

Bacteria Monitoring in the Eastern Sierra Nevada Summary of Results for 2011

STAFF REPORT



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SUMMARY

Staff of the California Regional Water Quality Control Board, [Lahontan Region](#), collected water samples from 37 streams in the eastern Sierra Nevada from spring through autumn of 2011. Samples were analyzed for two bacterial indicators (fecal coliform and *E. coli*), and results were compared to relevant state water quality standards. This report summarizes the project, including its purpose, monitoring questions, site locations, methods, and analytical results. The results document that the highest concentrations of fecal coliform bacteria typically occurred at sites where rangeland livestock grazing is the predominant land use at the time of sampling. All data (including results for both fecal coliform and *E. coli*, and associated metadata) are now available to the public on the Internet via the California Environmental Data Exchange Network ([CEDEN](#)).

INTRODUCTION

For the purposes of protecting water quality and allocating water uses in California, the Legislature in 1967 established the [State Water Resources Control Board](#) and [nine regional water boards](#). The Lahontan Region is located in eastern California, from the Oregon border in the north to the San Bernardino mountains and eastern Los Angeles County in the south. (A [map of the region](#), and other background information, is available at the Region's [website](#).)

The Region implements numerous [programs](#) to protect and enhance water quality. This project was initiated by the Region's [Nonpoint Source Program](#), with assistance from its Total Maximum Daily Load ([TMDL](#)) program, its Surface Water Ambient Monitoring Program ([SWAMP](#)), and other programs.

The purpose of the current project is twofold: 1) to characterize concentrations of bacterial indicators at targeted locations representing a variety of land uses; and 2) to provide numeric data on the relative concentrations of fecal coliform vs. *E. coli* at targeted stream sites.

The fecal coliform results can be immediately used in many ways. Fecal coliform results can be directly compared to existing state [water quality objectives](#) in order to assess the status and trends of bacterial water quality at targeted sites (for example, by Nonpoint Source Program staff as they develop waivers for rangeland grazing operations, by TMDL staff as they design remedial programs to address known impairments, by Grants Program staff as they seek cooperative partners to install management practices to reduce bacterial discharges, by Planning Program staff as they conduct water quality assessments (e.g., Water Boards' Clean Water Act Section 303(d)/305(b) "[Integrated](#)

[Report](#)”), and by Enforcement Program staff as they investigate complaints or perform follow-up on exceedances as appropriate.

Because the Region currently has no numeric water quality objectives for *E. coli*, a direct comparison of the *E. coli* results to state standards cannot be made at this time. However, it is expected that the *E. coli* data collected by this project will assist in current efforts to develop appropriate water quality objectives for *E. coli*.

The specific monitoring questions are as follows:

1. Do fecal coliform concentrations at targeted sites comply with the water quality objectives for bacteria as contained in the *Water Quality Control Plan for the Lahontan Region* (“[Basin Plan](#)”)?
2. Where fecal coliform is detected, what are the accompanying concentrations of *E. coli*?

Specific waterborne pathogens (such as *Cryptosporidium*, *Giardia*, *Campylobacter*, etc.) are very difficult, expensive, or even impossible to monitor on a routine basis, and the methods for monitoring them are not well standardized or widely accepted. Therefore, cost-effective bacterial indicators such as fecal coliform and *E. coli* have long been used to evaluate the risk of water contamination by enteric pathogens. While the presence of fecal coliform bacteria and *E. coli* do not necessarily indicate in every case that water is unsafe for human uses, they are widely accepted measures of bacterial water quality because they signal fecal contamination. For these reasons, the USEPA continues to recommend the use and enforcement of standards for bacterial water quality that rely on bacterial indicator organisms.

This report presents only the fecal coliform results, since those can be directly compared to existing water quality objectives. All results (for both fecal coliform and *E. coli*) and associated metadata are available to the public via the California Environmental Data Exchange Network ([CEDEN](#)).

METHODS

Sites were selected to include a variety of land uses, including residential housing and developed resorts that utilize septic systems for waste disposal (e.g., Willow Springs area), recreation camps that utilize pit toilets and/or closed systems for waste disposal (e.g., Camp Azusa, Golden Trout Camp), rangelands grazed by livestock (on both federal and nonfederal lands), mixed land uses (e.g., Mammoth Lakes area, East Walker River at Bridgeport, Swauger Creek above Huntoon Valley), and several “control sites” with few or no known or potential bacterial discharges. Sites were selected based on ease of access (i.e., highway rights-of-way and/or public lands, and accessible via

roads, without long hikes, in order to meet standard 8-hour “holding times” for bacterial analyses). The 37 sample sites are listed at Appendix A.

Samples were collected and transported by Water Board staff following standard collection, preservation, and chain-of-custody procedures. All applicable quality assurance and quality control (QA/QC) procedures were followed (LRWQCB 2011, SWAMP 2008). Samples were analyzed at the laboratory following *Standard Methods for the Examination of Water and Wastewater* (2006). Most samples were analyzed at the Region’s in-house laboratory at South Lake Tahoe, CA, using standard membrane filter techniques (i.e., fecal coliform by SM9222D and *E. coli* by SM9222G via a two-step membrane filtration process). Some samples were analyzed at the Inyo County Health Services laboratory in Independence, CA, using a 15-tube multiple tube procedure (fecal coliform by SM9221E). All results and associated metadata are available to the public via the on-line California Environmental Data Exchange Network ([CEDEN](#)).

The *Water Quality Control Plan for the Lahontan Region* (“[Basin Plan](#)”) contains the following water quality objectives for bacteria in surface waters of the Region:

The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 ml, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml. The log mean shall ideally be based on a minimum of not less than five samples collected as evenly spaced as practicable during any 30-day period. However, a log mean concentration exceeding 20/100 ml for any 30-day period shall indicate violation of this objective even if fewer than five samples were collected.

Where feasible, effort was made to sample five times per calendar month. Log means were calculated using electronic computational routines developed by Dr. Bruce Warden of the Lahontan Water Board’s staff. The data computations for the tables below are located in the Region’s electronic files at: *S:\Eastern Sierra Bacteria Study\2011 Field season data\FINAL R6-NPS_11.23.2011 AES.xls* and *S:\Eastern Sierra Bacteria Study\2011 Field season data\FINAL SWAMP sites_11.23.2011 AES.xls*.

To assess compliance with the Basin Plan’s water quality objectives, the data are analyzed for 30-day periods, not specific to a calendar month. The tables below present the 30-day log mean results assessed relative to the 20/100ml objective, and also in some cases the results for the 90th percentile (i.e., where exceedances of the 40/100ml objective were found). For rangeland grazing sites, post-grazing data are shaded in blue, to depict samples collected after livestock were removed at the end of the grazing season.

Field crews were instructed to note whether livestock was observed upstream of the sampling location at the time of sample collection. A “No” to this question does not mean definitively that no livestock were present anywhere upstream; it means only that livestock were not observed upstream of the site at the time of sampling.

RESULTS

The results are presented below, generally in order from north to south. A list of sites is provided at Appendix A.

Carson River sites

Two sites were sampled along the two forks of the Carson River, including: 1) West Fork Carson River at Paynesville Bridge; and 2) East Fork Carson River at the USGS gaging station. The sites are shown in Figure 1.

The West Fork Carson at the Paynesville Bridge sampling site is located a few miles downstream of several ranches. Due to access issues, staff was not able to determine the status of grazing operations upstream past the sampling location. For many of the dates sampled, grazing information was not available N/A).

