

Skagit County/Environmental Canine Services
Human Sewage Detection Project



Skagit County Public Works
Environmental Canine Services

June, 2014

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Introduction

As part of Skagit County and the Clean Samish Initiative's efforts to locate and remediate sources of fecal coliform bacteria in the Samish Basin, the County contracted with Environmental Canine Services (ECS) of New Hampshire to provide a sewage-sniffing dog and handler for a project in the Samish Basin to locate sources of human sewage. During the week of May 26, the dog Crush, its handler Aryn Havel, and ECS Manager Karen Reynolds were in Skagit County to pursue the project.

Activities included bringing field samples to the dog for testing in the County parking lot, and deploying Crush to field locations. The field locations were chosen based on the parking lot results or in areas where failing septic systems were suspected.

A number of quality control samples were also tested, including positive control samples from a septic system, negative controls consisting of distilled water processed in the field and in the parking lot, and alternative fecal coliform sources such as horse and cow manure. Crush passed all the quality control checks, successfully identifying the diluted septic system samples and passing on the negative controls and alternative fecal coliform sources.

Crush identified a number of field samples as positive for human sewage. Skagit County is following up on those positive tests. Most of the positive tests occurred in very small watercourses or drainage systems. Fecal coliform counts for samples that were positive for human sewage ranged from 4 mpn to 920 mpn.

Background

Excess fecal coliform bacteria have been a problem in the Samish Bay Watershed for many years. Renewed focus on the basin was triggered in 2008 by a storm event that led to extreme fecal coliform loading detected by routine monitoring. Focused storm event monitoring revealed that the problem was basin-wide and led to the downgrading of the Samish Bay shellfish growing area and the establishment of the Clean Samish Initiative (CSI). The CSI, a collaboration of over 20 organizations led by Skagit County, aims to reduce fecal coliform pollution in the basin, foster the upgrading of the shellfish growing area, and return the fresh waters to compliance with Washington State Water Quality Standards.

Skagit County and its CSI partners established a Pollution Identification and Correction (PIC) program in 2010. The PIC program uses focused water quality monitoring, education and outreach, property inspections, septic system monitoring, and other tools to locate and remediate pollution sources. The Environmental Canine Services project reported here is yet another tool for locating fecal coliform sources and identifying their origins.

Methods

Environmental Canine Services provides dogs (with handlers) trained to detect human sewage. Numerous projects have shown their capabilities in detecting human sources of fecal coliform bacteria and ignoring other sources.

This project used two methods of exposing the dog to samples: The “Bucket Test” method, where field samples were brought into a scent-neutral parking lot and placed in open containers for the dog to smell; and field tests, where the dog was taken out to locations within the Samish Basin to check the waters in situ or in open containers near the source. Crush identified samples with human sewage by lying down next to the open container or watercourse. See Figures 1 and 2.

Field samples were taken mostly at previously identified locations although a few “samples of opportunity” were obtained. Samples were taken directly into new, pre-labeled 4-L HDPE sample bottles, rinsed three times with the water to be sampled. GPS coordinates were recorded at each sample site. A map of bucket sample sites and field tests is included as Figure 3.

Quality control samples included positive control samples taken from the Edison town septic system before and after the UV sterilization step; negative controls consisting of distilled water processed in the field and in the parking lot; and alternative fecal matter controls consisting of horse or cow manure suspensions in distilled water.

On the first day, the bucket tests were conducted in the late morning (after field samples were obtained and returned to the test area), and the dog was deployed to the field in the afternoon. Some of the sites that had positive samples in the morning bucket tests did not have positive field identifications, and it was thought possible that the morning “first flush” may have shown up in the bucket test samples but dissipated by the afternoon field tests. Consequently, on the second day Crush was deployed to the field in the morning and the bucket tests occurred in the early afternoon with samples obtained in the morning.

