

Alaska Department of Environmental Conservation

Waterbody Field Report

Pederson Hill Creek, Juneau, Alaska



Abstract

In 2019 the Alaska Department of Environmental Conservation (DEC) conducted a bacteria water quality assessment of the Pederson Hill Creek watershed in Juneau, Alaska. The study objectives were to augment the 2013-2014 focused monitoring performed in the upper watershed; and to determine if the water quality has improved with decreased bacteria levels in response to best management practices implemented by the City and Borough of Juneau. Sampling was conducted at 11 locations in Pederson Hill Creek consisting of 5 samples per location during a 30-day period and tested for fecal coliform bacteria, *Escherichia coli* (*E. coli*), and microbial source tracking. Six monitoring locations exceeded the Alaska Water Quality Standards for fecal coliform bacteria; three of these locations also exceeded *E. coli* criteria. Human, dog and horse DNA were detected within several segments of the watershed downstream from potential fecal bacteria sources. Field measurements showed limited Alaska Water Quality standard exceedances and generally represented healthy stream concentrations.

Basic Waterbody Information

Table 1. Basic Waterbody Information

Assessment Unit ID	AK_R_1030106_038
Assessment Unit Name	Pederson Hill Creek/Casa Del Sol
Location description	Mendenhall River-Frontal Gastineau Channel; Hydrologic Unit Code 12: HUC 190103010606
Water Type	Stream
Length sampled	3.56 miles
Time of year sampled	May 16 – June 13, 2019

Water Quality Evaluation

Background

Pederson Hill Creek, also known as Casa Del Sol Creek, located in the Mendenhall Valley of Juneau, Alaska, is an anadromous stream (ADFG Catalog #111-50-10490-2013) and is bordered by the Glacier Highway and Engineers Cutoff Road. The watershed drains from uplands and forested wetlands then through residential and commercial development into the Mendenhall Wetlands State Game Refuge. The 4,000-acre wildlife refuge stretches nine miles along the shores of Gastineau Channel, and provides a vital feeding and resting area for both resident birds and migrant birds traveling to and from their Arctic breeding grounds. Table 1 provides

basic waterbody information. Table 2 provides monitoring location descriptions and site selection rationale. Figure 1 displays the general watershed location and Figure 2 shows the monitoring locations and potential fecal bacteria pollution sources throughout the watershed.

Pederson Hill Creek was first included on Alaska's Clean Water Act Section 303(d) list of impaired waterbodies in 1990, based on non-attainment of the Alaska Water Quality Standards (WQS) for fecal coliform bacteria. At the time, failing on-site septic tanks were identified as the probable pollution source. A water quality assessment was conducted in 2006 and a Total Maximum Daily Load (TMDL)¹ was approved by the U.S. Environmental Protection Agency (USEPA) in 2008.

From 2010-2011, the City and Borough of Juneau (CBJ) extended the municipal sewage treatment system lines on Glacier Highway, connected all properties to the CBJ sewage treatment system and on-site septic tanks were properly decommissioned. However, the municipal sewer line was not extended onto Engineers Cutoff Road, and according to CBJ there are no plans for an extension at this time. The Engineers Cutoff Road area is serviced by individual on-site septic systems and the area drains to the west fork of Pederson Hill Creek.

In 2013 and 2014, water samples were collected in the upper Pederson Hill Creek watershed and analyzed for fecal bacteria and microbial source tracking. The 2013 and 2014 reports² concluded that fecal pollution contributors within the mid-east fork of the watershed appear to be human sources from upgradient septic systems on Engineers Cutoff Road (PHC-5). Other likely pollution sources included wildlife and upgradient farm and horse stables (PHC-3).

¹ *Total Maximum Daily Load (TMDL) for Fecal Coliform in the Waters of Pederson Hill Creek in Juneau, Alaska (February 2008)* <https://dec.alaska.gov/water/water-quality/impaired-waters/>

² *Pederson Hill Creek Water Quality Monitoring July 2, 2012 – June 30, 2013, and Pederson Hill Creek Water Quality Monitoring May 2014 – June 2014* <https://dec.alaska.gov/water/water-quality/reports/>. The Quality Assurance Project Plan for Water Quality Monitoring, Sampling and Analysis Activities (QAPP) and supporting data can be obtained from DEC southeast staff in the Juneau office.