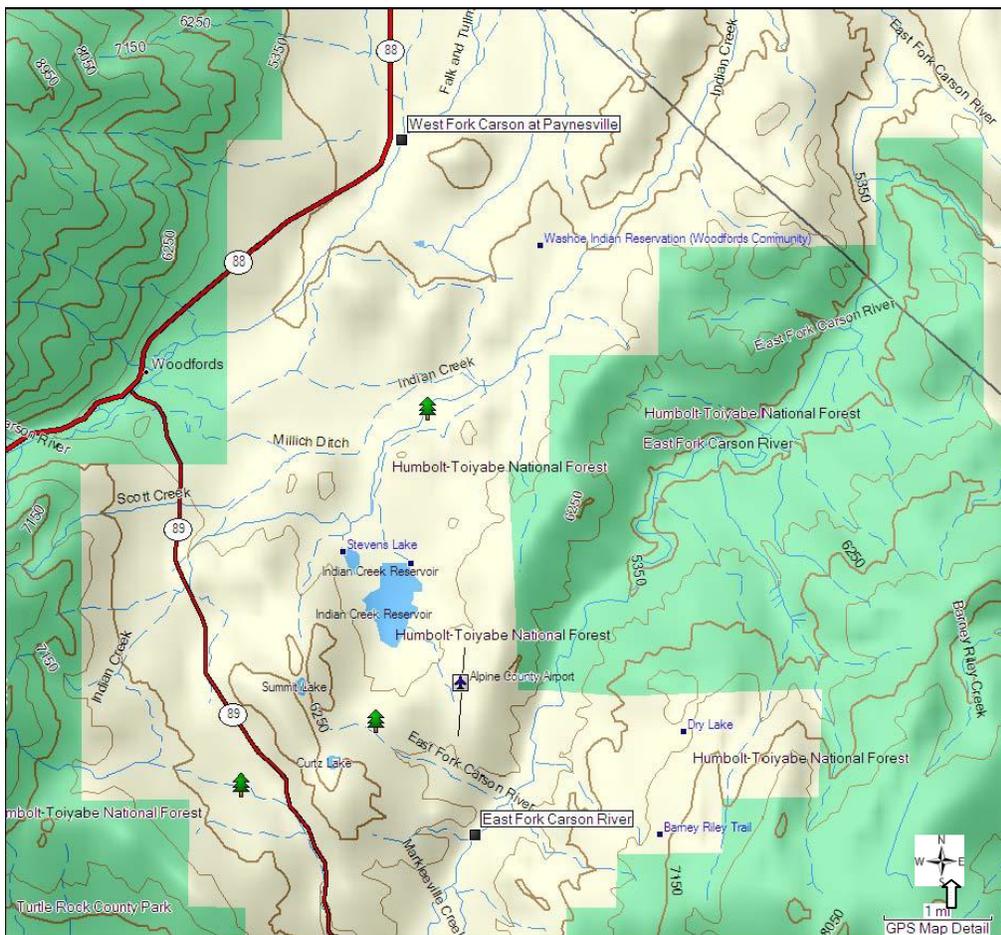


Figure 1. Map of Carson River sampling sites

West Fork Carson River at Paynesville Bridge (633WFCB02)

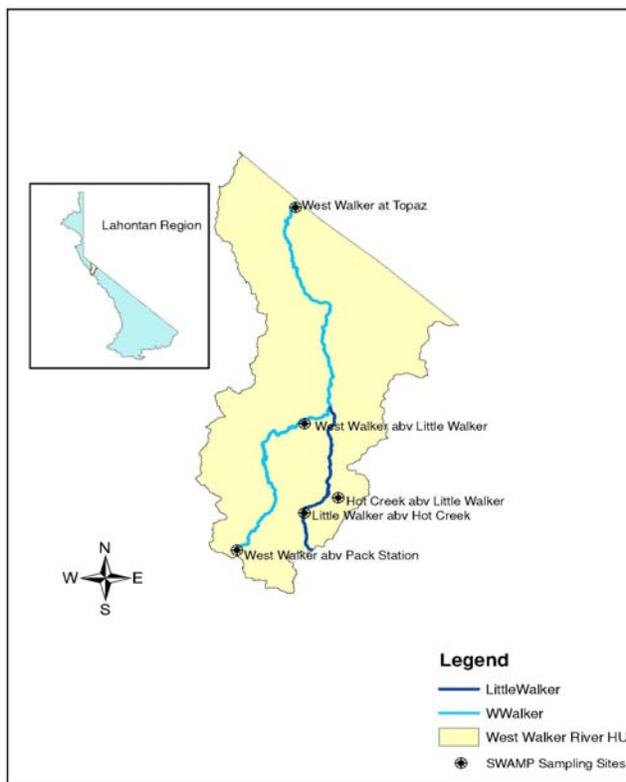
DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
6/9/2011	7/9/2011	10	38	58	294	cattle
6/14/2011	7/14/2011	9	294	61	294	N/A
6/14/2011	7/14/2011	8	296	50	139	N/A
6/27/2011	7/27/2011	13	15	40	75	N/A
6/27/2011	7/27/2011	12	25	43	76	N/A
6/28/2011	7/28/2011	13	60	38	75	N/A
6/28/2011	7/28/2011	12	35	37	76	N/A
6/28/2011	7/28/2011	11	33	37	76	N/A
7/6/2011	8/5/2011	12	72	34	76	No
7/6/2011	8/5/2011	11	68	31	76	No
7/19/2011	8/18/2011	13	92	26	74	cattle
7/19/2011	8/18/2011	12	76	23	63	cattle
7/21/2011	8/20/2011	11	64	21	54	cattle
7/21/2011	8/20/2011	10	54	19	45	cattle
7/26/2011	8/25/2011	10	14	19	46	cattle
7/26/2011	8/25/2011	9	14	20	48	cattle
7/28/2011	8/27/2011	8	16	21	50	cattle
7/28/2011	8/27/2011	7	14	21	52	cattle
8/4/2011	9/3/2011	7	20	25	52	N/A
8/4/2011	9/3/2011	6	20	26	54	N/A
8/9/2011	9/8/2011	7	44	37	80	N/A
8/16/2011	9/15/2011	8	12	58	241	N/A
8/18/2011	9/17/2011	7	11	73	244	N/A
8/23/2011	9/22/2011	9	63	109	239	N/A
8/30/2011	9/29/2011	10	40	100	236	N/A
9/6/2011	10/6/2011	9	80	110	239	N/A
9/8/2011	10/8/2011	8	80	115	241	N/A
9/13/2011	10/13/2011	9	258	95	239	N/A
9/13/2011	10/13/2011	8	234	84	171	N/A
9/21/2011	10/21/2011	9	132	57	134	N/A
9/21/2011	10/21/2011	8	116	51	124	N/A
9/21/2011	10/21/2011	7	144	45	94	N/A
9/29/2011	10/29/2011	8	48	32	52	N/A
9/29/2011	10/29/2011	7	60	30	50	N/A
10/12/2011	11/11/2011	6	43	27	42	cattle
10/12/2011	11/11/2011	5	40	24	35	cattle
10/20/2011	11/19/2011	4	27	21	26	N/A
10/20/2011	11/19/2011	3	20	20	23	N/A
10/26/2011	11/25/2001	2	16	20	23	N/A
10/26/2011	11/25/2011	1	24	24	24	N/A

East Fork Carson River at USGS Gaging Station (632ECR005)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
1/27/2011	2/26/2011	1	0	1	No
3/17/2011	4/16/2011	2	3	3	No
4/12/2011	5/12/2011	1	3	3	No
5/19/2011	6/18/2011	2	1	2	No
6/9/2011	7/9/2011	1	6	6	cattle
7/20/2011	8/19/2011	2	15	15	cattle
9/7/2011	10/6/2011	1	5	5	cattle

West Walker River sites

Several sites were sampled along the West Walker River, including (from downstream to upstream): 1) West Walker River at Topaz; 2) West Walker River near Coleville; 3) West Walker River above confluence with Little Walker River; 4) Little Walker above Hot Creek; 5) West Walker River above the commercial pack station; and 6) Hot Creek above Little Walker River. These sites are shown in Figure 2



By Alanna Misico 2012

Figure 2. Map of West Walker River HU sampling sites

West Walker River at Topaz (631WWK008)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
4/29/2011	5/29/2011	2	0	4	14	No
5/31/2011	6/30/2011	2	15	17	20	No
6/20/2011	7/20/2011	2	20	14	19	cattle
7/7/2011	8/6/2011	2	10	17	28	cattle
8/1/2011	8/31/2011	1	30	30	30	cattle
9/9/2011	10/9/2011	6	16	12	26	cattle
9/19/2011	10/19/2011	7	36	10	34	cattle
9/27/2011	10/27/2011	8	13	10	38	cattle
9/29/2011	10/29/2011	7	12	10	40	No
10/4/2011	11/3/2011	6	10	9	42	No
10/7/2011	11/6/2011	5	4	9	43	No
10/13/2011	11/12/2011	4	32	11	45	No
10/19/2011	11/18/2011	3	1	8	43	No
10/21/2011	11/20/2011	2	51	23	47	No
10/27/2011	11/26/2011	1	10	10	9	No
12/12/2011	1/11/2012	1	2	2	2	No