For the bucket tests, open containers (approx. 4-L) were distributed through the parking lot with about 5-m of spacing to prevent cross-contamination of odors. Samples were processed in groups of 12. Samples were carefully poured into the containers with an identifying tag visible. Once all the samples were distributed, the handler led the dog to the containers one by one. If the dog detected human sewage in a sample, she sat next to it and was rewarded with a small treat by the handler. Then the dog would go on to the next sample until all 12 samples in the set had been examined. The dog worked quickly and examining the whole sample set would take about one minute. Dog reactions were recorded by County staff with assistance from the ECS Manager. Once the sample set was processed, the samples were capped and removed approximately 100 m away to prevent carryover odors.

Field operations consisted of taking the dog to locations identified either by previous bucket tests or by high fecal coliform counts in areas suspected of having failing septic systems. At the identified locations, after ensuring traffic safety, the handler took the dog out of a vehicle and exposed it either directly to the watercourse in question or to a fresh sample in an open container in the cases where site

characteristics prevented direct access by the dog. The signal from the dog was the same as for the bucket tests. A distilled water field blank was tested in an open container in at least one location. On some occasions the dog bypassed an open container and proceeded directly to the watercourse with a positive reaction.

Concurrent samples were taken at many of the sampling locations for analysis of chemical tracers of human sewage such as sucralose and caffeine. Results of that analysis will be available later.

Results

Results from the bucket and field tests are listed in Tables 1 and 2. Positive and negative results are mapped in Figure 3.

Crush correctly identified all quality control samples. The Edison town septic system sample taken downstream of the UV sterilizer had a non-detectable fecal coliform count, but Crush still identified it as human sewage. The dog passed by the horse and cow manure samples even though there was sufficient manure (approx. 20 g in 4 L) to significantly discolor the distilled water diluent, and the fecal coliform counts were extremely high (2300 mpn in the horse manure sample, 144,000 mpn in the cow manure sample). The negative controls (manure and distilled water samples) also served as a check on odor carryover, and there was no apparent effect from the proximity of the positive controls.

In the bucket tests, Crush detected human sewage in 12/33 field samples (Table 1). Many of samples Crush identified as positive turned out to have low levels of fecal coliform. Fecal coliform counts in bucket test samples with positive dog responses ranged from 4 mpn to 920 mpn. Counts in samples with negative dog responses ranged from 23 mpn to 540 mpn.

In the field tests, Crush detected human sewage at 11/22 locations (Table 2). There was one instance of repeat testing of a location (Bob Smith Creek) in the field tests, triggered by a positive response in a bucket test and a negative response in the afternoon field test. Crush gave a positive response in a field test the next morning.

In the Swede Creek sub basin, a drain pipe discharging to the Grip Road ditch (and eventually into Swede Creek) tested positive, but a bucket sample from further downstream on Swede Creek was negative.

In the Thomas Creek sub basin, several tributaries in the upper basin tested positive either in bucket tests or in the field, but Thomas Creek at F&S Grade Road, downstream from the positive tests, was negative in a bucket test.

In the Friday Creek sub basin, Silver Creek in Alger had a positive response in a bucket test, while Friday Creek further downstream (below the confluence with Silver Creek) had a negative response.

On the mainstem Samish River, a drain pipe tested positive in a "field bucket test" (meaning the sample was brought ¼ mile down the levee to the road, where it was placed in an open container for the dog to

test). However, the Samish River downstream of the drain pipe did not test positive in a similar test. The drain pipe flow was very low, probably less than 10 gpm, while the river flow at the time was 145 cfs or 65,000 gpm.

The ditch downstream of the Edison town septic system tested negative for human sewage.