Figure 1. Pederson Hill Creek watershed, Juneau Alaska³

³ The Pederson Hill Creek watershed is outlined in black.

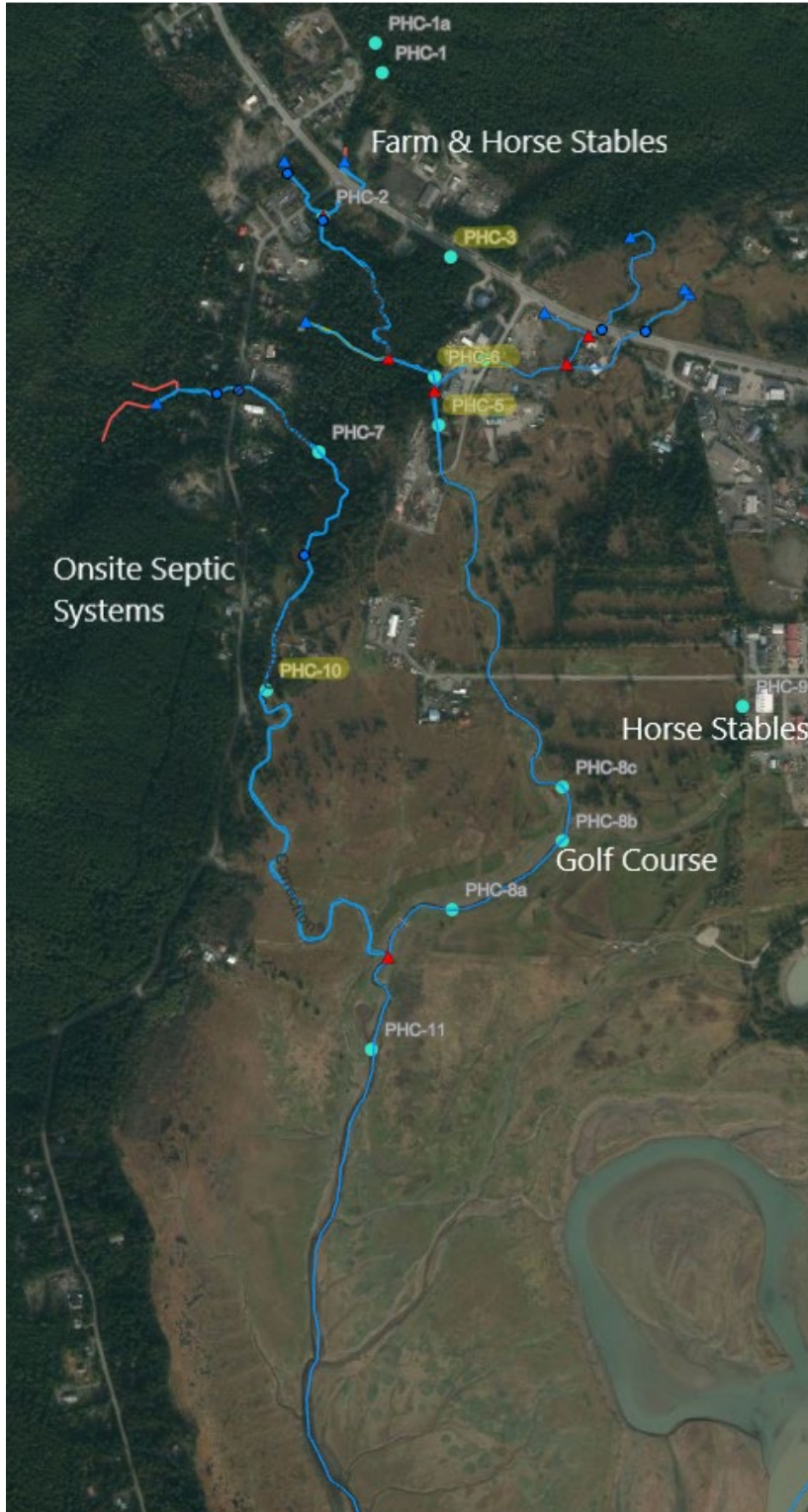


Figure 2. Pederson Hill Creek site locations with potential fecal bacteria pollution source areas.⁴

⁴ Alaska Department of Fish and Game Anadromous Waters Catalog map shows red anadromous stream segments having resident fish, blue as corrected anadromous stream segments, and green as added anadromous stream segments.

