

DEPARTMENT OF ENVIRONMENTAL CONSERVATION
NONPOINT SOURCE POLLUTION PROGRAM
ACWA NPS WATER QUALITY GRANT

FY 2006
FINAL REPORT

PROJECT #: ACWA-06-11

**Watershed Protection and Recovery for
Pederson Hill Creek, Juneau, AK**

July 2006

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Project Description and Purpose

The purpose of this monitoring effort was to characterize the water quality of Pederson Hill Creek in the Mendenhall Watershed (Figure 1), with a particular emphasis on the status of fecal coliform concentrations in the stream. Pederson Hill Creek is an anadromous stream (ADF&G Catalog # 111-50-10490-2013) boarded by Glacier Highway and Engineers Cutoff Road (Figure 2). It drains uplands and forested wetlands as well as residential and commercial development. Residential and commercial structures in the drainage are not connected to sewage treatment facilities and rely on septic tanks for sewage disposal. Continued development of residential subdivision will increase the volume of septic tank discharge as well as the amount of stormwater runoff from roads and driveways. Water quality parameters of concern include dissolved oxygen, temperature, turbidity, pH, and conductivity and the presence of fecal coliform bacteria as an indicator of how well septic tank systems are functioning.

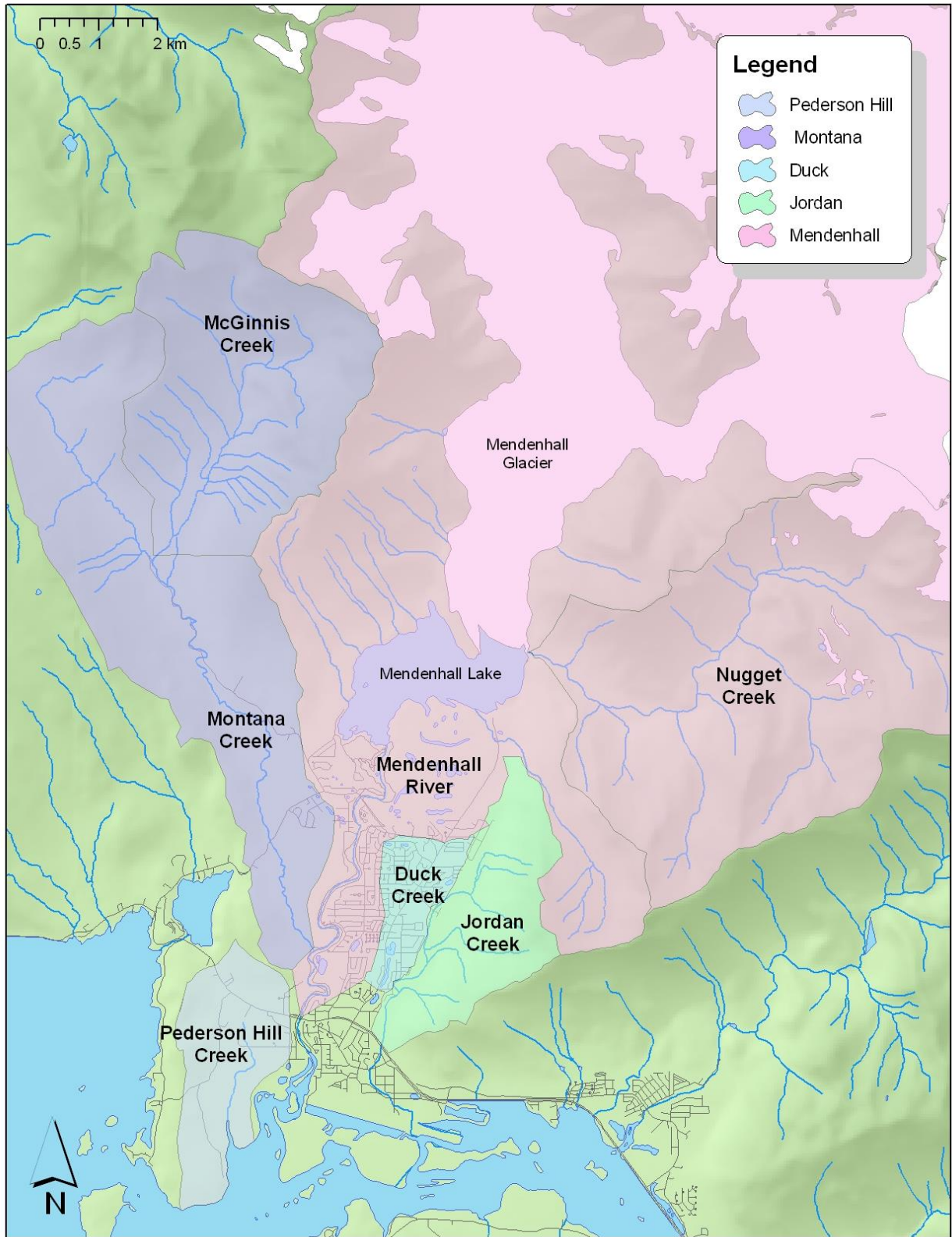


Figure 1: Location of Pederson Hill Creek watershed and other watersheds in the Mendenhall Valley, Juneau.

