

Chehalis Best Management Practices Evaluation Project-- Beaver/Allen Creek Water Quality Data Report 1995-96

Abstract

This report describes the water quality monitoring results during the second year of a six year project to evaluate the effectiveness of best management practices (BMPs). Pre-BMP monitoring was done on Beaver Creek and post BMP monitoring on Allen Creek, a tributary to Beaver Creek. Beaver Creek drains to the Black River near Littlerock in Thurston County. The 1995-96 monitoring results show violations in fecal coliform criteria for all sites and increases in nitrogen loads from upstream to downstream. Post-BMP monitoring is recommended for Beaver Creek beginning in 1996-97, and possible nitrogen sources between the BMP site and the mouth of Beaver Creek should be investigated.

Introduction

This report presents the results for the 1995-96 wet season water quality monitoring of Beaver and Allen Creeks as part of the Chehalis Best Management Practices evaluation project. The purpose of the monitoring is to gather pre-BMP data for a dairy operation adjacent to Beaver Creek between creek mile (CM) 4.2 and CM 2.7, and post-BMP data for riparian restoration on Allen Creek. Results are shown in Tables 1 and 2. Sampling sites are shown in Figure 1. All sampling was conducted as described by the Quality Assurance Project Plan (QAPP) and addendum (Sargeant; 1994, 1995).

Results

Best Management Practices

Several BMPs have been implemented at the large commercial dairy operation that is located between monitoring sites BeCM 4.2 and BeCM 2.5 on Beaver Creek. Thurston Conservation District developed a conservation plan for the site, and construction of a waste management system including a storage pond was completed in September 1996. Revegetation of a portion of Beaver Creek at this site is scheduled to begin in 1997.

In 1993, the Chehalis Fisheries Restoration Program (CFRP) funded stream clean-up of Beaver Creek around RM 0.5.

On Allen Creek approximately two miles upstream of the mouth, the CFRP has funded BMPs along a 3/4 mile stretch of the creek. The BMPs installed include 7,011 feet of stream bank fencing, 15,000 square feet of buffer restored (Dominguez, 1995), placing and anchoring of ten large woody debris structures and one gravel weir, and construction of a livestock water access

area (Edwards, 1995) These sites are periodically checked and have received maintenance when necessary.

Precipitation and Flows

Precipitation for the sampling period, November 1995 through March 1996, was 40.88" measured at the Olympia Airport NOAA Weather Station. This is higher than the normal average of 35.39" (Perrich, 1992) expected for November through March and higher than in 1994-95. The preceding 24 and 48 hour rainfall for each sampling day as of 4:00 a. m. is shown in Table 3.

Sampling for the 1995-96 winter season occurred during more high flow events than in 1994-95 winter season sampling. During 1994-95 the average discharge during sampling at BeCM 0.1 was 122 cfs and ranged from 17.9 to 254 cfs (Sargeant, 1996). During 1995-96 average discharge during sampling at BeCM 0.1 was 175 cfs, ranging from 132 to 252 cfs.

During the winter season, flow discharge measurements for BeCM 2.5 can not be safely obtained. Flows for BeCM 2.5 were estimated by totaling flows from BeCM 4.2 and BeCM 2.6T. Allen Creek is the only significant tributary between BeCM 4.2 and BeCM 2.5. Additional flow along that stretch could come from ground water inputs and overland flow during heavy rain events. If the discharge at BeCM 2.5 was underestimated, then the fecal coliform and nitrogen loadings presented for BeCM 2.7e in Figures 2 and 3 would be underestimates.

Water Quality Characterization

During all sample events, temperature, ammonia, and pH met water quality standards for all sites.

The site at BeCM 0.1 did not meet the water quality criterion for turbidity on November 8, 1995. Using site BeCM 2.5 as background, site BeCM 0.1 was 12 NTU over background. More than 5 NTU over background exceeds the criterion.