Table 2. Pederson Hill Creek Site Locations

Site ID	Site Description	Site Selection Rationale/ Nonpoint Source Contributions	Latitude	Longitude
PHC-A	Upstream of background sample PHC-1.	Alternate background	58.376581	-134.620736
PHC-1	Above development at end of Hamilton Drive.	Background	58.376109	-134.620511
PHC-2	Southeast side of Engineers Cut-off Road, confluence of two creek stems in wooded forest.	Residential, roadways, drainage ditches	58.373701	-134.622399
PHC-3	Outlet of culvert on southwest side of Glacier Highway.	Residential, roadways, drainage ditches, farm and horse pastures	58.373017	-134.618338
PHC-4	Culvert intersection adjacent to northwest side of Sherwood Lane.	Residential, roadways, drainage ditches, commercial, parking lots	58.371308	-134.617260
PHC-5	Under bridge, upstream of mitigation pond (Millers Pond).	Commercial, roadways, drainage ditches, parking lots, decommissioned septic system/field	58.370204	-134.618703
PHC-6	Confluence of two creek stems, west of commercial area.	Commercial, roadways, drainage ditches, parking lots	58.371006	-134.618836
PHC-7	Southeast side of Engineers Cut-off Road, downstream of residential sewer systems.	Residential, roadways, drainage ditches, active septic systems	55.369738	-131.622532
PHC-8a	East creek fork, west of golf course; 2019 dry year had to traverse upstream to collect adequate sample.	Downstream of entire east fork creek system, golf course	55.362090	-131.618289
PHC-8b			58.363246	-134.614767
PHC-8c			58.364138	-134.614741
PHC-9	East creek fork stem, west of horse stable and commercial area.	Commercial, roadways, drainage ditches, horse stable	58.365489	-134.609010
PHC-10	Southeast side of Engineers Cut-off Road, downstream of residential sewer systems.	Residential, roadways, drainage ditches, active septic systems, downstream of entire west creek fork	58.365764	-134.624212
PHC-11	Confluence of entire creek system in Mendenhall Wetlands State Game Refuge.	Downstream of entire creek system	55.359744	-131.620827

Objective

The study objectives were to conduct a bacteria water quality assessment of the entire Pederson Hill Creek watershed; and to determine if the water quality has improved with decreased bacteria levels in response to best management practices implemented by the CBJ.

Methods

Water quality samples were collected at 11 locations on Pederson Hill Creek during a 30-day period from May 16 – June 13, 2019, and laboratory analyzed for fecal coliform bacteria and E.coli (five samples/site within the 30-day period), and for microbial source tracking (MST) (one sample/site on June 10, 2019). MST laboratory testing consisted of several DNA markers based on the potential bacteria source within the site locations to help determine the fecal bacteria source(s). MST tests included bacteroidetes IDs of human, horse, dog, goose, and ruminant (deer). Field water quality measurements were also collected during each sampling event and included turbidity, specific conductivity, temperature, dissolved oxygen, and pH. The Hach HQ40D portable multi meter was used for field measurements in May, and the newly acquired Aqua TROLL 500 multiparameter Sonde was used in June. All data was collected following a DEC approved Quality Assurance Project Plan.

Data Quality Review Summary

The project goal was to sample and monitor water quality throughout the watershed to determine whether Pederson Hill Creek consistently meets water quality standards regulatory limits. The QAPP outlined the data objective goals for 100% completeness, precision, accuracy, and representativeness. All data goals were met and there were no deviations from the QAPP. Additional data quality review information is available from the DEC project manager.

Results Summary

Bacteria exceedances were detected in three locations (PHC-3, PHC-5/PHC-6, PHC-10) downstream of potential bacteria source areas of horse stables and on-site septic systems. Human DNA was detected through MST analysis in three locations (PHC-5, PHC-10, PHC-11) downstream of on-site septic systems; dog DNA in one location (PHC-11) along a popular dog walking trail; and horse DNA in two locations (PHC-2 and PHC-3) downgradient of farm and horse stables. Field measurements showed limited exceedances of WQS: low DO and pH in the background site and low DO in the downstream of farm and horse stables. Additional details are in the following sections.

