PEDERSON HILL CREEK WATER QUALITY MONITORING

JULY 2, 2012 – JUNE 30, 2013

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JUNEAU WATERSHED PARTNERSHIP

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SUMMARY

Pederson Hill Creek in the Mendenhall Valley near Juneau, Alaska is an anadromous stream (ADF&G Catalog #111-50-10490-2013) boarded by Glacier Highway and Engineers Cutoff Road. The creek drains from uplands and forested wetlands, through residential and commercial development into the Mendenhall Wildlife Refuge.

Pederson Hill Creek was first included on the State's 303(d) list of impaired waterbodies in 1990 due to impairment from elevated levels of fecal coliform bacteria. Failing septic tanks were identified as the probable pollution source. An assessment was conducted in 2006 and a Total Maximum Daily Load (TMDL) was approved by the Environmental Protection Agency (EPA) in 2008.

This project evaluated the current hydrologic and selected chemical and biological conditions of Pederson Hill Creek. Water quality sampling for fecal coliform and other water quality parameters took place from July 2012 through June 2013 during high and low flow events.

Working closely with the DEC project manager the Juneau Watershed Partnership (JWP) developed an in-depth Sampling Plan and monitoring Quality Assurance Project Plan (QAPP) approved by the DEC. Samples were collected at five different sample locations within the Pederson Hill Creek watershed over a period of 30 days starting on June 5th, 2013.

JUNEAU WATERSHED PARTNERSHIP

Our mission is to promote watershed integrity in the City and Borough of Juneau through education, research and communication while encouraging sustainable use and development.

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ABOUT PEDERSON HILL CREEK

Pederson Hill Creek, located in the Mendenhall Valley, is approximately two miles long and contains roughly one mile of tidally influenced estuarine channels. The creek originates on the north side of Glacier Highway from springs at the base of a bedrock outcrop and discharges into the Mendenhall River. Pederson Hill Creek is an anadromous system that supports populations of coho, pink, and chum salmon, cutthroat trout, and Dolly Varden char. Pederson Hill Creek runs through forested wetlands, hemlock forest, and developed areas. The Pederson Hill Creek watershed provides habitat for a variety of waterfowl, raptors, songbirds, as well as small and large mammals.

Pederson Hill Creek was first included on the State's 303(d) list of impaired waterbodies in 1990 due to impairment from elevated levels of fecal coliform bacteria. Failing septic tanks were identified as the likely pollution source. At that time, the residential and commercial buildings within the Pederson Hill Creek watershed were not connected to the CBJ sewage treatment system and relied on on-site septic systems, and the Pederson Hill Creek watershed had a documented history of problems associated with failing septic systems. An assessment was conducted in 2006 and a Total Maximum Daily Load (TMDL) was approved by the Environmental Protection Agency (EPA) in 2008 in order to help the waterbody meet State water quality standards. The presence of fecal coliform can indicate an increased risk of pathogen contamination, and consumption of or contact with pathogen contaminated water presents a health risk.

PEDERSON HILL MONITORING LOCATIONS

Pederson Hill Creek is a lightly forested watershed comprised of mixed use areas including homes, horse farms and office complexes. The soils and vegetation are primarily forested wetland. Glacier Highway is perpendicular to the northern part of the various reaches of Pederson Hill Creek and contributes road run-off to stream flow. Site PHC-1, PHC-2 and PHC-3 are located near a residential and newly industrial development area while PHC-4 and PHC-5 are downstream of urbanized development and open wetland areas. Table 1 provides a site description for each sampling/monitoring location. The selection of the locations is based on the representativeness of the site as well as previous use for TMDL assessment, development, and implementation. Table 2 describes the rationale for developing each of the sampling/monitoring locations and the criteria for site selection.

Figure 1 shows the aerial view of the Pederson Hill Creek watershed and the location of each sampling/monitoring site. Potential sources of pollution and runoff are also labeled on the map, including the location of a decommissioned septic tank, urbanized development and animal pastures.

Table 1: Monitoring Locations and Site Descriptions

Site ID	Latitude	Longitude	Site Description
PHC1	58°22'33.96"N	134°37'13.8"W	Above development at the end of Hamilton Drive. The area has dense brush and many areas of stagnant flow.
PHC2	58°22'25.32"N	134°37'20.6"W	Southeast side of Engineers cut-off. The site is downstream from the confluence of two stems of Pederson Hill Creek in the wooded forest. Receives runoff from Glacier Hwy, Engineers Cutoff and a culvert that runs under Engineers Cutoff.
PHC3	58°22'23.23"N	134°37'6.99"W	Outlet of a culvert located on the southwest side of Glacier Hwy. This culvert receives water runoff collected from both sides of Glacier Hwy and receives direct contribution from horse farms and pastures up gradient.
PHC4	58°22'16.75"N	134°37'2.1"W	Culvert intersection adjacent to the northwest side of Sherwood Lane. Receives contribution from ditches along Sherwood Lane and parking lot and buildings located on Sherwood.
PHC5	58°22'12.72"N	134°37'7.75"W	Downstream of all the parking lots and building structures on Sherwood Lane. Site is located underneath a bridge that crosses the stream, just upstream of a mitigation pond.

Table 2: Monitoring Site Rationale

Site ID	Monitoring Purpose	Measurements
PHC1	Comparison with state water quality standards	Background
PHC2	Comparison with state water quality standards	Nonpoint source and drainage ditch contribution
PHC3	Comparison with state water quality standards	Residential and farm contribution
PHC4	Comparison with state water quality standards	Residential and commercial contribution
PHC5	Comparison with state water quality standards	Total contributions

Figure 1: Sample sites for the Pederson Hill Creek water quality monitoring project.