Fecal coliform levels at all of the sites did not meet water quality standards. Compliance with fecal coliform criteria is summarized below in Table 4. Results for the 1994-95 winter season show a lower geometric mean for fecal coliform at all sites. During 1994-95 only the sites at BeCM 2.5 and BeCM 0.1 did not meet fecal coliform standards. However, in 1995-96 the magnitude of exceedance increased in the downstream direction consistent with the 1994-95 results. Fecal coliform (FC) levels and loading during the 1995-96 winter season were greater than in 1994-95. This is probably due to 1995-96 sampling occurring during periods of higher flow than 1994-95.

Figure 2 presents FC loading per sample day for each station. Bacterial loading generally increased in the downstream direction, with the largest increase between Case Road (BeCM 4.2) and the site above Allen Creek (BeCM 2.7e).

In the Black River Wet Season Nonpoint Source Total Maximum Daily Load (TMDL) Study (Coots, 1994), a target fecal coliform (FC) load allocation for the mouth of Beaver Creek was set at 1.31×10^{11} FC per day. If loading were reduced to this level during critical conditions, the

criteria for fecal coliform would be met at the mouth of Beaver Creek (critical conditions are defined as soil saturated conditions on a rising hydrograph with 0.5" of rainfall occurring in the preceding 48 hours) Table 5 presents geometric mean fecal coliform levels during critical conditions for three wet seasons and the average 48 hour rainfall before sampling Fecal coliform loading appears to be increasing each wet season, although the increase between 1994-95 and 1995-96 can partially be explained by the average 48 hour rainfall before sampling. Since BMPs are not fully implemented, it is not surprising that the TMDL load allocation is not being met

Figure 3 shows an increase in nitrogen loads upstream to downstream, except on February 6, 1996, when site BeCM 2.5 had the highest levels Usually the dominant nitrogen component was organic nitrogen Loads during the 1995-96 winter season were greater than in 1994-95 This is probably due to 1995-96 sampling occurring during periods of higher flow than 1994-95

Conclusions

Nitrogen loading increased from upstream to downstream between BeCM 4.2 and BeCM 2.7e, downstream of Allen Creek at BeCM 2.5, and between BeCM 2.5 and BeCM 0.1 Increases in fecal coliform levels were found between BeCM 4.2 and BeCM 2.7e, and three out of five sample events show an increase between BeCM 2.5 and BeCM 0.1 These results suggest a source of nitrogen and bacteria between BeCM 4.2 and BeCM 2.5, most likely the dairy BMP site There is also probably an unknown source or sources between BeCM 2.5 and BeCM 0.1 that contribute to nitrogen loading and some increase in fecal coliform

Surface water post-BMP monitoring of the BMP site located between BeCM 4.2 and BeCM 2.5 is scheduled to begin winter 1996 Ecology is currently conducting a ground water monitoring study of the site (Erickson, 1995). Ground water sampling will continue until October 1996, with a report slated for March 1997 A detailed analysis of the surface water quality data for Beaver and Allen Creeks is planned for the final report in 1999, after two-years of post BMP data have been collected.

Recommendations

- Start post-BMP water quality monitoring in Beaver Creek in winter 1997-98.
- Monitor operation and maintenance of BMPs for Allen Creek and at the dairy on Beaver Creek
- Investigate possible nitrogen sources between BeCM 2.5 and BeCM 0.1.