Bacteria

Water samples collected from the 11 locations in Pederson Hill Creek during a 30-day period in May to June were analyzed for fecal coliform and E.coli bacteria. Fecal coliform and E.coli exceeded bacteria criteria in the upper east fork (PHC-3, downstream of farm and horse stables), the mid-east fork (PHC-5 and PHC-6, downstream of onsite septic systems), and the west fork (PHC-10, downstream of onsite septic systems). Fecal coliform also exceeded bacteria criteria in east fork (PHC -8, within golf course area) and in the lower watershed segment (PHC-11, most downstream sample site).

Figure 2 shows the monitoring locations highlighted in yellow with the potential bacteria source areas. Table 3 shows the fecal coliform and E.coli bacteria data as maximums, geometric means, and percent exceedances of WQS within the watershed. Figures 3 and 4 display graphs of the fecal coliform and E.coli bacteria data results for all 11 sampling sites on Pederson Hill Creek.

Table 3. 2019 Fecal coliform & E.coli bacteria water data summary – bold blue values exceed criteria

Sample site	Fecal coliform ⁵			E.coli ⁶		
	Maximum individual		Geomean	Maximum individual		Geomean
	Maximum	% exceedance		Maximum	% exceedance	
PHC-1	1	0	1	2	0	1
PHC-2	28	0	3	13	0	1
PHC-3	540	20	15	730	20	11
PHC-4	20	0	3	6	0	2
PHC-5	420	80	39	870	20	45
PHC-6	290	20	25	340	0	50
PHC-7	8	0	2	7	0	2
PHC-8	54	40	8	130	0	22
PHC-9	7	0	2	5	0	2
PHC-10	1300	100	232	1600	60	498
PHC-11	72	20	13	69	0	10

⁵ Fecal coliform criteria is 40 CFU/100 ml, geomean criteria 20 CFU/100 ml per 18 AAC 70.2(A)i.

⁶ E.coli criteria is criteria 410 CFU/100 ml, geomean 126 CFU/100 ml per 18 AAC 70.2(B)i.