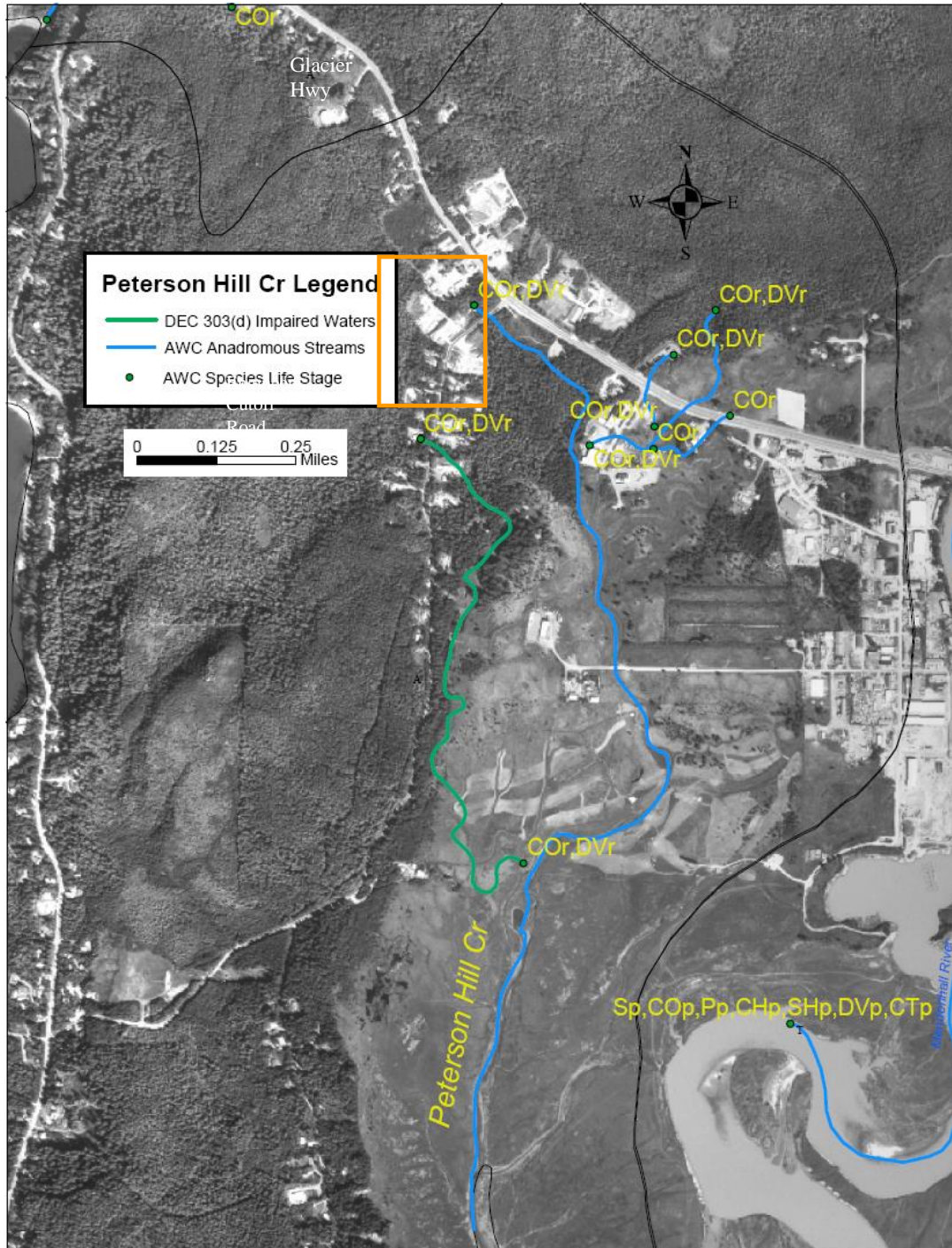


Figure 2. Labeled aerial photograph of Pederson Hill Creek. Sampling for this project was concentrated in the upper east fork section of the stream, in the orange box inset (see Figure 2). The large river on the lower right is the Mendenhall River. Coding along the stream is from the ADF&G Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes (Johnson and Weiss 2006) and specifies species of fish present (S=sockeye salmon, CO=coho salmon; P=pink salmon, CH=chum salmon, DV=dolly varden, CT= cutthroat trout). Map template courtesy Lori Sowa of ADEC.

Research Design

Six sites were selected along Pederson Hill Creek for seasonal fecal coliform and water quality parameter sampling, (following consultation with Lori Sowa of the ADEC) (Figure 3). Funding constraints allowed for only 3 rounds of measurements at the 6 sites (and the 3rd round allowed for sampling only 4 of the 6 sites). We sampled the creek at a higher spatial resolution (6 sites) on fewer dates instead of at one or two sites on a more frequent basis, in order to help determine the source locations of high fecal coliform concentrations. One site was located upstream of the area of development to serve as a background site. Other sites were selected to reflect flows primarily from residential areas. We chose a point in back of the troopers building (with historically high levels of bacteria), and also an area of commercial/industrial use by a Fire Training Center. All testing was conducted on what is known as the east fork of the creek – in earlier times it was identified as Casa Del Sol Creek.

