulent – habitat unit with flow that has a smooth surface and is less deep than in pools.
- Fast turbulent – habitat unit with supercritical flow, with hydraulic jumps sufficient to have a water surface that is rippled or contains whitewater.
- Pools – habitat units with a maximum depth at least 1.5 times the pool tail crest depth (WADOE 1999).

The locations of all habitat unit breaks were identified in the field. Where there were consecutive pools in a series, all were included as a single habitat unit with the downstream pool dimensions being measured and the others tallied.

Channel Dimensions

Physical channel dimensions were measured at each major and minor transect using standard field methods. At major transects, these dimensions included wetted width, bankfull width, bar

width, wetted depth, slope, and bearing. The same data were collected at minor transects, except for bankfull depth.

Shading and Riparian Vegetation

Densitometer readings were taken at each major transect to evaluate the percent shade. Readings were taken from the center of the channel facing upstream, downstream, right bank, left bank, and at the channel banks.

A categorical assessment of the riparian vegetation structure was also conducted at each major transect. Vegetation type and abundance was evaluated for the canopy, under-canopy, and ground cover.

Fish Cover and LWD

The amount of available fish cover including woody debris, brush, over-hanging vegetation, undercut banks, boulders, ledges, and artificial structures was evaluated at each major transect. The presence of algae and macrophytes/bryophytes was also recorded.

Pieces of LWD with a diameter greater than 0.1 meter and length greater than 2 meters were tallied between each major transect. Only pieces of LWD located within the bankfull channel were counted.

Substrate Size and Embeddedness

Substrate size and fine sediment embeddedness were evaluated at major and minor transects. The dominate and sub-dominate substrate size classes and percent relative abundance were visually estimated at sample points across each transect. Substrate sizes classes included boulder, cobble, coarse gravel, fine gravel, sand, fines and hardpan.

Habitat Assessment Field Forms were used to document habitat characteristics according to field protocols. The entire set of completed field forms is included in Attachment B (Habitat Assessment Field Forms).

Additionally, the City Outfall Reconnaissance Inventory/Sample Collection Field Forms were completed to document characteristics of all outfalls observed during the habitat field surveys downstream of 163rd Avenue SE. Outfalls upstream of 163rd Avenue SE were inventoried during the landslide inventory and included in Tetra Tech (2014). There may have been additional outfalls within the project area that were not detected due to vegetation cover and therefore not surveyed. The field data collected included the following items regarding detected outfalls:

- Location data (GPS Point, Photo)
- Outfall type (Material, Shape, Size)

- Flow dependent indicators (Odor, Color, Turbidity, Floatables)
- Site indicators (Outfall Damage, Deposits/Stains, Abnormal Vegetation, Poor Pool Quality, Pipe Benthic Growth)

The entire set of completed field forms is included in Attachment C (Lower Vasa Outfall Reconnaissance Inventory/Sample Collection Field Forms).

2.2 Methodology Limitations

Since this assessment occurred in June, only low flow habitat conditions within lower Vasa Creek were assessed. While historically the Lake Sammamish kokanee had three distinct run timings that spanned August through December, the current opinion is that only the late-run kokanee (late October through early January) spawn in any great numbers (LSKWG 2013).

The field protocols used for this assessment did not include a fish passage barrier assessment; therefore, one was not completed. During the habitat survey, the location of potential barriers was documented and photographs were taken. Although these observations provide for an estimate of fish passage conditions during low flows, more detailed observations in winter months, during higher flow conditions, would be needed to evaluate fish passage potential during the period when late-run kokanee are thought to be present. In addition, the Washington Department of Fish and Wildlife (WDFW) Fish Passage and Diversion Screening Inventory (FPDSI) database was reviewed for existing fish passage evaluations (see Section 6.0). Figure A-1 to Figure A-3 in Attachment A contain the location of culverts with existing fish passage evaluations.

3. Summary of Findings

3.1 Habitat Assessment

All survey transects were located in lower Vasa Creek, between the mouth of Vasa Creek and the I-90 crossing. The Left Bank Tributary (LBTrib) is represented by a single transect just upstream of the Vasa Creek confluence.

Two areas were not surveyed due to restricted landowner access: 1) the 90 meters (295 feet) downstream of Transect A and 2) the area between stations A.4 and B.0, due to restricted landowner access just upstream of West Lake Sammamish Parkway (140 meters (460 feet)). The following subsections summarize the results of the data collected during the assessment. The completed field data forms can be found in Attachment B.

3.1.1 Habitat Units

Habitat units were delineated for the entire length of the survey. Individual habitat units were identified with an alphanumeric code beginning with downstream transect letter followed by a number incrementing in the upstream direction (e g., A-1, A-2, A-3). The majority (83 percent) of the habitat in the survey area was classified as fast, turbulent habitat, commonly referred to as riffles. A smaller proportion (4 percent) was classified as fast, non-turbulent habitat, commonly referred to as glides or runs. Pools represented 12 percent of the total length. Table 1 summarizes the length of the habitats found in Vasa Creek. The field data can be found in the forms included in Attachment B. There were no side-channels detected during the habitat assessment of lower Vasa Creek.

Table 1. Habitat Unit Length

Habitat Type	Length Present (m)	Percent of Reach Length (%)
Turbulent	849.5	83
Non-Turbulent	44.2	4
Fast Water Subtotal	**893.7**	**88**
Scour Pool (10)	17.9	2
Plunge Pool (55)	108.4	11
Slow Water Subtotal	**126.3**	**12**
Total	**1,020**	**100**

A total of 65 pools were identified along lower Vasa Creek (0.06 pools per meter surveyed). Table 2 summarizes the dimensions for each pool identified. Pool habitat was found in each of the segments surveyed; however, the number of pools per segment was variable (Table 2). The pools identified were scour pools and plunge pools formed by boulder or woody debris steps (Figure 3). Some of the structures creating plunge pools (D2, D4, D6, E4, and G6) may be potential barriers to upstream passage by adult kokanee due to the shallow pool depths compared to the height of the structures.

Figure 3. Plunge Pool A4

Table 2. Pool Habitat Units

Habitat Unit	Habitat Type[1/]	Pool Code	Pool Width (m)	Pool Length (m)	Max Pool Depth (m)	Pool Crest Depth (m)	Notes
A2	PS	B	1.3	0.5	0.16	0.08	
A4	PS	B	1.9	0.8	0.35	0.03	
B4	PP	SWD	2.2	1.0	0.12	0.04	
B8	PS	B	0.5	1.1	0.13	0.08	
B10	PS	B	0.8	3.0	0.2	0.1	
B12	PS	B	1.1	3.5	0.19	0.08	
C2	PS	SWD	1.0	3.0	0.16	0.08	
C4	PP	LWD	1.7	1.2	0.27	0.01	
C6	PP	B	1.9	1.1	0.28	0.06	2 pools
C8	PP	SWD	1.3	1.4	0.23	0.06	
D2	PP	B	1.9	1.2	0.27	0.04	Potential Barrier
D4	PP	B	1.0	0.8	0.17	0.06	Potential Barrier
D6	PP	LWD	2.2	1.5	0.17	0.04	2 pools, Potential Barrier
D8	PP	B	1.8	6.3	0.2	0.04	2 Consecutive pools
E2	PS	LWD	0.7	1.5	0.17	0.05	2 pools
E4	PP	LWD	1.3	1.2	0.3	0.06	2 pools, Potential Barrier
E6	PP	B	1.7	1.1	0.2	0.09	2 pools
E8	PP	B	2.0	1.3	0.21	0.06	
E10	PP	B	0.8	0.8	0.13	0.09	
E12	PP	B	1.8	1.0	0.25	0.08	
E14	PP	B	1.3	1.0	0.15	0.05	
F2	PP	B	1.4	1.1	0.19	0.04	
F4	PP	B	1.1	6.0	0.15	0.07	3 Consecutive pools
F6	PP	B	0.9	7.5	0.26	0.07	2 Consecutive pools
F8	PP	Concrete	1.9	27	0.24	0.07	9 Consecutive micro pools
F10	PP	B	2.0	1.1	0.26	0.06	
G2	PS	R	0.8	2.6	0.16	0.07	
G4	PP	B/SWD	1.2	0.8	0.18	0.09	
G6	PP	B	1.2	7.3	0.26	0.08	3 Consecutive pools, Potential Barrier

Table 2. Pool Habitat Units (continued)

Habitat Unit	Habitat Type[1/]	Pool Code	Pool Width (m)	Pool Length (m)	Max Pool Depth (m)	Pool Crest Depth (m)	Notes
G8	PP	B	0.6	1.4	0.22	0.09	
H2	PP	SWD	0.9	0.9	0.14	0.02	
H4	PP	SWD	1.0	1.1	0.16	0.06	
H6	PP	SWD	1.1	1.2	0.19	0.03	
H8	PP	SWD	1.0	0.6	0.13	0.03	
I2	PS	B	1.6	0.9	0.13	0.01	
J2	PS	LWD	0.8	1.0	0.15	0.06	
J4	PP	B/SWD	1.1	1.3	0.16	0.08	
J6	PP	SWD	1.1	18	0.16	0.05	4 Consecutive pools
J8	PP	B	1.0	5.5	0.20	0.04	
J10	PP	B	2.1	1.7	0.28	0.04	
Trib2	PP	LWD	2.4	2.0	0.37	0.04	Installed LWD
Trib4	PP	LWD	2.3	1.5	0.31	0.06	Installed LWD
Trib6	PP	LWD	2.0	1.5	0.35	0.04	Installed LWD
Mean			**1.4**	**2.9**	**0.21**	**0.06**	
SD			**0.5**	**4.8**	**0.07**	**0.02**	

[1/] PP- Plunge Pool, PS- Scour Pool, B-Boulder, SWD-Small Woody Debris, LWD-Large Woody Debris

3.1.2 Channel Dimensions

Channel dimensions, slope, and bearing were measured at major and minor transects. Table 3 contains channel dimensions collected at each transect and summary statistics. Wetted channel widths at the time of survey ranged from 0.7 meter to 2.0 meters, with a mean of 1.4 meters. Wetted channel depths ranged from 0.04 meters (4 cm) to 0.10 meters (10 cm), with a mean of 0.06 meter (6 cm). Mean bankfull width and depth are 2.2 meters and 0.33 meter, respectively. Channel gradient ranged from 1.3 percent in downstream extent to 8 percent, excluding the steep (>20 percent) gradient barrier at the upstream extent. Additional water depths were taken as part of the habitat survey and can be found on the field forms in Attachment B.

Table 3. Channel Dimensions at Habitat Assessment Transects

Transect	Wetted Width (m)	Wetted Depth (m)	Bankfull Width (m)	Bankfull Depth (m)	Bar Width (m)	Percent Slope (ft/ft)	Bearing (degrees)
A	1.5	0.10	2.9	0.4	0	1	270
A'	1.7	0.04	3.0	--	0	1	270
B	1.7	0.09	2.5	0.3	0	2	240
B'	1.1	0.07	1.4	--	0	2	270
C	1.1	0.05	2.0	0.3	0	3	260
C'	1.1	0.05	1.6	--	0	3	270
D	1.1	0.09	2.9	0.35	0	5	280
D'	1.0	0.06	2.2	--	0.5	5	270
E	1.6	0.06	1.8	0.3	0	5	305
E'	1.1	0.08	1.7	--	0	5	210
F	0.7	0.04	1.1	0.5	0	5	290
F'	1.8	0.06	1.6	--	0	5	240
G	2.0	0.04	2.8	0.2	0	5	270
G'	0.7	0.05	1.2	--	0	5	300
H	1.0	0.10	1.5	0.4	0	8	270
H'	1.7	0.08	2.3	--	0	8	280
I	1.6	0.08	2.5	0.3	0	8	220
I'	2.0	0.04	3.1	--	0.5	8	270
J	1.8	0.07	2.5	0.3	0	4	300
J'	1.1	0.07	4.0	--	0.6	4	280
K	0.9	0.04	1.4	0.3	0	20	330
Mean	**1.4**	**0.06**	**2.2**	**0.33**	**0.08**	**4.7**	**271.2**
SD	**0.4**	**0.02**	**0.8**	**0.08**	**0.19**	**2.1**	**NA**
LBTrib	**0.9**	**0.03**	**1.7**	**0.3**	**0**	**4.7**	**320**

3.1.3 Shading and Riparian Vegetation

The results of the densitometer measurements are representative of overall streamside shading present along lower Vasa Creek, showing fairly high percentages of shading along the survey area, with a few exceptions (Table 4).

The section downstream of West Lake Sammamish Parkway (Transect A) flows through a residential area and is mostly backyard lawns with some patchy overhanging vegetation (Figure 4). This is reflected in the result of 23 percent shading (Table 4). Transect E occurred at a bend where the right bank consisted of an open lawn that ran up to the bank edge, resulting in 49 percent shading.

Figure 5 and Figure 6 show the dense riparian vegetation at Transects K and B, respectively, resulting in 100 percent shading.

Figure 4. Vegetation at Transect A

Table 4. Summary of Densitometer Readings

Transect	Center Upstream	Center Left Bank	Center Downstream	Center Right Bank	Left Bank	Right Bank	Percent Shading
A	2	1	0	4	6	10	23
B	17	17	17	17	17	17	100
C	17	17	17	17	17	17	100
D	11	17	15	14	17	14	88
E	12	14	3	1	15	4	49
F	17	17	17	16	17	15	99
G	17	17	17	17	17	17	100
H	15	15	14	15	17	16	92
I	17	17	17	17	17	17	100
J	15	16	13	15	17	17	93
K	17	17	17	17	16	17	100
LBTrib	17	17	17	17	17	17	100

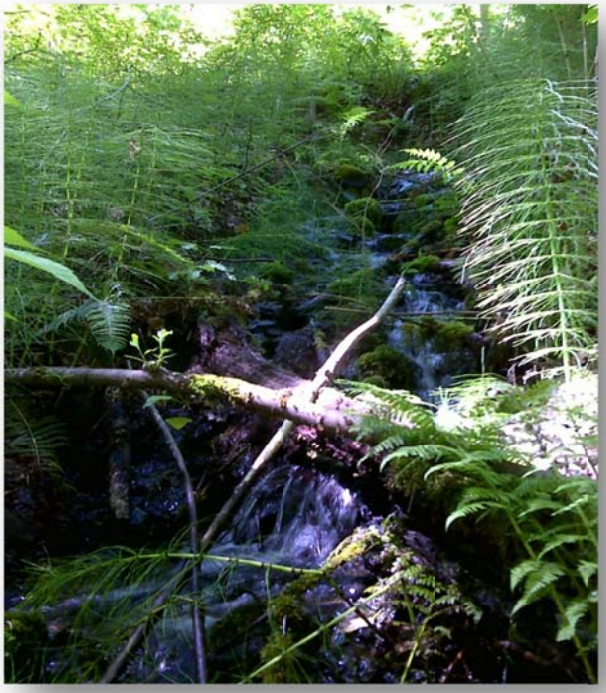

Figure 5. View Upstream of Transect K

Figure 6. Vegetation at Transect B

A summary of vegetation type and abundance for the canopy, under-canopy, and ground cover is contained in Table 5. The riparian canopy varied by type and abundance throughout the survey area. At Transects A, E, and F, riparian canopy was either absent or minimal (Table 5), which directly correlates with the low percentage of shading in those areas. Alternatively, at transects with greater shading, such as Transect B, all three layers of riparian vegetation were present and the canopy was dominated by large trees (Table 5).

