

Monitoring Surface Water for *Escherichia coli* in the Lindsay Creek Watershed

Final



**State of Idaho
Department of Environmental Quality**

**Prepared by
Lewiston Regional Office
1118 F Street
Lewiston, Idaho 83501**

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Contents

1 Introduction.....	1
2 Sample Site Locations.....	2
3 Sampling Procedure and Methods	6
4 Results.....	6
5 Conclusion	7
References.....	8
Appendix A. Lindsay Creek <i>E. coli</i> sampling results.....	9

List of Figures

Figure 1. Sampling locations.	2
Figure 2. Site L1: at the bridge on Main Street to the west of the Odom Corporation Wholesale Beverage Distributors buildings. Samples were taken from the bridge using a bridge sampler.	3
Figure 3. Site L2: upstream from where Gun Club Creek enters Lindsay Creek and from the bridge that crosses Lindsay Creek on Gun Club Road.	3
Figure 4. Site L3: downstream from where Gun Club Creek enters Lindsay Creek and from the bridge that crosses Lindsay Creek on Gun Club Road.	3
Figure 5. Site L4: on the west side of Lindsay Creek Road where creek exits culvert.	4
Figure 6. Site L5: on the west side of Lindsey Creek Road at the intersection of Hamilton Lane.	4
Figure 7. Site L6: approximately at 543 Lindsay Creek Road on the southwest side of the road. There is a circular pullout with a road leading to a private residence. A bridge crosses Lindsay Creek on this road. A bridge sampler was used to collect this sample.	4
Figure 8. Site L7: upstream from where Lindsay Creek crosses Lindsay Lane. A bridge sampler was used at this site.	5
Figure 9. Site L8: on private property with Lindsay Creek on the west side of the property. There is a path leading to the creek and a plank bridge where sampling occurred with permission from the resident.	5
Figure 10. Site L9: on the north side of Lindsay Creek Road where Lariat Lane intersects. A bridge sampler was used at this site.	5

List of Tables

Table 1. Sampling locations along Lindsay Creek (assessment unit ID17060306CL003_02).	2
Table 2. Lindsay Creek site geometric means.	6
Table A-1. Lindsay Creek <i>E. coli</i> sampling results—2012.	9
Table A-2. Lindsay Creek <i>E. coli</i> sampling results—2013.	10

1 Introduction

The Lindsay Creek watershed encompasses approximately 14,200 acres entirely within the city boundaries of Lewiston, Idaho. The main stem of Lindsay Creek originates from springs at the wetland just below Mann's Reservoir and flows northwest through farmland in the upper reaches and then through a canyon until it converges with the Clearwater River. Lindsay Creek is a 3rd-order tributary to the Clearwater River within the subbasin designated by hydrologic unit code 17060306. The designated beneficial uses for Lindsay Creek are cold water aquatic life and secondary contact recreation. Primary land uses in the watershed include dry-land agriculture, small livestock operations, and suburban uses in the northeast section of Lewiston, Idaho.

The Idaho Department of Environmental Quality (DEQ) is responsible for monitoring and assessing surface waters in support of the federal Clean Water Act. Lindsay Creek (assessment unit ID17060306CL003_02) is listed in Category 4a of *Idaho's 2012 Integrated Report* (DEQ 2014) as not supporting aquatic life and recreation designated beneficial uses. A total maximum daily load was written, and approved by the US Environmental Protection Agency in 2007, to address the exceedance of Idaho water quality standards criteria for *Escherichia coli* (*E. coli*), nutrients, and sediment in the Lindsay Creek watershed (DEQ 2007). Following routine monitoring, elevated levels of *E. coli* were detected in Lindsay Creek. DEQ chose nine sites to investigate and found cause to resume monitoring *E. coli* levels in Lindsay Creek.

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.

Initial monitoring focused on validating the concern of *E. coli* contamination at the site that generated the complaint (L4). Subsequent monitoring expanded the sampling network to identify and quantify bacteria loading upstream. Beginning on October 29, 2012, a total of nine sites were routinely sampled on Lindsay Creek in 2012 and 2013 to assess *E. coli* bacteria contamination (Figure 1).

A numeric criterion for *E. coli* is included in the state water quality standards for protecting primary and secondary contact recreation (IDAPA 58.01.02.100.02), and 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). A geometric mean was calculated after five samples were collected over a 30-day period in order to identify spatial concerns relative to potential sources. Bacteria sources were further identified by laboratory results (bacterial and DNA analysis) as well as by land use and visual observation.



