Escherichia coli monitoring in the Mink Creek Watershed, Bannock Co., Idaho, 2017

Final

State of Idaho
Department of Environmental Quality

Prepared by
Hannah Harris
Pocatello Regional Office
444 Hospital Way #300
Pocatello, Idaho 83201

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1 Introduction

The Mink Creek watershed encompasses 49 square miles of the Portneuf River subbasin south of the city of Pocatello, Idaho. Most of the watershed is located on United States Forest Service land that is managed for multiple uses including cattle grazing and recreation by the Caribou-Targhee National Forest. Major tributaries to this 4th order stream include South Fork, West Fork, and East Fork Mink creeks. Beneficial uses in the subbasin include cold water aquatic life, salmonid spawning, and secondary contact recreation.

The Idaho Department of Environmental Quality (DEQ) is responsible for monitoring and assessing surface waters in support of the federal Clean Water Act. Mink Creek (ID17040208SK004_03a and ID17040208SK004_04a) and two of its tributaries (South Fork Mink Creek ID17040208SK004_02c, East Fork Mink Creek ID17040208SK004_02d) are listed in Category 5 of *Idaho's 2014 Integrated Report* (DEQ 2017b) as not supporting their recreation beneficial use because exceeding *E. coli* bacteria standards. Another assessment unit of Mink Creek (ID17040208SK004_04) has a TMDL for [1]*E. coli*.

In 2014, DEQ conducted monitoring to assess if recreation was supported at several locations in the watershed. Results indicated violations of water quality standards for *E. coli* in South Fork Mink Creek, East Fork Mink Creek, the third order segment of Mink Creek (ID17040208SK004_03a), Mink Creek downstream of East Fork (ID17040208SK004_04a), and Mink Creek below the Forest boundary (ID17040208SK004_04). In 2016, Mink Creek was sampled for *E. coli* as part of a data collection effort in support of a 5-year review of the Portneuf River TMDL. After sampling revealed violations of water quality standards for *E. coli* at Cherry Springs Nature Area (an access site on the Forest) DEQ continued bacterial sampling into October and met with staff at the Westside Ranger District. At the meeting, a sampling regime for 2017 was agreed on.

A numeric criterion for *E. coli* is included in Idaho's water quality standards for protecting primary and secondary contact recreation (IDAPA 58.01.02.100.02), and 2014 and 2016 samples were collected on a schedule to determine compliance with this criterion. Waters designated for primary or secondary contact recreation are not to contain *E. coli* bacteria in concentrations exceeding a geometric mean of 126 *E. coli* organisms per 100 milliliters (mL) based on a minimum of five samples taken every 3 to 7 days over a 30-day period (IDAPA 58.01.02.251.a).

In 2017, bi-monthly samples were collected at 4 tributary and 3 main-stem locations in the Mink Creek watershed from June to October (Figure 1). Seasonal geometric means were generated to compare sites to each other and to compare values against water quality standards (for informational purposes). Seasonal geometric means were above 126 cfu / 100 mL at all locations except West Fork Mink Creek (West Fork Mink Creek is a municipal watershed for the City of Pocatello where cattle grazing is not permitted). Patterns of *E. coli* tracked timing of grazing in

[1] *E. coli* is a bacteria found in the normal intestinal flora of warm-blooded animals. Its presence in water indicates that the water has been in contact with, or been contaminated by, fecal material; thus, *E. coli* can be used as an indicator for other bacteria and pathogens associated with human and animal waste.

South Fork Mink Creek and in East Fork Mink Creek with high bacterial values coinciding with cattle being on stream-side grazing units.

Lead Draw, an intermittent watershed, had the highest seasonal geometric mean of *E. coli* bacteria in 2017. This watershed was grazed from 6/1/2017 to 6/23/2017, but bacterial levels remained elevated (>5× above standards) through the final sampling date on 10/5/2017. Lead Draw was in Category 2 as fully supporting beneficial uses in the latest Integrated Report, but had not been sampled for bacteria previously due to its intermittency. 2017 was an unusually wet year with a high snowpack, and the creek ran throughout the year. Based on data collected in 2017, this AU will be placed in Category 5 for the recreation use due to *E. coli* exceedances in the next Integrated Report.

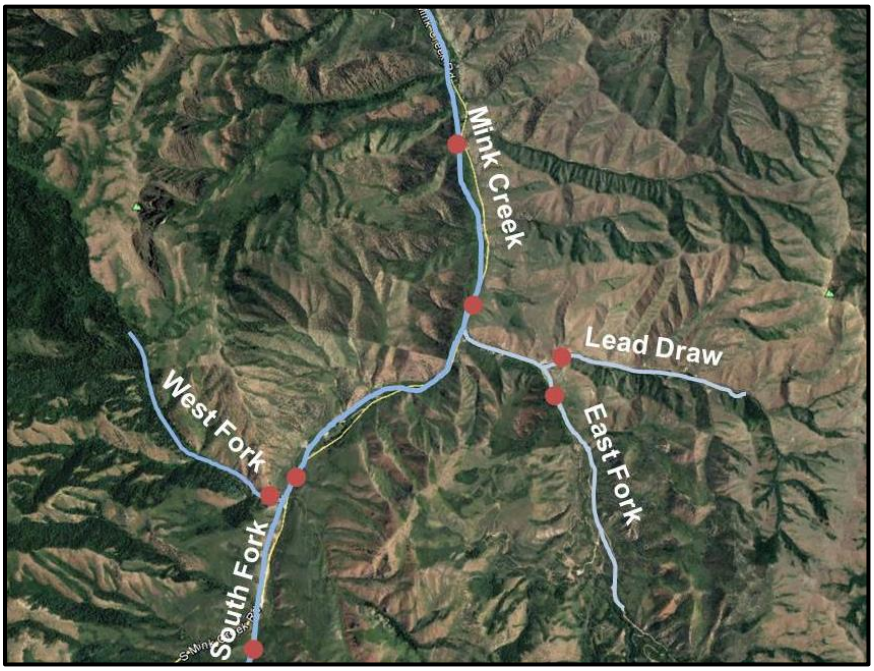

Figure 1. Sampling locations in the Mink Creek watershed, 2017.