Table 5. Summary of Riparian Vegetation Assessment

	Canopy			Under-canopy			Ground		
Transect-Bank	Type[1/]	Big Trees[2/]	Small Trees	Type[1/]	Woody	Non-woody	Woody	Non-woody	Bare
A-LB	N	0	0	D	1	1	0	3	1
A-RB	N	0	0	M	2	0	0	3	1
B-LB	D	3	2	D	1	2	1	2	2
B-RB	D	3	1	D	0	2	1	2	2
C-LB	M	2	1	D	2	3	2	1	2
C-RB	M	2	0	D	3	3	2	1	1
D-LB	C	2	0	D	0	0	0	3	0
D-RB	D	1	0	D	1	2	0	3	0
E-LB	D	2	1	D	2	1	0	3	1

Table 5. Summary of Riparian Vegetation Assessment (continued)

Transect-Bank	Canopy			Under-canopy			Ground		
	Type[1/]	Big Trees[2/]	Small Trees	Type[1/]	Woody	Non-woody	Woody	Non-woody	Bare
E-RB	N	0	0	N	0	0	0	3	2
F-LB	N	0	1	D	2	3	3	0	0
F-RB	N	0	0	N	0	2	0	3	0
G-LB	M	3	2	D	2	3	2	1	2
G-RB	N	0	0	D	2	1	1	1	2
H-LB	M	2	1	D	1	1	1	2	2
H-RB	M	2	1	D	1	1	2	3	1
I-LB	M	3	1	D	3	2	1	2	2
I-RB	M	3	2	D	3	2	2	2	2
J-LB	M	2	0	D	3	1	2	1	2
J-RB	D	2	1	D	3	1	2	1	2
K-LB	D	3	1	D	1	1	2	1	2
K-RB	M	3	0	D	3	1	2	1	2
LBTrib-LB	C	3	2	D	1	2	2	1	2
LBTrib-RB	D	3	2	D	2	1	2	1	2

[1/] D=Deciduous, C=Conifer, M=Mixed, and N=None. 0=Absent, 1=Sparse (<10%), 2=Moderate (10-40%), 3=Heavy (40-75%) and 4=Very Heavy (>75%).

[2/] Big trees are defined as greater than 5 meters in height.

3.1.4 Fish Cover and LWD

Fish cover is limited throughout the survey area with most resulting from in-stream boulders and overhanging vegetation. All of the transects were documented as having some fish cover, mostly documented as sparse or moderate (Table 6). Three transects were noted as having "heavy" (40-75%) fish cover of some type, Transects E, G, and K, and none were documented as having "very heavy" (>75%) fish cover of any type (Table 6). Table 6 summarizes the abundance of fish cover by type for each of the major transects.

Table 6. Summary of Fish Cover

Transect	Algae	Macrophytes / Bryophytes	Woody Debris	Brush	Overhanging Veg	Undercut Banks	Boulders Ledges	Artificial Structures
A	0	1/0	0	0	0	0	2	1
B	0	0/0	1	1	1	0	0	1
C	0	0/0	0	0	2	0	0	0
D	0	0/0	0	0	1	0	0	0
E	0	0/0	0	0	2	0	3	3

Table 6. Summary of Fish Cover (continued)

Transect	Algae	Macrophytes / Bryophytes	Woody Debris	Brush	Overhanging Veg	Undercut Banks	Boulders Ledges	Artificial Structures
F	0	0/0	0	1	2	0	2	0
G	0	0/0	0	0	2	1	0	3
H	0	0/0	1	0	1	1	2	0
I	0	0/1	2	0	2	1	1	0
J	0	0/0	2	1	2	0	1	0
K	0	0/3	1	0	2	0	3	0
LB Trib	0	0/0	1	1	2	0	2	0

Scale: 0=Absent, 1=Sparse (<10%), 2=Moderate (10-40%), 3=Heavy (40-75%), and 4=Very Heavy (>75%)

The quantity of LWD (diameter greater than 0.1 meter and length greater than 2 meters) in the survey area is also limited. Some LWD was found in all segments, with the exception of F-G, where no LWD was documented (Table 7). The smaller pieces of wood were more abundant and did function in the channel to form steps and scour pools. Table 7 includes LWD quantities for stream segments between the major transects.

Table 7. Summary of Large Woody Debris Inventory

	Log Dimensions (length / diameter)			
Segment	2-5 (m) / 0.1-0.3 (m)	2-5 (m) / 0.3-0.6 (m)	5-15 (m) / 0.1-0.3 (m)	5-15 (m) / 0.3-0.6 (m)
A-B	1	0	0	0
B-C	1	1	0	0
C-D	0	2	0	0
D-E	1	1	0	0
E-F	3	0	0	0
F-G	0	0	0	0
G-H	0	0	1	0
H-I	2	0	1	2
I-J	1	1	2	0
J-K	2	0	1	1
K	0	0	1	0
LBTrib	0	4	0	0

3.1.5 Substrate Size and Embeddedness

Channel substrates in the survey area ranged from fines to cobbles with the most common dominate substrate type being fine gravel. Boulders placed along the channel for bank protection and within the channel for grade control are common. Table 8 contains the dominant and sub-dominant substrate types, as well as embeddedness for each of the major and minor

transects. The field data taken from the substrate cross-sections can be found on the field forms in Attachment B.

Table 8. Summary of Substrate Size and Embeddedness

Transect	Dominant Substrate	Dominant (%)	Sub-Dominant Substrate	Sub-Dominant (%)	Mean Embeddedness (%)
A	GF	46	SA	36	56
A'	GF	46	GC	36	--
B	GF	64	GC	27	30
B'	CB	36	SA	27	--
C	GF	82	FN	18	26
C'	GF	36	CB	27	--
D	GF	36	FN	27	57
D'	GF	55	GC	27	--
E	BL	36	GC	36	40
E'	GF	45	SA	36	--
F	GF	45	SA	18	66
F'	GC	55	GF	27	--
G	GF	36	GC	18	61
G'	GC	82	BL	2	--
H	CB	45	SA	36	53
H'	GF	55	GC	18	--
I	GF	36	GC	27	56
I'	GC	45	GF	18	--
J	CB	27	GC	27	37
J'	SA	55	GC	27	--
K	SA	73	CB	9	84
LBTrib	SA	73	GC	18	78

BL=Boulder, CB=Cobble, GC=Gravel Coarse, GF=Gravel Fine, SA=Sand, FN=Fines, HP=Hardpan

3.2 Outfall Reconnaissance Inventory

During the habitat assessment, the location of additional previously unobserved outfalls was documented and Outfall Reconnaissance Inventory/Sample Collection Filed Forms completed. The completed Outfall Reconnaissance Inventory/Sample Collection Filed Forms are included as Attachment C.

Three additional outfalls were inventoried during the habitat assessment, which were dry at the time of survey. These were added to the eighteen outfalls detected during the landslide assessment, for a total of twenty-one out falls recorded on the surveyed portions of Vasa Creek.

Table 9 contains a summary of the data collected at the outfall reconnaissance inventory sites. The locations of the outfalls inventoried are shown on Figures 2 and 3 in Attachment A.

Table 9. Outfall Reconnaissance Inventory

ID#	Reach	Material	Diameter (inches)	Flow	Notes about Discharge
OF-H1	F-G	PVC	4in	None	None
OF-H2	F-G	Concrete	8in	None	None
OF-H3	F-G	PVC	4in	None	None

4. Macroinvertebrate Samples

In 2011, macroinvertebrate samples were collected from Vasa Creek and delivered to Rithron and Associates for assessment (Rithron 2011). Analysis indicated that the B-IBI (Benthic Inventory of Biotic Integrity) site score was 24, typically a "poor" rating, however the RIVPACS (River Invertebrate Prediction and Classification System) result was 0.81, indicating unimpaired conditions. The B-IBI is a method of evaluating stream health by looking at the local macroinvertebrate community across ten metrics. Each metric is given a score of 5, 3 or 1, where 5 is little to no degradation, 3 is moderate degradation and 1 is serious degradation. These ten metrics are summed together creating a score ranging from 10 to 50. The RIVPACS is a statistical model that uses macroinvertebrate communities to evaluate stream conditions.

The analysis also revealed the presence of sensitive taxa, indicating decent water quality conditions. The overall species composition indicated a preference towards to cool water temperatures, while the cold stenotherm taxa (only lives in water less than 10 degrees Celsius) were not present in substantial numbers. Stoneflies were found to be common, which suggests the availability of coarse organic matter and that the macroinvertebrate community is not adversely affected by sediment deposition. Overall, taxa richness was high, with proportions that are typically appropriate for a lowland stream that ultimately feeds into the Puget Sound. The summary results from this sampling effort are included as Attachment F, and the full report is available from the City of Bellevue (Rithron 2011).

5. Electrofishing

A fish survey was conducted in July 2014 by the City of Bellevue to assess status and trends of resident populations of fish in Vasa Creek and identify resident species diversity and size classes (City of Bellevue 2014). Electrofishing was conducted along 151 feet of Vasa Creek at approximately river mile 0.38 using a backpack electrofishing unit. A total of 86 cutthroat trout were captured during this effort and no other fish species were found. Almost 92 percent of the

fish captured were less than 80 mm, with only 8 percent being between 80 mm and 150 mm. A description of the methods used and the data from this effort are included as Attachment E.

6. Discussion and Recommendations

During the habitat assessment, habitat metrics were collected to create a baseline data set with which to describe the current conditions of lower Vasa Creek. These data were summarized and presented in the above sections of this report, and the field data are contained in Attachment B. The field data can be used for additional analysis and comparison with other spawning tributaries to Lake Sammamish, and in support of future surveys on Vasa Creek. These field observations were also used to develop the recommendations included in this section.

Habitat conditions appear adequate for kokanee spawning (similar to existing Lake Sammamish tributaries where active spawning occurs). Yet, anecdotal evidence of kokanee usage of Vasa Creek is limited to downstream of the West Lake Sammamish Drive crossing (WDFW 2009). Immediately upstream of the crossing is a forested corridor, where casual observation may have been limited in the past. The 2008/2009 Lake Sammamish Late-Run Kokanee Survey and Summary report indicated that Vasa Creek was spot-checked (time permitting) three times during the standard run-timing for late-run kokanee (mid-November 2008 to the end of January 2009) (WDFW 2009). No live or dead kokanee were detected during these spot checks. Additionally, the escapement at the primary spawning streams during this same timeframe was nearly nonexistent when compared to other years (Figure 7).

Overall, conditions in Vasa Creek are adequate for kokanee spawning throughout the survey area. The active channel width, depth, and sediment composition are similar to that found in the three major kokanee spawning creeks that flow into Lake Sammamish: Ebright, Laughing Jacobs, and Lewis Creeks. Despite having a "poor" rating from the Benthic Inventory of Biotic Integrity index, the rest of the macroinvertebrate assessment indicates relatively unimpaired conditions.

The lowest portion of Vasa Creek, downstream of West Lake Sammamish Parkway, exhibits the most human impact with a heavily confined channel and armored stream banks surrounded by managed residential lawns. Additionally, that area was limited in fish cover, pool habitat, and LWD. Upstream of West Lake Sammamish Parkway there is more established riparian vegetation, although some intermittent residential lawns still occur within the riparian area, and other habitat elements are more diverse and abundant.

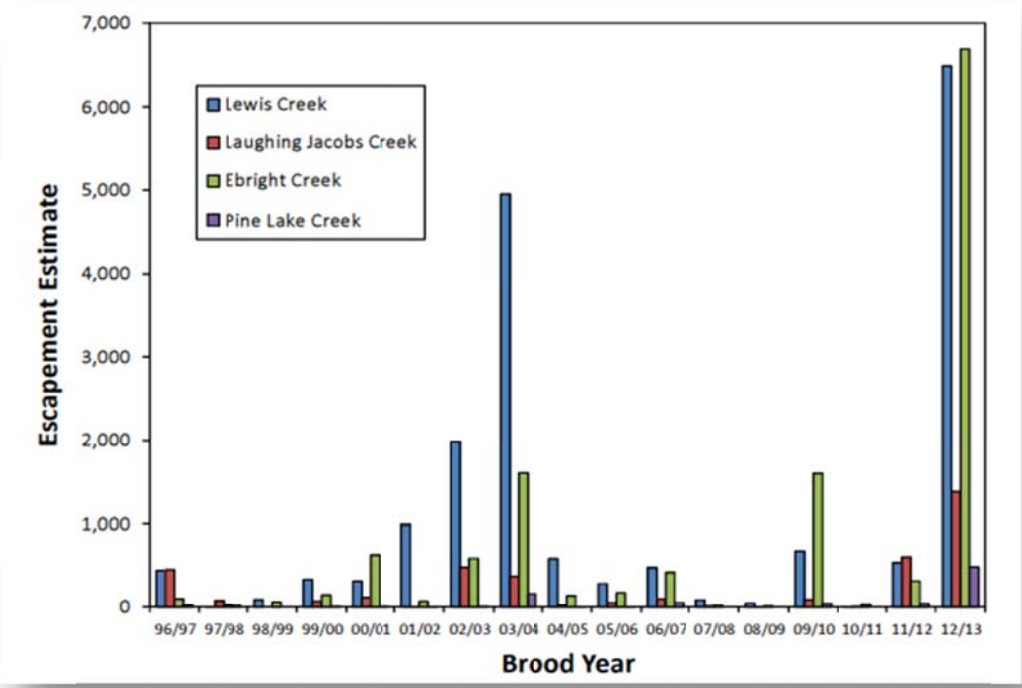

Figure 7. AUC Escapement Estimates for the Four Primary Kokanee Spawning Tributaries (LSKWG 2013)

Although a fish passage barrier assessment was not conducted as part of this survey, there were several potential fish passage barriers identified during field surveys. The maximum jump height recommended for adult kokanee is six inches, with a minimum approach pool depth of two feet (0.6 meter) (FHW 2007).

None of the plunge pools documented within the survey area met the minimum approach pool depth criteria of 0.6 meter. Although jump heights were not specifically measured as part of the methods used during this survey, the following plunge pools were observed as being potential passage barriers to upstream adult kokanee movement due to unfavorable jump heights: D2, D4, D6, E4, and G6.

For example, the plunge pool at D4 splits the limited flow and the resulting pool is mostly full of fines and sand (Figure 8). The current pool depth is shallow (0.17 meter)

Figure 8. Split Plunge Pool D4 from Constructed Grade Control

and does not have sufficient depth for adult kokanee to attempt jumping upstream over the structure. Fish passage conditions may improve at higher flows.