Figure 1. Sampling locations.

2 Sample Site Locations

Monitoring for *E. coli* bacteria was conducted at nine sites within this assessment unit (Table 1; Figure 2–Figure 10). Each sample site is either upstream or downstream from a potential source in order to help identify possible sources.

Table 1. Sampling locations along Lindsay Creek (assessment unit ID17060306CL003_02).

Description	Latitude	Longitude
L1	46.41792	116.98929
L2	46.41073	116.97723
L3	46.41073	116.97723
L4	46.40566	116.96820
L5	46.40315	116.96576
L6	46.40159	116.96496
L7	46.39877	116.96027
L8	46.31106	116.89143
L9	46.39447	116.95235

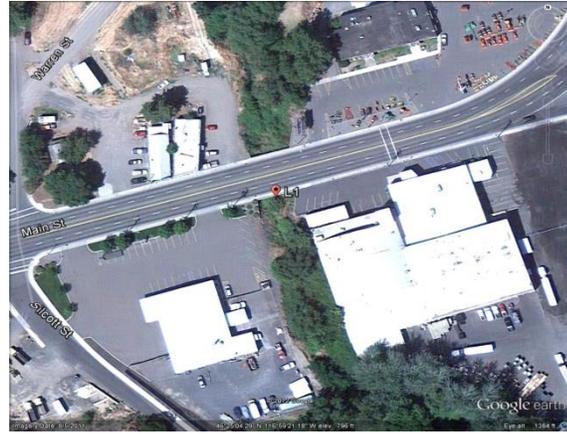


Figure 2. Site L1: at the bridge on Main Street to the west of the Odom Corporation Wholesale Beverage Distributors buildings. Samples were taken from the bridge using a bridge sampler.



Figure 3. Site L2: upstream from where Gun Club Creek enters Lindsay Creek and from the bridge that crosses Lindsay Creek on Gun Club Road.



Figure 4. Site L3: downstream from where Gun Club Creek enters Lindsay Creek and from the bridge that crosses Lindsay Creek on Gun Club Road.



Figure 5. Site L4: on the west side of Lindsay Creek Road where creek exits culvert.



Figure 6. Site L5: on the west side of Lindsey Creek Road at the intersection of Hamilton Lane.



Figure 7. Site L6: approximately at 543 Lindsay Creek Road on the southwest side of the road. There is a circular pullout with a road leading to a private residence. A bridge crosses Lindsay Creek on this road. A bridge sampler was used to collect this sample.



Figure 8. Site L7: upstream from where Lindsay Creek crosses Lindsay Lane. A bridge sampler was used at this site.



Figure 9. Site L8: on private property with Lindsay Creek on the west side of the property. There is a path leading to the creek and a plank bridge where sampling occurred with permission from the resident.



Figure 10. Site L9: on the north side of Lindsay Creek Road where Lariat Lane intersects. A bridge sampler was used at this site.

3 Sampling Procedure and Methods

All sampling and analyses conducted as part of this investigation followed commonly accepted procedures and methods. 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. *E. coli* bacteria laboratory analyses were conducted by Anatek Laboratories of Moscow, Idaho, using Quanti-Tray/2000 methods or equivalent. Field sampling for *E. coli* DNA followed procedural instructions provided by Source Molecular Laboratory (Miami, Florida), which conducted the bacterial DNA analyses.

4 Results

In 2012, eight of the nine sites had a geometric mean that exceeded the 126 organisms/100 mL criterion (sites L1 through L8). In 2013, seven of the sites exceeded the criterion (Table 2). Site L8 had the greatest geometric mean concentration both years and is considered to have the potential to influence downstream concentrations. The sample site at the upper end of the reach, L9, shows relatively low levels of *E. coli* bacteria both years compared to all downstream sites and is considered the upper extent of potential sources.

Data generated by this project is attached in Appendix A.

Table 2. Lindsay Creek site geometric means.