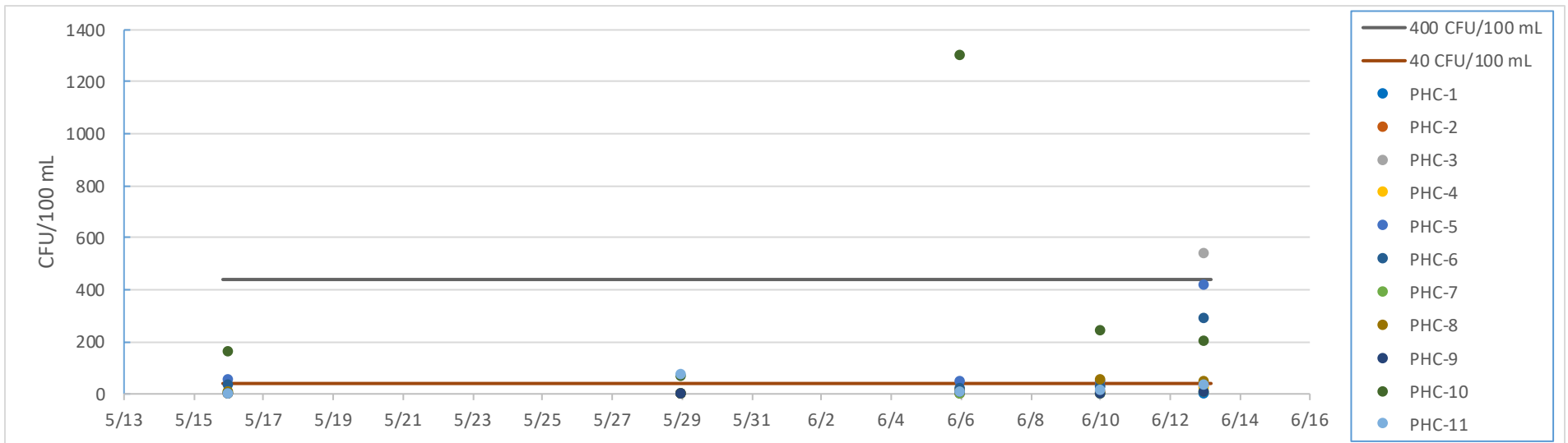


Figure 3. 2019 Fecal Coliform Bacteria water results

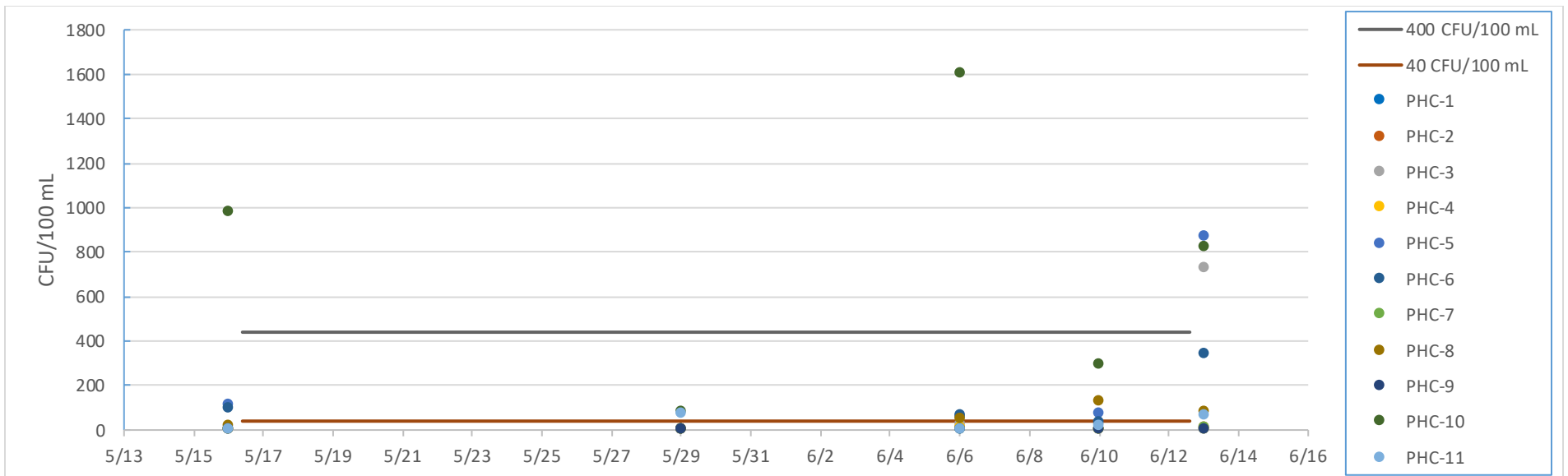


Figure 4. 2019 E.coli Bacteria water results

Microbial Source Tracking

Water samples collected from the 11 locations in Pederson Hill Creek during the June sampling event were all analyzed for microbial source tracking. DNA host marker analysis included human, dog, horse, goose, and ruminant deer. The host markers examined for each sample depended on the most likely bacteria source(s) for that monitoring location based on the surrounding landscape and potential sources. Microbial source tracking revealed human DNA in the upper east fork, west fork, and the most downstream site (PHC-5, PHC -10 and PHC-11 respectively). PHC-11 is downstream of known on-site septic systems. Dog DNA was found in the most downstream site PHC-11, along a popular dog walking trail; and horse DNA in the upper east fork (PHC-2 and PHC-3, downgradient of farm and horse stables).

Table 4 shows the MST host marker analytical detections. Figure 5 shows the monitoring locations with associated human, dog and horse MST host markers.