There were also culverts that have been identified as partial fish passage barriers in the survey area. There were five culverts in the WDFW FPDSI database in the survey area (ID# 930484, 930485, 930486, 930487, and 930488). Two of these culverts were assessed as partial barriers; one culvert (930488) on private ownership near the mouth (Figure A-1) and the other culvert (930484) on City of Bellevue ownership under 163rd Avenue SE (Figure A-2) (WDFW, 2014).

The following recommendations are based on the findings of the fish habitat assessment and a review of existing data:

- Incorporate Vasa Creek into the late-run Lake Sammamish kokanee spawner surveys to develop baseline data prior to any restoration actions and to establish the upstream extent of kokanee access and redds. If possible, spawner surveys should cover the entire length of habitat surveyed (approximately 1,270 meters). However, if there are no kokanee or redds observed from the mouth to the second partial barrier culvert at 163rd Avenue SE (670 meters), surveys could be concluded.
- Conduct additional surveys of near-shore Lake Sammamish to detect littoral spawning activity by kokanee.
- Conduct a more thorough fish passage assessment including the two partial barrier culverts and other potential passage barriers identified during this assessment.
- Identify the factors limiting productivity in Vasa Creek and develop restoration alternatives to improve kokanee habitat.

Overall, the existing data coupled with the information gathered through this assessment indicate that habitat in the lower portion of Vasa Creek may be suitable to support kokanee. However, additional information regarding current use of Vasa Creek and nearshore Lake Sammamish by spawning kokanee, as well as any fish passage barriers or other limiting factors that kokanee may encounter in Vasa Creek would be helpful in better understanding the potential. This additional information would also help to focus restoration efforts within the Vasa Creek Watershed to implement the most effective projects to support kokanee.

7. References

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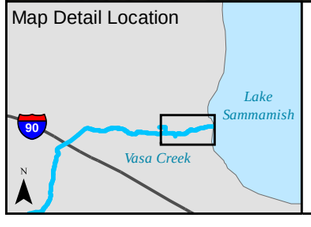
ATTACHMENT A

MAPS

Map Detail Location



- Outfall
- WDFW Culvert Inventory
- Habitat Assessment Transect
- Fast Non-Turbulent Habitat Unit
- Pool Habitat Unit
- Habitat Assessment Reach
- Access Denied Parcel

Figure A-1
Habitat Assessment Transects and Outfalls

N

0 50 100 200 Feet

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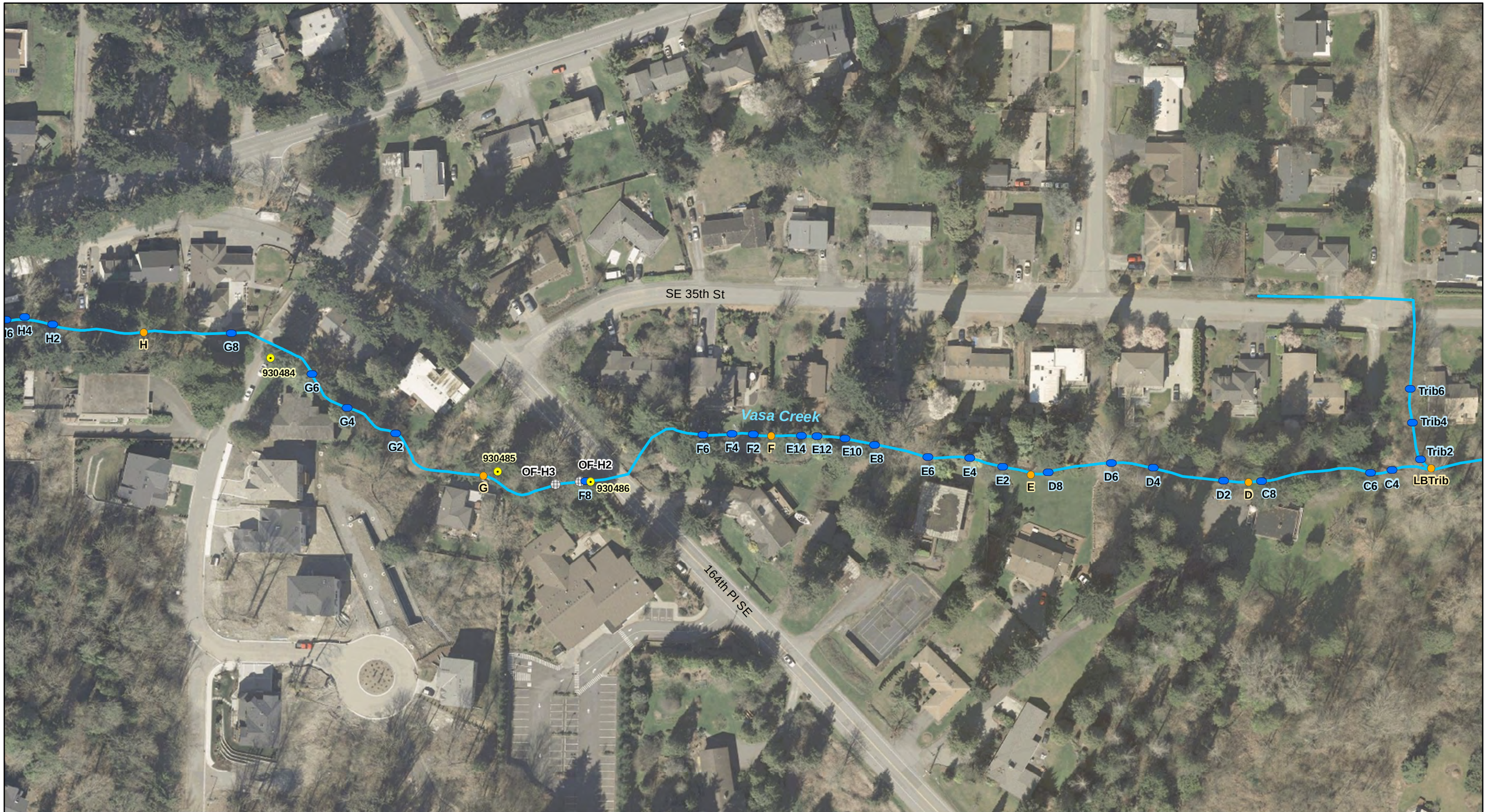

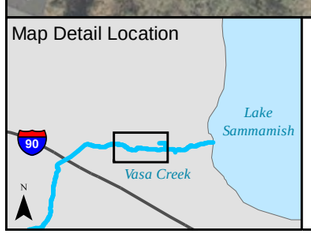

Outfall
WDFW Culvert Inventory
Habitat Assessment Transect
Fast Non-Turbulent Habitat Unit
Pool Habitat Unit
Habitat Assessment Reach
Access Denied Parcel

Figure A-2
Habitat Assessment Transects and Outfalls

N
0 50 100 200 Feet

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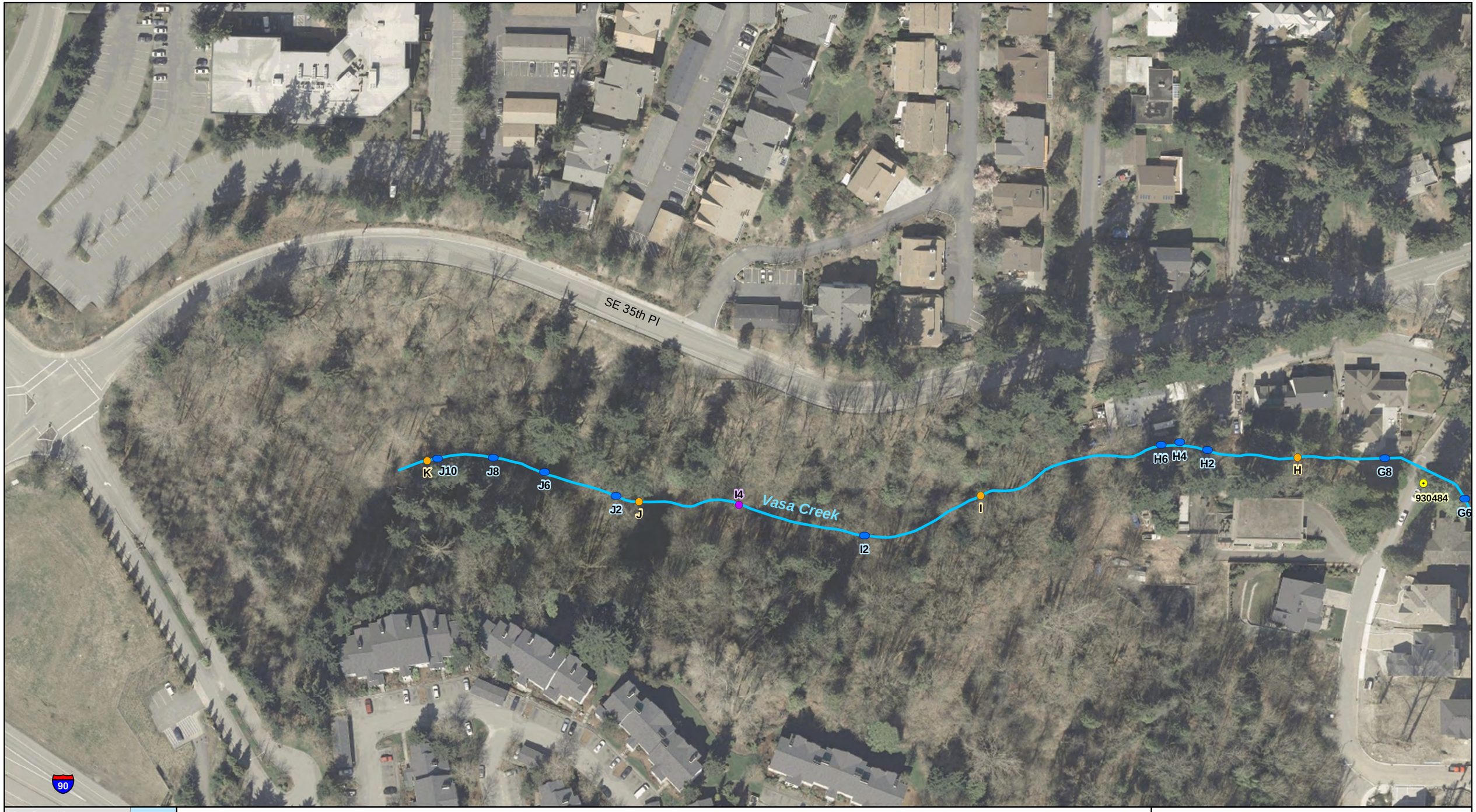
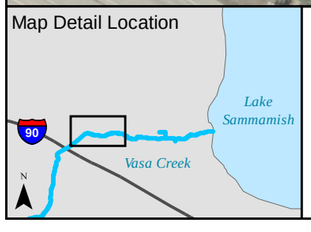


Map Detail Location



- Outfall
- WDFW Culvert Inventory
- Habitat Assessment Transect
- Fast Non-Turbulent Habitat Unit
- Pool Habitat Unit
- Habitat Assessment Reach
- Access Denied Parcel

Figure A-3
Habitat Assessment Transects and Outfalls

N

0 50 100 200 Feet

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ATTACHMENT B

HABITAT ASSESSMENT FIELD FORMS

Habitat field forms | Major: @139m Minor @67.5m Thalwag: @134m

Site Name: **Vasa Creek** | Date: 6/18/14 10:00

Site ID: **Lower Vasa** | Surveyors: **JKP** **JCP**

Transect: (A) a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.1	Y/N	Y/N	1	270	no	—	—
0.1	0.04	Y/N	Y/N	1	270	no	—	—
0.2	0.08	Y/N	Y/N	3	270	no	—	—
0.3	0.09	Y/N	Y/N	3	210	no	—	—
0.4	0.04	Y/N	Y/N	5	270	no	—	—
0.5	Road xing	Y/N	Y/N					
0.6	No access	Y/N	Y/N					
0.7	↓	Y/N	Y/N					
0.8		Y/N	Y/N					
0.9		Y/N	Y/N					

a' — 0.5 — 0.8

#	Habitat Type	Pool Code 1	Pool Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		1.5	—	—
2	PS	B		1.3	0.16	0.08
3	FT	N		1.4	—	—
4	PS	B		1.9	0.35	0.03
5	FT	N		1.0	—	—
6						
7						
8						
9						
10						
11						
12						
13						
14						

GPS DSC109 DSC111 Hab3 DSC112

Unit types
- FT- Turbulent
- FN-Non-Turbulent
- PS-Scour Pool
- PD-Dammed Pool
- PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

* landscape timber (treated)

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.5 (1.7)		xx.x%	0-360
Bar Width	0 (0)		1.3	270
Bankfull Width	2.9 (3.0)			270
R Bankfull Ht	0.4			
L Bankfull Ht	~~0~~ 0.4			
	%			
RB Instability	0			
LB Instability	30			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	1*	—	—
0.3 - 0.6	—	—	—
0.6 - 0.8	—	—	—
> 0.8 m	—	—	—

Comments

RB is 0% unstable because it is concrete armored

Habitat unit 4 is a series of 3 pools - obs juvenile trout

Habitat field forms

Site Name: **Vasa Creek** | Date: 6/18/14

Site ID: **Lower Vasa** | Surveyors: **JKP** **JCP**

Transect: (A) a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover: 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

D = Decidious; C = Conifer; E = Broadleaf Evergreen; M = Mixed; N = None

Fish Cover/Other (10 m x 20m): 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	None	None	
Big Trees	0	0	
Small Trees	0	0	
Understory (0.5 to 5 m tall			
Vegetation	D	M	
Woody Shrubs & Saplings	1	2	
Non-Woody Herbs & Grasses	1	0	
Ground Cover (<0.5m)			
Woody Debris	0	0	
Non-Woody Herbs & Grasses	3	3	
Barren, Bare, Dry, or Duff	1	1	

Fish Cover/Other (10 m x 20m)	
Filamentous Algae	0
Macrophytes	1
Woody Debris	0
Brush	0
Overhanging veg	0
Undercut banks	0
Boulders/Ledges	2
Artificial Structures	1
Bryophytes	0

Canopy Density bank (0-17)	
Up	2
Left	1
Down	0
Right	4
LB	6
RB	10

Substrate

	Wet Depth	AW BF Depth	Size Class	Embed	Flag
LB	0	0.4 m	SA (GF)	100	
0.1	0.11	0.51	GF (GF)	10	
0.2	0.07	0.47	GF (GF)	40	
0.3	0.08	0.48	GF (GC)	50	
0.4	0.08	0.48	CB (GC)	20	
0.5	0.09	0.49	SA (CB)	100	
0.6	0.03	0.43	GC (CB)	20	
0.7	0.02	0.42	SA (GC)	100	
0.8	0.01	0.41	SA (GC)	100	
0.9	0.01	0.41	GF (GF)	20	
RB	0	0.4	GF (GF)	50	