Site	Geometric Mean (organisms/100 mL)	
	2012	2013
L1	170	303
L2	156	124
L3	184	190
L4	317	202
L5	883	359
L6	675	383
L7	619	734
L8	1207	1350
L9	106	37

In 2012, sites L5 and L8 had the highest *E. coli* concentrations. Samples from these sites were further analyzed for the presence or absence of *Bacteroides* and *Enterococcus* bacteria species gene biomarkers (DNA). DNA analyses measured the presences or absences of human, cow, horse, and general ruminant (cattle, deer, goat, and sheep) DNA. The DNA analyses showed the presence of human fecal bacteria and general ruminant fecal bacteria at sites L5 and L8. In 2013, site L8 had the highest *E. coli* concentration and was analyzed again for the presence of *Bacteroides* gene biomarkers (DNA) for human fecal bacteria. The DNA analyses again showed the presence of human fecal bacteria at site L8.

5 Conclusion

The majority of sites tested in Lindsay Creek were found to have *E. coli* concentrations above the geometric mean set forth in Idaho's surface water quality standards. Site L8 had the greatest concentration both years and has the potential to influence concentrations measured downstream. Additional excessive loading occurs periodically between L5 and L6. At this time however, it is unclear how much of the loading measured at the site is independent or influenced by upstream sources.

Wildlife and livestock numbers near sites L5 and L8 are less than or similar to downstream sites, suggesting the highly elevated concentrations found at L5 and L8 are from another source. DNA analyses of samples collected at L5 and L8 indicate that portions of the *E. coli* load at those sites can be attributed to human waste material entering the creek.

DEQ will provide this report to Public Health—Idaho North Central District for further action regarding the potential of residences near L5 and L8 having a failed or inadequate on-site sewage disposal system.

Landowners with livestock corralled adjacent to Lindsay Creek will be informed of the excessive *E. coli* bacteria loads and their responsibilities to manage their livestock without contaminating Lindsay Creek.

Monitoring should continue in the future to determine if additional actions are needed to reduce *E. coli* bacteria loads in Lindsay Creek.

References

DEQ (Idaho Department of Environmental Quality). 2007. *Lindsay Creek Watershed Assessment and Total Maximum Daily Loads*. Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2014. *Idaho's 2012 Integrated Report*. Boise, ID: DEQ.

IDAPA. 2014. "Idaho Water Quality Standards." Idaho Administrative Code. IDAPA 58.01.02.

Appendix A. Lindsay Creek *E. coli* sampling results

Table A-1. Lindsay Creek *E. coli* sampling results—2012.

Sample Dates	<i>E. coli</i> Sampling Sites (organisms/100 mL)								
	L1	L2	L3	L4	L5	L6	L7	L8	L9
03/27/2012	>2419								
04/04/2012				488	387				
04/09/2012				345	1046				
04/18/2012	102			276	291				
05/01/2012	770			1733	1986				
05/10/2012	579			1553	1203				
05/22/2012	1046			1414	1986				
06/06/2012	435			>2419	>2419				186
06/19/2012	411			461	1046				119
08/30/2012	345			272	285				133
09/06/2012	866			210	548				130
09/11/2012	435			411	579				96
09/18/2012	344			326	579				178
09/24/2012	461			579	1300				68
10/18/2012					291	261	921		
10/23/2012					1120	655	1553		
10/29/2012	411	649	461	687	>2419	1120	980	1203.3	231
11/01/2012	129	71	86	291	204	345	201	727	50
11/05/2012	208	117	201	231	1062	688	222	858	106
11/08/2012	167	192	219	214	727	866	1203	1414	119
11/13/2012	78	91	121	326	1414	613	1733	>2419	93
Geometric Mean^a	170	156	184	317	883	675	619	1207	106

^a The geometric mean was calculated from the five samples collected October 29–November 13, 2012.

Table A-2. Lindsay Creek *E. coli* sampling results—2013.

Sample Dates	<i>E. coli</i> Sampling Sites (organisms/100 mL)								
	L1	L2	L3	L4	L5	L6	L7	L8	L9
10/22/2013	365.4	98.7	135.4	224.7	435.2	204.6	>2419.2	>2419.2	90.9
10/28/2013	102.2	142.1	161.6	146.7	816.4	866.4	>2419.2	866.4	35.0
11/04/2013	206.3	117.8	261.3	272.3	344.8	613.1	344.8	>2419.2	41.9
11/07/2013	137.6	290.9	507.3	104.6	410.6	155.3	228.2	365.4	38.8
11/13/2013	>2419.2	60.1	84.2	361.2	117.8	488.4	461.1	>2419.2	13.5
Geometric Mean	303.3	123.6	189.5	202.3	358.5	383.0	733.5	1349.9	37.1