2 Sample Site Locations

Monitoring for *E. coli* bacteria was conducted at seven sites within the Mink Creek watershed (Table 1; Figure 1). Sample sites were located to try and bracket potential source areas to better understand the frequency, magnitude and duration of *E. coli* concentrations throughout the summer season.

Table 1. Sampling locations in the Mink Creek watershed, 2017.

Site	Assessment Unit	Latitude	Longitude
South Fork Mink Creek	ID17040208SK004_02c	42.70827	-112.42265
West Fork Mink Creek	ID17040208SK004_02b	42.72307	-112.41999
Mink Creek at Group Site	ID17040208SK004_03a	42.72600	-112.41759
East Fork Mink Creek	ID17040208SK004_02d	42.73637	-112.38441
Lead Draw Creek	ID17040208SK004_02	42.73776	-112.38403
Mink Creek downstream of East Fork	ID17040208SK004_04a	42.74396	-112.39482
Mink Creek at Cherry Springs	ID17040208SK004_04a	42.75155	-112.39488

3 Sampling Procedure and Methods

All sampling and analyses conducted as part of this investigation followed commonly accepted procedures and methods and a Field Sampling Plan (DEQ 2017b). Field sampling for *E. coli* bacteria followed DEQ's standard operating procedures for sampling *E. coli* in surface water and the associated quality assurance project plan (DEQ 2012; DEQ 2017d). *E. coli* bacteria laboratory analyses were conducted by IAS EnviroChem of Pocatello, Idaho, using Quanti-Tray/2000 methods or equivalent.

During each sampling event, sites were monitored for water quality indicators and flow. Water quality parameters (temperature, specific conductivity, dissolved oxygen, pH, and turbidity) were measured with a calibrated Yellowsprings Instruments, model 6920 sonde, and stream discharge was measured with a top-set wading rod equipped with a Marsh-McBirney FlowMate velocity meter (DEQ 2017c).

4 Results and Discussion

Data generated by this project is attached in Appendix A. All sites had seasonal geometric means above 126 cfu / 100mL except West Fork Mink Creek (for comparison purposes, a 30-day geomean of above 126 cfu/100mL based on collecting 5 samples 3-7 days apart is a violation of State of Idaho water quality standards). The highest seasonal geometric mean was observed at Lead Draw, followed by the site directly below Mink Creek's confluence with East Fork Mink Creek (of which Lead Draw is a tributary).

Table 2. Mink Creek seasonal geometric means from June 1 to October 5, 2017.

Site	Seasonal geometric mean of *E. coli* (MPN / 100 mL)	Minimum value	Maximum value
South Fork Mink Creek	253	<1	2419
West Fork Mink Creek	52	<1	548
Mink Creek at Group Site	247	70	1414
East Fork Mink Creek	181	13	>2419
Lead Draw	1617	687	>2419
Mink Creek below East Fork	549	105	1414
Mink Creek at Cherry Springs	435	21	2419

Cattle grazing took place in the Mink Creek drainage on USFS and Idaho Department of Lands within the Pocatello allotment from June 1 to October 1, 2017 (Table 3; Figure 3).

Table 3. Timing of cattle presence on grazing units in the Mink Creek watershed, 2017.

Grazing Unit name	Possibly affected downstream site	Dates of occupancy
Lead Draw/Kinney Creek	Lead Draw	June 1-June 23
Catch	South Fork Mink Creek	June 1-June 30
Lower Cowcamp	East Fork Mink Creek	June 24-July 12
Highway	South Fork Mink Creek and Mink Creek at Group Site	July 1-August 16
Upper Cowcamp	East Fork Mink Creek	July 13-August 10
Scout Mountain	East Fork Mink Creek	August 11-October 1

E. coli levels at the South Fork Mink Creek site were associated with cattle presence in the Highway Unit (Figure 2). In June, *E. coli* levels remained below the secondary contact trigger of 576 cfu / 100 mL. After cattle were in the Highway Unit, *E. coli* concentrations exceeded this trigger value. Following cattle removal from the Highway Unit, *E. coli* levels declined in September and October.