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Transect A is located just upstream of foot bridge
View upstream: DSC...109 - start of unit 1
View at transect: DSC...110
Transect a' is located just D/s of road xing
a' photo waypoint: DSC...113

Habitat field forms — Major: @135m Minor @67.5m Thalwag: @13.5m

Site Name: **Vasa Creek** — Date: 6/18/14

Site ID: **Lower Vasa** — Surveyors: **JKP** **JCP**

Transect: A a' (B b') C c' D d' E e' F f' G g' H h' I i' J j' K

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.09	Y/N	Y/N	1	240	No	—	—
0.1	0.05	Y/N	Y/N	3	270	No	—	—
0.2	0.12	Y/N	Y/N	3	300	No	—	Bar width 1.1
0.3	0.09	Y/N	Y/N	3	270	No	—	Bar width 0.6
0.4	0.04	Y/N	Y/N	5	270	No	—	—
b' → 0.5	0.07	Y/N	Y/N	7	270	No	—	—
0.6	0.14	Y/N	Y/N	10	305	No	—	—
0.7	0.05	Y/N	Y/N	11	300	No	—	—
0.8	0.08	Y/N	Y/N	13	310	No	—	—
0.9	0.02	Y/N	Y/N	13	250	No	—	—

Unit Length (m)	#	Habitat Type	Pool Code Code 1	Pool Code Code 2	HU Width	Max Pool	Crest Pool
13	1	FT	N		1.7	—	—
	2	FN	N		1.3	—	—
	3	FT	N		1.1	~~0.12~~	—
1.0	4	PP	W-small		2.2	0.12	0.04
3.6	5	FT	N		2.4	—	—
5.6	6	FN	N		2.7	—	—
	7	FT	N		1.1	—	—
1.1	8	PS	B		0.5	0.13	0.08
	9	FT	N		1.2	—	—
3.0	10	PS	B		0.8	0.2	0.1
	11	FT	N		1.3	—	—
3.5	12	PS	B		1.1	0.19	0.08
	13	FT	N		1.2	—	—
	14						

6 PS point + 114 Hab_B2 Hab_B3 118 Hab_B5 Hab_B6 Hab_B7 Hab_B11 122 Hab_B13

Unit types
FT- Turbulent
FN-Non-Turbulent
PS-Scour Pool
PD-Dammed Pool
PP-Plunge pool
DC-Dry channel

Pool forming code
119 N-Not a pool
120 W- LWD
121 R-Rootwad
B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.7 (1.1)		xx.x%	0-360
Bar Width	0 (0)		1.9	240 (270)
Bankfull Width	2.5 (1.4)			
R Bankfull Ht	0.3			
L Bankfull Ht	0.3			
	%			
RB Instability	0			
LB Instability	30			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	1	-	-
0.3 - 0.6	1	-	-
0.6 - 0.8	-	-	-
> 0.8 m	-	-	-

Comments

Habitat unit 1 has reasonable spawning quality for Kokanee
View upstream of transect B: DSC...114
View downstream of Transect B: DSC...115
ALSO JCP camera shot of Transect B
View upstream of Transect b': DSC...119

There was some LWD but spanning and outside of bankfull

Habitat field forms

Site Name:	**Vasa Creek**	Date:	6/18/14
Site ID:	**Lower Vasa**	Surveyors:	**JKP JCP**

Transect: A a' (B b') C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover: 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

D = Decidious; C = Conifer; E = Broadleaf Evergreen; M = Mixed; N = None

Fish Cover/Other (10 m x 20m): 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	D	D	
Big Trees	3	3	
Small Trees	2	1	
Understorey (0.5 to 5 m tall			
Vegetation	—	—	
Woody Shrubs & Saplings	1	0	
Non-Woody Herbs & Grasses	2	2	
Ground Cover (<0.5m)			
Woody Debris	1	1	
Non-Woody Herbs & Grasses	2	2	
Barren, Bare, Dry, or Duff	2	2	

Filamentous Algae	0
Macrophytes	0
Woody Debris	1
Brush	1
Overhanging veg	1
Undercut banks	0
Boulders/Ledges	0
Artificial Structures	1
Bryophytes	0

Canopy Density bank (0-17)	
Up	17
Left	17
Down	17
Right	17
LB	17
RB	17

Substrate

	Wet Depth	BF Depth (Δ)	Size Class	Embed	Flag
LB	- 0	0.25	6F (BL)	20	
0.1	0.01	0.26	6F (CB)	20	
0.2	0.01	0.26	6F (CB)	20	
0.3	0.03	0.28	6F (GC)	60	
0.4	0.01	0.26	GC (CB)	10	
0.5	0.04	0.29	6F (GF)	50	
0.6	0.05	0.30	GC (CB)	10	
0.7	0.06	0.31	GC (SA)	20	
0.8	0.06	0.31	GF (SA)	10	
0.9	0.08	0.33	GF (SA)	10	
RB	- 0	0.25	FN (FN)	100	

CB-4
SA-3
FN-1

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms								Major: @135m Minor @67.5m Thalwag: @13.5m
Site Name:	Vasa Creek					Date:	6/18/14	12:30
Site ID:	Lower Vasa					Surveyors:	JKP	JCP
Transect:	A a' B b' (C c') D d' E e' F f' G g' H h' I i' J j' K							

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.05	Y/N	Y/N	1	260	NO	—	—
0.1	0.06	Y/N	Y/N	3	280	NO	—	—
0.2	0.06	Y/N	Y/N	3	240	NO	—	—
0.3	0.07	Y/N	Y/N	3	250	NO	—	Bar width 0.9
0.4	0.06	Y/N	Y/N	3	270	NO	—	—
C' → 0.5	0.05	Y/N	Y/N	3	270	NO	—	—
0.6	0.04	Y/N	Y/N	5	270	NO	—	—
0.7	0.07	Y/N	Y/N	7	270	NO	—	—
0.8	0.10	Y/N	Y/N	7	280	NO	—	—
0.9	0.05	Y/N	Y/N	7	260	NO	—	—

Length (m)	#	Habitat Type	Pool Code Code 1	Pool Code Code 2	HU Width	Max Pool	Crest Pool
	1	FT	N		1.1	—	—
3.0	2	PS	W-small		1.0	0.16	0.08
	3	FT	N		2.1	—	—
1.2	4	PP	W		1.7	0.27	0.01
	5	FT	N		2.0	—	—
?@1.1	6	PP	B		1.9	0.28	0.06
	7	FT	N		0.9	—	—
1.4	8	PP	W-small		1.3	0.23	0.06
	9						
	10						
	11						
	12						
	13						
	14						

Unit types
- FT- Turbulent
- FN-Non-Turbulent
- PS-Scour Pool
- PD-Dammed Pool
- PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.1 (1.1)		xx.x%	0-360
Bar Width	0 (0)		3.0	260 (270)
Bankfull Width	2.0 (1.6)			
R Bankfull Ht	0.3			
L Bankfull Ht	0.4			
	%			
RB Instability	0			
LB Instability	50			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3			
0.3 - 0.6	11		
0.6 - 0.8			
> 0.8 m			

Comments: View upstream of Transect C: DSC_0123
View of Transect C Looking downstream: DSC_0124
Habitat unit 6 is a series of 2 pools (see 135)

Habitat field forms

Site Name:	**Vasa Creek**	Date:	6/19/14
Site ID:	**Lower Vasa**	Surveyors:	**JKP** **JCP**

Transect: A a' B b' (C c') D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover	0 = Absent 1 = Sparse 2 = Moderate 3 = Heavy 4 = Very Heavy	D = Decidious C = Conifer E = Broadleaf Evergreen M = Mixed N = None

Fish Cover/Other (10 m x 20m)	
0 = Absent	
1 = Sparse	
2 = Moderate	
3 = Heavy	
4 = Very Heavy	

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	M	M	
Big Trees	2	2	
Small Trees	1	0	
Understory (0.5 to 5 m tall			
Vegetation	D	D	
Woody Shrubs & Saplings	2	3	
Non-Woody Herbs & Grasses	3	3	
Ground Cover (<0.5m)			
Woody Debris	2	2	
Non-Woody Herbs & Grasses	1	1	
Barren, Bare, Dry, or Duff	2	1	

Filamentous Algae	0
Macrophytes	0
Woody Debris	0
Brush	0
Overhanging veg	2
Undercut banks	0
Boulders/Ledges	0
Artificial Structures	0
Bryophytes	0

Canopy Density bank (0-17)	
Up	17
Left	17
Down	17
Right	17
LB	17
RB	17

Substrate

	Wet Depth	BF Depth (AJ)	Size Class	Embed	Flag
LB	- 0	0.35	FN (GF)	100	
0.1	0.03	0.38	GF (GF)	10	
0.2	0.03	0.38	(CB)	10	
0.3	0.04	0.39	(GC)	10	
0.4	0.03	0.38	(GC)	10	
0.5	0.04	0.39	(GF)	10	
0.6	0.05	0.40	(CB)	10	
0.7	0.03	0.38	(GC)	10	
0.8	0.04	0.39	(CB)	10	
0.9	0.03	0.38	(GF)	10	
RB	- 0	0.35	FN (FN)	100	

GF 4
GC-3
CB-3

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms

Major: @135m Minor @67.5m Thalwag: @13.5m

Site Name: Vasa Creek	Date: 6/18/14
Site ID: Lower Vasa	Surveyors: JKP JCP

Transect: A a' B b' C c' (D d') E e' F f' G g' H h' I i' J j' K

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.09	Y/(N)	Y/(N)	1	280	No	–	–
0.1	0.06	Y/(N)	Y/(N)	1	270	No	–	–
0.2	0.07	Y/(N)	Y/(N)	3	260	No	–	–
0.3	0.05	Y/(N)	Y/(N)	3	290	No	–	–
0.4	0.06	Y/(N)	Y/(N)	3	280	No	–	–
0.5	0.06	(Y)/N	Y/(N)	5	270	No	–	Bar width 0.5
0.6	0.13	Y/(N)	Y/(N)	7	280	No	–	–
0.7	0.06	Y/(N)	Y/(N)	7	330	No	–	–
0.8	0.04	Y/(N)	Y/(N)	7	220	No	–	–
0.9	0.05	Y/(N)	Y/(N)	9	210	No	–	–

Habitat #	Habitat Type	Pool Code 1	Pool Code 2	HU Width	Max Pool	Crest Pool	
1	FT	N		1.1	–	–	
2	PP	B		1.9	0.27	0.04	1.2
3	FT	N		1.1	–	–	
4	PP	B		1.0	0.17	0.06	0.8
5	FT	N		1.0	–	–	~~[illegible]~~
6	PP	W		2.2	0.17	0.04	5+0.9
7	FT	N		1.1	–	–	
8	PP	B		1.8	0.2	0.04	pools (6.3)
9	FT	N		1.0	–	–	
10							
11							
12							
13							
14							

Unit types (handwritten beside: 6PS Pool+, 135, 137, Hab.D3, 138, Hab.D5, 139, Hab.D7, 140, Hab.D9)
- FT- Turbulent
- FN-Non-Turbulent
- PS-Scour Pool
- PD-Dammed Pool
- PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

	Dist (m)	Flag	Slope xx.x%	Bearing 0-360
Wetted Width	1.1 (1.0)		5.1	280 (270)
Bar Width	0 (0.5)			
Bankfull Width	2.9 (2.2)			
R Bankfull Ht	0.35			
L Bankfull Ht	0.35			
	%			
RB Instability	0			
LB Instability	0			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	|		
0.3 - 0.6	|		
0.6 - 0.8			
> 0.8 m			

Comments

View upstream of Transect D: DSC..135
View of transect D + downstream: DSC...136
* Habitat unit #D2 may be a partial barrier to kokanee migration. Formed by concrete slab (see 137)
* Habitat unit #D4 is a complete barrier for kokanee (see 138) and has a RB scour pool upstream of large step
* Habitat unit 6 has 2 pools, the downstream is a complete barrier to kokanee.

Habitat field forms

Site Name: **Vasa Creek** Date: 6/13/14

Site ID: **Lower Vasa** Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

D = Decidious
C = Conifer
E = Broadleaf Evergreen
M = Mixed
N = None

Fish Cover/Other (10 m x 20m)
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	C	D	
Big Trees	2	1	
Small Trees	0	0	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	0	1	
Non-Woody Herbs & Grasses	0	2	
Ground Cover (<0.5m)			
Woody Debris + Stems	0	0	
Non-Woody Herbs & Grasses	3	3	
Barren, Bare, Dry, or Duff	0	0	

Filamentous Algae	0
Macrophytes	0
Woody Debris	0
Brush	0
Overhanging veg	1
Undercut banks	0
Boulders/Ledges	0
Artificial Structures	0
Bryophytes	0

Canopy Density	
bank (0-17)	
Up	11
Left	17
Down	15
Right	14
LB	17
RB	14

Substrate

	Wet Depth	BF Depth (ΔV)	Size Class	Embed	Flag
LB	- 0	0.35	FN (CB)	100	
0.1	0.08	0.43	FN (CB)	100	
0.2	0.06	0.41	GF (GF)	30	
0.3	0.07	0.42	GF (GF)	30	
0.4	0.05	0.40	GF (GC)	30	
0.5	0.08	0.43	GF (GF)	20	
0.6	0.04	0.39	GC (GF)	10	
0.7	0.05	0.40	GC (GF)	10	
0.8	0.04	0.39	SA (GC)	100	
0.9	0.04	0.39	SA (GC)	100	
RB	- 0	0.35	FN (GF)	100	

FN-3 GF6
GF4 GC3

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms — Major: @135m Minor @67.5m Thalwag: @13.5m

Site Name: **Vasa Creek** — Date: 6/18/14

Site ID: **Lower Vasa** — Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.06	Y/N	Y/N	1	305	No	–	–
0.1	0.11	Y/N	Y/N	2	290	No	–	–
0.2	0.09	Y/N	Y/N	4	300	No	–	–
0.3	0.05	Y/N	Y/N	5	260	No	–	–
0.4	0.06	Y/N	Y/N	7	240	No	–	–
e' → 0.5	0.08	Y/N	Y/N	7	210	No	–	–
0.6	0.07	Y/N	Y/N	7	340	No	–	–
0.7	0.08	Y/N	Y/N	9	330	No	–	–
0.8	0.06	Y/N	Y/N	11	230	No	–	–
0.9	0.09	Y/N	Y/N	12	290	No	–	–

#	Habitat Type	Pool Code 1	Pool Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		1.6	–	–
2	PS+PP	W		0.7	0.17	0.05
3	FT	N		1.2	–	–
4	PP	W		1.3	0.31	0.06
5	FT	N		1.9	–	–
6	PP	B	W	1.7	0.2	0.09
7	FT	N		1.3	–	–
8	PP	B		2.0	0.21	0.06
9	FT	N		1.1	–	–
10	PP	B		0.9	0.13	0.09
11	FT	N		0.9	–	–
12	PP	B		1.8	0.25	0.08
13	FT	N		0.8	0.15	0.05
14	PP	B		1.3	0.15	0.05

length (m)
pool 1.5+1.0
pools -1,2
1.1+0.8
1.3
.8 cascade
1.0
1.0
( )'