Discussion

Since the dog tests had to be scheduled in advance, we were not able to choose the weather for the tests. Consequently, the tests took place during a period with only a little rain (0.07" on 5/28) and relatively low fecal coliform counts in most locations, even those with positive dog responses. While the low flows may have enhanced the ability to detect septic tank runoff (due to lack of dilution), it leaves open the question of the relative contribution of the human sources compared to livestock and wildlife sources in the areas that did test positive. For initial follow-up activities, the County will prioritize those areas that had both high fecal coliform counts and positive responses from Crush. It remains unknown whether a rain event that resulted in higher fecal coliform counts would have triggered more positive dog responses.

Most of the positive responses in both the bucket and field tests were from very small streams, ditches, and drain pipes. The larger waterbodies, such as Friday Creek and the Samish River, did not produce positive tests. Many of these were downstream of positive responses in the tributaries, as delineated in the results section above. The largest stream to trigger a positive dog response was Silver Creek in Alger, which was flowing at approximately 5-10 cfs at the time of sampling. The positive response was not repeated further downstream in Friday Creek, which had a similar (low) fecal coliform count but was sampled the previous day.

The relatively high proportion of positive results reflects that many of the areas chosen for sampling were suspected by County staff as having possible failing septic systems. These areas were targeted based on previous fecal coliform sampling results and knowledge of soils and locations of previous failing septic systems.

Remaining interpretation questions, hampered somewhat by the generally low fecal coliform counts detected during this project, include: Do the positive responses disappear downstream due to dilution or degradation of the substances that trigger the positive response? What proportion of the fecal coliform detected at the downstream (negative) locations was due to carryover from the human sources upstream? During higher fecal coliform events, are the higher numbers in the areas that tested positive for human sewage due to additional human sewage runoff, or due to other sources of fecal coliform being washed in by precipitation?

Table 1. Results from “Bucket Tests” in Skagit County/Environmental Canine Services Project

<u>Site/Label</u>	<u>Date</u>	<u>Description</u>	<u>Fecal Coliform (mpn/100 ml)</u>	<u>Canine response</u>
BSCreek	5/28/2014	Bob Smith Creek near mouth	130	Negative
BSUp	5/28/2014	EF Bob Smith Creek at Bow Hill Rd	140	Positive
BSDark	5/28/2014	WF Bob Smith Creek near Bow Hill Rd	79	Negative
WCPR	5/28/2014	Weir Creek at Prairie Rd	94	Negative
FC1	5/28/2014	Friday Creek at first Friday Creek Rd crossing	49	Negative
BCFCR	5/28/2014	Butler Creek at Friday Creek Rd	46	Negative
QC1	5/28/2014	QC sample distilled water	N/A	Negative
QC2	5/28/2014	QC sample distilled water	N/A	Negative
QC3	5/28/2014	Quality Control sample - ~ 20 g cow manure	140,000	Negative
QC4	5/28/2014	Quality Control sample - ~ 20 g horse manure	2300	Negative
Edsep1	5/28/2014	Edison septic system before treatment	>16,000	Positive
Edsep2	5/28/2014	Edison septic system after UV treatment	ND	Positive
Edditch	5/28/2014	Ditch near Edison septic system	46	Negative
CAO4	5/28/2014	Thomas Creek at F&S Grade Rd	79	Negative
THOMOS	5/28/2014	Thomas Creek (NE fork) at Mosier Rd	170	Positive
THOBridge	5/28/2014	Thomas Creek at Bridgewater Rd	240	Positive
SCGrip1	5/28/2014	Swede Creek at upper Grip Rd	130	Negative
CAO8	5/28/2014	Swede Creek a lower Grip Rd	49	Negative
PAR	5/28/2014	Parsons Creek at mouth	49	Negative
SKARPCR	5/28/2014	Skarrup Creek at Parsons Creek Rd	23	Negative
SKAR	5/28/2014	Skarrup Creek at Double Creek Ln	49	Negative
WCPR2	5/28/2014	Weir Creek at Prairie Rd	79	Negative
WILDES	5/29/2014	Wildes Creek at Friday Creek Rd	140	Negative
SILVER	5/29/2014	Silver Creek at Alger Community Hall	49	Sample lost
CAIN	5/29/2014	Cain Lake outlet	23	Negative
BCCR	5/29/2014	Butler Camp Creek at Kelleher Rd	240	Positive
SFTHO	5/29/2014	South Fork Thomas Creek at Grip Rd	540	Negative
THOMOS	5/29/2014	Thomas Creek (NE Fork) at Mosier Rd	920	Positive
THOBridge	5/29/2014	Thomas Creek at Bridgewater Rd	110	Positive
SILVER2	5/29/2014	Silver Creek at Alger Community Hall	33	Positive (resample)
BSUp	5/29/2014	EF Bob Smith Creek at Bow Hill Rd	70	Negative
MCEGATE	5/29/2014	Ditch draining to McElroy Slough	350	Positive
NE7	5/29/2014	Estes Road ditch	4	Positive
VOSPIPE	5/29/2014	Vos drain pipe at Samish River	540	Positive
CAO32	5/29/2014	Samish River at Thomas Road	130	Negative
SUNSET AND THOMAS	5/29/2014	Ditch at intersection	140	Negative
CAO38	5/29/2014	North Edison pump station	170	Positive
CAO37	5/29/2014	Edison pump station	240	Negative
CAO39	5/29/2014	Colony Creek at Colony Rd (near Colony Mt Rd	33	Negative
ESBCR	5/29/2014	Edison Slough at Bow Cemetery Rd	48	Positive