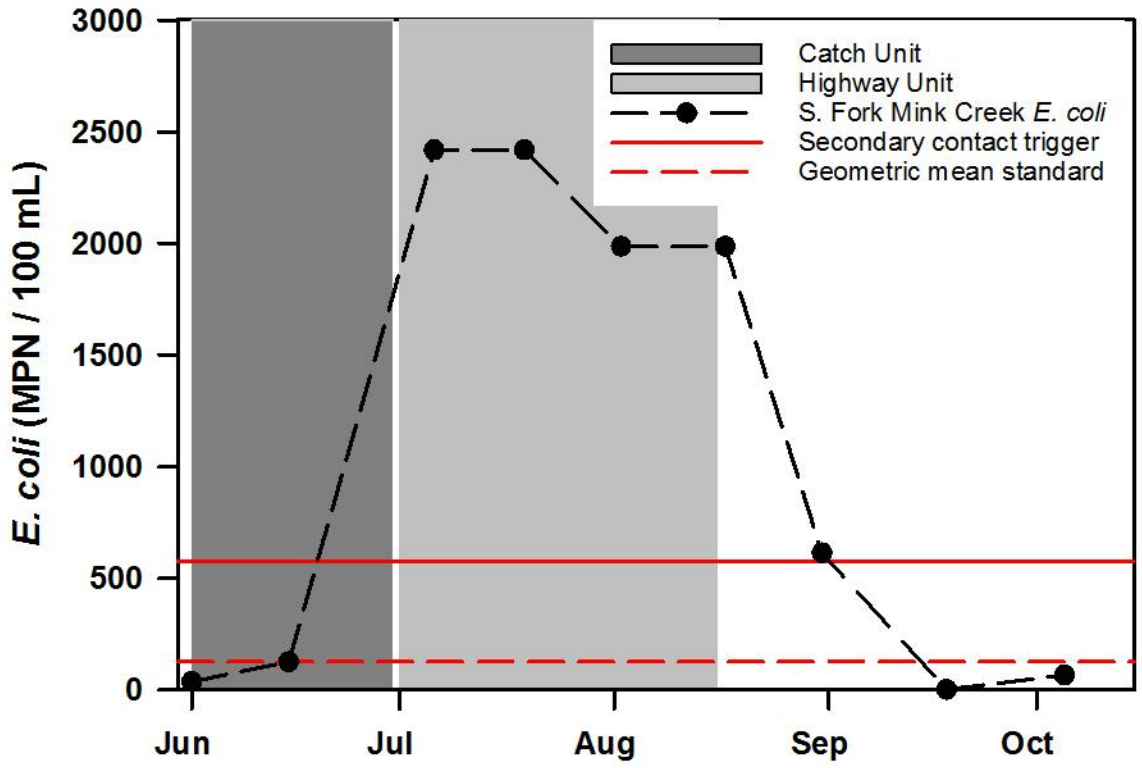

Figure 2. Timing of cattle grazing in two grazing units indicated by shading (Catch Unit and Highway Unit) and *E. coli* concentrations in South Fork Mink Creek, 2017.

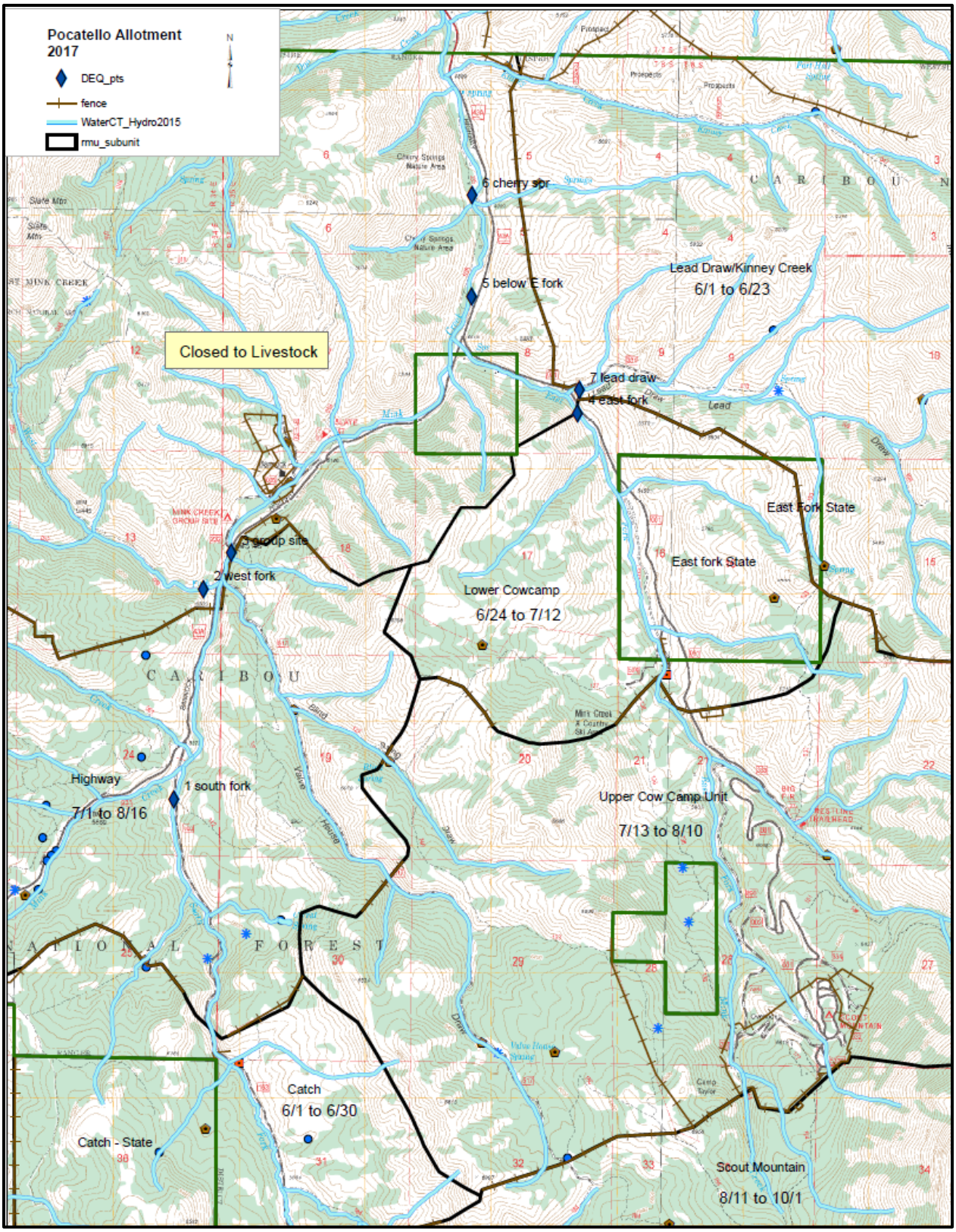

Figure 3. Locations and timing of grazing unit utilization in the Mink Creek watershed, 2017.