METHODS

Samples were collected for the Pederson Hill Creek project at five (5) different sample locations (see Figure 1) within the Pederson Hill Creek watershed over a 30-day period. The first sample was collected on June 5, 2013 and the final sample was collected on June 26, 2013. The sampling period was chosen to meet the requirements of the Total Maximum Daily Load (TMDL) for fecal coliform in the waters of Pederson Hill Creek, which was established for the achievement of water quality standards when a waterbody is water quality limited. The TMDL represents the amount of pollutant the waterbody can assimilate while maintaining compliance with applicable water quality standards. Applicable water quality standards for fecal coliform in Pederson Hill Creek establish water quality criteria for the protection of designated uses for water supply, water recreation, and growth and propagation of fish, shellfish, other aquatic life, and wildlife. The TMDL for Pederson Hill Creek was developed for the most stringent of guidelines - the fecal coliform criteria for drinking, culinary, and food processing water supply that state that "in a 30-day period, the geometric mean may not exceed 20 FC/100 mL, and not more than 10 percent of the samples may exceed 40 FC/100 mL (18 AAC 70 (1)(A)(i))."

Samples were collected to determine fecal coliform concentrations and measured field parameters at the five (5) sites on Pederson Hill Creek as well as for Microbial Source Tracking to be determined by the positive fecal coliform results or colonies that develop for each sample. Each fecal coliform sample was collected using the grab method with a 120 ml bottle preserved with sodium thiosulfate and each MST sample was collected into a 500 ml sterile polycarbonate Corning bottle, unpreserved. Field parameter samples were each collected into a 1000 ml high-density polyethylene (HDPE) sample bottle and were measured in-situ immediately after sample collection using a Hach 40d rugged portable multi-parameter meter. Samples for Total Suspended Solids (TSS) and turbidity were analyzed according to Standard Methods and within holding periods for each analysis at the University of Alaska Southeast's Natural Science Research Laboratory (NSRL). A field replicate was collected from one site per sampling period on a rotating schedule so that replicates were collected from each sampling site. Temperature blanks accompanied all coolers to ensure that samples remained within acceptable limits.

The Juneau Watershed Partnership staff collected all samples by following Standard Operating Procedures as described in the Pederson Hill Creek Tier II Water Quality Monitoring QAPP. To collect the water samples sterile sampling gloves were used and changed between each sampling site. Water samples were collected about six inches below the surface of the water to avoid collecting surface scum,

if the depth of the water was conducive to collection at that depth. During sampling at each location notes were taken on observations of wildlife, weather, and potential sources of pollution.

Two laboratories were used for microbiological sample analysis for the Pederson Hill project. Admiralty Environmental, LLC, a DEC approved water quality laboratory in Juneau, performed analyses of fecal bacteria colonies present in the samples. Admiralty Environmental provided all sampling bottles, materials, and coolers. After collection samples were stored in a cooler between 1 and 10 degrees Celsius and were returned to the laboratory within 6 hours of collection. Sample analysis was started within 8 hours of collection time, the new standard holding period adapted by the Department of Environmental Conservation, Division of Water. Laboratory staff at Admiralty Environmental checked each temperature blank upon receipt to ensure that samples were delivered less than 10 degrees Celsius. Source Molecular, an environmental laboratory in Florida that provides molecular and genetic microbial source tracking services for determination of sources of fecal pollution, provided sampling kits for each MST sampling event, which included sample bottles, cooler, ice packs, Chain of Custody (COC) forms and shipping instructions. MST samples were packed in the cooler with gel ice and accompanying COC and temperature blank, and were shipped Fed Ex standard overnight to Source Molecular immediately after the project sample collection. The samples were filtered and stored at less than 6 degrees Celsius until JWP provided verbal instruction as to which samples to perform MST on.

Admiralty Environmental submitted fecal coliform results to JWP verbally immediately after the final fecal coliform result was determined at the laboratory. Based on these results, JWP contacted Gretchen Pikul, the DEC Project Manager, to discuss the final fecal count and which samples to proceed with MST analysis on. Once the decision was made, JWP contacted Source Molecular and instructed them on which samples to analyze for MST, hosts to target, and samples to discard. In the case of several sampling events, all of the MST samples were discarded and none were analyzed for MST.

Field Forms and COC were scanned and emailed to Gretchen Pikul, the DEC contact and project manager. All field data was entered into an MS Excel spreadsheet and supplied to the DEC. Data was then reviewed for quality control and assurance by DEC staff and ultimately uploaded to the state Alaska Water Quality Monitoring System (AQWMS) database.

RESULTS

The five (5) Pederson Hill Creek sampling sites were sampled five (5) times during the month of June in FY2013 (see Table 3). Graphs for measured field parameters and fecal coliform results are listed in the Appendix to this report.

Presence of fecal coliform colonies ranged from non-detect (<2 FC/100 ml) and 220 FC/100 ml at the Pederson Hill Creek sampling sites, but fail to meet the stringent water quality criteria put forward by the Alaska water quality standards for fecal coliform. According to the final TMDL developed for Pederson Hill Creek in 2008, these criteria apply to drinking, culinary, and food processing water supply (classified as drinking, culinary and food processing in the water supply category described by the Alaska water quality standards). The geometric mean and exceedance limits that the fecal coliform samples must meet for each sampling site are summarized in Table 3 below. Of the five sites monitored, PHC-1, the site chosen as a background representation for Pederson Hill Creek, was the only site that did not exceed the fecal coliform limits set by the State of Alaska, stating that "not more than 10 percent of the samples may exceed 40 FC/100 mL (18 AAC 70 (1)(A)(i))." Site PHC-3 exceeded the geometric mean limit of 20 FC/100 ml, with a geometric mean result of 96.5 FC/100 ml and site PHC-5 also exceeded the geometric mean limit, with a geometric mean result of 53.6 FC/100 ml. The other three (3) sites, PHC-1, PHC-2 and PHC-4 met the geometric mean limit.