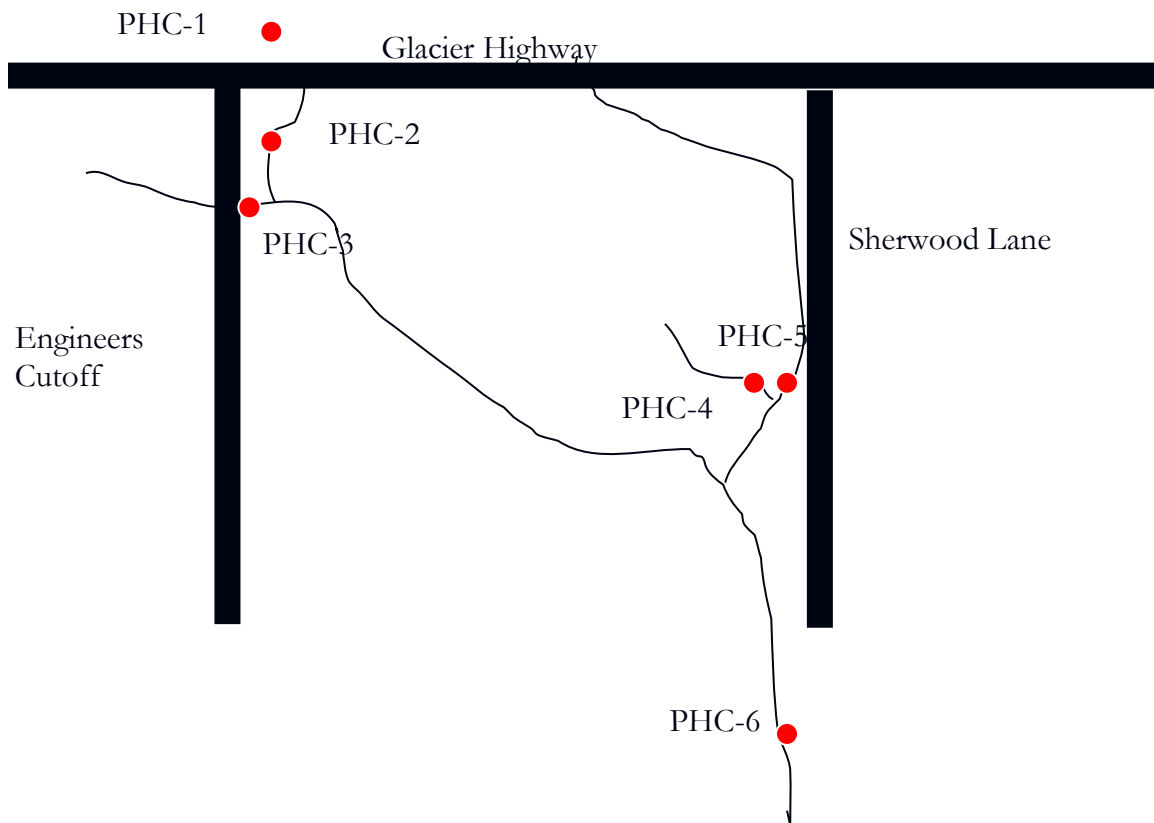


Figure 3. Sketch of location of sampling sites along Pederson Hill Creek. The area shown above is equivalent to the orange inset in Figure 2.

Specific site location descriptions are below:

- Site PHC-1: Uphill of the Baptist church near the intersection of Glacier Highway and Engineers cutoff road. The area has dense brush and many areas of stagnant flow.
- Site PHC-2: Directly across Glacier Highway from the Baptist church is a small tributary that runs parallel to the highway and is fed by the water source for site #1 and other drainage. It runs under the highway through a culvert. This site represents water runoff from the drainage ditches on both sides of the highway.
- Site PHC-3: This sampling site was selected because of historically high measurements of fecal coliform bacteria in past studies. The source is primarily a residential development across Engineers Cutoff, runs under the road through a culvert. Accessible on the maintained nature trail in this area. (Photo: Figure 4)
- Site PHC-4: In between two office buildings, one housing the DMV, the other the USDA Forestry Sciences Laboratory, there is ready access to the stream on the edge of the parking lot. This site was chosen to test the tributary (the west fork in the stream), which emerges from an area of wetlands.
- Site PHC-5: The east side of the fork described in PHC-4 was selected again due to historically high reports of fecal coliform bacteria. It contains the runoff from the parking lot and office buildings on Sherwood Lane. (Photo: Figure 5)
- Site PHC-6: This site is reached by driving to the end of Sherwood Lane. The road goes to gravel, and has a small turn around. A short walk through tall grass leads to a footbridge, the sampling site. This is the lowest point in the stream used for collection, and has higher flow levels than the upper sites. (Figure 6)



Figure 4. *Pederson Hill Creek at site PHC-3, near the intersection of Glacier Highway and Engineers Cutoff Road; site accessible on the nature trail footpath. May, 2006.*