Table 2. Results from field tests for Skagit County/Environmental Canine Services Project

<i>Label</i>	<i>Location description</i>	<i>GPS</i>	<i>Time</i>	<i>Bucket Sample (Y/N)</i>	<i>Canine Response (pos/neg)</i>	<i>Comments</i>
5/28/2014						
Site 2a	Lillian Lane/Garden of Eden Rd	48.35195; -122.2502	13:32	y	Negative	Willard
Site 2b	Lillian Lane/Garden of Eden Rd	48.5193; -122.2500	13:35	y	Positive	Willard East
Site 4	(8106) Garden of Eden	48.5264; -122.2507	13:45	N	Negative	Catch basin
Site 3	Birch Land Willard Creek	48.5193; -122.2476	13:40	N	Negative	
Site 5	22849 Cully	48.5288; -122.2551	14:00	Y	Positive	
Site 6	SF Thomas Cr at Grip Rd	48.5328; -122.2482	14:10	Y	Positive	Negative in bucket test on 5/29
Site 7	Thomas Cr 23162 Mosier Rd	48.5428; -122.2451	14:15	Y	Positive	Landowner allows access to 20 acres
Site 8	Erwin Lane/Bridgewater	48.5504; -122.2558	14:30	n	Negative	
Site 9	EF Bob Smith Cr (BSUp)	48.5592; -122.3358	14:40	n	Negative	
5/29/2014						
BSUp	EF Bob Smith Creek at Bow Hill Rd (BSUp)	48.559; -122.3355	8:00	Y	Positive	
CAO33	Alice Bay pump station	48.5551; -122.4845	8:30	Y	Positive	
	Alice Bay road left side	48.5544 -122.4862	8:35	Y	Positive	
	Alice Bay road right side	48.5546 -122.4862	8:40	Y	Positive	
	Alice Bay drainage at Samish Island Rd	48.5483; -122.4773	9:00	Y	Positive	
	Alice Bay drainage at Bay View-Edison Rd	48.5445; -122.4722	9:15	Y	Positive	
	Sunset Ditch	48.5454; -122.4004	9:30	Y	Negative	
	Wallace Farm	48.5355; -122.4114	9:50	Y	Negative	
	Vos Pipe	48.5208; -122.4051	10:30	Y	Positive	
	White Pipe	48.5580; -122.2546	11:00	Y	Positive	
	Black pipe	48.5579; -122.2542	11:05	Y	Negative	
	Ditch	48.5579; -122.2537	11:10	Y	Negative	

Follow-up

Skagit County Environmental Health personnel have already begun following up on the results of the canine detection project. Actions taken thus far include review of septic system permit records, visits to properties in the areas with positive detections, and contact with landowners to request permission to dye test their septic systems. Skagit County Environmental Health personnel will continue to follow up

on positive responses from the canine detection project. Skagit County Public Works personnel will continue to obtain fecal coliform samples in the areas with positive human sewage detections as well.



