

Alaska Department of Environmental Conservation

Waterbody Field Report

Cottonwood Creek: Wasilla, Alaska



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Abstract

In 2010, seven miles of Cottonwood Creek were listed as impaired for fecal coliform in Alaska's Integrated Water Quality Monitoring and Assessment Report. The Alaska Clean Water Actions Program has funded several best management practices to treat urban runoff and educate watershed residents on septic system placement and maintenance with the goal of improving water quality in Cottonwood Creek. In summer 2023, water samples were collected from three sites in Cottonwood Creek and compared to water quality criteria to see if water quality in the creek has improved to meet Water Quality Standards. Water quality continues to exceed criteria for both fecal coliform and *Escherichia coli* (*E. coli*). Microbial Source Tracking results showed a moderate target abundance for bird DNA markers and low target abundance for horse DNA markers. DNA markers for humans and dogs were not detected. Cottonwood Creek would benefit from further best management practice implementation, particularly around the downstream sites of Surrey and Edlund Roads and the neighborhoods draining to those creek areas.

Basic Waterbody Information

Table 1. Basic Waterbody Information

Assessment Unit ID	AK_R_2040108_004_001
Assessment Unit Name	Cottonwood Creek
Location description	Wasilla area in southcentral Alaska. Spring-fed headwaters with mouth in Knik Arm of Cook Inlet
Hydrologic unit code	190204010803
Water Type	Freshwater Stream
Area sampled	Three locations from seven-mile span of impairment: one just south of the Parks Highway, one at Edlund Road, and one at Surrey Road, the most downstream extent of the sampling used to inform the impairment listing.
Time of year sampled	Mid-July through Mid-September 2023

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Water Quality Evaluation

Background

Cottonwood Creek is a 39.4 square mile spring-fed watershed located near Wasilla in southcentral Alaska in the Matanuska-Susitna Borough. In 2010, Cottonwood Creek was listed as impaired for fecal coliform in Alaska's Integrated Water Quality Monitoring and Assessment Report². In 2015, EPA approved a Total Maximum Daily Load (TMDL) for fecal coliform for 7 miles of Cottonwood Creek downstream of the Parks Highway in Wasilla³. Since the impairment listing, DEC has funded several activities designed to improve water quality in Cottonwood Creek, including green stormwater infrastructure near the Fern Street creek crossing and outreach and education on septic system pumping and maintenance. Water quality criteria for pathogens in freshwater are specified in Alaska's Water Quality Standards 18 AAC 70.020(2) and (14) and are summarized in Table 2.

Table 2. Water quality criteria for freshwater supply and recreation uses

Designated Use	Freshwater Criteria
(A) Water Supply (i) drinking, culinary, and food processing	In a 30-day period, the geometric mean may not exceed 20 fecal coliform colony forming units (cfu)/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform cfu/100 ml.
(B) Water Recreation (i) contact recreation	In a 30-day period, the geometric mean of samples may not exceed 126 <i>Escherichia coli</i> (<i>E. coli</i>) cfu/100 ml, and not more than 10% of the samples may exceed a statistical threshold value of 410 <i>E. coli</i> cfu/100 ml.

Objective

The objective of this project was to see if Cottonwood Creek water quality has improved and is meeting pathogen water quality criteria.

Quality Assurance Review

This project followed DEC's Water Quality Programmatic Quality Assurance Project Plan, the project sampling plan⁴, and standard operating procedures for pathogen sampling collection and AquaTROLL operation. A few sample events were adjusted slightly from the exact date specified in the sampling plan, but all sample events occurred in the same weeks as originally planned. Data collected equated to 100 % project completeness.

² 2010. Alaska Department of Environmental Conservation (ADEC). Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report. Juneau, Alaska.

³ 2015. ADEC. Total Maximum Daily Load for Fecal Coliform Bacteria in the Waters of Cottonwood Creek, Wasilla, Alaska. Juneau, Alaska.