Unit types
FT- Turbulent
141 FN-Non-Turbulent
Hab-E2 PS-Scour Pool
Hab-E5 PD-Dammed Pool
143 PP-Plunge pool
Hab-E5 DC-Dry channel
144
Hab-E7 **Pool forming code**
146 N-Not a pool
Hab-E9 W- LWD
147 R-Rootwad
Hab-E11 B-Boulder/Bedrock
Hab-E12
Hab-E13
150

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.6 (1.1)		xx.x%	0-360
Bar Width	0 (0)		5.0	305 (210)
Bankfull Width	1.8 (1.7)			
R Bankfull Ht	0.4			
L Bankfull Ht	0.3			
	%			
RB Instability	0 (armor)			
LB Instability	0 (bedrock)			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	III		
0.3 - 0.6			
0.6 - 0.8			
> 0.8 m			

Comments

upstream view from Transect E: DSC_141
Downstream view of Transect E: DSC_142
* Habitat Unit #E4 is a barrier to kokanee (see 143)

Habitat field forms

Site Name:	**Vasa Creek**	Date:	6 / 13 / 14
Site ID:	**Lower Vasa**	Surveyors:	**JKP** **JCP**
Transect:	A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K		

Riparian Vegetation Cover	0 = Absent 1 = Sparse 2 = Moderate 3 = Heavy 4 = Very Heavy	D = Decidious C = Conifer E = Broadleaf Evergreen M = Mixed N = None

Fish Cover/Other (10 m x 20m)	
0 = Absent	
1 = Sparse	
2 = Moderate	
3 = Heavy	
4 = Very Heavy	
Filamentous Algae	0
Macrophytes	0
Woody Debris	0
Brush	0
Overhanging veg	2
Undercut banks	0
Boulders/Ledges	3
Artificial Structures	3
Bryophytes	0

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	D	0	
Big Trees	2	0	
Small Trees	1 (C)	0	
Understory (0.5 to 5 m tall) ↗ Lawn			
Vegetation	D	0	
Woody Shrubs & Saplings	2	0	
Non-Woody Herbs & Grasses	1	0	
Ground Cover (<0.5m)			
Woody Debris + Stems	0	0	
Non-Woody Herbs & Grasses	3	3	
Barren, Bare, Dry, or Duff	1	2	

Canopy Density	
bank (0-17)	
Up	12
Left	14
Down	3
Right	1
LB	15
RB	4

Substrate

	Wet Depth	BF Depth (AJ)	Size Class	Embed	Flag
LB	- 0	0.35	GF (SA)	30	
0.1	0.01	0.36	GF (GF)	30	
0.2	0.02	0.37	BL (GF)	30	
0.3	0.06	0.41	GF (GF)	30	
0.4	0.07	0.42	GC (GF)	30	
0.5	0.08	0.43	GC (CB)	30	
0.6	0.09	0.43	CB (GF)	20	
0.7	0.05	0.40	CB (SA)	20	
0.8	0.08	0.43	GC (SA)	30	
0.9	0.09	0.44	BL (SA)	90	
RB	- 0	0.35	BL (FN)	100	

GF3 GC3 BL S#4
RL3 CB2 GF5

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments upstream view of transect e'; DSC... 145

Habitat field forms — Major: @135m Minor @67.5m Thalwag: @13.5m

Site Name: **Vasa Creek** — Date: 6/19/14

Site ID: **Lower Vasa** — Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.04	Y/N	Y/N	1	290	No	–	–
0.1	0.19	Y/N	Y/N	2	290	No	–	–
0.2	0.04	Y/N	Y/N	4	240	No	–	–
0.3	0.03	Y/N	Y/N	5	300	No	–	–
0.4	0.07	Y/N	Y/N	6	250	No	–	–
0.5	0.06	Y/N	Y/N	7	240	No	–	–
0.6	0.07	Y/N	Y/N	8	240	No	–	–
0.7	0.03	Y/N	Y/N	8	270	No	–	Bar width = 1.0
0.8	0.06	Y/N	Y/N	8	280	No	–	Bar width = 1.4
0.9	0.04	Y/N	Y/N	9	270	No	–	–

#	Habitat Type	Pool Code 1	Pool Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		0.7	–	–
2	PP	B		1.4	0.19	0.04
3	FT	N		1.0	–	–
4	PP	B		1.1	0.15	0.07
5	FT	N		1.2	–	–
6	PP	B		0.9	0.26	0.07
7	FT	N		1.8	–	–
8	PP	B (concrete)		1.9	0.24	0.07
9	FT	N		1.6	–	–
10	PP	B		2.0	0.26	0.06
11	FT	N		0.8	–	–
12						
13						
14						

Unit types
- FT- Turbulent
- FN-Non-Turbulent
- PS-Scour Pool
- PD-Dammed Pool
- PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	0.7 (1.8)		xx.x%	0-360
Bar Width	0 (0)		5.2	290 (240)
Bankfull Width	1.1 (1.6)			
R Bankfull Ht	0.5			
L Bankfull Ht	0.5			
	%			
RB Instability	0 (armor)			
LB Instability	0			
Comments				

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	–	–	–
0.3 - 0.6	–	–	–
0.6 - 0.8	–	–	–
> 0.8 m	–	–	–

View upstream of Transect F: DSC.. 151

View looking downstream Transect F: DSC. 152

* Habitat unit #F8 is just upstream of bridge crossing it is a series of small pools with 3 larger pools

* top of reach upstream of 0.9 thalweg is in driveway Culvert (not a barrier)

Habitat field forms

Site Name: **Vasa Creek** | Date: 6/19/14

Site ID: **Lower Vasa** | Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' (F f') G g' H h' I i' J j' K

Riparian Vegetation Cover
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

D = Decidious
C = Conifer
E = Broadleaf Evergreen
M = Mixed
N = None

Fish Cover/Other (10 m x 20m)
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	D	D	
Big Trees	0	0	
Small Trees	1	0	
Understory (0.5 to 5 m tall)			
Vegetation	D	0	
Woody Shrubs & Saplings	2	0	
Non-Woody Herbs & Grasses	3	2	
Ground Cover (<0.5m)			
Woody Debris + Stems	3	0	
Non-Woody Herbs & Grasses	0	3	
Barren, Bare, Dry, or Duff	0	0	

Fish Cover/Other (10 m x 20m)	
Filamentous Algae	0
Macrophytes	0
Woody Debris	12
Brush	1
Overhanging veg	2
Undercut banks	0
Boulders/Ledges	2
Artificial Structures	0
Bryophytes	0

Canopy Density bank (0-17)	
Up	17
Left	17
Down	17
Right	16
LB	17
RB	15

Substrate

	Wet Depth	BF Depth (AW)	Size Class	Embed	Flag
LB	- 0	0.5	FN (FN)	100	
0.1	0.02	0.52	FN (GF)	100	
0.2	0.02	0.52	SA (GF)	100	
0.3	0.06	0.56	SA (GC)	100	
0.4	0.05	0.55	GF (GF)	40	
0.5	0.04	0.54	GF (GC)	40	
0.6	0.04	0.54	GF (GC)	40	
0.7	0.05	0.55	GF (GC)	40	
0.8	0.05	0.55	GF (GC)	40	
0.9	0.04	0.54	GC (GC)	30	
RB	- 0	0.5	BL (SA)	100	

GF-5 FN-SA-2 | GF3 GC6

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms								Major: @135m Minor @67.5m Thalwag: @13.5m
Site Name:	Vasa Creek					Date:	6/19/14	
Site ID:	Lower Vasa					Surveyors:	JKP JCP	
Transect:	A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K							

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.04	Y/N	Y/N	1	270	No	—	—
0.1	0.04	Y/N	Y/N	1	240	No	-	Bar width 1.1
0.2	0.07	Y/N	Y/N	1	260	No	-	-
0.3	0.00	Y/N	Y/N	2	290	No	-	-
0.4	0.10	Y/N	Y/N	3	290	No	-	-
0.5	0.05	Y/N	Y/N	5	300	No	-	-
0.6	0.06	Y/N	Y/N	6	340	No	-	-
0.7	0.10	Y/N	Y/N	7	240	No	-	-
0.8	0.09	Y/N	Y/N	9	290	No	-	-
0.9	0.08	Y/N	Y/N	9	270	No	-	-

9' →

Habitat		Pool Code		HU	Max	Crest
#	Type	Code 1	Code 2	Width	Pool	Pool
1	FT	N		2.0	—	—
2	PS	B		0.8	0.16	0.07
3	FT	N		0.9	—	—
4	PP	B	W-small	1.2	0.18	0.09
5	FT	N		0.7	—	—
6	PP	B (cemented)		1.2	0.26	0.08
7	FT	N		1.1	—	—
8	PP	B		0.6	0.22	0.09
9	FT	N		0.8	—	—
10						
11						
12						
13						
14						

2.6

0.8

series of 3 pools

1.4

6 PS point
159
161
Hab-63
Hab-65
162
164
Hab-66
165
Hab-68

Unit types
FT- Turbulent
FN-Non-Turbulent
PS-Scour Pool
PD-Dammed Pool
PP-Plunge pool
DC-Dry channel

Pool forming code
N-Not a pool
W- LWD
R-Rootwad
B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	2.0 (0.7)		xx.x%	0-360
Bar Width	0 (0)		5.3	270 (310)
Bankfull Width	2.8 (1.2)			
R Bankfull Ht	0.2			
L Bankfull Ht	0.2			
	%			
RB Instability	10			
LB Instability	10			
Comments				

LWD (all/partially within BF)	2-5m	5-15m	>15m
0.1 - 0.3		1	
0.3 - 0.6			
0.6 - 0.8			
> 0.8 m			

View upstream from Transect G: DSC...159
View downstream at Transect G: DSC. 160
* Habitat unit #66 is a series of 3 plunge pools at outlet of culvert. Upstream 2 of 3 are "kokanee barriers" → also culvert may be a partial barrier (velocity, sediment)

Habitat field forms

Site Name:	**Vasa Creek**	Date:	6/19/14
Site ID:	**Lower Vasa**	Surveyors:	**JKP JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover: 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

D = Decidious; C = Conifer; E = Broadleaf Evergreen; M = Mixed; N = None

Fish Cover/Other (10 m x 20m): 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	M	N	
Big Trees	3	0	
Small Trees	2	0	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	2	2	
Non-Woody Herbs & Grasses	3	1	
Ground Cover (<0.5m)			
Woody Debris + Stems	2	1	
Non-Woody Herbs & Grasses	1	1	
Barren, Bare, Dry, or Duff	2	2	

Filamentous Algae	0
Macrophytes	0
Woody Debris	0
Brush	0
Overhanging veg	2
Undercut banks	1
Boulders/Ledges	0
Artificial Structures	3
Bryophytes	0

Canopy Density	
bank (0-17)	
Up	17
Left	17
Down	17
Right	17
LB	17
RB	17

Substrate

	Wet Depth	BF Depth (Adj)	Size Class	Embed	Flag
LB	- 0	0.2	FN (BL)	100	
0.1	0.08	0.28	SA (GC)	100	
0.2	0.08	0.28	SA (GC)	100	
0.3	0.07	0.27	GC (GC)	40	
0.4	0.06	0.26	GF (GC)	40	
0.5	0.05	0.25	GF (GC)	40	
0.6	0.04	0.24	GF (GC)	40	
0.7	0.04	0.24	GF (GC)	40	
0.8	0.01	0.21	CB (GC)	60	
0.9	0.04	0.24	GC (GC)	40	
RB	- 0	0.2	FN (BL)	100	

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments: GF-4 | GC9
GC 2 | BL-2

Habitat field forms								Major: @135m Minor @67.5m Thalwag: @13.5m
Site Name: **Vasa Creek**						Date: 6/19/14		
Site ID: **Lower Vasa**						Surveyors: **JKP** **JCP**		
Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K								
	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	~~SC Notes~~
0	0.10	Y/N	Y/N	1	270	No	–	–
0.1	0.08	Y/N	Y/N	1	290	No	–	–
0.2	0.10	Y/N	Y/N	1	250	No	–	–
0.3	0.08	Y/N	Y/N	3	300	No	–	–
0.4	0.03	Y/N	Y/N	5	290	No	–	Bar width = 0.9
0.5	0.08	Y/N	Y/N	7	280	No	–	–
0.6	0.09	Y/N	Y/N	7	260	No	–	–
0.7	0.09	Y/N	Y/N	7	220	No	–	Bar width = 2.5
0.8	0.04	Y/N	Y/N	7	270	No	–	–
0.9	0.08	Y/N	Y/N	7	270	No	–	Bar width = 1.7

#	Habitat Type	Pool Code Code 1	Pool Code Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		1.5	–	–
2	PP	W-small		0.9	0.14	0.02
3	FT	N		1.2	–	–
4	PP	W-small		1.0	0.16	0.06
5	FT	N		1.1	–	–
6	PP	W-Small		1.1	0.19	0.03
7	FT	N		1.2	–	–
8	PP	W-Small		1.0	0.13	0.03
9	FT	N			–	–
10						
11						
12						
13						
14						

GPS point
168
170
171
172

Unit types
FT- Turbulent
FN-Non-Turbulent
PS-Scour Pool
PD-Dammed Pool
PP-Plunge pool
DC-Dry channel

Pool forming code
N-Not a pool
W- LWD
R-Rootwad
B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.0 (1.7)		xx.x%	0-360
Bar Width	0 (0)		7.9	270 (280)
Bankfull Width	1.5 (2.3)			
R Bankfull Ht	0.4			
L Bankfull Ht	0.4			
	%			
RB Instability	40			
LB Instability	0			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	11	1	
0.3 - 0.6		11	
0.6 - 0.8			
> 0.8 m			

Comments

View upstream of Transect H: DSC...168
View looking downstream of Transect H: DSC 169
View downstream of Transect h': DSC...173

Habitat field forms

Site Name: **Vasa Creek** Date: 6/19/14

Site ID: **Lower Vasa** Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

D = Decidious
C = Conifer
E = Broadleaf Evergreen
M = Mixed
N = None

Fish Cover/Other (10 m x 20m)
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	M	M	
Big Trees	2	2	
Small Trees	1	1	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	1	1	
Non-Woody Herbs & Grasses	1	1	
Ground Cover (<0.5m)			
Woody Debris + Stems	1	2	
Non-Woody Herbs & Grasses	2	3	
Barren, Bare, Dry, or Duff	2	1	

Filamentous Algae	0
Macrophytes	0
Woody Debris	1
Brush	0
Overhanging veg	1
Undercut banks	1
Boulders/Ledges	2
Artificial Structures	0
Bryophytes	0