In West Fork Mink Creek, *E. coli* remained below the secondary contact trigger value for the entire sampling period. Three of the sample dates had *E. coli* values in excess of the geometric mean standard of 126 cfu/100 mL, but none were higher than the trigger for geometric mean sampling (Figure 4).

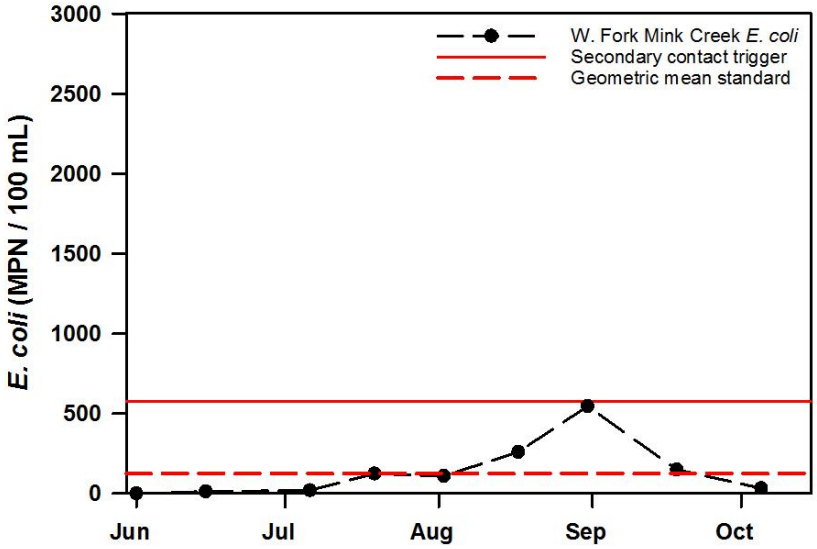

Figure 4. *E. coli* concentrations in West Fork Mink Creek, 2017.

In East Fork Mink Creek, *E. coli* concentrations were associated with the presence of cattle in the Lower and Upper Cowcamp grazing units (Figure 5). When cattle were present in these units, *E. coli* concentrations exceeded the secondary contact trigger value. Following the removal of cattle from these units, *E. coli* values were reduced but still remained above the geometric mean criteria value (126 cfu / 100 mL) until October 5.

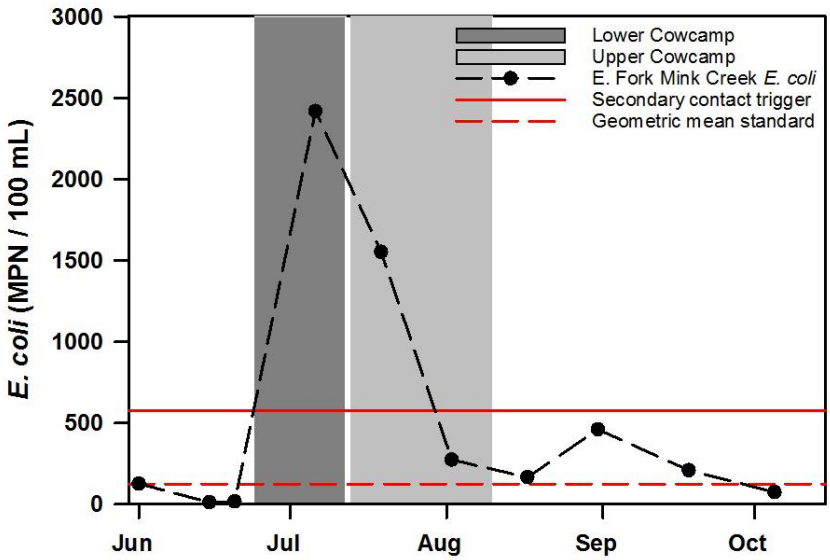

Figure 5. Timing of cattle grazing in two units indicated by shading (Lower Cowcamp and Upper Cowcamp) and *E. coli* concentrations in East Fork Mink Creek, 2017.

Lead Draw had the highest observed *E. coli* concentrations, with 6 of the 11 samples exceeding the maximum measureable value of 2419 cfu / 100 mL. Before cattle grazing began in the Mink Creek watershed, the highest observed *E. coli* value was 127 at East Fork Mink Creek. All samples at Lead Draw exceeded the secondary contact trigger value (Figure 6). After cattle were removed from the Lead Draw/Kinney Creek unit on June 23, *E. coli* numbers remained above the maximum detection value until the middle of July when values began to decline. *E. coli* values rose from September to October, potentially as fall rains transported fecal matter from the riparian area to the stream.