Table 3: Summary of Fecal Coliform results

Sampling Location	Fecal Coliform Results (CFU/100 mL)			
	Total # of Samples	Geomean*	# > 40 CFU/100 mL	% of samples > 40 CFU/100 mL**
PHC-1	5	< 2	0	0%
PHC-2	5	14.4	1	20%
PHC-3	5	96.5	4	80%
PHC-4	5	20	1	20%
PHC-5	5	53.6	4	80%

*Geomean may not exceed 20 cfu/100ml **Not > 10% of samples may exceed 40 cfu/100ml

The first Pederson Hill Creek sampling event, which took place on June 5, 2013, was the event that yielded the highest fecal coliform results. The last four sampling events yielded consistently lower fecal coliform results than the first event, which was collected in overcast and rainy weather and was

the wettest sampling event that took place during the month of June. Southeast Alaska had unseasonably warm and dry weather this summer, with record highs being recorded throughout the months of May and June. After the initial rainfall that was received on and prior to the June 5, 2013 sampling event, the remainders of the samplings were collected during periods of dry weather.

Sampling site PHC-3 yielded the highest overall sampling results for fecal coliform, with values ranging from 18 FC/100 ml to 220 FC/100 ml. The final value for site PHC-3, sampled June 5, 2013, was reported as Too Numerous to Count (TNTC) by the analytical laboratory. Admiralty Environmental, the analytical laboratory, failed to run a low enough dilution during the analysis method to produce a countable range of fecal coliform colonies, therefore producing the final result of TNTC. Unofficially, the lab was able to estimate that the final count would be at least greater than 4000 fc/100 ml, which is the highest fecal count that would be found in the entire Pederson Hill Creek sample set. This high fecal count will be discussed in the next section addressing the MST analysis.

Based on the final positive fecal coliform bacteria results found in the samples, the JWP and DEC project manager Gretchen Pikul discussed which samples would be analyzed for human and horse bacteria hosts. Table 4 below depicts which samples had microbial source tracking requested, the host bacteria that were targeted and the final results of the analyses. Of all of the samples that were analyzed for a source bacteria present, only one site, PHC-5 sampled June 5, 2013, was positive for human bacteroidetes ID, with a quantification count of 2980 copy numbers per 100 mL of water.

Table 4: Summary of Microbial Source Tracking results

Pederson Hill Creek	**Microbial Source Tracking Host Requests and Results**				
	PHC-1	**PHC-2**	**PHC-3**	**PHC-4**	**PHC-5**
6/5/2013	NT	NT	Horse, Human, Dog, Pig, Bird, Goose, Chicken	Horse, Human	Horse, ***Human***
6/12/2013	NT	NT	Horse, Human	NT	NT
6/19/2013	NT	NT	NT	NT	NT
6/24/2013	NT	NT	NT	NT	NT
6/26/2013	NT	NT	NT	NT	NT

NT= Not Tested Host Species ***Bold & Italized*** Tested Positive for Bacteroidetes

Site PHC-5 is located downstream from a number of potential contamination sources, including a decommissioned septic field that serviced several office buildings in this area. There are also several PVC and plastic pipes that are directly inputting discharge into the Creek. Several of these pipes run

underground from the DMV parking lot and the actual point of discharge from the pipe is located midway up the stream bank.

The sample collected from site PHC-3 on June 5, 2013 was reported with a final fecal coliform count of TNTC, but a laboratory estimation of the fecal count yielded > 4000 FC/100ml. Since the MST analysis on this sample was absent for both Human and Horse Bacteroidetes, additional analysis was requested in order to identify the bacteria host species present in this sample. Based on the animal species present in the watershed up-gradient of the sample site, the JWP and DEC decided to order the additional microbial source analysis of Dog, Pig, Bird, Goose and Chicken host species. However, all five of these additional host species were returned as not being present in the sample and there was no host bacterium that was identified for the PHC-3 sample collected June 5, 2013. The high fecal coliform count at this site appears to be an anomaly and would require repeated sampling in both wet and dry conditions in order to draw more definitive conclusions as to the contributor(s) of fecal pollution.

In summary, the microbial source tracking analysis yielded several interesting results based on the fecal coliform counts. Because of the drier sampling period, fecal coliform results were lower than anticipated and did not provide the higher amount of colonies needed for the source tracking analysis. Of the samples that were analyzed for several different host species, only one host was positively identified. On two (2) separate occasions, June 5 and June 12, 2013 sample PHC-3 did exhibit a signal indicating the presence of the horse-associated Bacteroidetes gene, but the signal was below the laboratory's limit of detection. The samples were therefore classified as negative and require further sampling to draw definitive conclusions about the contributor(s) of fecal pollution.

Field parameters were measured at each site alongside the bacteria sample collections and Total Suspended Solids (TSS) and Turbidity tests were performed at the UAS Laboratory. The graphs for each of these field parameters are available in the appendix to this document. These field parameters yielded several interesting results. Overall, there appeared to be increasing water temperatures throughout the month, which can be attributed to the stream water warming with the temperatures of summer and the increasingly warmer temperatures that Juneau experienced during the month of June. All of the stream temperatures were less than 20 degrees Celsius, which is the Alaska Water Quality standard for waters available to support aquatic life. Correlating with these warmer water temperatures, Conductivity exhibited a slight increasing trend after the rainy sampling event on June 5, 2013. The addition of freshwater (rain) lowers conductivity due to its initially lower conductivity and the increase in water levels dilutes mineral concentrations. The four sampling dates after the initially rainy sample collection

followed drier periods of weather, and this is demonstrated through the temperature and conductivity values collected for this project. The conductivity values ranged from 28 uS/cm to 623 uS/cm, all values which support aquatic life in freshwater streams. pH values for sites PHC-2, PHC-3, PHC-4 and PHC-5 ranged between 6.5 and 8.5, the water quality standard put forth by the State of Alaska to support aquatic life. Site PHC-1, however, had pH values that all fell below the lower pH limit of 6.5 to support aquatic life. Dissolved Oxygen (DO) values for site PHC-1, PHC-2, PHC-4 and PHC-5 are all within the greater than 7 mg/L standard DO concentrations recommended for anadromous fish habitat. Site PHC-3 values fell below 5 mg/L, which is the water quality standard required for healthy non-anadromous fish populations.