Canopy Density bank (0-17)	
Up	15
Left	15
Down	14
Right	15
LB	17
RB	16

Substrate

	Wet Depth	Av BF Depth	Size Class	Embed	Flag
LB	- 0	0.40	SA (GF)	100	
0.1	0.01	0.41	SA (SA)	100	
0.2	0.03	0.43	SA (GC)	100	
0.3	0.07	0.47	SA (GC)	100	
0.4	0.10	0.90	GF (GF)	30	
0.5	0.01	0.41	CB (SA)	20	
0.6	0.08	0.48	GC (GF)	20	
0.7	0.03	0.43	CB (GF)	20	
0.8	0.02	0.42	CB (GF)	30	
0.9	0.01	0.41	CB (GF)	30	
RB	- 0	0.40	CB (FN)	30	

SA-4 GF6
CB-5 GC2

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms								Major: @135m Minor @67.5m Thalwag: @13.5m
Site Name:	Vasa Creek				Date:	6/19/14		
Site ID:	Lower Vasa				Surveyors:	JKP JCP		
Transect:	A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K							

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.08	Y/N	Y/N	1	220	No	–	–
0.1	0.04	Y/N	Y/N	1	220	No	–	–
0.2	0.07	Y/N	Y/N	1	320	No	–	–
0.3	0.15	Y/N	Y/N	1	280	No	–	–
0.4	0.04	Y/N	Y/N	3	260	No	–	–
i' → 0.5	0.04	Y/N	Y/N	3	270	No	–	Bar width = 0.5 (mid channel)
0.6	0.06	Y/N	Y/N	3	300	No	–	Bar width = 1.4
0.7	0.06	Y/N	Y/N	3	260	No	–	Bar width = 1.7
0.8	0.16	Y/N	Y/N	4	270	No	–	–
0.9	0.07	Y/N	Y/N	5	240	No	–	–

Habitat #	Habitat Type	Pool Code Code 1	Pool Code Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		1.6	–	–
0.9 2	PS	B		0.9	0.13	0.01
3	FT	N		1.1	–	–
17.8 4	FN	N		2.4	–	–
5	FT	N		1.1	–	–
6						
7						
8						
9						
10						
11						
12						
13						
14						

Unit types
- FT- Turbulent
- 174 FN-Non-Turbulent
- 179 PS-Scour Pool
- Hab_I 3 PD-Dammed Pool
- Hab_I 4 PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.6 (2.0)		xx.x%	0-360
Bar Width	0 (0.5)		7.8	220 (270)
Bankfull Width	2.5 (3.1)			
R Bankfull Ht	0.3			
L Bankfull Ht	0.4			
	%			
RB Instability	0			
LB Instability	30			
Comments				

LWD (all/partially within BF)	2-5m	5-15m	>15m
0.1 - 0.3	1	11	
0.3 - 0.6	1		
0.6 - 0.8			
> 0.8 m			

View upstream from transect I: DSC.. 174
View looking downstream of transect I: DSC.. 178
View upstream looking at transect i': DSC.. 180
* Habitat unit # I 4 is caused by top of fallen tree backing up flow

Habitat field forms

Site Name: **Vasa Creek** Date: 6/19/14

Site ID: **Lower Vasa** Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover: 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

D = Decidious; C = Conifer; E = Broadleaf Evergreen; M = Mixed; N = None

Fish Cover/Other (10 m x 20m): 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	M	M	
Big Trees	3	3	
Small Trees	1	2	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	3	3	
Non-Woody Herbs & Grasses	2	2	
Ground Cover (<0.5m)			
Woody Debris	1	2	
Non-Woody Herbs & Grasses	2	2	
Barren, Bare, Dry, or Duff	2	2	

Filamentous Algae	0
Macrophytes	0
Woody Debris	2
Brush	0
Overhanging veg	2
Undercut banks	1
Boulders/Ledges	1
Artificial Structures	0
Bryophytes	1

Canopy Density bank (0-17)	
Up	17
Left	17
Down	17
Right	17
LB	17
RB	17

Substrate

	Wet Depth	BF Depth (Av)	Size Class	Embed	Flag
LB	- 0	0.35	GF (SA)	50	
0.1	0.03	0.38	SA (GC)	100	
0.2	0.05	0.40	SA (CB)	100	
0.3	0.05	0.40	GC (GC)	30	
0.4	0.05	0.40	GC (GC)	30	
0.5	0.07	0.42	GC (GC)	30	
0.6	0.05	0.40	GF (GC)	30	
0.7	0.04	0.39	CB (GF)	50	
0.8	0.03	0.38	GF (SA)	50	
0.9	0.02	0.37	GF (GF)	50	
RB	- 0	0.35	SA (FN)	100	

SA 3 GF 4 GC 3 | GC-5 GF-2

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms — Major: @135m Minor @67.5m Thalwag: @13.5m

Site Name: **Vasa Creek** — Date: 6/19/14

Site ID: **Lower Vasa** — Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.07	Y/N	Y/N	1	300	No	–	–
0.1	0.05	Y/N	Y/N	1	280	No	–	Bar width = 0.8
0.2	0.05	Y/N	Y/N	3	300	No	–	–
0.3	0.09	Y/N	Y/N	3	280	No	–	–
0.4	0.04	Y/N	Y/N	6	300	No	–	–
0.5	0.07	Y/N	Y/N	7	290	No	–	–
0.6	0.08	Y/N	Y/N	7	240	No	–	Bar width = 0.6
0.7	0.05	Y/N	Y/N	9	300	No	–	–
0.8	0.05	Y/N	Y/N	9	300	No	–	–
0.9	0.16	Y/N	Y/N	10	300	No	–	Bar width = 1.2

J' →

#	Habitat Type	Pool Code Code 1	Pool Code Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		1.8	–	–
2	PS	W		0.8	0.15	0.06
3	FT	N		0.9	–	–
4	PP	B	W-small	1.1	0.16	0.08
5	FT	N		1.1	–	–
6	PP	W-small		1.1	0.16	0.05
7	FT	N		1.7	–	–
8	PP	B		1.0	0.20	0.04
9	FT	N		1.2	–	–
10	PP	B		2.1	0.28	0.04
11	FT	N		0.9	–	–
12						
13						
14						

Length (m)

1.0

1.3

series of 4 pools

series of 3 pools

1.7

()'

Unit types
- FT- Turbulent
- FN-Non-Turbulent
- PS-Scour Pool
- PD-Dammed Pool
- PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	1.8 (1.1)		xx.x%	0-360
Bar Width	0 (0.6)		4.2	300 (280)
Bankfull Width	2.5 (4.0)			
R Bankfull Ht	0.3			
L Bankfull Ht	0.4			
	%			
RB Instability	0			
LB Instability	0			

Comments

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3	11	1	
0.3 - 0.6		1	
0.6 - 0.8			
> 0.8 m			

View upstream of transect J: DSC_181
View downstream of transect J: DSC_182
View upstream of transect j': DSC_186

Habitat field forms

Site Name: **Vasa Creek** | Date: 6 | 19 | 14

Site ID: **Lower Vasa** | Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover: 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

D = Decidious; C = Conifer; E = Broadleaf Evergreen; M = Mixed; N = None

Fish Cover/Other (10 m x 20m): 0 = Absent; 1 = Sparse; 2 = Moderate; 3 = Heavy; 4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	M	D	
Big Trees	3	2	
Small Trees	0	1	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	3	3	
Non-Woody Herbs & Grasses	1	1	
Ground Cover (<0.5m)			
Woody Debris + stems	2	2	
Non-Woody Herbs & Grasses	1	1	
Barren, Bare, Dry, or Duff	2	2	

Fish Cover/Other (10 m x 20m)	
Filamentous Algae	0
Macrophytes	0
Woody Debris	2
Brush	1
Overhanging veg	2
Undercut banks	0
Boulders/Ledges	1
Artificial Structures	0
Bryophytes	0

Canopy Density bank (0-17)	
Up	15
Left	16
Down	13
Right	15
LB	17
RB	17

Substrate

	Wet Depth	BF Depth (AW)	Size Class	Embed	Flag
LB	- 0	0.35	FN (SA)	100	
0.1	0.04	0.39	SA (SA)	100	
0.2	0.04	0.39	GF (SA)	30	
0.3	0.06	0.41	GF (GF)	30	
0.4	0.01	0.41	GC (GF)	30	
0.5	0.06	0.41	GF (GC)	30	
0.6	0.05	0.40	CB (GC)	10	
0.7	0.07	0.42	CB (GC)	10	
0.8	0.06	0.41	GC (SA)	20	
0.9	0.03	0.38	GC (SA)	20	
RB	- 0	0.35	CB (SA)	30	

GF 3 | SA 6
GC 3
CB 3 | GC 3

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms | Major: @135m Minor @67.5m Thalwag: @13.5m

Site Name: **Vasa Creek** | Date: 6/19/14

Site ID: **Lower Vasa** | Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' (K)

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.04	Y/N	Y/N	1	330	N	—	—
0.1		Y/N	Y/N					
0.2		Y/N	Y/N					
0.3		Y/N	Y/N					
0.4		Y/N	Y/N					
0.5		Y/N	Y/N					
0.6		Y/N	Y/N					
0.7		Y/N	Y/N					
0.8		Y/N	Y/N					
0.9		Y/N	Y/N					

#	Habitat Type	Pool Code Code 1	Pool Code Code 2	HU Width	Max Pool	Crest Pool
1	FT	N		0.9	—	—
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

Unit types
FT- Turbulent
FN-Non-Turbulent
PS-Scour Pool
PD-Dammed Pool
PP-Plunge pool
DC-Dry channel

Pool forming code
N-Not a pool
W- LWD
R-Rootwad
B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	0.9		xx.x%	0-360
Bar Width	0		[illegible]20%	330
Bankfull Width	1.4			
R Bankfull Ht	0.3			
L Bankfull Ht	0.5			
	%			
RB Instability	0			
LB Instability	0			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3		1	
0.3 - 0.6			
0.6 - 0.8			
> 0.8 m			

Comments

View upstream of transect K; DSC...191

View looking downstream of Transect K; DSC...192

Habitat field forms

Site Name: **Vasa Creek** | Date: 6/19/14

Site ID: **Lower Vasa** | Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' (K)

Riparian Vegetation Cover
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

D = Decidious
C = Conifer
E = Broadleaf Evergreen
M = Mixed
N = None

Fish Cover/Other (10 m x 20m)
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	D	M	
Big Trees	3	3	
Small Trees	1	0	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	1	3	
Non-Woody Herbs & Grasses	1	1	
Ground Cover (<0.5m)			
Woody Debris + stems	2	2	
Non-Woody Herbs & Grasses	1	1	
Barren, Bare, Dry, or Duff	2	2	

Filamentous Algae	0
Macrophytes	0
Woody Debris	1
Brush	0
Overhanging veg	2
Undercut banks	0
Boulders/Ledges	3
Artificial Structures	0
Bryophytes	3

Canopy Density bank (0-17)	
Up	17
Left	17
Down	17
Right	17
LB	16
RB	17

Substrate

	Wet Depth	Δw BF Depth	Size Class	Embed	Flag
LB	- 0	0.[illegible]4	GF	50	
0.1	0.02	0.42	CB	30	
0.2	0.03	0.43	SA	100	
0.3	0.04	0.44	SA	100	
0.4	0.04	0.44	SA	100	
0.5	0.03	0.43	GC	40	
0.6	0.03	0.43	SA	100	
0.7	0.02	0.42	SA	100	
0.8	0.02	0.42	SA	100	
0.9	0.01	0.41	SA	100	
RB	- 0	0.[illegible]4	SA	100	

Sa 8
CB1

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

Habitat field forms									Major: @135m Minor @67.5m Thalwag: @13.5m
Site Name:	Vasa Creek						Date:	6/18/14	
Site ID:	Lower Vasa						Surveyors:	JKP JCP	
Transect:	A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K								(L3 trib)

	Thalwag Depth	Bar	Edge Pool	Habitat Unit	Slope Bearing	Side Channel	SC Width	SC Notes
0	0.03	Y/N	Y/N	1	320	NO	—	—
0.1	0.04	Y/N	Y/N	5	0	NO	—	—
0.2	0.08	Y/N	Y/N	6	0	NO	—	—
0.3	0.16	Y/N	Y/N	6	10	NO	—	—
0.4	0.08	Y/N	Y/N	7	10	NO	—	—
0.5		Y/N	Y/N					
0.6		Y/N	Y/N					
0.7		Y/N	Y/N					
0.8		Y/N	Y/N					
0.9		Y/N	Y/N					

Habitat		Pool Code		HU	Max	Crest
#	Type	Code 1	Code 2	Width	Pool	Pool
1	FT	N		0.9	—	—
2	PP	W		2.4	0.37	0.04
3	FT	N		1.1	—	—
4	PP	W		2.3	0.31	0.06
5	FN	N		1.2	—	—
6	PP	W		2.0	0.35	0.04
7	FT	N		1.2	—	—
8						
9						
10						
11						
12						
13						
14						

length (m): 2.0, 1.5, 7.8, 1.5

127 trib2 tr.b3 128 Tr.b 5 129

Unit types
- FT- Turbulent
- FN-Non-Turbulent
- PS-Scour Pool
- PD-Dammed Pool
- PP-Plunge pool
- DC-Dry channel

Pool forming code
- N-Not a pool
- W- LWD
- R-Rootwad
- B-Boulder/Bedrock

	Dist (m)	Flag	Slope	Bearing
Wetted Width	0.9		xx.x%	0-360
Bar Width	0		4.7	320
Bankfull Width	1.7			
R Bankfull Ht	0.4			
L Bankfull Ht	0.3			
	%			
RB Instability	20			
LB Instability	40			

LWD (all/partially within BF)

	2-5m	5-15m	>15m
0.1 - 0.3			
0.3 - 0.6	IIII		
0.6 - 0.8			
> 0.8 m			

Comments

View upstream of Trib transect: DSC...126 Also Hab_T2
View downstream and Trib transect: DSC 127
Unit 6 pools are series of logs w/ notch cut out (placed)
DSC...130 is photo of SE 35th St culvert outlet
DSC...131 photo of roadside ditch on SE 35th St

*The downstream plunge pool and LWD are a partial to complete barrier to kokanee.