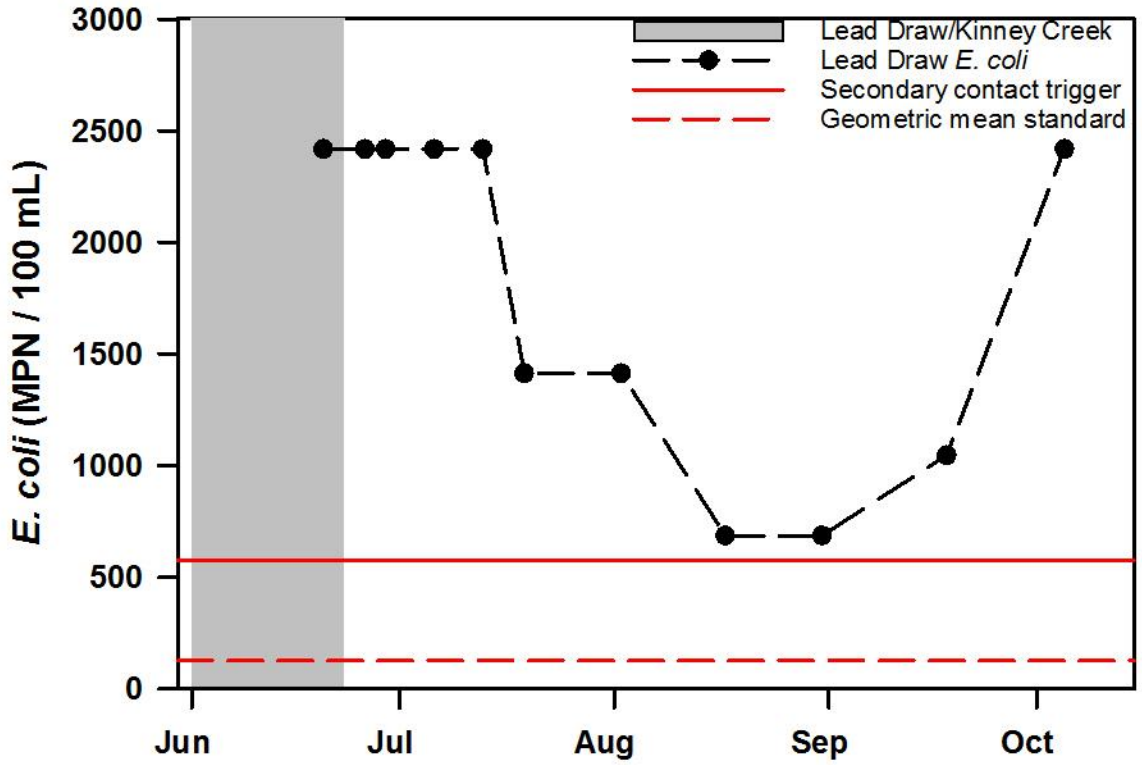

Figure 6. Timing of cattle grazing in the Lead Draw/Kinney Creek grazing unit, indicated by shading, and *E. coli* concentrations in Lead Draw Creek, 2017.

E. coli in Mink Creek at the Group Use Site tracked patterns observed in South Fork Mink Creek (see Figure 2). The dilution effect from West Fork Mink Creek, however, was evident in that values were lower at Mink Creek at the Group Site than in South Fork upstream. *E. coli* concentrations were highest in early August, and all samples from July to September exceeded the geometric mean standard.

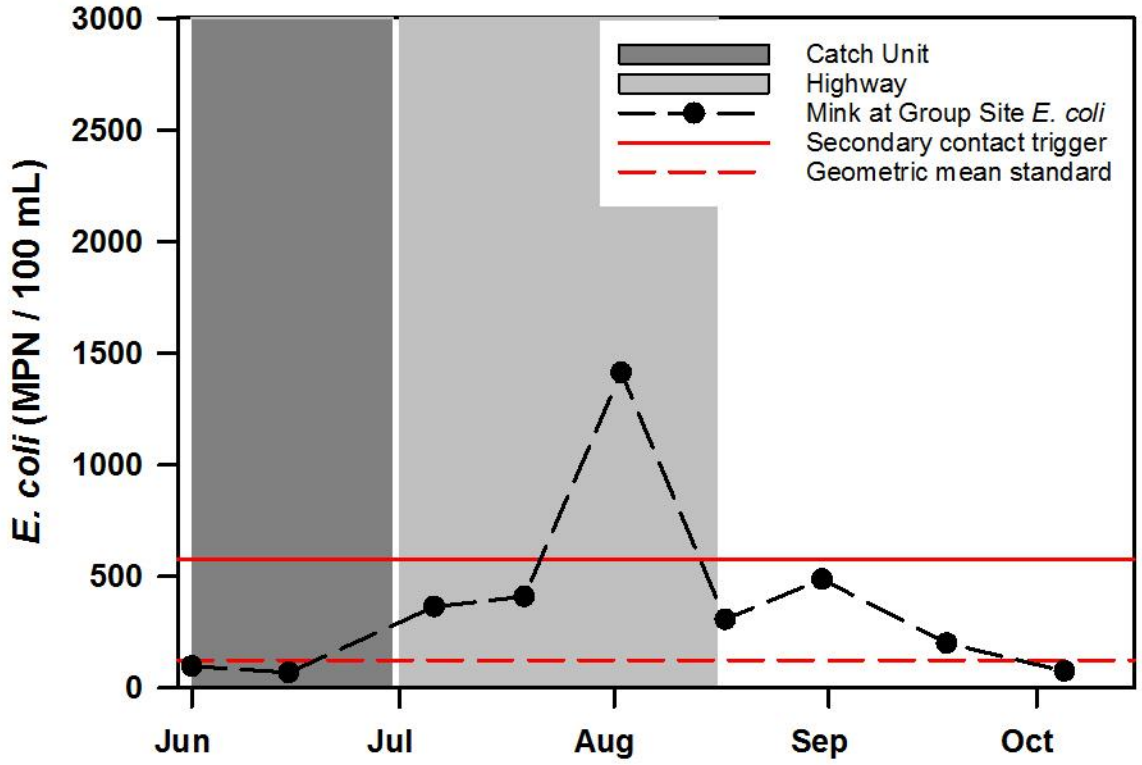

Figure 7. Timing of cattle grazing in two allotments, indicated by shading (Catch Unit and Highway), and *E. coli* concentrations in Mink Creek at the Group Use Site, 2017.

E. coli in Mink Creek below East Fork Mink Creek was above the geometric mean criteria on 9 of 10 sampling dates. *E. coli* levels were above the secondary contact trigger value in 6 of the 10 sampling dates (Figure 8). *E. coli* is likely coming from upstream sources such as South Fork Mink Creek, Lead Draw and East Fork Mink Creek. There is potential for *E. coli* to be stored in sediments and mobilized during high flow events triggered by precipitation.