Solids values for Pederson Hill Creek generally stayed consistently low throughout the sampling project, with the exception of one outlying sampling event. During the sample collection on June 24, 2013 the water at site PHC-2 was visibly turbid and cloudy with sediment, which was not the normal condition of the stream. The turbid water can be seen in Figure 2 below.

Figure 2: Abnormally turbid water present during sample collection at site PHC-2.

This visual observation was later confirmed with the turbidity and TSS results, which were both significantly higher than their normal values. These anomalies can be seen in Figure 5 and 6 of the appendix. After a discussion of these results with the DEC project manager and her communication with

several other DEC departments, it was later determined that a water truck had been brought in to a large construction site that was immediately upstream of and adjacent to Pederson Hill Creek. The water truck was increasing water flow as well as the amount of solids that were eroding and discharging into the stream. Two days later during the next sample collection on June 26, 2013 the turbidity and TSS values were back to normal background levels.

PUBLIC OUTREACH

The Juneau Watershed Partnership wrote and published an article about the Pederson Hill Creek monitoring in our "Stream Scene" Newsletter in May 2013. Also, the JWP staff was able to talk to the public during sampling events and at the Wild and Scenic Film Festival in February 2013 explaining the background of the project. A comprehensive project write-up will also be featured in our upcoming issue of our "Stream Scene" Newsletter in August/September 2013, wrapping up the sampling project and providing a synopsis of sampling results.

ACKNOWLEDGEMENTS

The Juneau Watershed Partnership thanks DEC project manager Gretchen Pikul for her support and patience during the development and implementation of this program.

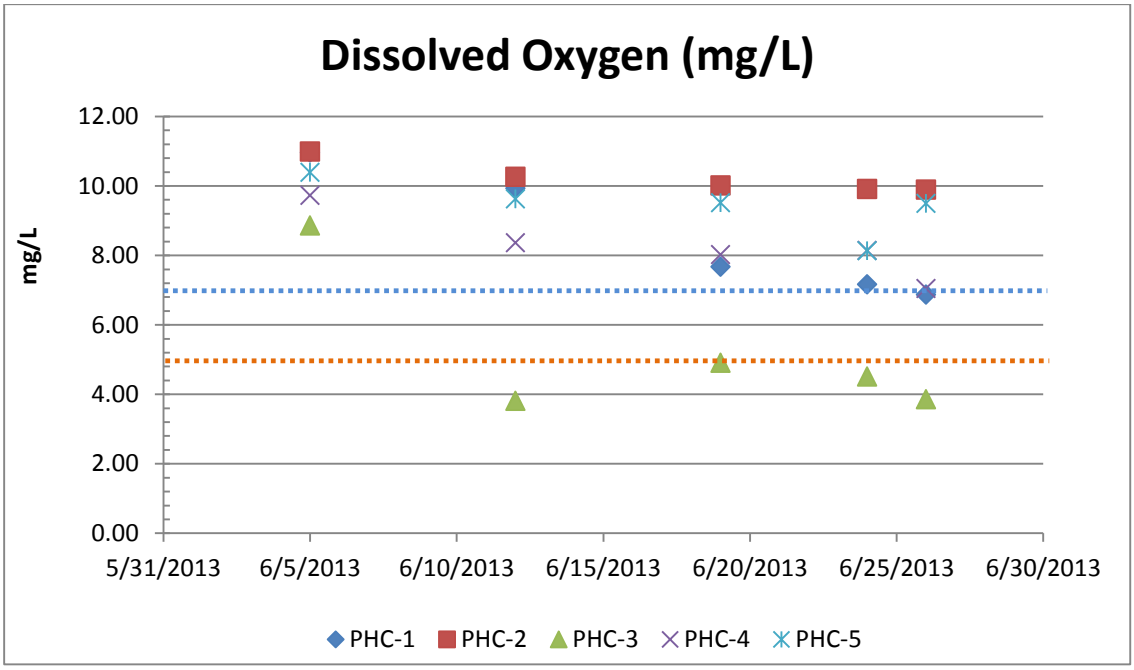

Figure 1: Dissolved Oxygen (DO) values from Pederson Hill Creek water quality monitoring during June 2013. Alaska WQS call for > 7 mg/l for anadromous fish; > 5 mg/l for non-anadromous fish; < 17 mg/l for aquatic life (the dotted lines correlate to DO concentrations required for healthy fish populations).