Table 4. 2019 MST water data results (copies/100 ml)

Sample site	Human	Dog	Horse	Goose	Ruminant
PHC-1	ND ⁷	-	-	-	-
PHC-2	ND	-	DNQ	-	-
PHC-3	ND	-	DNQ	-	-
PHC-4	ND	-	-	-	-
PHC-5	DNQ ⁸	-	-	-	-
PHC-6	ND	-	-	-	-
PHC-7	ND	-	-	-	ND
PHC-8	ND	ND	ND	ND	ND
PHC-9	ND	-	ND	-	-
PHC-10	DNQ	-	-	-	ND
PHC-11	3080	DNQ	ND	ND	ND

⁷ ND – Not detected

⁸ DNQ – Detected not quantified, low concentration

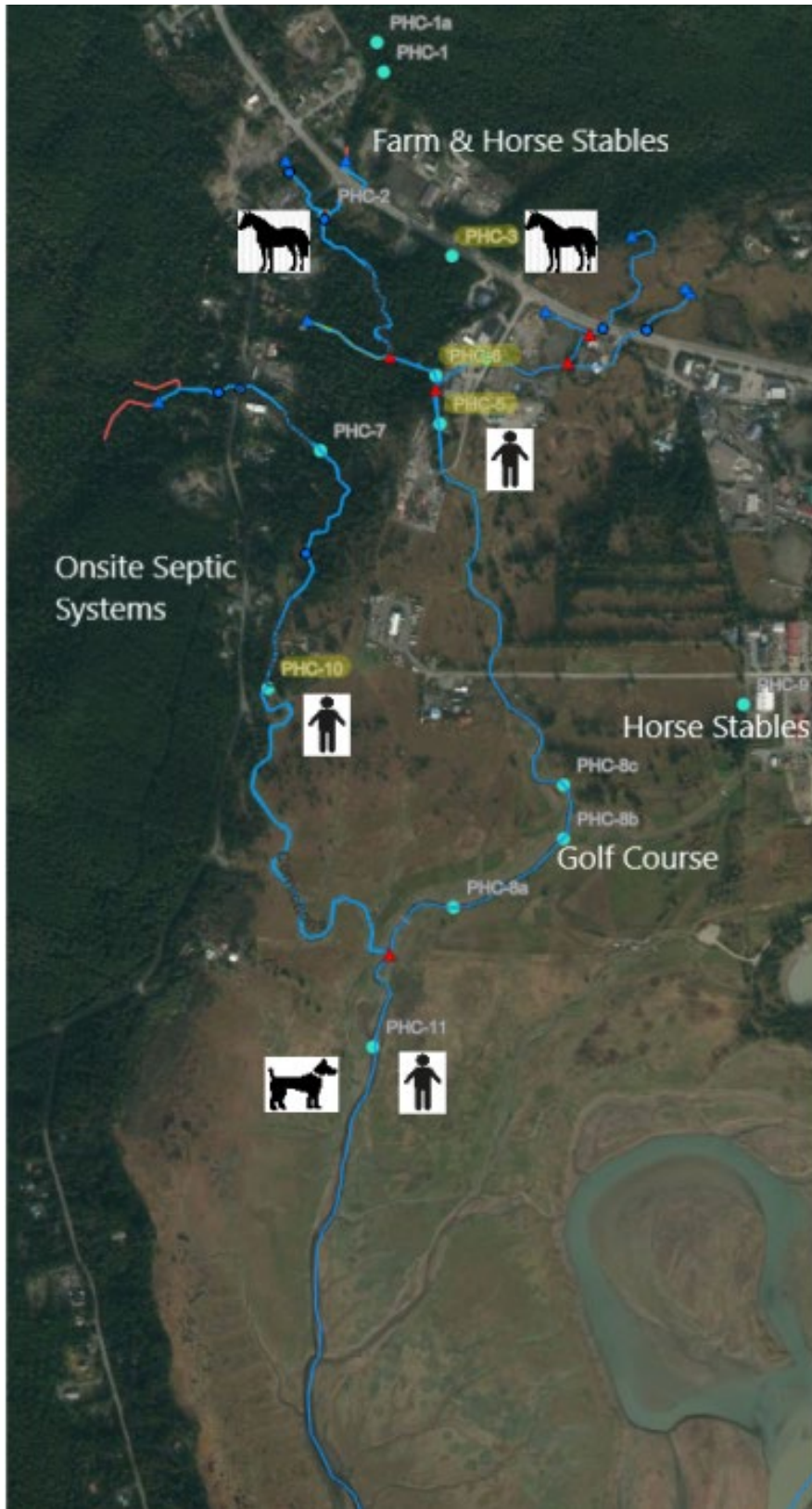


Figure 5. Pederson Hill Creek site locations with MST host markers of human, horse and dog

Field Measurements

Field measurements of water temperature, DO, pH, and turbidity were within expected ranges as compared with WQS with a couple of exceptions. Low DO and pH were measured in the background site (PHC-1) and low DO was also measured in the site (PHC-3) directly downstream of farm and horse stables. The lower watershed area such as PHC-11 is tidally influenced as evidenced by the elevated specific conductivity values in the brackish water. Table 5 shows the range and average of field measurements within the watershed.