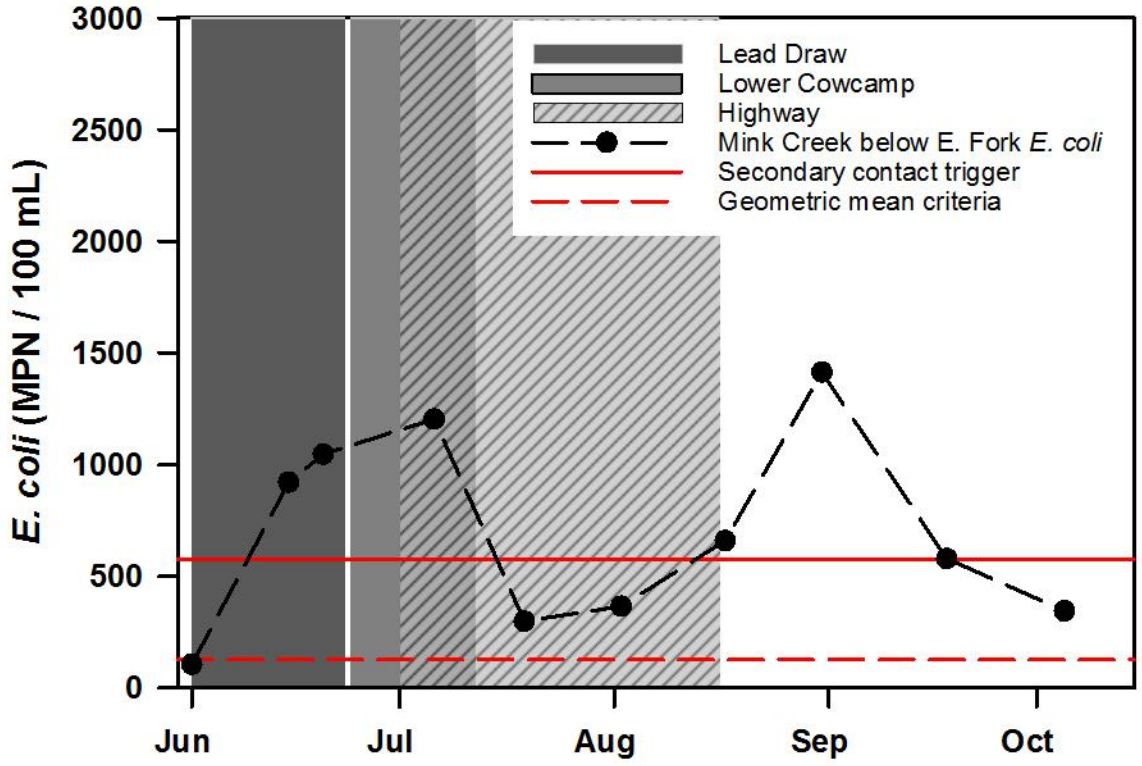

Figure 8. Timing of cattle grazing in three allotments, indicated by shading (Lower Cow Camp, Lead Draw, and Highway), and *E. coli* concentrations in Mink Creek below its confluence with the East Fork, 2017.

Overall, *E. coli* concentrations in Mink Creek at Cherry Springs were similar to levels below East Fork (Table 3). Eight of nine samples exceeded the geometric mean criteria (Figure 9). In early September, *E. coli* values were particularly elevated (high values were noted at several other sites at this time--West Fork Mink Creek, East Fork Mink Creek, and Mink Creek below East Fork).