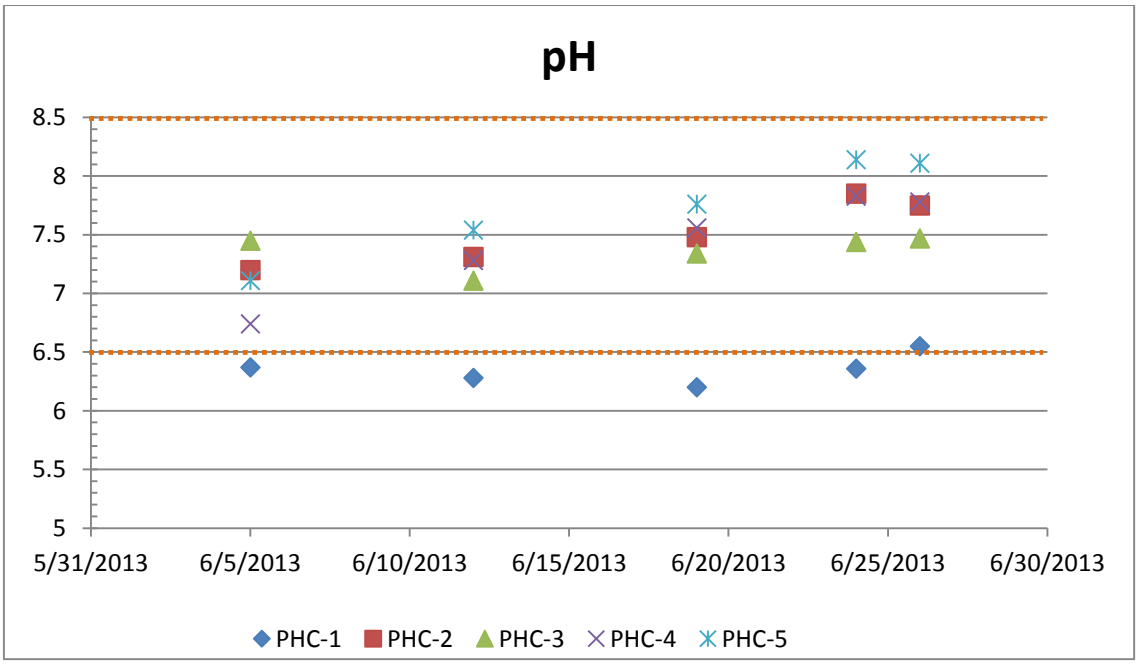

Figure 2: pH values from Pederson Hill Creek water quality monitoring during June 2013. Alaska WQS call for pH values ranging from 6.5 to 8.5 to support aquatic life (the dotted line correlates to pH values required for healthy fish populations.

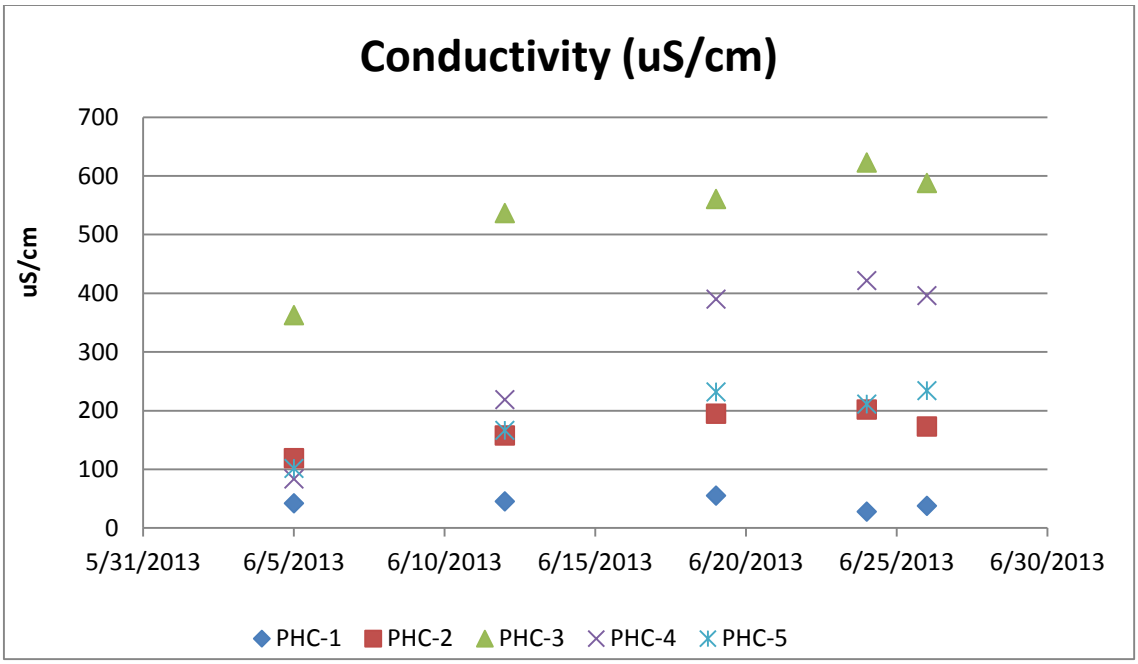

Figure 3: Conductivity values from Pederson Hill Creek water quality monitoring during June 2013.