References

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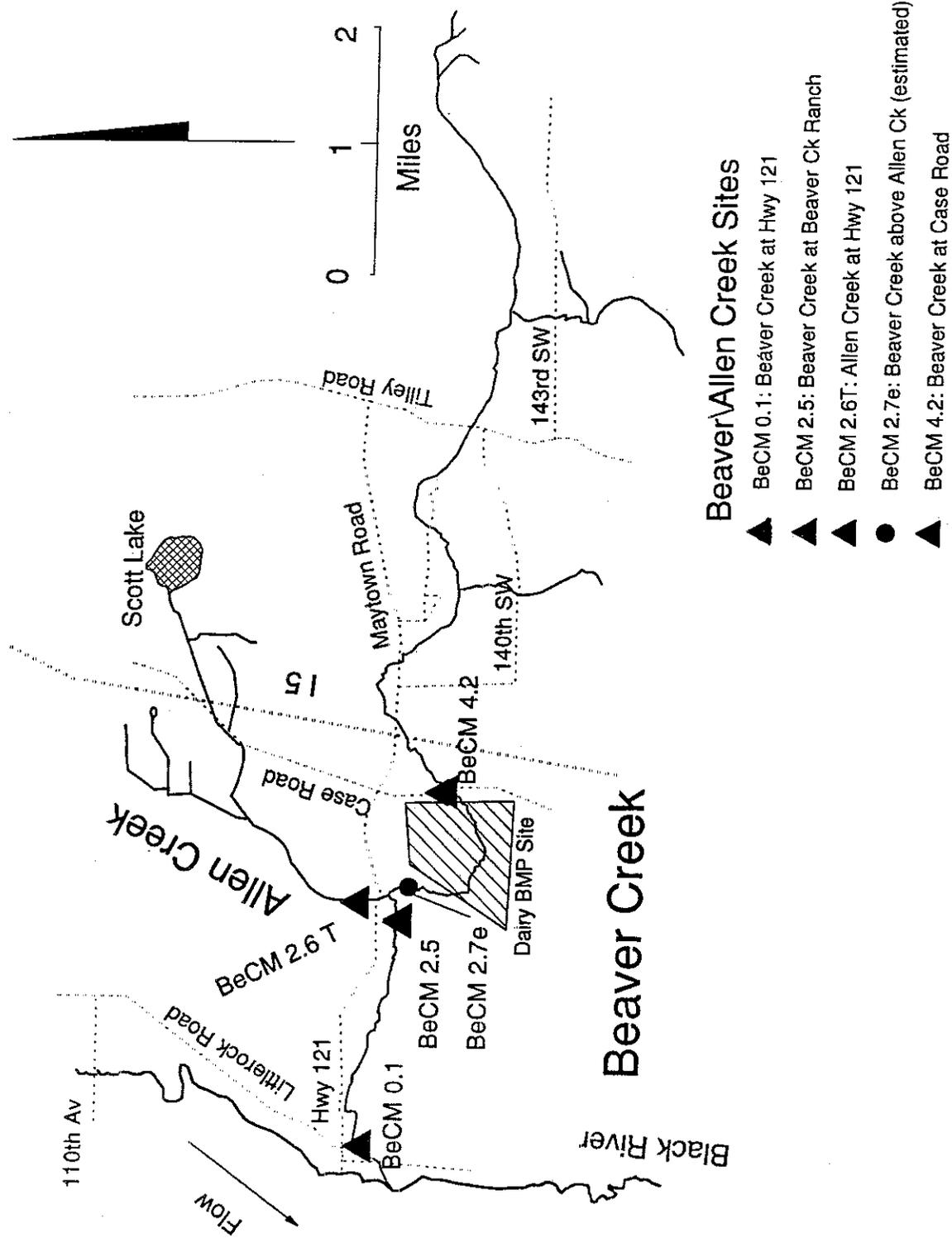