⁴ Available from DEC Water Quality Program

All samples were delivered to DEC's Environmental Health Laboratory well within the 6 hour hold time requirement, and cooler temperatures were 6 degrees F or cooler. All quality control field replicate sample pairs were within 60% relative percent difference except for one sample pair. Due to the nature of bacteria growth, it was determined that the exceedance of the 60% difference did not mean the data were invalid.

All AquaTROLL calibration and verification records were stored digitally as well as in a hard copy logbook kept in the instrument case.

Methods

Staff collected water samples and took in situ measurements of Cottonwood Creek at three locations (Figures 1 through 7 and Table 1). Eight sample events were completed mid-July through mid-September 2023, 6 of which were completed within the 30-day window as required by DEC's pathogen water quality criteria and listing methodology (Table 2).⁵ Water samples were analyzed for fecal coliform bacteria and *E. coli* by the Alaska Department of Environmental Conservation's Environmental Health Laboratory in Anchorage, AK. Duplicate samples were collected at one rotating location for each sampling event. At one event in early September, water samples were collected at the Surrey Road site and shipped to LuminUltra for Microbial Source Tracking genetic analysis for human, dog, horse, and bird Bacteroides DNA markers. During each sample event, an In Situ AquaTROLL 500 was used at each site to record in situ measurements for pH, specific conductance, water temperature, dissolved oxygen, and turbidity. All activities were conducted according to DEC's standard operating procedures for pathogen sample collection and AquaTROLL operation.

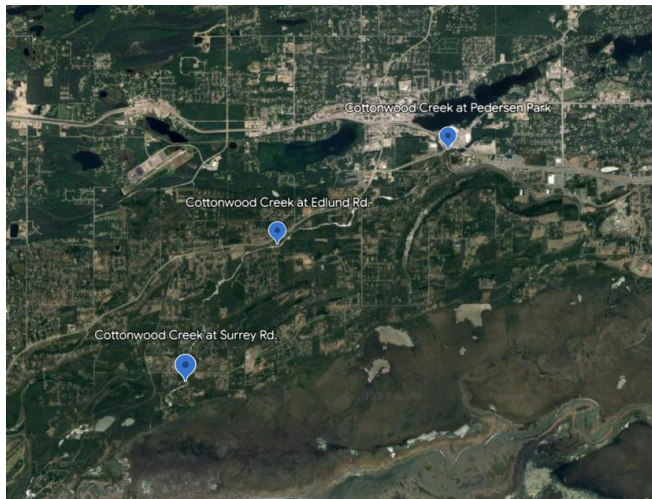


Figure 1. Cottonwood Creek pathogen sampling sites. The farthest upstream is Cottonwood Creek at Pedersen Park, just south of the Parks Highway and the farthest downstream site is Cottonwood Creek at Surrey Road.

⁵ 2019. ADEC. Listing Methodology for Determining Water Quality Impairment from Pathogens. Juneau, Alaska.



Figure 2. Looking upstream at the Surrey Road sample site.



Figure 3. Looking downstream at the Surrey Road sample site.



Figure 4. Looking upstream at the Edlund Road sample site. Centered in the foreground is the AquaTROLL.



Figure 5. Looking downstream at the Edlund Road sample site.



Figure 6. Looking upstream at the Pedersen Park sample site.



Figure 7. Looking downstream at the Pedersen Park sample site.

Table 3. Locations for water quality sampling and in situ monitoring along Cottonwood Creek.

Site ID	Description	Latitude	Longitude
CW-Pedersen	Cottonwood Creek at Pedersen Park (at end of Old Matanuska Road). Sample site downstream of trail bridge and upstream of Alaska Railroad	61.57456	-149.41324
CW-Edlund	Cottonwood Creek downstream of Edlund Road crossing	61.55444	-149.48833
CW-Surrey	Cottonwood Creek downstream of Surrey Road crossing	61.52493	-149.52985

Table 4. Sample event dates and activity summaries.