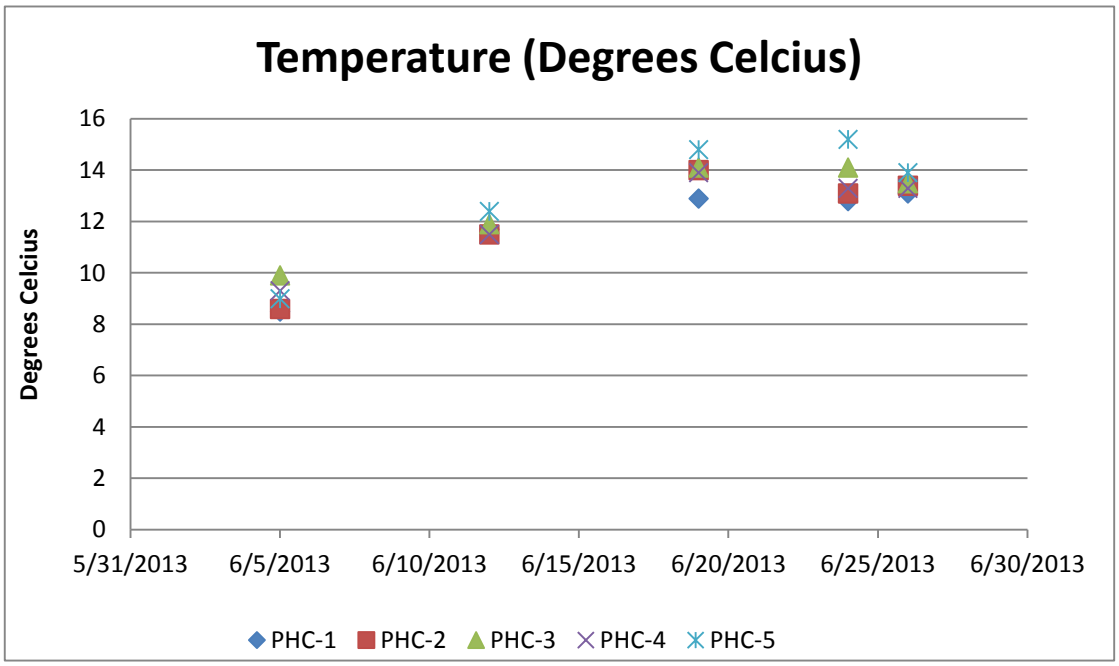

Figure 4: Temperature values from Pederson Hill Creek water quality monitoring during June 2013. Alaska WQS call for temperatures < 20 degrees Celsius to support aquatic life.

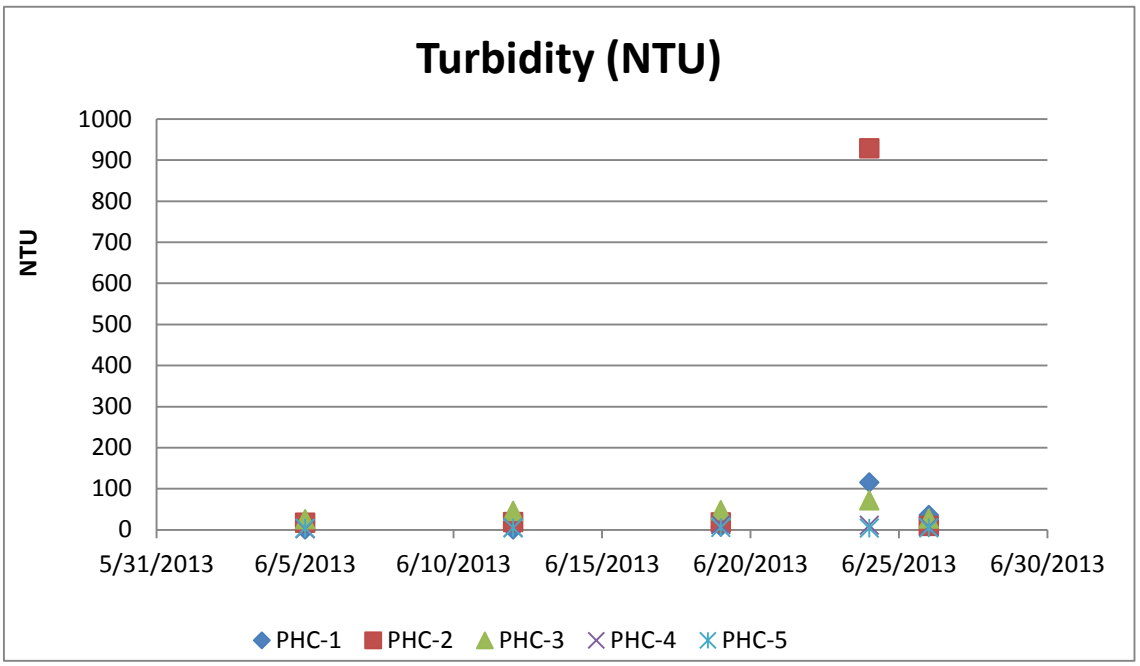

Figure 5: Turbidity values from Pederson Hill Creek water quality monitoring during June 2013, with outlying turbidity value displayed from site PHC-2.