Figure 5. *Pederson Hill Creek at site PHC-5, flowing along the edge of the parking lot for the office buildings on Sherwood Lane. May, 2006.*



Figure 6. *Pederson Hill Creek- Downstream view from the footbridge at PHC-6. February, 2006.*

Sampling occurred 3 times between November, 2005 and May, 2006. A November (11/5/05) collection represented fall high flow conditions; a February sample (on 2/20/2006) represented winter conditions, and a May sample (on 5/15/2006) represented late spring conditions.

Methods

Water quality parameters at the six sample sites were measured 3 times during the study year (11/5/2005, 2/20/2006, and 5/15/2006). Water temperature, conductivity, and pH were measured in the field using a YSI multi-probe unit. Dissolved oxygen was measured using a dedicated D.O. meter. Both meters were calibrated in the laboratory at the beginning of each sampling event. All in situ parameters were measured and recorded 3 times; averages of the triplicate values are presented in this report. Grab samples were also collected and returned to the UAS lab for analysis of turbidity. Turbidity measurements for each event were bracketed by standard checks and were made within 6 hours of sample collection. Duplicate analyses were performed on 10% of samples to check for precision. All analyses were performed according to the approved QAPP for Pederson Hill Creek (MWP and UAS, 2005). Fecal coliform analyses were performed by the Analytica Laboratory in Juneau, AK.

Results

A) Fecal coliform concentrations

Results indicate that fecal coliform levels continue to exceed water quality standards at least on some sites during parts of the year. Our study was not comprehensive enough on a temporal scale to determine the extent and duration of the contamination on a year-round basis; nonetheless on each of our three sampling events, some violation was detected for at least one type of water use. Alaska water quality standards for fecal coliform depend on the type of use (Table 1).