Habitat field forms

Site Name: **Vasa Creek** Date: 6/18/14

Site ID: **Lower Vasa** Surveyors: **JKP** **JCP**

Transect: A a' B b' C c' D d' E e' F f' G g' H h' I i' J j' K

Riparian Vegetation Cover
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

D = Decidious
C = Conifer
E = Broadleaf Evergreen
M = Mixed
N = None

Fish Cover/Other (10 m x 20m)
0 = Absent
1 = Sparse
2 = Moderate
3 = Heavy
4 = Very Heavy

Visual Riparian	Left Bank	Right Bank	Flag
Canopy (> 5m Tall)			
Vegetation Type	C	D	
Big Trees	3	3	
Small Trees	2	2	
Understory (0.5 to 5 m tall)			
Vegetation	D	D	
Woody Shrubs & Saplings	1	2	
Non-Woody Herbs & Grasses	2	1	
Ground Cover (<0.5m)			
Woody Debris/stems	2	2	
Non-Woody Herbs & Grasses	1	1	
Barren, Bare, Dry, or Duff	2	2	

Fish Cover/Other (10 m x 20m)	
Filamentous Algae	0
Macrophytes	0
Woody Debris	1
Brush	1
Overhanging veg	2
Undercut banks	0
Boulders/Ledges	2
Artificial Structures	0
Bryophytes	0

Canopy Density bank (0-17)	
Up	17
Left	17
Down	17
Right	17
LB	17
RB	17

Substrate

	Wet Depth	BF Depth	Size Class	Embed	Flag
LB	- 0	0.35	SA	100	
0.1	0.01	0.36	SA	100	
0.2	0.04	0.39	SA	100	
0.3	0.06	0.41	SA	100	
0.4	0.09	0.44	SA	100	
0.5	0.09	0.44	SA	100	
0.6	0.12	0.47	GC	20	
0.7	0.10	0.45	GC	30	
0.8	0.05	0.40	BL	10	
0.9	0.04	0.39	SA	100	
RB	- 0	0.35	SA	100	

Sa 8
GC 2

RS = Bedrock (smooth)
RR = Bedrock (rough)
BL = Boulder
CB = Cobble
GC = Coarse Gravel
GF = Fine Gravel
SA = Sand
FN = Fines
HP = Hardpan
WD = Wood
OT = Other

Comments

ATTACHMENT C

LOWER VASA OUTFALL RECONNAISSANCE INVENTORY/SAMPLE COLLECTION FIELD FORMS

OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subwatershed: Vasa Creek		Outfall ID: OF-H1	
Today's date: 6/18/14		Time (Military):	
Investigators: JCP and JKP		Form completed by: Jeff Phillips (Tetra Tech)	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera: Garmin		Photo #s: DSC000120	

Land Use in Drainage Area (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☒ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional
- Other: _____
- Known Industries: _____

Notes (e.g., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☒ Closed Pipe	☐ RCP ☐ CMP ☒ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☒ Circular ☐ Eliptical ☐ Box ☐ Other: ____	☒ Single ☐ Double ☐ Triple ☐ Other: ____	Diameter/Dimensions: 4 inch	In Water: ☒ No ☐ Partially ☐ Fully With Sediment: ☒ No ☐ Partially ☐ Fully
☐ Open drainage	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: ____	☐ Trapezoid ☐ Parabolic ☐ Other: ____		Depth: ____ Top Width: ____ Bottom Width: ____	
☐ In-Stream	(applicable when collecting samples)				
Flow Present?	☐ Yes ☒ No	*If No, Skip to Section 5*			
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		RESULT	UNIT	EQUIPMENT
☐ Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐ Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☒ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☒ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☒ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No	
2. If yes, collected from:	☐ Flow	☐ Pool	
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subwatershed: Vasa Creek		Outfall ID: OF-H2	
Today's date: 6/19/14		Time (Military):	
Investigators: JCP + JKP		Form completed by: Jeff Phillips (Tetra Tech)	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera: Garmin		Photo #s: DSC000157	

Land Use in Drainage Area (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☒ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional
- Other: _____
- Known Industries: _____

Notes (e.g., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☒ Closed Pipe	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☒ Other: Concrete	☒ Circular ☐ Eliptical ☐ Box ☐ Other: ____	☒ Single ☐ Double ☐ Triple ☐ Other: ____	Diameter/Dimensions: 8 inch	In Water: ☒ No ☐ Partially ☐ Fully With Sediment: ☒ No ☐ Partially ☐ Fully
☐ Open drainage	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: ____	☐ Trapezoid ☐ Parabolic ☐ Other: ____		Depth: ____ Top Width: ____ Bottom Width: ____	
☐ In-Stream	(applicable when collecting samples)				
Flow Present?	☐ Yes ☒ No *If No, Skip to Section 5*				
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		RESULT	UNIT	EQUIPMENT
☐ Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐ Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☒ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☒ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☒ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No	
2. If yes, collected from:	☐ Flow	☐ Pool	
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subwatershed: Vasa Creek		Outfall ID: OF-H3	
Today's date: 6/19/14		Time (Military):	
Investigators: JCP & JKP		Form completed by: Jeff Phillips (Tetra Tech)	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera: Garmin		Photo #s: DSC00158	

Land Use in Drainage Area (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☒ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional
- Other: _____
- Known Industries: _____

Notes (e.g., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☒ Closed Pipe	☐ RCP ☐ CMP ☒ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☒ Circular ☐ Eliptical ☐ Box ☐ Other: ____	☒ Single ☐ Double ☐ Triple ☐ Other: ____	Diameter/Dimensions: 4 inch	In Water: ☑ No ☐ Partially ☐ Fully With Sediment: ☑ No ☐ Partially ☐ Fully
☐ Open drainage	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: ____	☐ Trapezoid ☐ Parabolic ☐ Other: ____		Depth: ____ Top Width: ____ Bottom Width: ____	
☐ In-Stream	(applicable when collecting samples)				
Flow Present?	☐ Yes ☒ No *If No, Skip to Section 5*				
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		RESULT	UNIT	EQUIPMENT
☐ Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐ Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☑ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☒	☒ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	Cracked, looks like impact damage
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☒ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No	
2. If yes, collected from:	☐ Flow	☐ Pool	
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

ATTACHMENT D

DIGITAL DELIVERABLES (PROVIDED SEPARATELY)

Attachment D contains a summary of digital data that will be delivered separately including: 1) GPS point locations and associated digital photographs, and 2) a list of the GIS data that will be included the project geodatabase.

1) Photolog of Digital Photographs

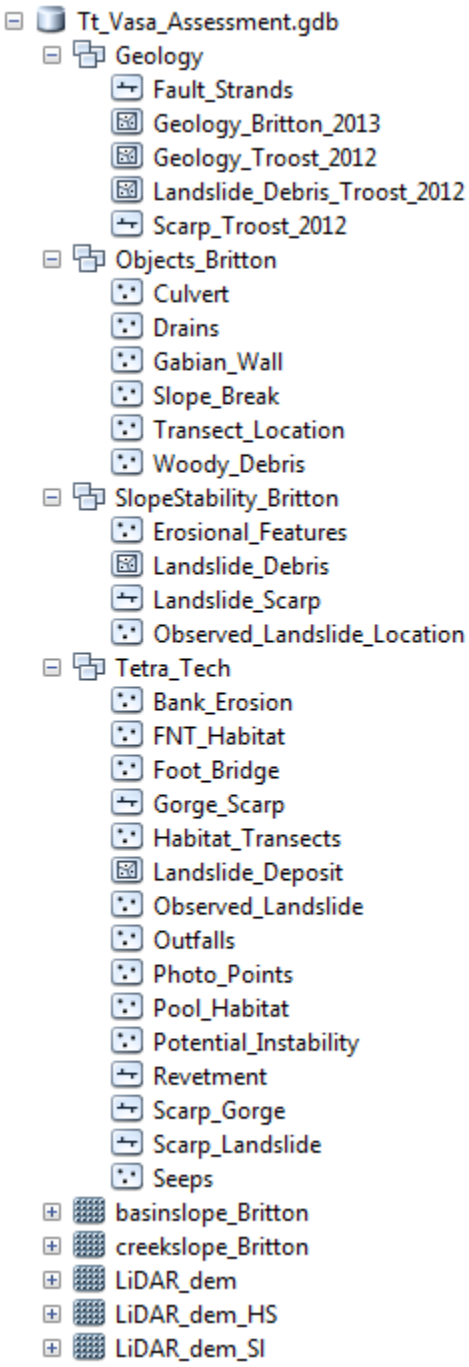
Photo Name	Point Type	Latitude Longitude	Time	Comments
DSC00109 20140618 Transect A us	Photo	47.57852500 -122.11260800	2014/06/18 17:20:49	Upstream view from Transect A
DSC00110 20140618 Transect A ds	Transect	47.57855200 -122.11261500	2014/06/18 17:22:30	Downstream shot of Transect A
DSC00111 20140618 A2 PS	Pool	47.57851300 -122.11292600	2014/06/18 17:30:16	Plunge Pool
DSC00112 20140618 a' and crossing	Transect	47.57843000 -122.11310300	2014/06/18 17:37:05	Upstream shot of minor transect looking at road crossing
DSC00113 20140618 Transect B us	Photo	47.57839600 -122.11335900	2014/06/18 17:50:55	Upstream view fromTransect B
DSC00114 20140618 Transect B ds	Transect	47.57800700 -122.11526300	2014/06/18 18:19:38	Downstream shot of Transect B
DSC00118 20140618 B4 PP	Pool	47.57804300 -122.11585400	2014/06/18 18:38:51	Plunge Pool
DSC00119 20140618 B8 and b' us	Transect	47.57799600 -122.11600500	2014/06/18 18:57:11	Upstream shot of minor transect
DSC00120 20140618 OF-H1	Outfall	47.57810300 -122.11608400	2014/06/18 19:03:32	Outfall
DSC00121 20140618 B10 PS	Pool	47.57805500 -122.11614100	2014/06/18 19:09:29	Scour Pool
DSC00122 20140618 B12 PS	Pool	47.57814800 -122.11639900	2014/06/18 19:17:49	Scour Pool
DSC00123 20140618 Transect C us	Photo	47.57808100 -122.11675700	2014/06/18 19:29:24	Upstream view from Transect C
DSC00124 20140618 Transect C ds	Transect	47.57821400 -122.11667200	2014/06/18 19:30:34	Downstream shot of Transect C
DSC00125 20140618 C2 PS	Pool	47.57807800 -122.11676200	2014/06/18 19:41:41	Scour Pool
DSC00126 20140618 Transect LB Trib us and LBT2 PP	Photo	47.57801300 -122.11721300	2014/06/18 20:10:00	Upstream view from Transect LBTrib
DSC00127 20140618 Transect LB Trib ds	Transect	47.57805200 -122.11722500	2014/06/18 20:10:34	Downstream shot of Transect LBTrib
DSC00128 20140618 LBT 4 PP	Pool	47.57807700 -122.11711000	2014/06/18 20:24:21	Plunge Pool
DSC00129 20140618 LBT 6 PP	Pool	47.57829000 -122.11716500	2014/06/18 20:31:08	Plunge Pool

Photo Name	Point Type	Latitude Longitude	Time	Comments
DSC00130 20140618 LBTrib input at road	Photo	47.57847300 -122.11719100	2014/06/18 20:38:55	Culvert on LB trib
DSC00131 20140618 LBTrib roadside ditch on 35th	Photo	47.57854800 -122.11765700	2014/06/18 20:40:32	Roadside ditch line on LB trib
DSC00132 20140618 C4 PP	Pool	47.57807900 -122.11729500	2014/06/18 21:12:56	Plunge Pool
DSC00133 20140618 C6 PP	Pool	47.57810900 -122.11736100	2014/06/18 21:22:08	Plunge Pool
DSC00134 20140618 C8 PP	Pool	47.57806000 -122.11787200	2014/06/18 21:34:47	Plunge Pool
DSC00135 20140618 Transect D us	Photo	47.57804300 -122.11792600	2014/06/18 21:46:28	Upstream view from Transect D
DSC00136 20140618 Transect D ds	Transect	47.57805000 -122.11796100	2014/06/18 21:47:04	Downstream shot of Transect D
DSC00137 20140618 D2 PP	Pool	47.57808500 -122.11802400	2014/06/18 21:51:26	Plunge Pool
DSC00138 20140618 D4 PP	Pool	47.57807100 -122.11836500	2014/06/18 22:02:28	Plunge Pool
DSC00139 20140618 D6 PP	Pool	47.57806200 -122.11855700	2014/06/18 22:14:16	Plunge Pool
DSC00140 20140618 D8 PP	Pool	47.57815800 -122.11884900	2014/06/18 22:24:15	Plunge Pool
DSC00141 20140618 Transect E us	Photo	47.57800500 -122.11891800	2014/06/18 22:49:31	Upstream view from Transect E
DSC00142 20140618 Transect E ds	Transect	47.57799000 -122.11893600	2014/06/18 22:50:12	Downstream shot of Transect E
DSC00143 20140618 E2 PS	Pool	47.57804300 -122.11919600	2014/06/18 22:57:18	Scour Pool
DSC00144 20140618 E4 PP	Pool	47.57811500 -122.11936900	2014/06/18 23:06:07	Plunge Pool
DSC00145 20140618 E6 PP	Pool	47.57800500 -122.11952800	2014/06/18 23:12:12	Plunge Pool
DSC00146 20140618 E8 PP	Pool	47.57808700 -122.11963100	2014/06/18 23:21:54	Plunge Pool
DSC00147 20140618 E10 PP	Pool	47.57811900 -122.11976600	2014/06/18 23:27:56	Plunge Pool
DSC00148 20140618 E12 PP	Pool	--	--	Plunge Pool
DSC00150 20140618 E14 PP	Pool	47.57807100 -122.11992500	2014/06/18 23:40:09	Plunge Pool
DSC00151 20140619 Transect F us	Photo	47.57798600 -122.12004200	2014/06/19 16:29:50	Upstream view from Transect F
DSC00152 20140619 Transect F ds	Transect	47.57800900 -122.12001300	2014/06/19 16:30:22	Downstream shot of Transect F

Photo Name	Point Type	Latitude Longitude	Time	Comments
DSC00153 20140619 F2 PP	Pool	47.57793200 -122.12018800	2014/06/19 16:34:53	Plunge Pool
DSC00154 20140619 F4 PP	Pool	47.57802900 -122.12020100	2014/06/19 16:39:17	Plunge Pool
DSC00155 20140619 F6 PP	Pool	47.57808200 -122.12041000	2014/06/19 16:48:48	Plunge Pool
DSC00156 20140619 F8 PP	Pool	47.57790400 -122.12086400	2014/06/19 17:05:45	Plunge Pool
DSC00157 20140619 OF-H3	Outfall	47.57804300 -122.12087300	2014/06/19 17:14:06	Outfall
DSC00158 20140619 OF-H3	Outfall	47.57790500 -122.12093900	2014/06/19 17:16:42	Outfall
DSC00159 20140619 Transect G us	Photo	47.57797400 -122.12140900	2014/06/19 17:49:32	Upstream view from Transect G
DSC00160 20140619 Transect G ds	Transect	47.57795600 -122.12139900	2014/06/19 17:50:03	Downstream shot of Transect G
DSC00161 20140619 G2 PS	Pool	47.57813700 -122.12181500	2014/06/19 17:57:21	Scour Pool
DSC00162 20140619 G4 PP	Pool	47.57822300 -122.12200100	2014/06/19 18:03:18	Plunge Pool
DSC00164 20140619 G6 PP	Pool	47.57827600 -122.12222100	2014/06/19 18:13:19	Plunge Pool
DSC00165 20140619 G8 PP	Pool	47.57833900 -122.12259300	2014/06/19 18:24:33	Plunge Pool
DSC00168 20140619 Transect H us	Photo	47.57838100 -122.12296500	2014/06/19 18:40:43	Upstream view from Transect H
DSC00169 20140619 Transect H ds	Transect	47.57840000 -122.12296300	2014/06/19 18:41:13	Downstream shot of Transect H
DSC00170 20140619 H2 PP	Pool	47.57841600 -122.12337900	2014/06/19 18:47:43	Plunge Pool
DSC00171 20140619 H4 PP	Pool	47.57843800 -122.12350700	2014/06/19 18:52:50	Plunge Pool
DSC00172 20140619 H6 PP	Pool	47.57842900 -122.12359200	2014/06/19 18:56:42	Plunge Pool
DSC00173 20140619 h' ds	Transect	47.57835700 -122.12377800	2014/06/19 19:02:46	Downstream shot at minor transect
DSC00174 20140619 Transect I us	Photo	47.57814100 -122.12438100	2014/06/19 19:41:42	Upstream view from Transect I
DSC00178 20140619 Transect I ds	Transect	47.57817900 -122.12450200	2014/06/19 19:43:47	Downstream shot of Transect I
DSC00179 20140619 I2 PS	Pool	47.57817000 -122.12495000	2014/06/19 19:56:53	Scour Pool
DSC00180 20140619 i' us	Transect	47.57820100 -122.12525900	2014/06/19 20:05:35	Upstream shot of minor transect