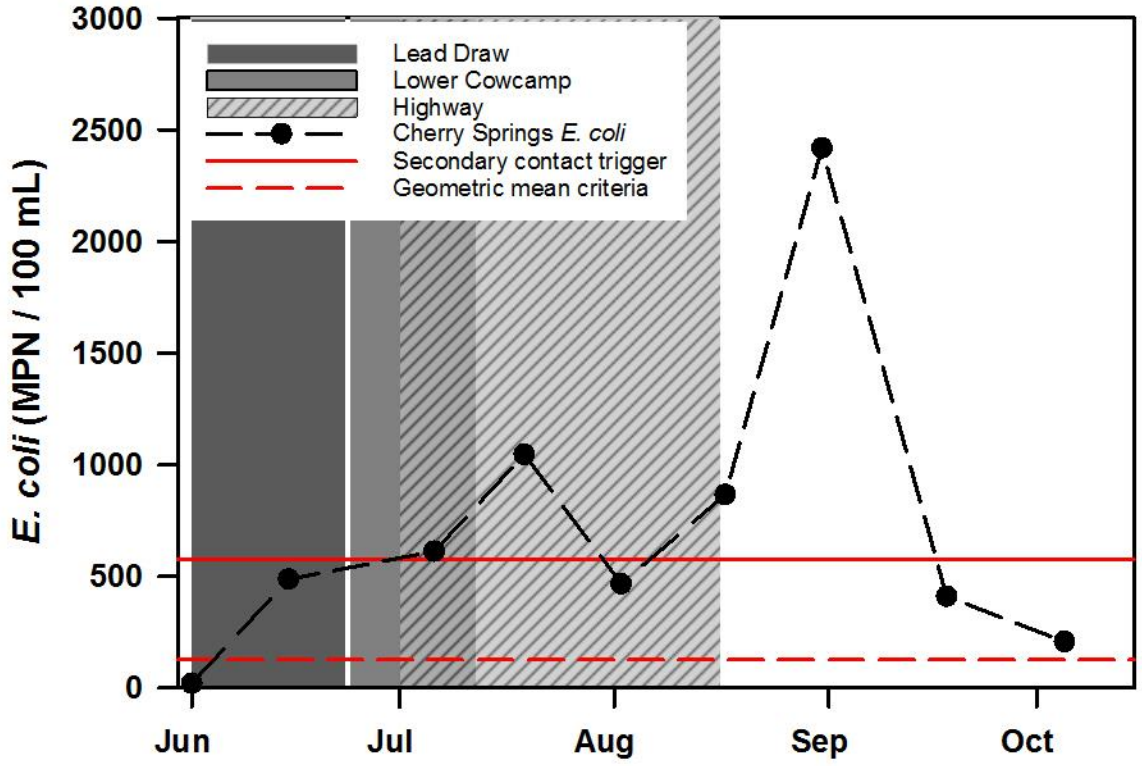

Figure 9. Timing of cattle grazing in three units, indicated by shading (Lower Cowcamp, Lead Draw, and Highway), and *E. coli* concentrations in Mink Creek at Cherry Springs, 2017.

5 Conclusion

E. coli sampling in the Mink Creek watershed indicates that many surface water assessment units are not meeting water quality standards for *E. coli* and therefore are not supporting secondary contact recreation. Patterns of stream-side cattle grazing generally correlate with *E. coli* levels. DEQ met with USFS staff on November 28, 2017 to discuss results of this study and ways to implement improved grazing practices on the Forest to reduce *E. coli* concentration in the Mink Creek watershed. Proposed solutions included additional development of off-stream watering sources, shifting of grazing unit locations to reduce time cattle spend in riparian areas, installation of temporary electric fencing to exclude cattle from riparian areas, and re-directing highway drainage to reduce *E. coli* transport to South Fork Mink Creek. The USFS will meet with grazing lease holders before the next grazing season to discuss this report and ways to reduce *E. coli* contamination in streams. DEQ will repeat this study in 2020 to reassess the

support status of the recreation beneficial use and track changes in *E. coli* concentrations in response to altered grazing practices.

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Appendix A. Mink Creek 2017 *E. coli* sampling results

Table A-1.

Site	Date	Time	Flow (cfs)	Temp (C°)	Spec. Cond (ms/cm²)	D.O. (%)	D.O. (mg/L)	pH	Turbidity (NTU)	*E. coli* (MPN/ 100 mL)
South Fork Mink Creek	6/1/2017	1400	5.4	12.99	0.396	84.1	8.85	8.05	12.7	36
South Fork Mink Creek	6/15/2017	1245	4.6	12.30	0.449	84.5	9.04	8.38	7.2	126
South Fork Mink Creek	7/6/2017	1305	1.6	18.33	0.509	89.7	8.42	8.16	15.4	2419
South Fork Mink Creek	7/19/2017	1300	1.2	17.67	0.516	90.4	8.60	8.80	6.7	2419
South Fork Mink Creek	8/2/2017	1330	0.9	17.15	0.499	85.1	8.19	8.00	5.5	1986
South Fork Mink Creek	8/17/2017	1303	1.0	14.79	0.493	83.3	8.42	8.15	6.2	1986
South Fork Mink Creek	8/31/2017	1125	1.0	13.53	0.490	79.5	8.26	8.44	7.6	613
South Fork Mink Creek	9/18/2017	1313	1.0	10.46	0.493	81.7	9.11	8.14	3.5	<1.0
South Fork Mink Creek	10/5/2017	1035	1.2	4.38	0.503	79.8	10.34	8.18	4.9	66
West Fork Mink Creek	6/1/2017	1425	7.4	10.84	0.391	83.6	9.24	8.22	7.7	<1.0
West Fork Mink Creek	6/15/2017	1310	7.9	10.23	0.396	83.6	9.38	8.36	7.0	13
West Fork Mink Creek	7/6/2017	1335	4.9	12.43	0.408	83.5	8.91	7.94	4.6	21
West Fork Mink Creek	7/19/2017	1325	3.7	12.15	0.408	83.0	8.9	8.37	3.7	125
West Fork Mink Creek	8/2/2017	1352	2.9	12.61	0.404	83.4	8.85	8.09	4.2	111
West Fork Mink Creek	8/17/2017	1325	2.6	11.54	0.404	83.2	9.04	8.27	3.1	260
West Fork Mink Creek	8/31/2017	1143	2.2	11.25	0.408	84.5	9.26	8.65	2.7	548
West Fork Mink Creek	9/18/2017	1334	2.5	9.68	0.410	84.8	9.63	8.34	1.1	150
West Fork Mink Creek	10/5/2017	1055	2.3	5.43	0.409	83.0	10.47	8.36	2.3	34
Mink Creek at Group Site	6/1/2017	1450	15.4	12.28	0.420	82.6	8.84	7.90	10.5	99
Mink Creek at Group Site	6/15/2017	1335	14.7	11.88	0.443	84.2	9.09	8.36	9.8	70
Mink Creek at Group Site	7/6/2017	1403	6.6	14.73	0.464	84.8	8.60	8.03	6.9	365
Mink Creek at Group Site	7/19/2017	1348	5.0	14.09	0.460	83.8	8.61	8.51	5.5	411
Mink Creek at Group Site	8/2/2017	1412	5.1	14.43	0.447	83.8	8.55	8.09	6.0	1414
Mink Creek at Group Site	8/17/2017	1343	3.9	13.02	0.440	83.8	8.81	8.28	3.8	308
Mink Creek at Group Site	8/31/2017	1204	3.8	12.31	0.441	84.3	9.01	8.56	4.4	488