Figure 1. Crush and Aryn check out a ditch in the Samish Basin



Figure 2. Crush detects human sewage in a bucket sample

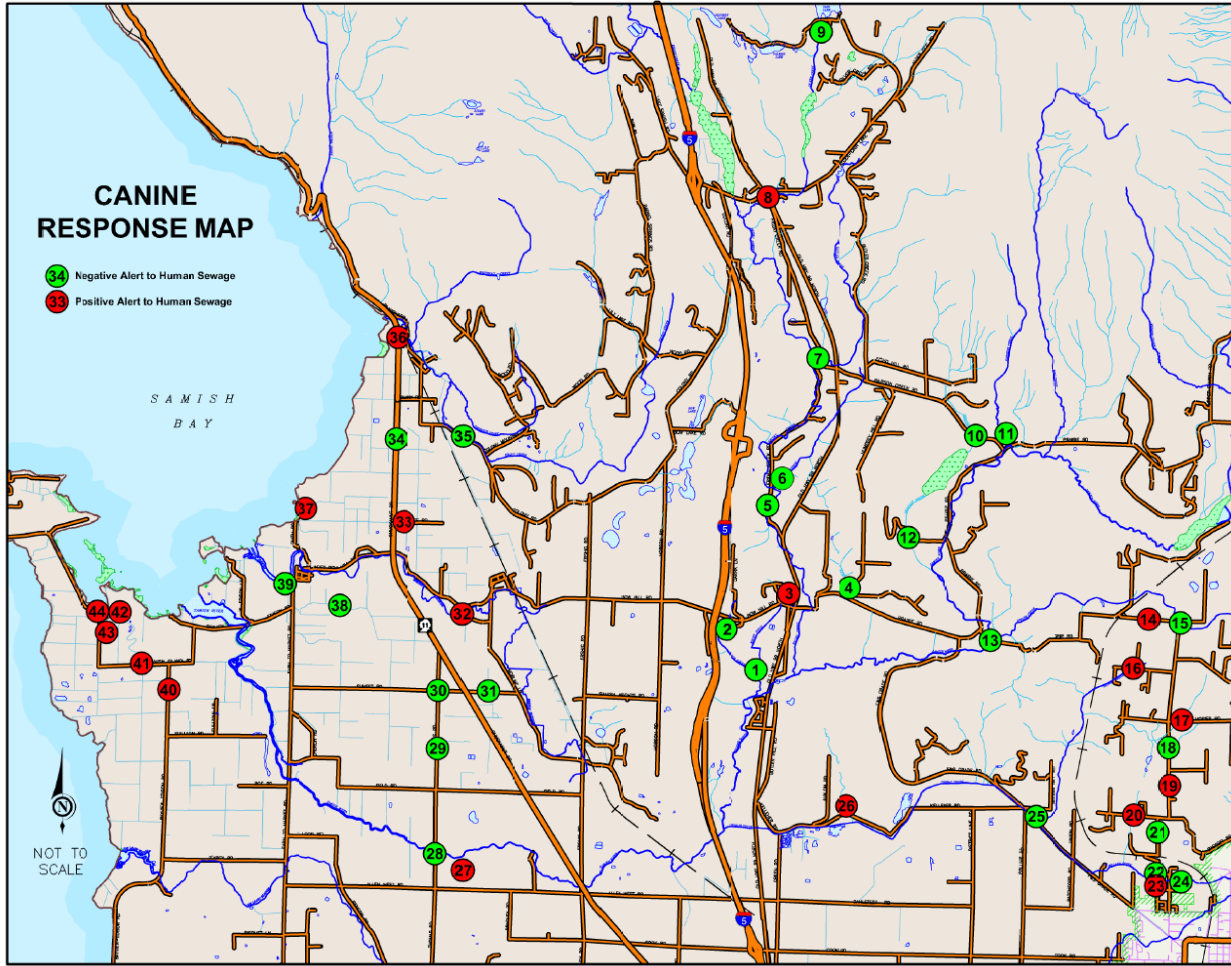


Figure 3. Map of positive and negative canine response locations (see site key on next page)

Site codes for Canine Response Map (Figure 3, above)

<u>Number</u>	<u>Site/Label</u>	<u>Description</u>	<u>Canine Response</u>
1	BSCreek	Bob Smith Creek near mouth	Negative
2	BSDark	WF Bob Smith Creek near Bow Hill Rd	Negative
3	BSUp	EF Bob Smith Creek at Bow Hill Rd	Positive
4	WCPR	Weir Creek at Prairie Rd	Negative
5	FC1	Friday Creek at first Friday Creek Rd crossing	Negative
6	WILDES	Wildes Creek at Friday Creek Rd	Negative
7	BCFCR	Butler Creek at Friday Creek Rd	Negative
8	SILVER2	Silver Creek at Alger Community Hall	Positive
9	CAIN	Cain Lake outlet	Negative
10	SKARPCR	Skarrup Creek at Parsons Creek Rd	Negative
11	PAR	Parsons Creek at mouth	Negative
12	SKAR	Skarrup Creek at Double Creek Ln	Negative
13	CAO8	Swede Creek a lower Grip Rd	Negative
14	White Pipe	Grip Rd, east of Hoogdal Branch Rd	Positive
15	SCGrip1	Swede Creek at upper Grip Rd	Negative
16	THOBridge	Thomas Creek at Bridgewater Rd	Positive
17	THOMOS	Thomas Creek (NE fork) at Mosier Rd	Positive
18	SFTHO	South Fork Thomas Creek at Grip Rd	Negative