Photo Name	Point Type	Latitude Longitude	Time	Comments
DSC00181 20140619 Transect J us	Photo	47.57816800 -122.12599300	2014/06/19 20:40:38	Upstream view from Transect J
DSC00182 20140619 Transect J ds	Transect	47.57822400 -122.12593100	2014/06/19 20:41:17	Downstream shot of Transect J
DSC00183 20140619 J2 PS	Pool	47.57838700 -122.12604500	2014/06/19 20:47:03	Scour Pool
DSC00184 20140619 J4 PP	Pool	--	--	Plunge Pool
DSC00185 20140619 J6 PP	Pool	47.57831400 -122.12641500	2014/06/19 20:58:43	Plunge Pool
DSC00186 20140619 j' us	Transect	47.57829600 -122.12653900	2014/06/19 21:06:15	Upstream shot at minor transect
DSC00189 20140619 J8 PP	Pool	47.57830300 -122.12668100	2014/06/19 21:14:24	Plunge Pool
DSC00190 20140619 J10 PP	Pool	47.57832000 -122.12697100	2014/06/19 21:21:11	Plunge Pool
DSC00191 20140619 Transect K us	Photo	47.57832500 -122.12694400	2014/06/19 21:33:44	Upstream view from Transect K
DSC00192 20140619 Transect K ds	Transect	47.57834200 -122.12685400	2014/06/19 21:34:37	Downstream shot of Transect K

2) Geodatabase Structure:



ATTACHMENT E

2014 VASA CREEK ELECTRO-FISHING SUMMARY REPORT

Vasa Creek 2014 Summer Electrofishing Study

On July 9, 2014, summer fish sampling was conducted on a 151 foot reach of Vasa Creek starting at approximately river mile 0.38. This was the first sample for status and trends of resident fish populations at a macroinvertebrate monitoring location. The purpose of the sampling was to determine fish species diversity and size classes of resident fish. The reach was 100% shallow riffle, so aquatic habitat was limited.

The only fish observed were cutthroat trout, the majority (95%) were less than 80 mm in length. Only two fish were likely older than young-of-the-year. Two large stoneflies and three crayfish were also captured.

Methods

Methods of sampling in 2014 were consistent with previous efforts by the City. Electrofishing was conducted using a Smith-Root Backpack Electrofisher Model 12b. Settings on the electrofishing equipment for Vasa Creek were most effective at 200 volts (v), 40 Hertz (Hz), and 6 milliseconds (ms).

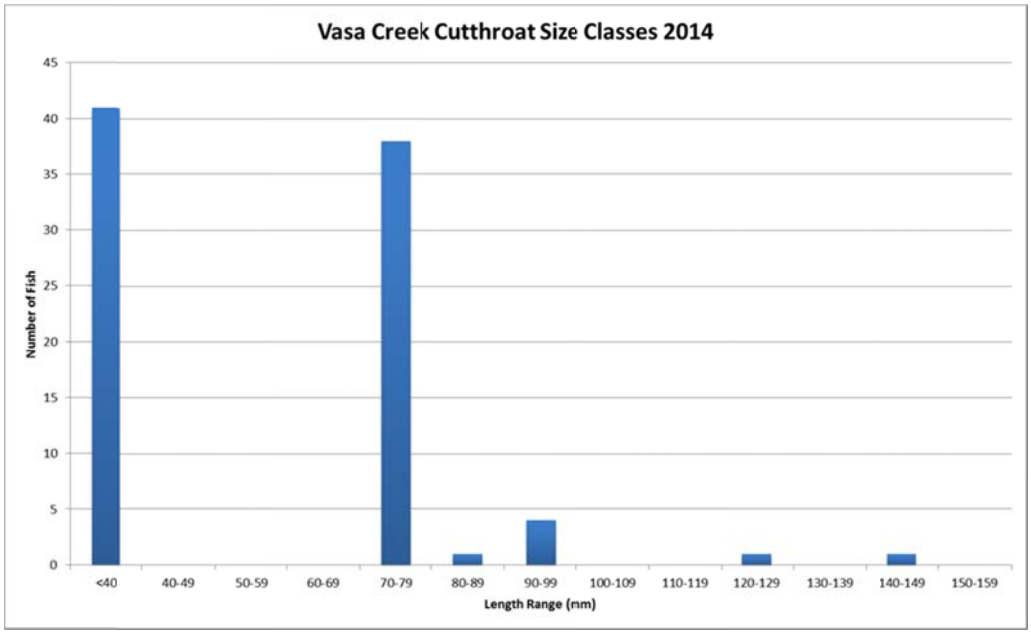
Block nets were placed at the bottom and top of the reach and a single pass was made with the electrofisher. One person utilized the electrofishing backpack and two people with long-handled dip nets followed closely alongside to capture stunned fish. Two netters were used throughout each reach. Netters were consistently swapped out and the team was comprised of at least one experienced netter and usually one inexperienced netter. Team members followed the electrofishing team with buckets of fresh stream water. Fish were tracked by habitat type (riffle or pool) and captured fish were placed in corresponding buckets. Captured fish were temporarily anesthetized on site using a dilute solution of MS-222 (Tricaine methanesulfonate) in water for identification and fork length measurements. Fish were then placed in fresh stream water supplied with an aerator until fully recovered. Once recovered, they were released on the outside of block nets so they would not be counted twice. Fish were captured as authorized under a Washington State Scientific Collection Permit.

Results

Species	***Total***	***Percent of Total***
Cutthroat	86	***95%***
Crayfish	3	3%
Stonefly	2	2%
Total organisms	91	100.0%
	Total	***Percent of Total***
Size (cutthroat)		
<80mm	79	91.9%
80-150 mm	7	8.1%
>150 mm	0	0.0%
Total	86	100.0%

Length (mm)	***Cutthroat***
Min	30
Max	145
Average	56
Median	75
Standard Deviation	27

Cutthroat	
Row Labels	***Count***
<40	41
70-79	38
80-89	1
90-99	4
120-129	1
140-149	1
Total	86



*Fish lengths calculated as median from length range. Fish lengths are NOT precise to individual fish lengths.

Date:	7/9/2014
Stream:	Vasa Creek
River Mile:	0.38
Latitude:	47.57
Longitude:	-122.12
Visibility:	Clear
Water:	14.8 °C
Total Reach Length:	151 ft.
Pool Length:	N/A
Riffle Length:	151 ft
Wetted Width:	3.0-4.5 ft.
Wetted Depth	2-2.5 inches
Bank Full Width:	5.9 ft.
Electrofishing Setting:	200 v, 50 Hz, 6 mS
Start Time	0.36458
End Time	0.4375
Netter Success:	Moderate-High
Sampling done by:	Kit Paulsen (employee - fish ID)
	Jim Starkes (consultant-electrofishing)
	Laurie Devereaux (employee)
	Zane Beall (intern)
	Volunteers: Jim McRoberts, Donna Oliver, Betty Peltzer, Christina Green

Fish #	***Species***	***Length (mm)***	***Habitat Type***	***Length Range***
1	Cutthroat	75	Riffle	70-79
2	Cutthroat	75	Riffle	70-79
3	Cutthroat	95	Riffle	90-99
4	Cutthroat	75	Riffle	70-79
5	Cutthroat	75	Riffle	70-79
6	Cutthroat	75	Riffle	70-79
7	Cutthroat	75	Riffle	70-79
8	Cutthroat	85	Riffle	80-89
9	Cutthroat	75	Riffle	70-79
10	Cutthroat	30	Riffle	<40
11	Cutthroat	30	Riffle	<40
12	Cutthroat	30	Riffle	<40
13	Cutthroat	30	Riffle	<40
14	Cutthroat	30	Riffle	<40

Fish #	*Species*	*Length (mm)*	*Habitat Type*	*Length Range*
15	Cutthroat	30	Riffle	<40
16	Cutthroat	30	Riffle	<40
17	Cutthroat	75	Riffle	70-79
18	Cutthroat	75	Riffle	70-79
19	Cutthroat	75	Riffle	70-79
20	Cutthroat	75	Riffle	70-79
21	Cutthroat	75	Riffle	70-79
22	Cutthroat	30	Riffle	<40
23	Cutthroat	30	Riffle	<40
24	Cutthroat	30	Riffle	<40
25	Cutthroat	30	Riffle	<40
26	Cutthroat	30	Riffle	<40
27	Cutthroat	145	Riffle	140-149
28	Cutthroat	30	Riffle	<40
29	Cutthroat	30	Riffle	<40
30	Cutthroat	30	Riffle	<40
31	Cutthroat	30	Riffle	<40
32	Cutthroat	30	Riffle	<40
33	Cutthroat	30	Riffle	<40
34	Cutthroat	30	Riffle	<40
35	Cutthroat	30	Riffle	<40
36	Cutthroat	30	Riffle	<40
37	Cutthroat	95	Riffle	90-99
38	Cutthroat	30	Riffle	<40
39	Cutthroat	30	Riffle	<40
40	Cutthroat	30	Riffle	<40
41	Cutthroat	30	Riffle	<40
42	Cutthroat	30	Riffle	<40
43	Cutthroat	30	Riffle	<40
44	Cutthroat	30	Riffle	<40
45	Cutthroat	30	Riffle	<40
46	Cutthroat	30	Riffle	<40
47	Cutthroat	30	Riffle	<40
48	Cutthroat	30	Riffle	<40
49	Cutthroat	30	Riffle	<40
50	Cutthroat	30	Riffle	<40
51	Cutthroat	30	Riffle	<40
52	Cutthroat	30	Riffle	<40
53	Cutthroat	30	Riffle	<40
54	Cutthroat	30	Riffle	<40
55	Cutthroat	30	Riffle	<40

Fish #	*Species*	*Length (mm)*	*Habitat Type*	*Length Range*
56	Cutthroat	30	Riffle	<40
57	Cutthroat	30	Riffle	<40
58	Cutthroat	125	Riffle	120-129
59	Cutthroat	75	Riffle	70-79
60	Cutthroat	75	Riffle	70-79
61	Cutthroat	75	Riffle	70-79
62	Cutthroat	75	Riffle	70-79
63	Cutthroat	75	Riffle	70-79
64	Cutthroat	75	Riffle	70-79
65	Cutthroat	95	Riffle	90-99
66	Cutthroat	75	Riffle	70-79
67	Cutthroat	75	Riffle	70-79
68	Cutthroat	75	Riffle	70-79
69	Cutthroat	75	Riffle	70-79
70	Cutthroat	75	Riffle	70-79
71	Cutthroat	95	Riffle	90-99
72	Cutthroat	75	Riffle	70-79
73	Cutthroat	75	Riffle	70-79
74	Cutthroat	75	Riffle	70-79
75	Cutthroat	75	Riffle	70-79
76	Cutthroat	75	Riffle	70-79
77	Cutthroat	75	Riffle	70-79
78	Cutthroat	75	Riffle	70-79
79	Cutthroat	75	Riffle	70-79
80	Cutthroat	75	Riffle	70-79
81	Cutthroat	75	Riffle	70-79
82	Cutthroat	75	Riffle	70-79
83	Cutthroat	75	Riffle	70-79
84	Cutthroat	75	Riffle	70-79
85	Cutthroat	75	Riffle	70-79
86	Cutthroat	75	Riffle	70-79
87	Crayfish	47	Riffle	40-49
88	Crayfish	65	Riffle	60-69
89	Crayfish	42	Riffle	40-49

ATTACHMENT F

2011 VASA CREEK MACROINVERTEBRATE SUMMARY REPORT

Vasa Creek River Mile 0.38

Bioassessment scores: 2011

The B-IBI site score for this site was 24, indicating "poor" conditions. In contrast, the RIVPACS result (0.81) indicated unimpaired conditions.

Indicators of ecological condition: 2011

a. Water quality

A single mayfly taxon was collected at the Vasa Creek site in 2011: this was the ubiquitous taxon Baetis tricaudatus. Although low mayfly taxa richness suggests impaired water quality, the biotic index value (3.87) was not different from expectations for a Puget Sound Lowlands stream. The moderately-sensitive benthic fauna suggests that water quality was good in this reach. The presence of relatively sensitive taxa such as the stonefly Sweltsa sp. and the caddisfly Glossosoma sp. also suggest good water quality. The metals tolerance index value (3.79) indicates that metals contamination probably did not influence the biota.

b. Thermal condition

The composition of the benthic fauna suggested cool water temperatures: the calculated preference for the assemblage was 13.7ºC. Cold stenotherm taxa were not well represented in the samples collected in this reach.

c. Sediment deposition

Fifteen "clinger" taxa and 6 caddisfly taxa were collected: it seems likely that colonization of benthic substrates was not limited by sediment deposition. The FSBI value (4.17) indicated a moderately sediment-tolerant assemblage. The nemourid stonefly Zapada cinctipes was abundant, suggesting that leafy and woody debris may have littered the channel floor.

d. Habitat diversity and integrity

Taxa richness (39) was relatively high, suggesting diverse instream habitats. The site supported at least 4 stonefly taxa: high richness in this group may be related to stable streambanks, natural channel morphology, and functional riparian zones. Four semivoltine taxa were collected in 2011; several of these taxa were common in the samples, suggesting stable instream conditions. Scour, toxic inputs, and thermal extremes seem unlikely. The abundance of shredders and the scarcity of scrapers suggest that riparian inputs of leafy and woody debris were ample, and that the channel may have been shaded. All other expected functional components were present in proportions that seemed appropriate for a Puget Sound Lowlands stream.