West Walker River near Coleville (631WWK001)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
1/20/2011	2/19/2011	1	0	0	No
3/8/2011	4/7/2011	1	0	0	No
4/27/2011	5/27/2011	2	0	0	No
5/23/2011	6/22/2011	2	0	0	No
6/15/2011	7/15/2011	2	0	0	No
7/7/2011	8/6/2011	2	25	14	No
8/1/2011	8/31/2011	1	8	8	No
9/19/2011	10/19/2011	7	0	1	No
9/27/2011	10/27/2011	8	1	1	No
9/29/2011	10/29/2011	7	0	1	No
10/4/2011	11/3/2011	6	0	1	No
10/7/2011	11/6/2011	5	0	1	No
10/13/2011	11/12/2011	4	1	1	No
10/19/2011	11/18/2011	3	0	1	No
10/21/2011	11/20/2011	2	0	1	No
10/27/2011	11/26/2011	1	2	2	No
12/12/2011	1/11/2012	1	1	1	No

West Walker River above the confluence with the Little Walker River (631WWK007)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100 ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
1/18/2011	2/17/2011	1	0	0	No
4/29/2011	5/29/2011	1	0	0	No
5/31/2011	6/30/2011	2	0	2	No
6/20/2011	7/20/2011	2	5	5	No
7/5/2011	8/4/2011	2	5	3	No
8/1/2011	8/31/2011	1	2	2	No
9/29/2011	10/29/2011	1	1	1	No

West Walker River above the commercial Pack Station (631WWK010)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
1/18/2011	2/17/2011	1	0	0	No
4/29/2011	5/29/2011	1	0	0	No
5/31/2011	6/30/2011	1	0	0	No
6/20/2011	7/20/2011	1	0	0	No
7/5/2011	8/4/2011	1	2	2	No
8/1/2011	8/31/2011	1	0	0	No
9/29/2011	10/29/2011	1	1	1	No

Little Walker above Hot Creek (631LWK004)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
1/18/2011	2/17/2011	1	1	0	1	No
4/29/2011	5/29/2011	1	0	0	0	No
5/31/2011	6/30/2011	2	0	2	5	No
6/20/2011	7/20/2011	2	6	20	63	No
7/5/2011	8/4/2011	2	69	33	64	No
8/1/2011	8/31/2011	1	16	16	16	No
9/29/2011	10/29/2011	1	525	525	525	cattle

Hot Creek above Little Walker (631HOT001)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
1/18/2011	2/17/2011	1	3	3	3	No
4/28/2011	5/28/2011	1	0	0	0	No
4/29/2011	5/29/2011	1	0	0	0	No
5/31/2011	6/30/2011	2	5	8	11	No
6/20/2011	7/20/2011	2	12	76	438	No
7/5/2011	8/4/2011	2	485	156	442	No
8/1/2011	8/31/2011	1	50	50	50	No
9/29/2011	10/29/2011	1	588	588	588	cattle

Sardine Creek (Sonora Pass) sites (Toiyabe National Forest)

Two sites were sampled along Sardine Creek, near Sonora Pass, as shown in Figure 3. Both sites can be accessed from Highway 108 and are in close proximity to the road. The first site (“above McKay”) is located in a meadow, while the second site (“below McKay”) is a short distance downstream and located near informal but popular camping and fishing spots. Snow at the beginning of October prevented access up the road to sample sites.

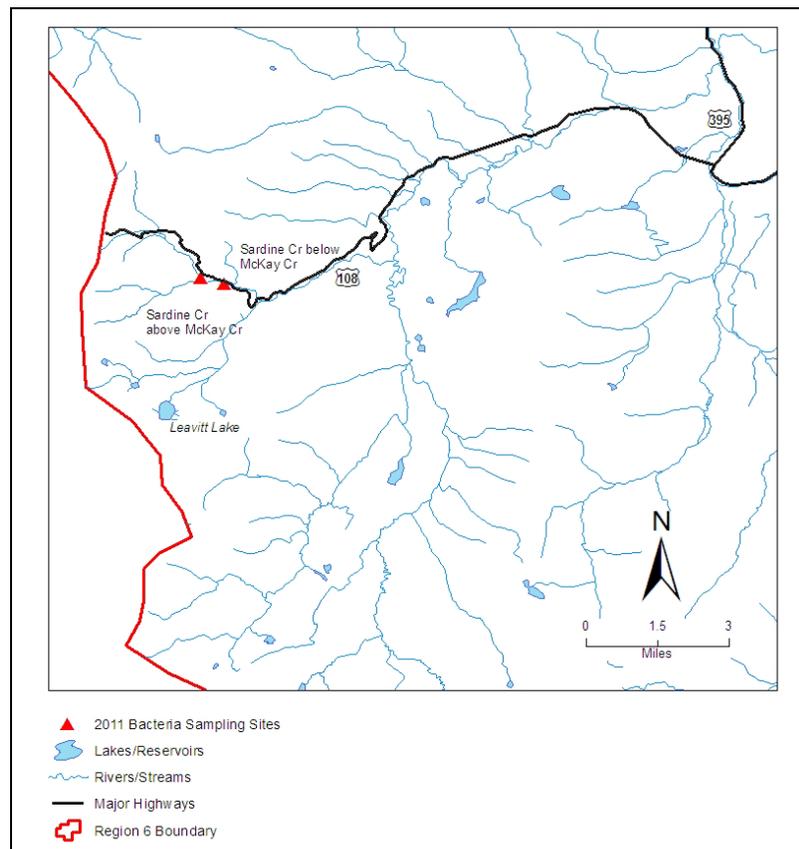


Figure 3. Map of Sardine Creek sampling sites

Sardine Creek above McKay (631SDCB02)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
8/17/2011	9/16/2011	9	41	23	52	No
8/23/2011	9/22/2011	8	40	21	52	cattle
8/29/2011	9/28/2011	8	38	20	52	cattle
8/30/2011	9/29/2011	7	58	18	53	cattle
8/31/2011	9/30/2011	6	0	15	39	No
9/7/2011	10/7/2011	5	14	26	41	No
9/8/2011	10/8/2011	4	28	30	43	No
9/9/2011	10/9/2011	3	50	31	45	No
9/15/2011	10/15/2011	2	25	24	25	No
9/21/2011	10/21/2011	1	24	24	24	No
10/13/2011	11/12/2011	4	2	4	37	No
10/19/2011	11/15/2011		3			No
10/21/2011	11/20/2011		1			No
10/27/2011	11/26/2011		52			No



Cows present downstream in meadow at Sardine Creek above McKay (8/23/11, CMN)



Cows crossing Sardine Creek above McKay (8/23/11, CMN)

Sardine Creek below McKay (631SDCB01)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
8/17/2011	9/16/2011	9	9	10	No
8/23/2011	9/22/2011	9	75	11	No
8/29/2011	9/28/2011	8	5	9	No
8/30/2011	9/29/2011	7	4	10	cattle
8/31/2011	9/30/2011	6	6	11	No
9/7/2011	10/7/2011	5	5	12	No
9/8/2011	10/8/2011	4	11	16	No
9/9/2011	10/9/2011	3	18	18	cattle
9/15/2011	10/15/2011	2	18	17	No
9/21/2011	10/21/2011	1	17	17	No
10/13/2011	11/12/2011	4	5	4	No
10/19/2011	11/15/2011		7		No
10/21/2011	11/20/2011		5		No
10/27/2011	11/26/2011		1		No



Cows present on bank at Sardine Creek below McKay (8/30/11, CMN)



Cows present on bank at Sardine Creek below McKay (8/30/11, CMN)

Bridgeport Area sites

Three groups of sites were sampled in the Bridgeport area, including: 1) Huntoon Valley; 2) Bridgeport Valley; and 3) Upper Buckeye. Figure 4 depicts the location of these sites.