Sample site PHC-1, the background site, had fecal coliform concentrations below detections on both of its sampling events. Site PHC-2 was either below detection for fecal coliform (November), frozen (February), or not sampled. Site PHC-3 had fecal coliform concentrations of 164, 22, and 82 FC/100 ml on the three occasions, indicating occasional violations. Site PHC-4 and PHC-5 had concentrations varying from below detection to the high of 5900 FC/100 ml, indicating a highly variable source of fecal coliform to these stream sections. Site PHC-6, the lowermost site in the study, showed high levels (390 FC/100 ml) when upstream sites PHC-4 and PHC-5 were at their highest.

Table 1. Excerpt from State of Alaska Department of Environmental Conservation list of water quality standards.

(2) FECAL COLIFORM BACTERIA (FC), FOR FRESH WATER USES (See note 1)	
(A) Water Supply (i) drinking, culinary, and food processing	In a 30-day period, the geometric mean may not exceed 20 FC/100 ml, and not more than 10% of the samples may exceed 40 FC/100 ml. For groundwater, the FC concentration must be less than 1 FC/100 ml, using the fecal coliform Membrane Filter Technique, or less than 3 FC/100 ml, using the fecal coliform most probable number (MPN) technique.
(A) Water Supply (ii) agriculture, including irrigation and stock watering	The geometric mean of samples taken in a 30-day period may not exceed 200 FC/100 ml, and not more than 10% of the samples may exceed 400 FC/100 ml. For products not normally cooked and for dairy sanitation of unpasteurized products, the criteria for drinking water supply, (2)(A)(i), apply.
(A) Water Supply (iii) aquaculture	For products normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 200 FC/100 ml, and not more than 10% of the samples may exceed 400 FC/100 ml. For products not normally cooked, the criteria for drinking water supply, (2)(A)(i), apply.

(A) Water Supply (iv) industrial	Where worker contact is present, the geometric mean of samples taken in a 30-day period may not exceed 200 FC/100 ml, and not more than 10% of the samples may exceed 400 FC/100 ml.
(B) Water Recreation (i) contact recreation	In a 30-day period, the geometric mean of samples may not exceed 100 FC/100 ml, and not more than one sample, or more than 10% of the samples if there are more than 10 samples, may exceed 200 FC/100 ml.
(B) Water Recreation (ii) secondary recreation	In a 30-day period, the geometric mean of samples may not exceed 200 FC/100 ml, and not more than 10% of the total samples may exceed 400 FC/100 ml.
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Not applicable.

Based on our 3 sampling events, the highest fecal coliform concentrations occurred in the winter (2/20/2006). A possible explanation for this is that the amount of water available for dilution was lowest during this cold and relatively dry period. In contrast, in November, 2005, when flow levels were very high in the local area due to heavy rains (though discharge was unquantified at Pederson Hill Creek), fecal coliform was above the water quality standard only at PHC-3. The 5/15/2006 sample was taken also after a period of frequent and steady precipitation during most of April and May.

Table 2. Results of fecal coliform analyses on samples taken from Pederson Hill Creek on the 3 sampling events. Values highlighted in yellow are those that exceed the water quality standard for at least one type of water use (see Table 1). Fecal coliform concentration data provided by Analytica Laboratory, Juneau.

Date	Site name	Fecal coliform (CFU/100 ml)
11/5/2005	PHC-1	<1.1
11/5/2005	PHC-2	<1.1
11/5/2005	PHC-3	164
11/5/2005	PHC-4	71.1
11/5/2005	PHC-5	<1.2
11/5/2005	PHC-6	60
2/20/2006	PHC-1	<1.1
2/20/2006	PHC-2	(frozen)
2/20/2006	PHC-3	22
2/20/2006	PHC-4	5100
2/20/2006	PHC-5	5900
2/20/2006	PHC-6	390
5/15/2006	PHC-3	82
5/15/2006	PHC-4	4
5/15/2006	PHC-5	<1
5/15/2006	PHC-6	137

Concentrations ranged from below detection to 5900 FC/100. Together, these results show an inconsistent but sometimes high level of fecal coliform contamination along the

measured stream sections of Pederson Hill Creek, with water quality violations occurring at some sites on each of the 3 sampling events.