Sample Event	Date	Activity
1	July 20, 2023	Pathogen sampling, in situ measurements, duplicates collected at Surrey Road.
2	July 26, 2023	Pathogen sampling, in situ measurements, duplicates collected at Edlund Road.
3	August 2, 2023	Pathogen sampling, in situ measurements, duplicates collected at Pedersen Park.
4	August 7, 2023	Pathogen sampling, in situ measurements, duplicates collected at Surrey Road.
5	August 8, 2023	Pathogen sampling, in situ measurements, duplicates collected at Edlund Road.
6	August 15, 2023	Pathogen sampling, in situ measurements, duplicates collected at Pedersen Park.
7	August 29, 2023	Pathogen sampling, in situ measurements, duplicates collected at Surrey Road.
8	September 11, 2023	Pathogen sampling, in situ measurements, duplicates collected at Edlund Road, MST sampling at Surrey Road.

Results

E. coli results ranged from 17.3 MPN/100ml to 344.1 MPN/100ml (Table 5). Fecal coliform results ranged from 21 cfu/100ml to 340 cfu/100ml (Table 6). For all sample events, *E. coli* and fecal coliform results were lower at the Pedersen Park site than at the Surrey and Edlund Road sites (Figure 8). For pathogens, where results may vary on an exponential level, a type of average called a geometric mean (geomean) is used. Geomeans for both *E. coli* and fecal coliform were highest at the Edlund Road site, followed closely by those for Surrey Road (Tables

7 and 8). All sample results for fecal coliform and *E. coli* are included in Appendix A. Microbial Source Tracking results from Surrey Road showed a moderate target abundance for bird DNA markers and low target abundance for horse DNA markers. DNA markers for humans and dogs were not detected.

Table 5. Summary of *E. coli* results for all sites and sample events.

<i>E. coli</i> (MPN/100 ml)	CW-Pedersen	CW-Edlund	CW-Surrey
Min	17.3	125.9	86
Geomean (n = 8)	19.8	199.1	151.3
Max	30.1	328.2	344.1

Table 6. Summary of fecal coliform results for all sites and sample events.

Fecal coliform (cfu/100 ml)	CW-Pedersen	CW-Edlund	CW-Surrey
Min	21	120	72
Geomean (n=8)	24.1	163.5	151.8
Max	49	240	340