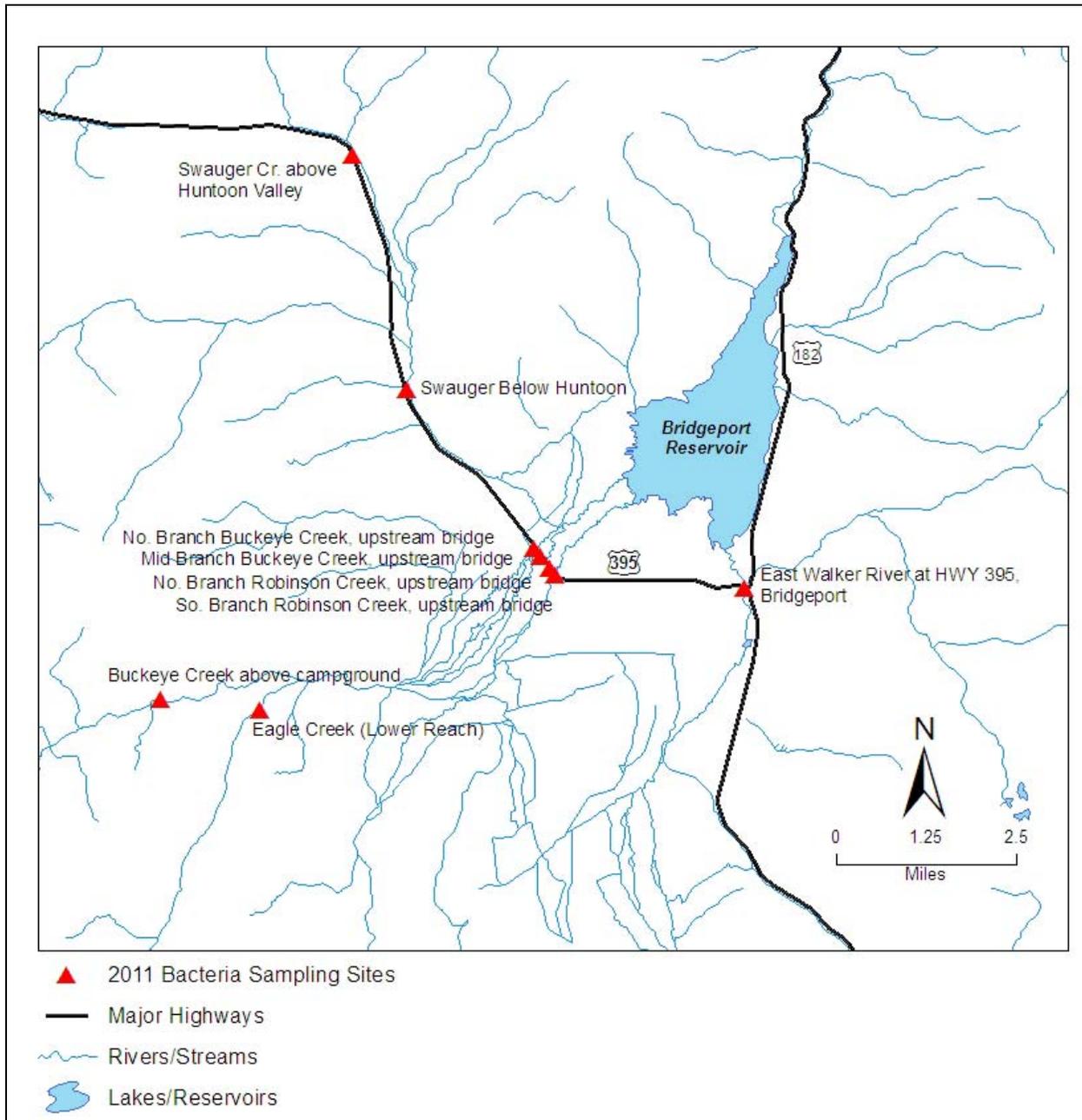


Figure 4. Map of Bridgeport Area sites: Huntoon Valley, Bridgeport Valley, and Upper Buckeye sites

Huntoon Valley sites (Swauger Creek)

The Huntoon Valley is located just north of the Bridgeport Valley, along Highway 395. It includes two sites along Swauger Creek (one above the Huntoon Valley ranching operation and one below).

Swauger Creek above Huntoon Valley (630SWA001) (above ranch)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100ml)	Livestock Upstream
7/14/2011	8/13/2011	4	5	22	33	No
7/27/2011	8/26/2011	6	18	31	53	No
8/1/2011	8/31/2011	5	60	34	54	No
8/10/2011	9/9/2011	4	46	29	42	No
8/16/2011	9/15/2011	4	32	28	34	No
8/17/2011	9/16/2011	3	16	26	34	No
8/23/2011	9/22/2011	3	32	33	35	No
9/15/2011	10/15/2011	2	35	34	35	No
9/19/2011	10/19/2011	1	33	33	33	No
10/27/2011	11/26/2011	2	7	5	5	No
11/17/2011	12/17/2011	1	3	3	3	No

Swauger Creek below Huntoon Valley (630SWA005) (below ranch)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100ml)	Livestock Upstream
7/10/2011	8/9/2011	4	260	303	cattle
7/14/2011	8/13/2011	4	215	299	cattle
7/27/2011	8/26/2011	6	420	307	cattle
8/1/2011	8/31/2011	5	360	288	cattle
8/10/2011	9/9/2011	4	245	272	cattle
8/16/2011	9/15/2011	3	145	282	cattle
8/17/2011	9/16/2011	3	100	387	cattle
8/23/2011	9/22/2011	3	1,550	526	cattle
9/15/2011	10/15/2011	2	375	306	cattle
9/19/2011	10/19/2011	1	250	250	cattle
10/27/2011	11/26/2011	1	575	575	cattle
11/17/2011	12/17/2011	1	12	12	No



Cows grazing along Swauger Creek (Huntoon Valley) (7/13/2011)



Cows standing in Swauger Creek (Huntoon Valley) (7/13/2011)

Bridgeport Valley sites

Five sites were sampled in the Bridgeport Valley: two sites on Robinson Creek and two sites on Buckeye Creek (both located on Highway 395, north of Bridgeport), and one site on the East Walker River at the southern end of Bridgeport. (All five sites were sampled just upstream of the highway overcrossing bridges.) The sites at Buckeye and Robinson creeks could not be sampled at times throughout the summer, due to road construction along Hwy 395, which precluded access.

North Buckeye Creek @ Hwy 395 (630BUC004)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
5/31/2011	6/30/2011	2	15	71	306	cattle
6/13/2011	7/13/2011	2	338	324	335	cattle
7/5/2011	8/4/2011	2	310	255	300	cattle
8/1/2011	8/31/2011	1	210	210	210	cattle
9/9/2011	10/9/2011	2	122	70	114	cattle
10/7/2011	11/6/2011	2	40	40	40	cattle
10/13/2011	11/12/2011	1	40	40	40	No

Mid Buckeye Creek @ Hwy 395 (630BUC005)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
5/31/2011	6/30/2011	2	0	19	338	cattle
6/13/2011	7/13/2011	2	375	352	371	cattle
7/5/2011	8/4/2011	2	330	199	196	cattle
8/1/2011	8/31/2011	2	120	173	224	cattle
9/9/2011	10/9/2011	2	250	229	246	cattle
10/7/2011	11/6/2011	2	210	92	86	cattle
10/13/2011	11/12/2011	1	40	40	40	No

North Robinson Creek @ Hwy 395 (630RBS007)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100ml)	90th percentile (40/100 ml)	Livestock Upstream
5/31/2011	6/30/2011	2	0	8	63	cattle
6/13/2011	7/13/2011	2	70	140	259	cattle
7/5/2011	8/4/2011	2	280	150	260	cattle
8/1/2011	8/31/2011	1	80	80	80	cattle
9/9/2011	10/9/2011	2	485	110	108	cattle
10/7/2011	11/6/2011	2	25	84	259	cattle
10/13/2011	11/12/2011	1	285	285	285	cattle

South Robinson Creek @ Hwy 395 (630RBS008)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
5/31/2011	6/30/2011	2	0	6	36	cattle
6/13/2011	7/13/2011	2	40	72	141	cattle
7/5/2011	8/4/2011	2	130	149	166	cattle
8/1/2011	8/31/2011	1	170	170	170	cattle
9/9/2011	10/9/2011	2	165	122	139	cattle
10/7/2011	11/6/2011	2	90	141	212	cattle
10/13/2011	11/12/2011	1	220	220	220	No