Figure 1. Beaver and Allen Creek Sampling Sites

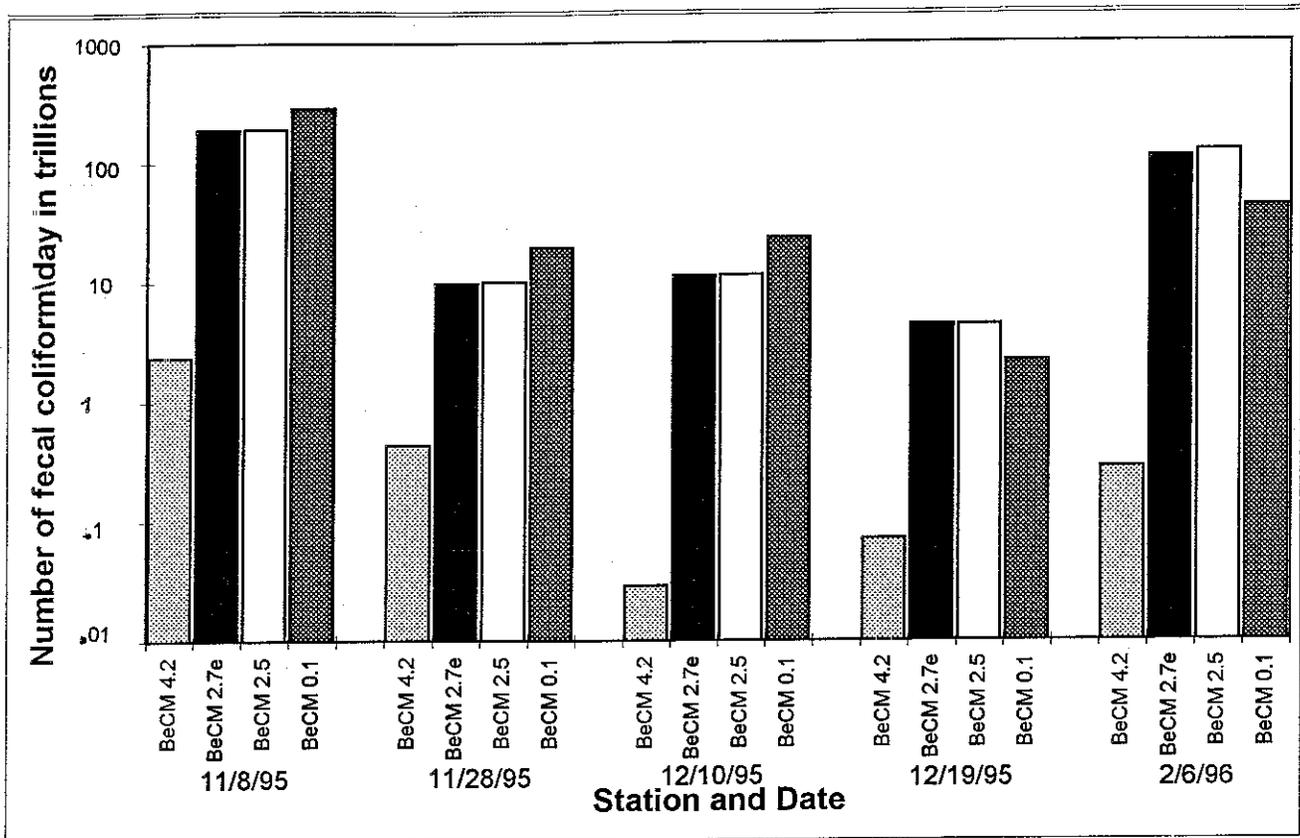


Figure 2. Fecal Coliform Loading Per Day for Beaver Creek Sites 1995-96.