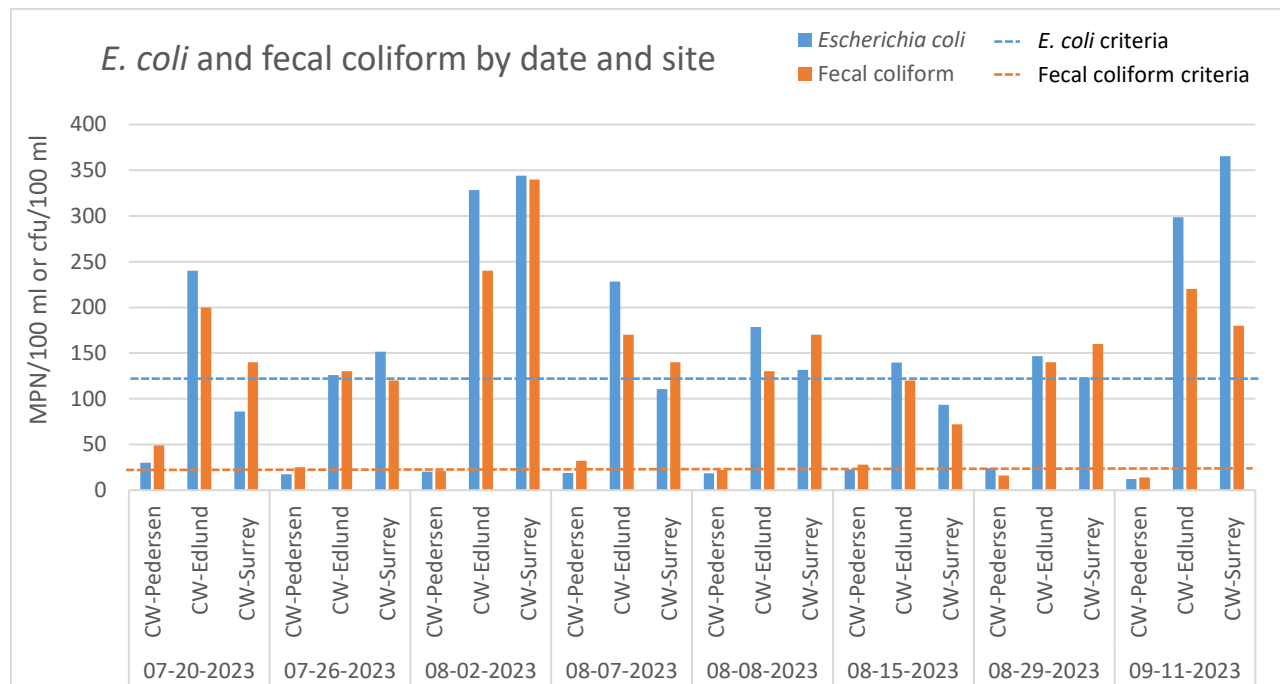


Figure 8. *E. coli* and fecal coliform results by date and site. Dashed lines indicate water quality criteria for *E. coli* geomean (126 MPN/100 ml) and fecal coliform geomean (20 cfu/ 100 ml).

All three sample sites fall within the same waterbody assessment unit. For comparison against water quality criteria, daily results from each sample site were averaged for each parameter and then compared against water quality criteria using the methods described in DEC's listing methodology for pathogens.⁶ It is also helpful to look at the metrics on a site-by-site basis for informing work on implementation of best management practices (BMPs). For comparison to the geometric mean criterion, geometric means were calculated for every possible 30-day period in which there were five or more samples. Table 7 summarizes the geometric mean exceedances for fecal coliform at each site and for the waterbody segment. Water quality criteria for pathogens include both a geomean criterion and a criterion which not more than ten percent of samples may exceed. Table 8 summarizes exceedances of the not-to-exceed criterion for fecal coliform. Tables 9 and 10 summarize the geometric mean and not-to-exceed criteria exceedances for *E. coli*, respectively. All calculated geometric means can be found in Appendix B.

Table 7. Summary of fecal coliform geometric mean criterion exceedances in Cottonwood Creek. The number of calculated geometric means is the number of separate 30-day periods within which there were at least five samples.

Evaluated area	Number of calculated 30-day geometric means	Exceed 20 cfu/100 ml	
		Number	Percent
CW - Pedersen	3	3	100%
CW - Edlund	3	3	100%
CW - Surrey	3	3	100%
Overall stream segment	3	3	100%

Table 8. Summary of exceedances of the not-to-exceed criterion for fecal coliform in Cottonwood Creek.

Evaluated site	Number of observations	Exceed 40 cfu/100 ml	
		Number	Percent
CW - Pedersen	8	1	12.5%
CW - Edlund	8	8	100%
CW - Surrey	8	8	100%
Overall stream segment	8	8	100%

⁶ 2019. ADEC. Listing Methodology for Determining Water Quality Impairment from Pathogens. Juneau, Alaska.

Table 9. Summary of *E. coli* geometric mean criterion exceedances in Cottonwood Creek.

Evaluated site	Number of calculated geometric means	Exceed 126 MPN*/100 ml	
		Number	Percent
CW - Pedersen	3	0	0
CW - Edlund	3	3	100%
CW - Surrey	3	3	100%
Overall stream segment	3	3	100%

*MPN= most probable number (equal to cfu but reported as MPN per lab method)

Table 10. Summary of exceedances of the not-to-exceed criterion for *E. coli* in Cottonwood Creek

Evaluated site	Number of observations	Exceed 410 MPN/100 ml	
		Number	Percent
CW - Pedersen	8	0	0%
CW - Edlund	8	0	0%
CW - Surrey	8	0	0%
Overall stream segment	8	0	0%

Table 11. Summary of in situ field measurements for each site.