Site	Date	Time	Flow (cfs)	Temp (C°)	Spec. Cond (ms/cm²)	D.O. (%)	D.O. (mg/L)	pH	Turbidity (NTU)	*E. coli* (MPN/ 100 mL)
Mink Creek at Group Site	9/18/2017	1354	3.8	10.03	0.443	84.6	9.53	8.34	2.0	201
Mink Creek at Group Site	10/5/2017	1112	4.1	4.74	0.458	82.4	10.58	8.31	3.4	77
East Fork Mink Creek	6/1/2017	1512	8.0	13.03	0.323	84.8	8.92	7.77	15.4	127
East Fork Mink Creek	6/15/2017	1400	6.2	14.18	0.359	88.5	9.08	8.45	8.0	13
East Fork Mink Creek	6/20/2017	1415	5.4	18.52	0.379	89.3	8.36	8.44	7.8	18
East Fork Mink Creek	7/6/2017	1427	3.1	20.37	0.425	84.3	7.6	8.30	17.4	>2419
East Fork Mink Creek	7/19/2017	1410	2.2	19.89	0.442	82.4	7.50	8.47	15.0	1553
East Fork Mink Creek	8/2/2017	1435	1.6	19.74	0.452	86.2	7.87	8.18	12.8	276
East Fork Mink Creek	8/17/2017	1403	1.3	17.62	0.45	84.2	8.03	8.46	9.2	167
East Fork Mink Creek	8/31/2017	1225	1.0	14.34	0.449	85.9	8.78	8.64	7.4	461
East Fork Mink Creek	9/18/2017	1417	1.1	11.34	0.455	88.4	9.66	8.51	3.5	210
East Fork Mink Creek	10/5/2017	1128	1.1	4.33	0.455	83.7	10.85	8.31	3.0	75
Lead Draw	6/20/2017	1340	0.4	17.64	0.526	81.6	7.77	8.16	265.0	>2419
Lead Draw	6/26/2017	1340	0.3	16.72	0.519	81.0	7.86	8.45	74.0	>2419
Lead Draw	6/29/2017	1450	0.2	14.79	0.517	80.8	8.18	8.28	43.0	>2419
Lead Draw	7/6/2017	1455	0.2	19.70	0.529	81.7	7.46	8.23	38.6	>2419
Lead Draw	7/13/2017	1432	0.1	19.18	0.533	82.6	7.62	8.14	30.5	2419
Lead Draw	7/19/2017	1426	0.1	19.06	0.523	81.1	7.50	8.47	36.0	1414
Lead Draw	8/2/2017	1452	0.1	19.52	0.546	81.6	7.48	8.32	26.5	1414
Lead Draw	8/17/2017	1417	0.1	17.56	0.535	82.2	7.83	8.77	14.5	687
Lead Draw	8/31/2017	1241	0.1	16.30	0.530	84.5	8.27	8.64	9.0	687
Lead Draw	9/18/2017	1435	0.1	11.40	0.557	83.5	9.11	8.41	31.8	1046
Lead Draw	10/5/2017	1141	0.1	4.00	0.571	82.1	10.74	8.39	23.1	>2419
Mink Creek below East Fork	6/1/2017	1530	26.2	13.04	0.407	84.8	8.91	7.69	12.6	105
Mink Creek below East Fork	6/15/2017	1425	23.3	13.33	0.435	87.2	9.11	8.40	11.6	921
Mink Creek below East Fork	6/20/2017	1430	18.9	16.77	0.452	89.0	8.63	8.32	11.4	1046
Mink Creek below East Fork	7/6/2017	1525	9.2	18.06	0.467	85.8	8.1	8.11	10.8	1203
Mink Creek below East Fork	7/19/2017	1445	6.1	16.95	0.469	85.5	8.25	8.39	7.8	299
Mink Creek below East Fork	8/2/2017	1510	7.1	17.01	0.463	87.1	8.41	8.14	6.3	365

Site	Date	Time	Flow (cfs)	Temp (C°)	Spec. Cond (ms/cm²)	D.O. (%)	D.O. (mg/L)	pH	Turbidity (NTU)	*E. coli* (MPN/ 100 mL)
Mink Creek below East Fork	8/17/2017	1430	6.6	14.92	0.462	86.7	8.75	8.31	5.0	659
Mink Creek below East Fork	8/31/2017	1255	5.9	13.55	0.459	85.9	8.93	8.46	6.4	1414
Mink Creek below East Fork	9/18/2017	1447	5.6	10.36	0.467	84.7	9.47	8.31	4.5	579
Mink Creek below East Fork	10/5/2017	1150	6.0	5.02	0.473	83.3	10.62	8.22	4.8	345
Mink Creek at Cherry Springs	6/1/2017	1600	25.9	12.99	0.409	85.7	9.02	7.66	11.7	21
Mink Creek at Cherry Springs	6/15/2017	1500	21.2	13.39	0.438	86.4	9.01	8.41	12.4	488
Mink Creek at Cherry Springs	7/6/2017	1555	11.1	18.03	0.469	85.2	8.04	8.12	11.5	613
Mink Creek at Cherry Springs	7/19/2017	1508	9.9	16.95	0.471	84.8	8.19	8.38	9.1	1046
Mink Creek at Cherry Springs	8/2/2017	1533	7.4	17.04	0.465	85.2	8.22	8.15	6.6	467
Mink Creek at Cherry Springs	8/17/2017	1452	6.5	15.17	0.463	85.6	8.59	8.32	5.6	866
Mink Creek at Cherry Springs	8/31/2017	1313	7.3	13.79	0.462	85.5	8.84	8.44	8.0	2419
Mink Creek at Cherry Springs	9/18/2017	1508	5.8	10.34	0.470	84.8	9.48	8.32	5.0	411
Mink Creek at Cherry Springs	10/5/2017	1208	6.5	5.29	0.475	83.4	10.56	8.22	5.1	208.1