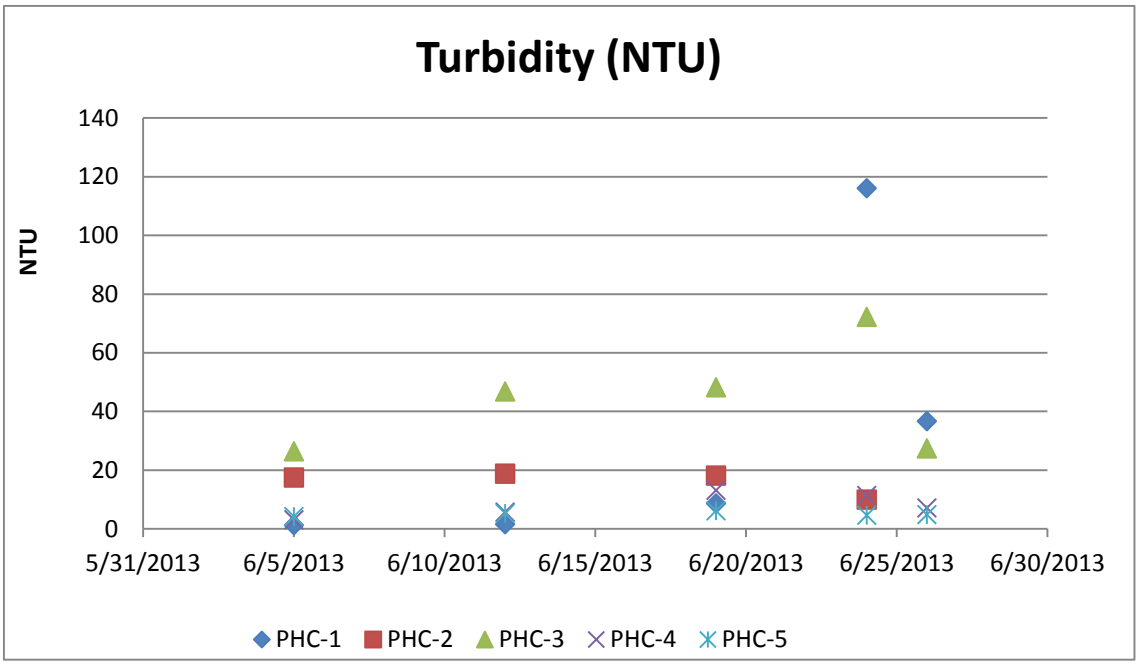

Figure 6: Turbidity values from Pederson Hill Creek water quality monitoring during June 2013, with outlying turbidity value from PHC-2 sampled 6/24/13 removed.

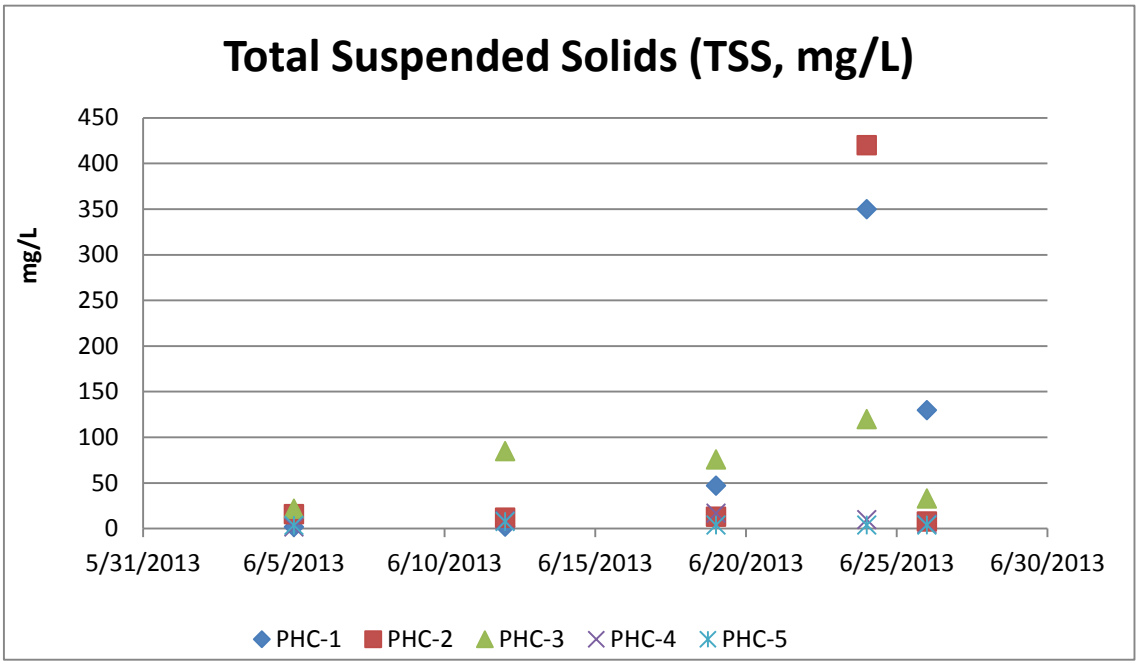

Figure 7: Total Suspended Solids (TSS) values from Pederson Hill Creek water quality monitoring during June 2013, with outlying turbidity values displayed from site PHC-1 and PHC-2 sampled 6/24/13.

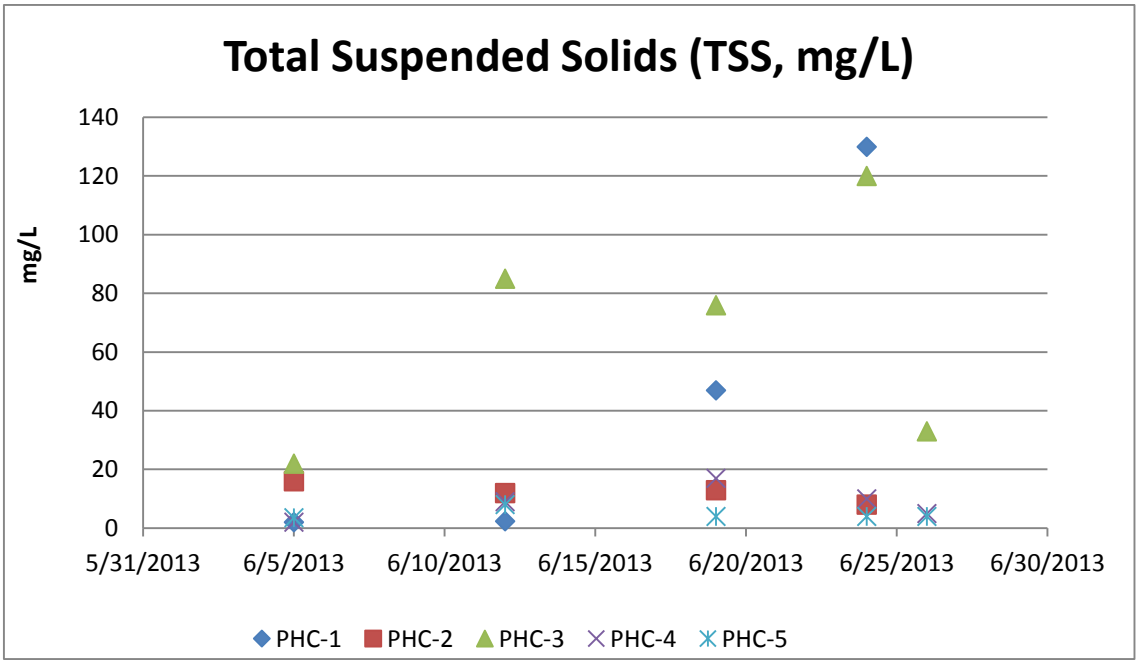

Figure 8: Total Suspended Solids (TSS) values from Pederson Hill Creek water quality monitoring during June 2013, with outlying values for site PHC-1 and PHC-2, sampled 6/24/13, removed.