East Walker River at Bridgeport @ Hwy 395 (630EWK006)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
6/13/2011	7/13/2011	3	515	566	655	cattle
7/5/2011	8/4/2011	4	510	483	684	cattle
7/7/2011	8/6/2011	3	690	474	686	cattle
7/14/2011	8/13/2011	2	230	393	385	No
8/1/2011	8/31/2011	3	670	315	286	cattle
8/29/2011	9/28/2011	7	300	170	161	cattle
8/31/2011	9/30/2011	6	155	155	303	cattle
9/8/2011	10/8/2011	6	116	128	130	cattle
9/9/2011	10/9/2011	5	280	131	170	cattle
9/15/2011	10/15/2011	5	325	67	263	No
9/19/2011	10/19/2011	5	170	34	122	cattle
9/27/2011	10/27/2011	4	50	22	50	cattle
10/7/2011	11/6/2011	3	50	17	42	No
10/13/2011	11/12/2011	2	10	10	10	No
10/19/2011	11/18/2011	1	10	10	10	No

East Walker River at CA/NV State Line (630EWK001)

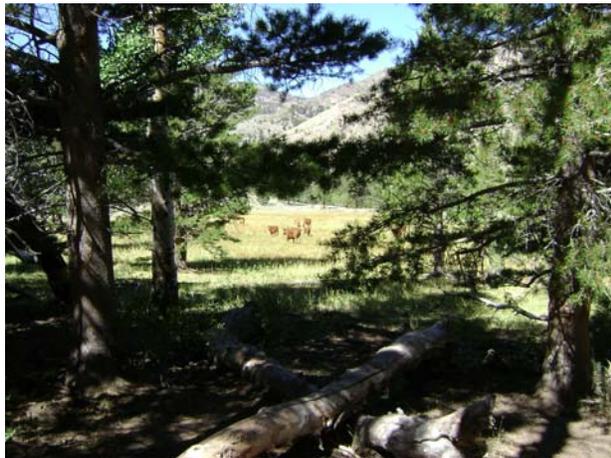
DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100 ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
1/6/2011	2/5/2011	1	10	10	10	No
3/8/2011	4/7/2011	1	0	0	0	No
4/27/2011	5/27/2011	2	0	2	2.7	No
5/23/2011	6/22/2011	2	3	19	110	No
6/13/2011	7/13/2011	1	122	122	122	No
7/7/2011	8/6/2011	2	25	46	79	No
8/1/2011	8/31/2011	1	85	85	85	No

Upper Buckeye sites

The “Upper Buckeye” sites are located west of the town of Bridgeport, upstream of the Bridgeport Valley, in the Toiyabe National Forest. From the USFS Buckeye campground, it is a one-mile hike to the upper Buckeye Creek site (“above campground”). Livestock graze upon National Forest System lands in the area, as well as upon private inholdings adjacent to Buckeye Creek. The Eagle Creek sampling location is located just off the Eagle Creek trail, about one-half mile from the Buckeye campground. A fire on Buckeye Road at the beginning of September 2011 prevented access to both Upper Buckeye sites.

Buckeye Creek above campground (630BUCB01)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
8/17/2011	9/16/2011	8	24	24	No
8/23/2011	9/22/2011	8	12	19	No
8/29/2011	9/28/2011	7	45	20	No
8/30/2011	9/29/2011	6	15	18	cattle
8/31/2011	9/30/2011	5	35	18	cattle
9/8/2011	10/8/2011	4	31	15	cattle
9/9/2011	10/9/2011	3	28	12	cattle
9/15/2011	10/15/2011	2	16	8	No
9/21/2011	10/21/2011	1	4	4	No
10/7/2011	11/6/2011	5	21	3	No
10/13/2011	11/12/2011		3		No
10/19/2011	11/15/2011		3		No
10/21/2011	11/20/2011		2		No
10/27/2011	11/26/2011		1		No



Meadow at Buckeye Creek with cows grazing (8/31/2011, CMN)



Uplands near Buckeye Creek with cows grazing (8/31/2011, CMN)

Eagle Creek (630EAGB01)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
8/31/2011	9/30/2011	5	19	9	No
9/8/2011	10/8/2011	4	5	7	No
9/9/2011	10/9/2011	3	4	8	No
9/15/2011	10/15/2011	2	15	12	No
9/21/2011	10/21/2011	1	9	9	No
10/7/2011	11/6/2011	5	0	1	No
10/13/2011	11/12/2011		3		No
10/19/2011	11/15/2011		0		No
10/21/2011	11/20/2011		1		No
10/27/2011	11/26/2011		0		No

Virginia Creek (below Willow Springs) and Lee Vining Creek (below Camp Azusa)

South of the town of Bridgeport, Virginia Creek flows along Highway 395 through the resort area of Willow Springs. A sampling site was established in 2011 at the USGS gaging station just downstream of Willow Springs. Figure 5 depicts the location of this site.

Camp Azusa is located in Lee Vining Canyon, upstream of the Forest Service ranger station. It is a senior citizens' "summer camp" that has been developed in very close proximity to Lee Vining Creek. A sampling location was established just below the camp. The location of this site is shown in Figure 5.



Figure 5. Virginia Creek and Lee Vining Creek sampling sites

Virginia Creek below Willow Springs (at USGS gage) (630VIR004)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)
7/27/2011	8/26/2011	2	12	13
8/23/2011	9/22/2011	3	15	6
8/30/2011	9/29/2011	2	14	4
9/19/2011	10/19/2011	1	1	1
11/17/2011	12/17/2011	1	1	1

Lee Vining Creek (below Camp Azusa) (601LVCB01)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)
8/16/2011	9/15/2011	2	6	2
9/13/2011	10/13/2011	2	0	0
9/19/2011	10/19/2011	1	0	0
11/17/2011	12/17/2011	2	0	0
12/7/2011	1/6/2012	2	0	0
12/12/2011	1/11/2012	1	0	0

Mammoth Creek sites

Four sites were sampled along Mammoth Creek (Figure 6). “Mammoth Creek above Horsecamp” is located within the town of Mammoth Lakes at the Mammoth Creek Park. “Mammoth Creek at Horsecamp” receives runoff from a stable operation. “Mammoth Creek at Hwy 395” is located southeast of the town of Mammoth Lakes, at Hwy 395. Although no cattle were noted this field season at the Hwy 395 site, livestock grazing has been evident in the past. “Mammoth Creek above Hot Creek” is located downstream of the Hot Creek Fish Hatchery. The area just upstream of this latter site is often grazed by cattle during the summer months.