Site	Parameter	Mean (n=8)	Median	Range
Pedersen	Temperature (°C)	17.36	17.78	11.75 -20.7
	Dissolved oxygen (mg/ L)	9.22	9.19	8.48- 9.93
	pH	8.12	8.18	7.75-8.32
	Turbidity (NTU)	0.49	0.00	0.0 -2.82
	Specific conductance (µg/L)	258.50	255.03	248.18 - 270.05
	Total dissolved solids (ppt)	0.17	0.17	0.16-0.18
Edlund	Temperature (°C)	16.07	16.52	10.81 - 18.99
	Dissolved oxygen (mg/ L)	8.96	8.74	8.23 - 9.78
	pH	7.73	7.79	7.28-7.96
	Turbidity (NTU)	0.30	0.00	0.0-2.02
	Specific conductance (µg/L)	262.39	264.99	238.7 - 278.1
	Total dissolved solids (ppt)	0.17	0.17	0.16-0.18
Surrey	Temperature (°C)	15.13	15.64	10.2 - 17.67
	Dissolved oxygen (mg/ L)	9.71	9.59	9.19- 10.7
	pH	7.70	7.62	7.35- 8.23
	Turbidity (NTU)	1.98	0.41	0.15 - 9.81
	Specific conductance (µg/L)	268.54	269.15	251.86 - 284.09
	Total dissolved solids (ppt)	0.17	0.18	0.16-0.18

Site	Parameter	Mean (n=8)	Median	Range
Overall	Temperature (°C)	16.19	16.60	10.2 - 20.70
	Dissolved oxygen (mg/ L)	9.30	9.30	8.23 - 10.70
	pH	7.85	7.84	7.28 - 8.32
	Turbidity (NTU)	0.92	0.08	0.0 - 9.81
	Specific conductance (µS/L)	263.14	266.61	238.7 - 284.09
	Total dissolved solids (ppt)	0.17	0.17	0.16 - 0.18

During the sample season, temperature on Cottonwood Creek averaged 16.19°C. Dissolved oxygen averaged 9.3 mg/L and the average pH was 7.85. The average specific conductance was 263.14 µS/cm and the average of total dissolved solids was 0.17 ppt. Measurements for individual sites are included in Table 11.

Conclusion

Cottonwood Creek continues to have levels of fecal coliform and *E. coli* that exceed water quality criteria. At the assessment unit level, three separate geomeans were calculated (five or more samples in a 30-day period) and all three exceeded the 20 cfu/100ml criterion for fecal coliform. Additionally, all calculated geomeans exceeded 126 MPN/100ml criterion for *E. coli*. More than 10% of samples exceeded the 40 cfu/100ml criterion for fecal coliform. No samples exceeded the 410 MPN/100ml criterion for *E. coli*.

Samples from CW-Pedersen had consistently lower levels of fecal coliform and *E. coli*. This site is the farthest upstream, is closest to the Parks Highway, a shopping center, and the outlet of Wasilla Lake. Geomeans calculated for fecal coliform at Pedersen Creek exceed the 20 cfu/100ml criterion and one sample exceeded the 40 cfu/100ml criterion. Geomeans for *E. coli* at Pedersen did not exceed the 126 MPN criterion, nor were there any exceedances of the 410 MPN/100ml criterion.

Samples from the Edlund and Surrey Road sites exceeded geomean and not-to-exceed criteria for fecal coliform and the geomean criteria for *E. coli*. There were no exceedances of the not-to-exceed criteria for *E. coli*.

Although several best management practices have been implemented to improve water quality in Cottonwood Creek, fecal coliform and *E. coli* levels are still exceeding water quality criteria. Microbial source tracking at the Surrey Road site detected DNA markers for horse and bird; however, additional DNA testing is recommended for all sites to help inform BMP development.