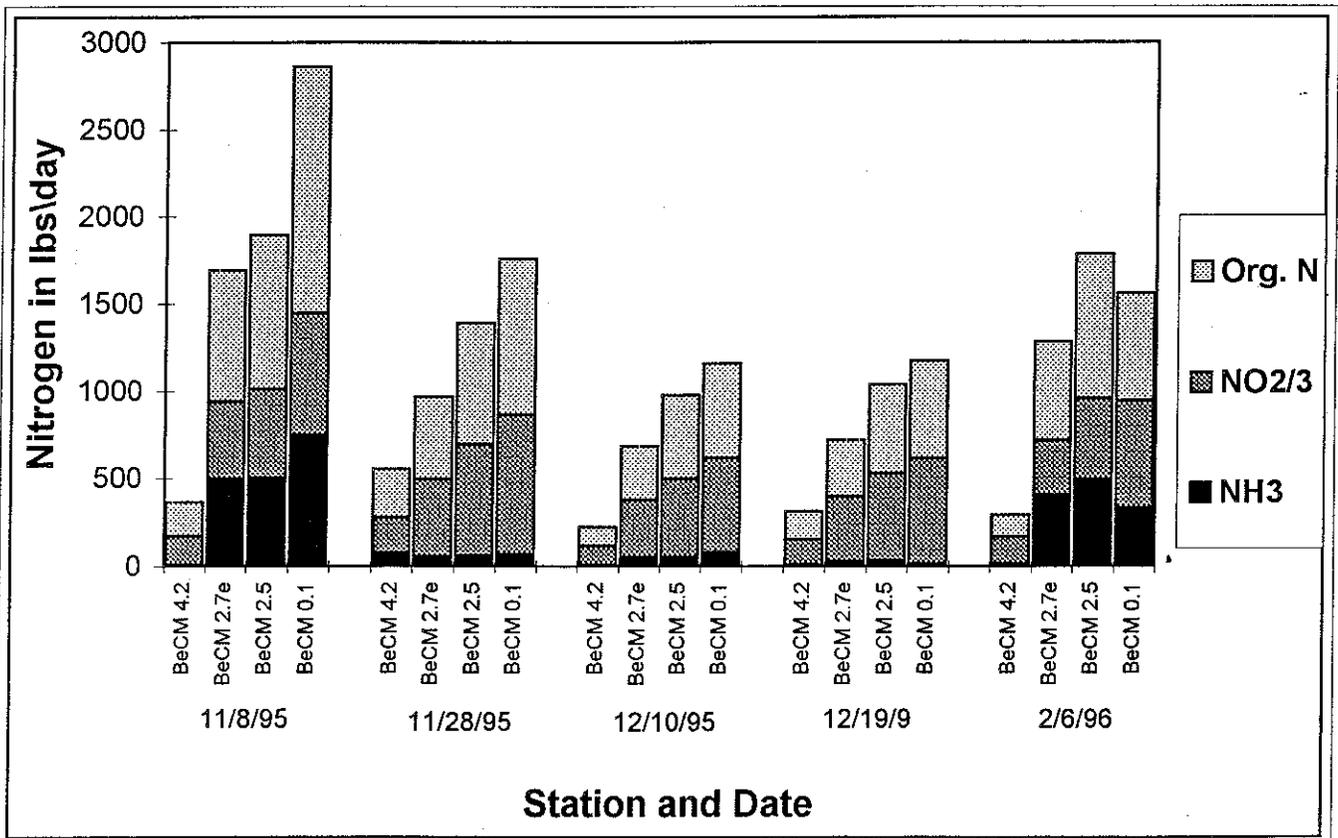


Figure 3. Nitrogen Levels for Beaver Creek Wet Season Sampling 1995-96.

TABLE 1
Beaver\Allen Creek Wet Season Field Data

Site Location	Station Creek Mile	Date	Time	Temp. ° C	pH	Cond. µmho/cm	Discharge cfs
Beaver Ck. (Case Rd.)	BeCM 4.2	11/8/95	9:50	9.6	6.9	69	80
Beaver Ck. (Case Rd.)	BeCM 4.2	11/28/95	13:25	9.8	6.5	45	130
Beaver Ck. (Case Rd.)	BeCM 4.2	12/10/95	14:05	5.4	7.1	63	59
Beaver Ck. (Case Rd.)	BeCM 4.2	12/19/95	13:05	7.3	6.6	61	80
Beaver Ck. (Case Rd.)	BeCM 4.2	2/6/96	9:55	3.0	6.5	55	88
Allen Ck. (mouth)	BeCM 2.6T	11/8/95	10:30	10.6	6.7	70	39
Allen Ck. (mouth)	BeCM 2.6T	11/28/95	13:45	10.5	6.7	66	78
Allen Ck. (mouth)	BeCM 2.6T	12/10/95	14:55	6.2	*	71	53
Allen Ck. (mouth)	BeCM 2.6T	12/19/95	13:50	7.3	6.7	80	56
Allen Ck. (mouth)	BeCM 2.6T	2/6/96	10:15	4.7	6.5	74	60
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	11/8/95	11:20	10.4	6.7	90	120
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	11/28/95	14:20	10.2	6.5	53	200
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	12/10/95	15:30	6.0	*	65	110
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	12/19/95	14:30	7.4	7.0	69	140
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	2/6/96	10:50	3.9	6.6	73	150
Beaver Ck. (Hwy 121)	BeCM 0.1	11/8/95	11:45	10.1	7.0	110	150
Beaver Ck. (Hwy 121)	BeCM 0.1	11/28/95	14:40	10.2	6.7	57	250
Beaver Ck. (Hwy 121)	BeCM 0.1	12/10/95	15:50	6.0	*	66	130
Beaver Ck. (Hwy 121)	BeCM 0.1	12/19/95	14:45	7.6	6.8	65	160
Beaver Ck. (Hwy 121)	BeCM 0.1	2/6/96	11:10	4.0	6.5	65	180

* pH meter not functioning

E Field estimate\gauge reading.

e Flow estimated as sum of Allen Creek flow and Beaver Ck (Case Rd) flow.