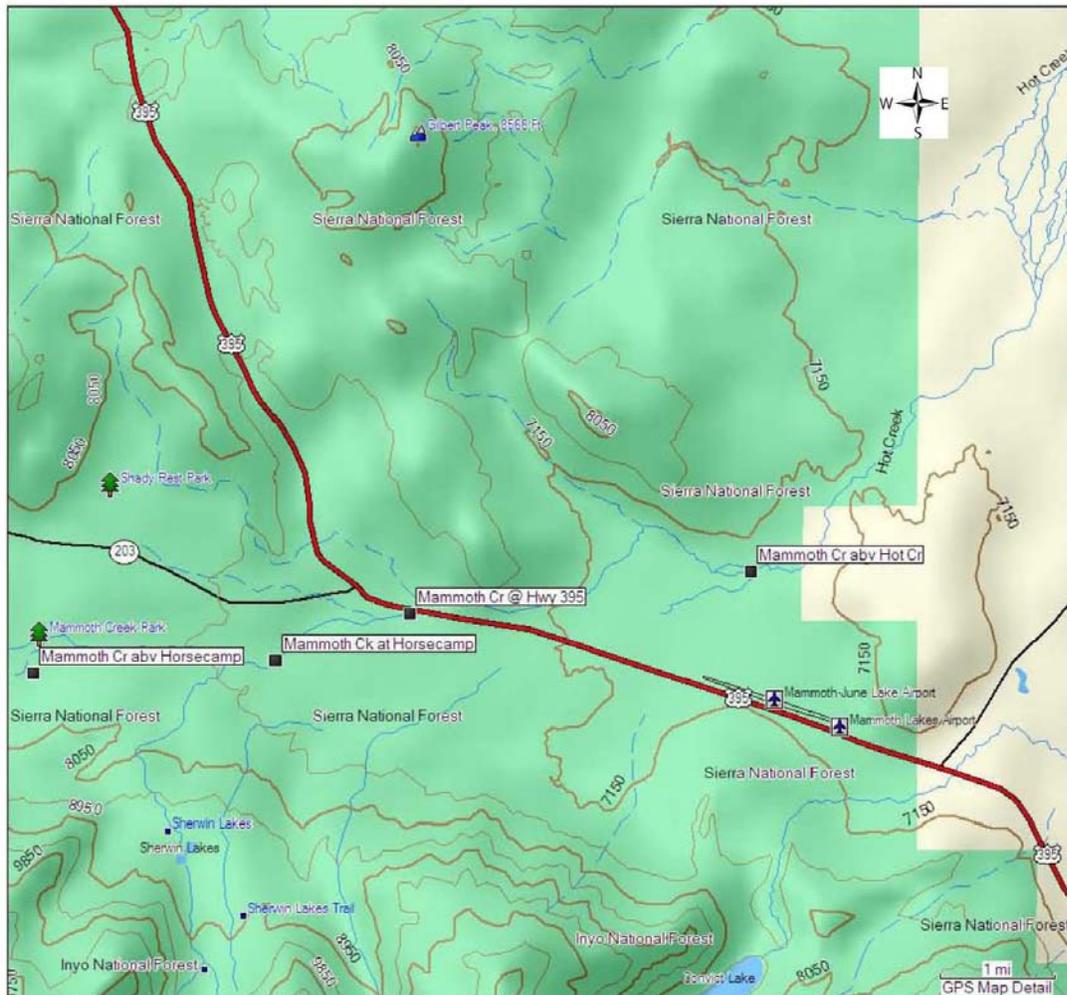


Figure 6. Mammoth Creek sampling sites

Mammoth Creek above Horsecamp (603MAM014)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies /100ml)	30-day log normalized mean (20/100 ml)
1/24/2011	2/23/2011	1	0	1
3/10/2011	4/9/2011	1	0	1
4/28/2011	5/28/2011	2	0	1
5/25/2011	6/24/2011	2	0	2
6/15/2011	7/15/2011	2	4	2
7/14/2011	8/13/2011	1	0	1
8/16/2011	9/15/2011	1	11	11
9/27/2011	10/27/2011	1	10	10

Mammoth Creek at Horsecamp (603MAM003)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies /100ml)	30-day log normalized mean (20/100 ml)	Livestock Upstream
1/24/2011	2/23/2011	1	0	1	No
3/10/2011	4/9/2011	1	0	1	No
4/28/2011	5/28/2011	2	0	3	No
5/25/2011	6/24/2011	2	10	4	No
6/15/2011	7/15/2011	2	2	1	horses
7/14/2011	8/13/2011	1	0	1	horses
8/16/2011	9/15/2011	1	12	12	horses
9/27/2011	10/27/2011	1	2	2	horses

Mammoth Creek at HWY 395 (603MAM006)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies /100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
1/24/2011	2/23/2011	1	3	3	3	No
3/10/2011	4/9/2011	1	0	0	0	No
4/28/2011	5/28/2011	2	0	2	4	No
5/25/2011	6/24/2011	2	4	11	26	No
6/15/2011	7/15/2011	2	28	12	26	No
7/14/2011	8/13/2011	1	5	5	5	No
8/16/2011	9/15/2011	1	112	112	112	No
9/27/2011	10/27/2011	1	8	8	8	No

Mammoth Creek above Hot Creek (603MAM013)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies /100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
1/24/2011	2/23/2011	1	0	0	0	No
3/10/2011	4/9/2011	1	0	0	0	No
6/15/2011	7/15/2011	2	386	150	353	No
7/14/2011	8/13/2011	1	58	58	58	cattle
8/16/2011	9/15/2011	1	150	150	150	cattle
9/27/2011	10/27/2011	1	12	12	12	No

Crooked Creek sites (Inyo National Forest)

Crooked Creek lies east of Bishop, CA, high in the arid White Mountains. Livestock are grazed on National Forest System lands at high elevations (up to 10,000 feet), where little forage is available except along the stream margins. Livestock therefore tend to congregate near the stream channel, and were observed standing in and near the creek. Only one visit was made to this area (on 8/15/11), during which a total of five samples were collected from three sites. Two of the five samples were collected downstream of active cattle grazing areas. The two samples collected downstream of grazed areas showed fecal coliform concentrations of 300 and 316. Three of the five samples were collected upstream of active cattle grazing areas, at sites where no grazing had yet occurred during 2011. Those three “upstream” samples showed almost no fecal coliform bacteria (0-1 colony/100ml). Refer to Figure 7 for locations.



Figure 7. Crooked Creek sampling sites

Crooked Creek Sampling Sites (all samples collected August 15, 2011)

Site Description	Site Code	# of samples in 30-day period	fecal coliform (colonies /100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
Crooked Creek, 1 mi below Deep Springs Cow Camp	605CRKB01	2	300	308	314	cattle
		1	316	316	316	cattle
Crooked Creek just below Deep Springs Cow Camp	605CRKB02	2	0	1	1	No
		1	1	1	1	No
Crooked Creek above Deep Springs Cow Camp	605CRKB03	1	0	0	0	No



Cattle congregating near Crooked Creek, approx. 9,000 feet elevation (8/15/11, TJS)



Ungrazed section of Crooked Creek (8/15/11, TJS)

Golden Trout Camp (Inyo National Forest)

The [Golden Trout Camp](#) (GTC) is a non-profit educational facility located within the Golden Trout Wilderness (Inyo National Forest). Access to the camp is via a 2-mile hike (each way) from the Horseshoe Meadow Road. Facilities at the camp include several log cabins, a pit toilet, and a corral used to confine several burros (which are used to transport supplies to the camp and to support its wilderness education outings).

Two site visits were made in 2011. Creeks in the vicinity and downstream of the GTC were sampled twice during July 2011, when the camp was in full operation for the summer season. The results are presented in the table below. Bacteria levels were low (<20/100mL) in all samples. Given the logistical constraints of meeting analytical holding times for the samples (i.e., approx. 1-hr hike each way), the small size of the

camp, the very small number of stock animals, and the low bacteria concentrations detected during two sampling events, monitoring at this site was discontinued.