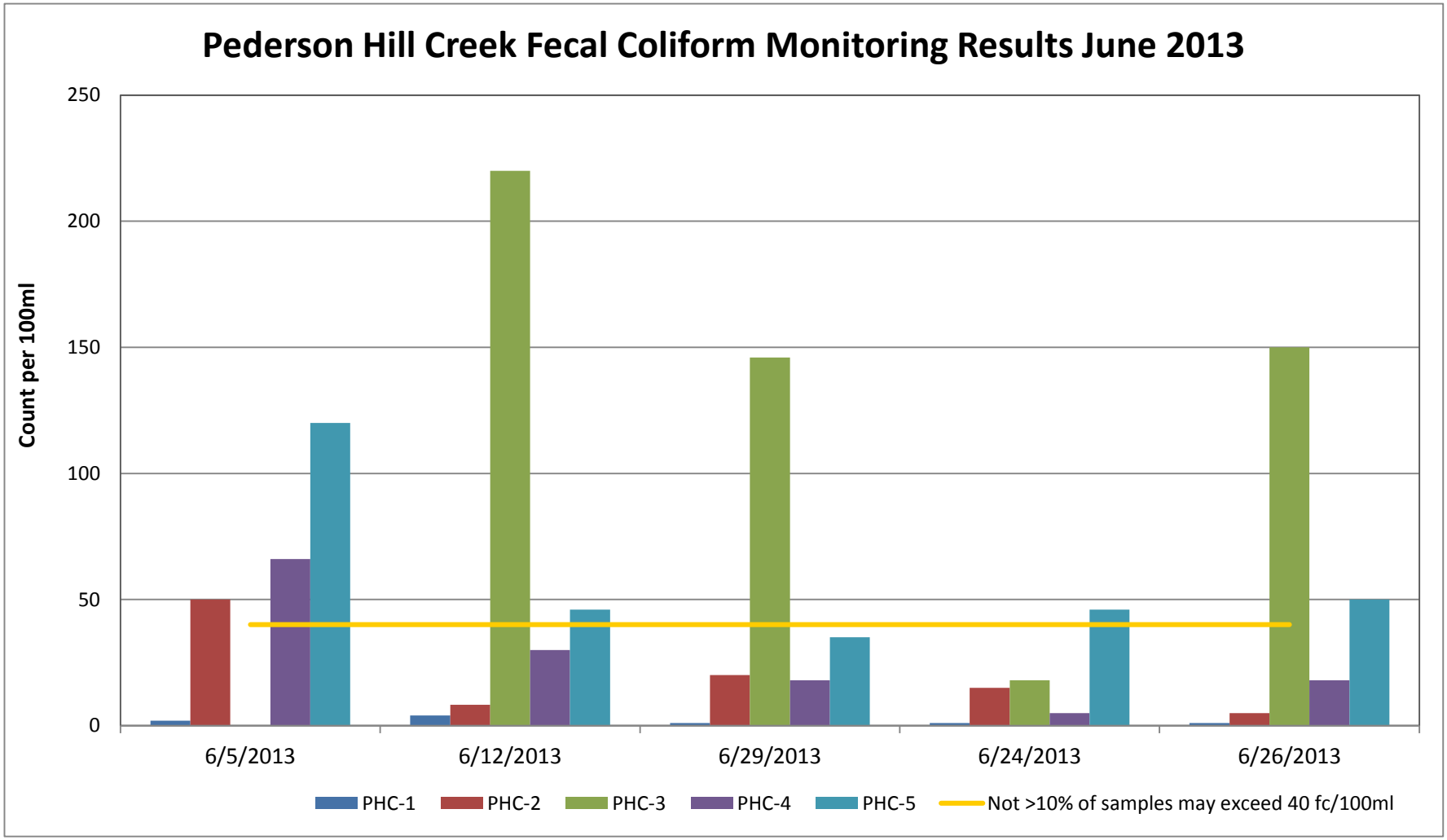

Figure 9: Fecal Coliform Results from Pederson Hill Creek water quality monitoring during June 2013. The yellow line represents the Alaska WQS that Pederson Hill Creek must meet according to the final TMDL report issued by the Alaska Department of Environmental Conservation. Four (4) out of the Five (5) Pederson Hill sampling sites exceed the water quality limits as set by the State of Alaska.

APPENDIX II - PHOTOS

Photo 1: Site PHC-2 of the Pederson Hill Creek water quality monitoring project during June 2013, looking downstream from the sampling site.

Photo 2: Site PHC-2 of the Pederson Hill Creek water quality monitoring project during June 2013, looking directly at sampling site.

Photo 3: Site PHC-3 of the Pederson Hill Creek water quality monitoring project during June 2013, looking directly at sampling site.

Photo 4: Site PHC-4 of the Pederson Hill Creek water quality monitoring project during June 2013.

Photo 5: Site PHC-5 of the Pederson Hill Creek water quality monitoring project during June 2013.

Photo 6: Site PHC-5 of the Pederson Hill Creek water quality monitoring project during June 2013, looking directly at the sampling location.