Table 5. 2019 Field Measurements water data summary – bold blue values exceed Aquatic Life criteria⁹

Sample site	Turbidity (NTU)		Specific Conductivity (µS/cm)		Temperature (°C)		Dissolved Oxygen (mg/l)		pH (NA)	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
PHC-1	0.4 – 35.6	7.6	21 – 59	32	9.2 – 13.9	11.39	4.6 – 10.2	6.9	5.5 – 6.7	6
PHC-2	3.2 – 9.6	5.5	152 – 3,296	838	9.5 – 11.5	10.61	9.6 – 10.9	10.5	6.6 – 7.6	7.3
PHC-3	1.8 – 8.2	4.9	512 – 8,595	2,143	10.6 - 13	11.46	3.8 – 9	6.4	5.9 – 7.2	6.8
PHC-4	2.3 – 5.1	3.7	217 – 3,964	1,075	10.7 – 12.2	11.49	8.3 – 10.3	9.2	6.6 – 7.7	7.4
PHC-5	1 – 2	1.5	141 – 3,129	788	9 – 11.6	10.62	9.3 – 11.1	10.2	7.5 – 7.8	7.7
PHC-6	1.6 – 4.7	3	168 – 3,412	878	9.9 – 12.3	11.16	9 – 10.9	10.1	7.5 – 8.1	7.7
PHC-7	1 – 1.9	1.4	49 - 912	243	8.8 – 13.8	10.73	8.4 – 10.2	9.4	6.2 – 7.5	7
PHC-8	3.4 – 8.5	5.5	284 – 9,107	3,811	14 – 28.5	21.43	9.5 – 12.9	11.6	7.4 – 9.5	8.5
PHC-9	3.2 – 6.3	4.6	13 – 3,316	768	11 – 16.6	14.77	6.3 – 16.3	10.4	7 – 9.3	7.9
PHC-10	3 – 7.8	5	102 – 1,299	411	10.8 – 16.8	13.5	8.8 – 10.5	9.8	7.4 – 7.6	7.5
PHC-11	6.8 – 12.9	10.5	21,572 – 123,990	55,757	12.4 – 21.8	17.8	6.4 – 14.6	9.8	6.8 – 8.1	7.3

⁹ Turbidity may not exceed 5 NTU above natural turbidity (PHC-1 is background site). Specific conductivity and temperature do not currently have applicable criteria. Dissolved oxygen must be ≥ 7.0. pH has minimum of 6.5 and maximum of 8.5.

Conclusion

Based on the results of this water quality assessment, Pederson Hill Creek continues to be impaired for pathogens with several potential sources identified. Fecal bacteria pollutants from urban development and stormwater runoff are present within the three areas of the watershed as highlighted on Figure 2: upper east fork (downstream of farm and horse stables), mid-east fork (downstream of onsite septic systems), and west fork (downstream of on-site septic systems). Human DNA markers were detected in the upper east fork and along the lower west fork (downstream of onsite septic systems); dog DNA markers were detected in the most downstream sample site (along a popular dog walking trail); and horse DNA markers were detected in the upper east fork (downgradient of farm and horse stables) as shown on Figure 5. Field measurements show limited WQS exceedances and generally represent healthy stream concentrations.

Recommended Next Steps

Levels of fecal coliform and E.coli bacteria above WQS continue to be present in the Pederson Hill Creek watershed. As a result, additional best management practices (BMPs) are necessary to reduce bacteria levels in the creek. Potential bacteria sources have been identified and could be the focus of future BMP work. DEC will conduct future water quality sampling after additional BMPs have been implemented to measure water quality improvements in the creek.