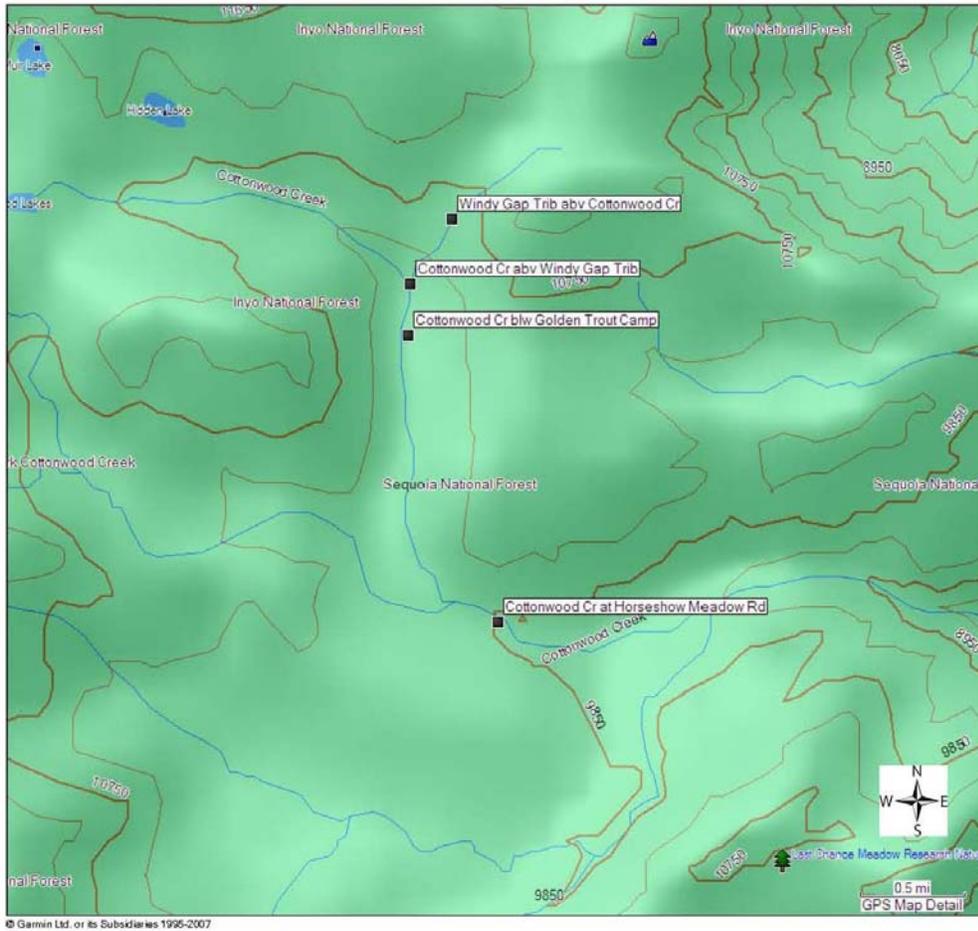


Figure 8. Golden Trout Camp sampling sites

Sites in vicinity of Golden Trout Camp	Date	fecal coliform (colonies per 100ml)
Cottonwood Cr above Windy Gap tributary (603CTNB03)	7/10/2011	2
	7/13/2011	0
Windy Gap trib above confluence with Cottonwood Cr (603WGTB01)	7/10/2011	4
	7/13/2011	1
Cottonwood Cr below GTC, below camp fence/gate (603CTNB02)	7/10/2011	17
	7/13/2011	2
Cottonwood Cr @ Horseshoe Meadow Road (603CTNB01)	7/10/2011	4
	7/13/2011	2

Horseshoe Meadow Sites (Inyo National Forest)

The [Horseshoe Meadow](#) sites are located west of Lone Pine, CA in the Inyo National Forest. A total of four sites were sampled (Figure 9), including three grazed sites and one ungrazed control site. The three rangeland sites (all within the “Mulkey Allotment” in the Golden Trout Wilderness) are: 1) Horseshoe Meadow Creek just above the Trail Pass trail crossing, 2) Horseshoe Meadow Creek just above its confluence with Round Valley Creek, and 3) Round Valley Creek just above its confluence with Horseshoe Meadow Creek. A nearby control site was established at Little Cottonwood Creek (just above the point where the creek crosses under Horseshoe Meadow Road). Little Cottonwood Creek is considered a control site because there is no known livestock grazing in its watershed, and no other known bacterial discharges other than wildlife and very light dispersed recreational (i.e., hiking) uses.

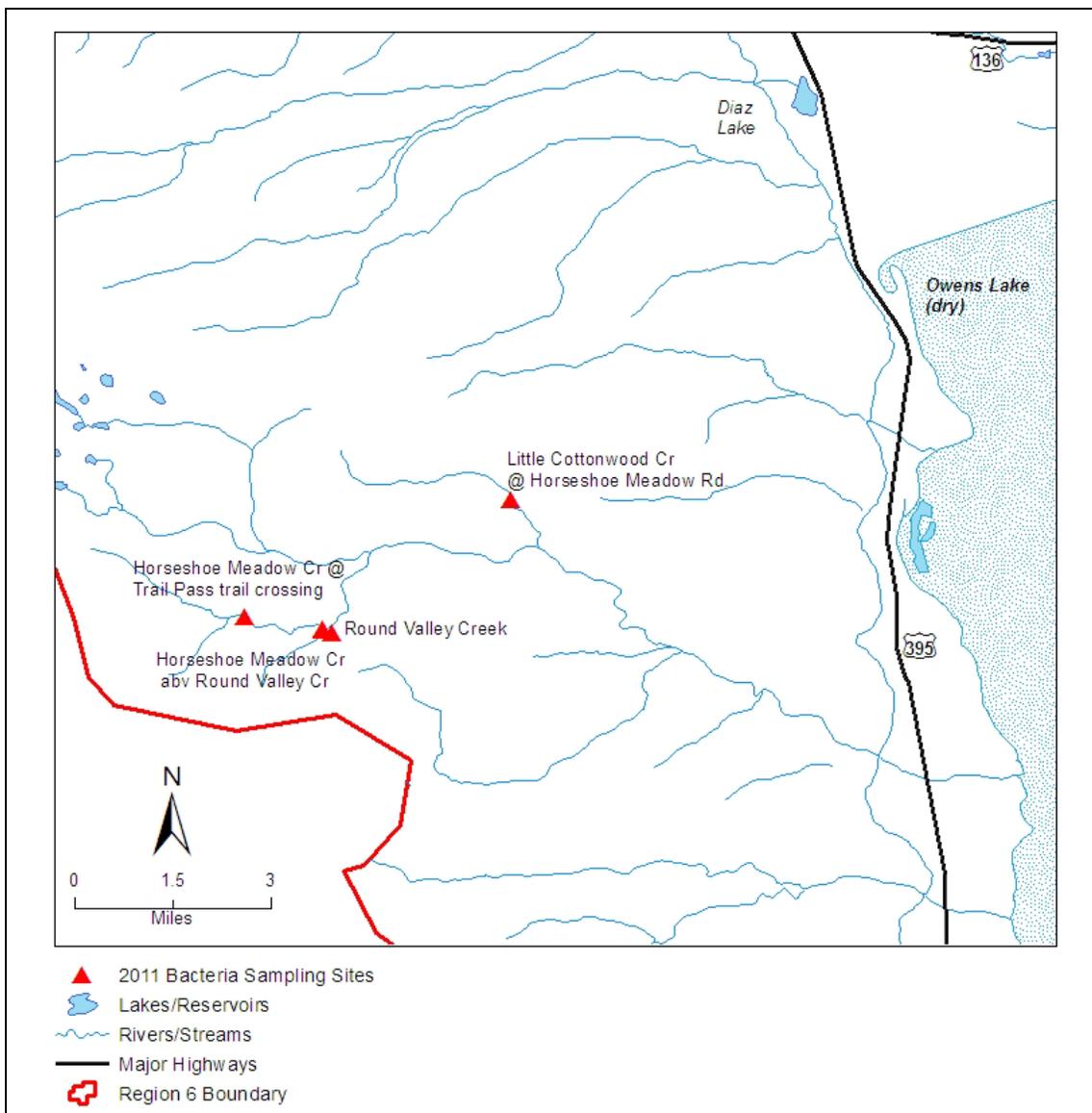


Figure 9. Map of Horseshoe Meadow sampling site

Horseshoe Meadow Creek above Trail Pass trail crossing (603HMCB02)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
7/10/2011	8/9/2011	3	2	2	3	No
7/13/2011	8/13/2011	3	1	3	12	No
7/27/2011	8/26/2011	2	3	6	13	No
8/10/2011	9/9/2011	2	14	18	21	cattle
9/9/2011	9/30/2011	5	22	33	46	cattle
9/12/2011	10/12/2011	4	50	37	47	No
9/13/2011	10/13/2011	3	32	33	38	No
9/19/2011	10/19/2011	2	30	34	38	No
9/20/2011	10/20/2011	1	39	39	39	cattle
10/4/2011	10/25/2011	4	8	7	8	No
10/22/2011			4			No
10/24/2011			8			No
10/25/2011			8			No



Horseshoe Meadow at Trail Pass sampling location (7/13/11, KH)



Meadow at the Horseshoe Meadow at Trail Pass sampling location (8/23/11)

Horseshoe Meadow Creek above Round Valley Creek (603HMCB01)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies per 100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
7/10/2011	8/9/2011	3	0	1	2	No
7/13/2011	8/13/2011	3	0	2	2	No
7/27/2011	8/26/2011	2	2	2	2	No
8/10/2011	9/9/2011	2	2	5	13	No
9/9/2011	9/30/2011	5	14	23	40	cattle
9/12/2011	10/12/2011	4	23	26	41	No
9/13/2011	10/13/2011	3	43	27	41	No
9/19/2011	10/19/2011	2	13	21	33	No
9/20/2011	10/20/2011	1	35	35	35	cattle
10/4/2011	10/25/2011	4	2	5	16	No
10/22/2011			5			No
10/24/2011			21			No
10/25/2011			4			No



Horseshoe Meadow Creek at Round Valley Creek confluence (7/13/11)