Appendix A. Fecal coliform and *E. coli* data for Cottonwood Creek

Table A.1. Sample results for fecal coliform and *E. coli* for Cottonwood Creek sites. Field replicates are indicated in parentheses and were used only for quality control. Results in bold exceed the threshold criteria of 40 cfu/100 ml for fecal coliform. No results exceeded the threshold criterion of 410 MPN/100ml for *E. coli*.

Sampling Site	Date	Fecal coliform (cfu/100 ml)	<i>E. coli</i> (MPN/100 ml)
CW-Pedersen	7/20/23	49.0	30.1
CW-Pedersen	7/26/23	25.0	17.3
CW-Pedersen	8/2/23	21.0	20.1
CW-Pedersen (field replicate)	8/2/23	25.0	26.9
CW-Pedersen	8/7/23	32.0	18.7
CW-Pedersen	8/8/23	22.0	18.5
CW-Pedersen	8/15/23	28.0	22.6
CW-Pedersen (field replicate)	8/15/23	17.0	30.9
CW-Pedersen	8/29/23	16	24.1
CW-Pedersen	9/11/23	14	12.2
CW-Edlund	7/20/23	200.0	240.0
CW-Edlund	7/26/23	130.0	125.9
CW-Edlund (field replicate)	7/26/23	120.0	124.6
CW-Edlund	8/2/23	240.0	328.2
CW-Edlund	8/7/23	170.0	228.2
CW-Edlund	8/8/23	130.0	178.5
CW-Edlund (field replicate)	8/8/23	160.0	285.1
CW-Edlund	8/15/23	120.0	139.6
CW-Edlund	8/29/23	140	146.7
CW-Edlund	9/11/23	220	298.7
CW-Edlund (field replicate)	9/11/23	210	387.3
CW-Surrey	7/20/23	140.0	86.0
CW-Surrey (field replicate)	7/20/23	130.0	148.3
CW-Surrey	7/26/23	120.0	151.5
CW-Surrey	8/2/23	340.0	344.1
CW-Surrey	8/7/23	140.0	110.6
CW-Surrey (field replicate)	8/7/23	160.0	275.5
CW-Surrey	8/8/23	170.0	131.4
CW-Surrey	8/15/23	72.0	93.3
CW-Surrey	8/29/23	160	123.6
CW-Surrey (field replicate)	8/29/23	130	120.1
CW-Surrey	9/11/23	180	365.4

Appendix B. Geometric Means

Table B.1. Rolling geometric means calculated from averaging fecal coliform results from all three sample sites. Range is the number of sample events used in calculating the geomean. A dash in the rightmost column means that there were insufficient samples (fewer than five) within a 30-day period to calculate a reportable geomean. Geomeans in bold font exceed the 20 cfu/100 ml geomean criterion.

Date	Fecal coliform 3-site average (cfu/100 ml)	# Range	Rolling Geomean	Reportable Rolling Geomean >=#5
7/20/2023	129.7	1	129.7	—
7/26/2023	91.7	2	109.1	—
8/2/2023	200.3	3	133.6	—
8/7/2023	114	4	127.9	—
8/8/2023	107.3	5	122.4	122.4
8/15/2023	73.3	6	110.5	110.5
8/29/2023	105.3	5	113.6	113.6
9/11/2023	138	3	117.3	—

Table B.2. Rolling geometric means calculated from averaging E. coli results from all three sample sites. Range is the number of sample events used in calculating the geomean. A dash in the rightmost column means that there were insufficient samples (fewer than five) within a 30-day period to calculate a reportable geomean. Geomeans in bold font exceed the 126 MPN/100 ml geomean criterion.

Date	E. coli 3-site average (cfu/100 ml)	# Range	Rolling Geomean	Reportable Rolling Geomean >=#5
7/20/2023	118.7	1	118.7	—
7/26/2023	98.2	2	108.0	—
8/2/2023	230.8	3	139.1	—
8/7/2023	119.2	4	139.3	—
8/8/2023	109.5	5	131.1	131.1
8/15/2023	85.2	6	120.3	120.3
8/29/2023	98.1	5	120.3	120.3
9/11/2023	225.4	3	133.6	—