19	Grip Rd/Greenough Ln	Ditch	Positive
20	22551 Cully Rd	Willard Creek tributary	Positive
21	8106 Garden of Eden Rd	At catch basin	Negative
22	Garden of Eden Rd/Kiens Ln	Willard Creek tributary	Negative
23	Garden of Eden Rd/Kiens Ln	Willard Creek west	Positive
24	Birch Ln	Willard Creek east	Negative
25	CAO4	Thomas Creek at F&S Grade Rd	Negative
26	BCCR	Butler Camp Creek at Kelleher Rd	Positive
27	VOSPIPE	Vos drain pipe at Samish River	Positive
28	CAO32	Samish River at Thomas Road	Negative
29	Wallace Farm	Thomas Road, between Sunset and Field Rd	Negative
30	Sunset & Thomas	Ditch at intersection	Negative
31	Sunset Ditch	east of Chuckanut Dr	Negative
32	ESBCR	Edison Slough at Bow Cemetery Rd	Positive
33	NE7	Estes Road ditch	Positive
34	4492 Chuckanut Dr	south of Colony Rd	Negative
35	CAO39	Colony Creek at Colony Rd	Negative
36	MCEGATE	Ditch draining to McElroy Slough	Positive
37	CAO38	North Edison pump station	Positive
38	Edditch	Ditch near Edison septic system	Negative
39	CAO37	Edison pump station	Negative
40	Alice Bay drainage	at Bay View-Edison Rd	Positive
41	Alice Bay drainage	at Samish Island Rd	Positive
42	CAO33	Alice Bay pump station	Positive
43	Alice Bay pump station road	left side	Positive
44	Alice Bay pump station road	right side	Positive