Looking upstream at Horseshoe Meadow Creek (7/13/11)

Round Valley Creek above Horseshoe Meadow Creek (603RVCB01)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)	90th percentile (40/100 ml)	Livestock Upstream
7/10/2011	8/9/2011	3	3	1	3	No
7/13/2011	8/13/2011	3	1	1	2	No
7/27/2011	8/26/2011	2	1	1	2	No
8/10/2011	9/9/2011	2	2	27	337	No
9/9/2011	9/30/2011	5	374	47	244	cattle
9/12/2011	10/12/2011	4	50	28	50	No
9/13/2011	10/13/2011	3	24	23	45	No
9/19/2011	10/19/2011	2	50	22	46	No
9/20/2011	10/20/2011	1	10	10	10	cattle
10/4/2011	10/25/2011	4	4	5	11	No
10/22/2011			12			No
10/24/2011			9			No
10/25/2011			2			No



Round Valley Creek (7/13/11)



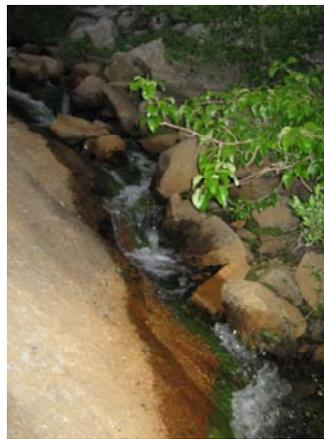
Round Valley Creek (7/13/11)

Little Cottonwood Creek (603LCCB01) (control site)

DATE	to date (30 days)	# of samples in 30-day period	fecal coliform (colonies/100ml)	30-day log normalized mean (20/100 ml)
7/14/2011	8/13/2011	3	1	1
7/27/2011	8/26/2011	2	0	1
8/10/2011	9/9/2011	2	2	1
9/9/2011	9/30/2011	5	0	1
9/12/2011	10/12/2011	4	2	1
9/13/2011	10/13/2011	3	1	1
9/19/2011	10/19/2011	2	2	1
9/20/2011	10/20/2011	1	1	1
10/4/2011	10/25/2011	4	2	1
10/22/2011			1	
10/24/2011			2	
10/25/2011			1	



Culvert below sampling site at Little Cottonwood Creek (7/13/11)



Cement reinforcement before going through culvert on Little Cottonwood Creek (7/13/11)

DISCUSSION

This report presents bacteria sampling results for 2011. It is not intended to be a stand-alone comprehensive assessment. For example, the results reported here for the Bridgeport area should be combined with data collected by other entities to provide a more comprehensive assessment for that area. All of these data should be combined with all other readily available data as part of the State's comprehensive "[Integrated Report](#)" assessments.

Of the sites sampled in this study, high concentrations of fecal coliform bacteria (e.g., 50 to 300+ colonies/100ml) were most commonly detected downstream of rangeland

grazing operations where cattle have uncontrolled access to surface waters. Low concentrations of bacteria were found at recreation camps and rural resort/housing areas.

It should be noted that the spring and summer of 2011 experienced a remarkably heavy and late-melting snowpack. We observed that forage in the high Sierra stayed green much later than normal (well into August and even September), even in many upland areas away from creek channels. This created favorable conditions for livestock distribution. Sampling during more normal (or lower) snowpack conditions could inform whether bacteria concentrations differ when livestock distribution conditions are not as favorable.

The results of this study will be assessed further by our Region's various programs (Nonpoint Source, TMDLs, planning, enforcement, etc.) for follow-up action(s) as appropriate. Sampling may continue at these (or other sites in the Region) in future years as staff time and funding allow.

ACKNOWLEDGEMENTS

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Surface Water Ambient Monitoring Program. 2008. [Quality Assurance Program Plan, Version 1.0](#). State Water Resources Control Board, Sacramento, CA. September 1, 2008. 190 pp.

APPENDIX A – Site List (from north to south), page 1 of 2

Site name	site code	latitude	longitude	Primary Land Use in 2011				
				C & R	REC	RNG	MXD	CTL
West Fork Carson River @ Paynesville bridge	633WFCB02	38.80889	-119.77714				X	
East Fork Carson River, at USGS gage blw Markleeville	632ECR005	38.71542	-119.76440				X	
West Walker River at Topaz	631WWK008	38.61051	-119.51758				X	
West Walker River, nr Coleville	631WWK001	38.51337	-119.44880				X	
West Walker River above confluence with Little Walker River	631WWK007	38.37927	119.45112				X	
West Walker River above Pack Station	631WWK010	38.32316	-119.54865				X	
East Walker River, at CA/NV state line	630EWK001	38.41399	-119.16574				X	
Hot Creek above confluence with Little Walker River	631HOT001	38.34206	-119.45074				X	
Little Walker River above confluence with Hot Creek	631LWK004	38.34170	-119.45089				X	
Sardine Creek above McKay Creek	631SDCB02	38.31423	-119.60825			X		
Sardine Creek below McKay Creek	631SDCB01	38.31231	-119.60114			X		
Swauger Creek, above Huntoon Valley	630SWA006	38.34283	-119.32310				X	
Swauger Creek, below Huntoon Valley	630SWA005	38.29586	-119.30966			X		
No. Branch Buckeye Creek, upstream bridge	630BUC004	38.26372	-119.27733			X		
Mid Branch Buckeye Creek, upstream bridge	630BUC005	38.26216	-119.27584			X		
No. Branch Robinson Creek, upstream bridge	630RBS007	38.25973	-119.27348			X		
So. Branch Robinson Creek, upstream bridge	630RBS008	38.25845	-119.27229			X		
East Walker River at HWY 395, Bridgeport	630EWK006	38.25533	-119.22380				X	
Buckeye Creek above campground	630BUCB01	38.23400	-119.37282			X		
Eagle Creek (lower reach)	630EAGB01	38.23178	-119.34756			X		
Virginia Creek, below Willow Springs (at USGS gage)	630VIR004	38.11310	-119.12330	X				
Lee Vining Creek below Camp Azusa	601LVCB01	37.93598	-119.13721		X			

Legend (all coordinates in decimal degrees, NAD 83)

C&R = commercial and/or residential development

REC = recreation camp

RNG = rangeland / agriculture

MXD = mixed land uses

CTL = control

APPENDIX A – Site List (continued), page 2 of 2

Site name	site code	latitude	longitude	Primary Land Use in 2011				
				C & R	R E C	R N G	M X D	C T L
Mammoth Creek above Horsecamp	603MAM014	37.63480	-118.96759	X				
Mammoth Creek Horsecamp	603MAM003	37.63394	-118.95952				X	
Mammoth Creek, at HWY 395	603MAM006	37.63799	-118.90771				X	
Mammoth above confluence with Hot Cr (near Hot Cr Hatchery)	603MAM013	37.64336	-118.85336				X	
Crooked Creek 1 mi below Deep Springs Cow Camp	603CRKB01	37.48449	-118.09371			X		
Crooked Creek just below Deep Springs Cow Camp	603CRKB02	37.49691	-118.10435					X
Crooked Creek above Deep Springs Cow Camp	603CRKB03	37.49528	-118.12099					X
Cottonwood Creek above confluence with Windy Gap Tributary	603CTNB03	36.48408	-118.17706					X
Windy Gap Tributary above confluence with Cottonwood Creek	603WGTB01	36.48425	-118.17689					X
Cottonwood Creek below Golden Trout Camp	603CTNB02	36.48056	-118.17728		X			
Cottonwood Creek at Horseshoe Meadow Rd	603CTNB01	36.45951	-118.16387				X	
Horseshoe Meadow Creek at Trail Pass trail crossing	603HMCB02	36.44745	-118.17867			X		
Horseshoe Meadow Creek above confluence with Round Valley Creek	603HMCB01	36.44503	-118.16156			X		
Round Valley Creek above confluence with Horseshoe Meadow Creek	603RVCB01	36.44464	-118.16135			X		
Little Cottonwood Creek at Horseshoe Meadow Rd	603LCCB01	36.47356	-118.12001					X

Legend (all coordinates in decimal degrees, NAD 83)

C&R = commercial and/or residential development

REC = recreation camp

RNG = rangeland / agriculture

MXD = mixed land uses

CTL = control