B) Water quality parameters

Measurements of pH, DO, conductivity, temperature, and turbidity at the 6 sites along Pederson Hill Creek indicate that water quality violations generally satisfactory for these parameters during the times the sites were sampled, with a few exceptions. Site PHC-5 was below the state water quality standard of 6.5 for pH and of 7.0 mg/l for dissolved oxygen (standards are for the growth and propagation of fish, shellfish, and other aquatic life) on all 3 sampling events. At this site, water was observed to be largely stagnant on the February and May events, when they were covered by a layer of ice (February) which appeared to limit oxygenation of the water, and fallen leaves (February and May), whose presence likely fed oxygen-consuming biological decay processes in the stream.

On the February sampling date, PHC-3 and PHC-6 were barely in violation of the water quality standard for pH (the standard is for pH=6.5, and these two sites were measured as 6.4). On the May sampling event, the pH at PHC-3 (pH=6.0) was also below the water quality standard. However, the background site (PHC-1) was also found to have low pH (pH=5.6 on 11/5/2005 and pH=5.1 on 2/20/2006), indicating that source areas in the wetland-dominated upper watershed are naturally acidic.

PHC-4 had relatively high conductivity values, perhaps a reflection of the heavy influence of soil water chemistry in the wetland area this tributary drains. The only violation of water quality standards for temperature were at site PHC-5 on May 15, 2006, when DO and pH values were also in violation and the stream was largely shallow and stagnant and choked with fallen leaves. The temperature was 14.8°C, which is above the the 13°C limit for egg and fry incubation and spawning, and at the 15°C limit for migration routes and rearing areas (DEC, 2006).

Turbidity levels were of acceptable quality according to state water quality standards.

Table 3. Results of DO, temperature, pH, and turbidity measurements along PHC during the study period. Yellow highlighted values are those that fall below state of Alaska water quality standards (ADEC, 2006).

Date	Site name	D.O. (mg/L)	Temp (°C)	Cond (mS/cm)	pH (units)	Turb (NTU)
11/5/2005	PHC-1	8.92	3.2	0.022	5.6	24
11/5/2005	PHC-2	5.39	2	0.234	6.5	40
11/5/2005	PHC-3	12.92	3.65	0.122	6.9	10
11/5/2005	PHC-4	11.97	3.22	0.333	7.2	9.6
11/5/2005	PHC-5	4.56	3.01	0.208	6.1	15
11/5/2005	PHC-6	11.98	3.06	0.085	6.5	5.3
2/20/2006	PHC-1	11.9	1.34	0.028	5.1	N/A
2/20/2006	PHC-2	Frozen	Frozen	Frozen	Frozen	Frozen

2/20/2006	PHC-3	13.38	1.86	0.213	6.4	16
2/20/2006	PHC-4	10.92	0.73	0.666	6.8	29
2/20/2006	PHC-5	5.46	1.08	0.236	5.7	5.7
2/20/2006	PHC-6	14.12	1.18	0.206	6.4	6.4
5/15/2006	PHC-3	11.92	6.42	0.174	6.6	7.3
5/15/2006	PHC-4	9.32	4.55	0.47	6.69	5.9
5/15/2006	PHC-5	4.49	14.78	0.292	6.0	4.2
5/15/2006	PHC-6	12.53	7.67	0.145	6.67	3.4

Summary and Conclusions

Violations of the State of Alaska fecal coliform concentrations were found along the studied section of Pederson Hill Creek on all 3 sampling events conducted between November, 2005 and May, 2006. Concentrations ranged from below detection (<1 FC/100 ml) to 5900 FC/100 ml. The sampling sites along Sherwood Lane (sites PHC-4 and PHC-5) had the highest FC concentrations. Some violations in pH and dissolved oxygen levels were also found along portions of the stream, particularly in areas of low to stagnant flow, although these conditions are likely naturally controlled. One temperature violation was also noted in May, 2006. Considering that the sites were sampled only 2-3 times in the study year, it is advisable that further sampling be conducted in the future to improve the understanding of the temporal dynamics and spatial location of the main sources of the bacterial contamination in the watershed and to monitor pH and dissolved oxygen levels.

Acknowledgments

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