TABLE 2
Beaver/Allen Creek Wet Season Laboratory Data
 (paired values are field duplicates)

Site Location	Station Creek Mile	Date	Time	Turbidity NTU	NH3 mg/L	NO2/3 mg/L	Total* Organic Nitrogen mg/L	TPN mg/L	Fecal Coliform cfu/100 mL
Beaver Ck. (Case Rd.)	BeCM 4.2	11/8/95	9:50	11	U 0.010	0.379	0.459	0.85	J 1200
Beaver Ck. (Case Rd.)	BeCM 4.2	11/28/95	13:25	3.1	0.111	0.301	0.410	0.82	140
Beaver Ck. (Case Rd.)	BeCM 4.2	12/10/95	14:05	1.1	U 0.010	0.347	0.355	0.71	20
Beaver Ck. (Case Rd.)	BeCM 4.2	12/19/95	13:05	1.1	U 0.010	0.336	0.380	0.73	36
Beaver Ck. (Case Rd.)	BeCM 4.2	2/6/96	9:55	3.3	0.022	0.325	0.269	0.62	130
Allen Ck. (mouth)	BeCM 2.6T	11/8/95	10:30	5.9	U 0.010	0.347	0.615	0.97	760
Allen Ck. (mouth)	BeCM 2.6T	11/28/95	13:45	3.6	U 0.010	0.464	0.54	1.01	170
Allen Ck. (mouth)	BeCM 2.6T	12/10/95	14:55	1.7	U 0.010 U 0.010	0.413 0.417	0.58	0.96 1.05	110
Allen Ck. (mouth)	BeCM 2.6T	12/19/95	13:50	1.6	U 0.010	0.437	0.63	1.08	6
Allen Ck. (mouth)	BeCM 2.6T	2/6/96	10:15	5.3	0.283	0.456	0.81	1.55	J 8600
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	11/8/95	11:20	11	0.781	0.795	1.38	2.96	J 64000 J 66000
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	11/28/95	14:20	2.9	0.055	0.579	0.64	1.27	J 2000
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	12/10/95	15:30	1.9	0.088	0.737	0.79	1.61	S 4100
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	12/19/95	14:30	1.4	0.040	0.681	0.70	1.42	1300
Beaver Ck. (Beaver Ck. Ranch)	BeCM 2.5	2/6/96	10:50	6.0	0.616	0.576 0.582	1.04	2.21 2.24	33000
Beaver Ck. (Hwy 121)	BeCM 0.1	11/8/95	11:45	23	0.938	0.875	1.77	3.58	J 78000 J 78000
Beaver Ck. (Hwy 121)	BeCM 0.1	11/28/95	14:40	4.1	0.048	0.586	0.66	1.29	J 3100
Beaver Ck. (Hwy 121)	BeCM 0.1	12/10/95	15:50	2.2	0.110	0.753	0.76	1.62	7100
Beaver Ck. (Hwy 121)	BeCM 0.1	12/19/95	14:45	1.4	0.015	0.700	0.66	1.37	650
Beaver Ck. (Hwy 121)	BeCM 0.1	2/6/96	11:10	5.1	0.335	0.615	0.62	1.57	9300

* Total organic nitrogen is calculated by subtracting ammonia and nitrate/nitrite from total persulfate nitrogen.

S Other bacteria present, count may be an underestimate.

U Less than the reported result

J Analyte was positively identified. The associated numerical result is an estimate.

Table 3. Previous rainfall for Beaver Creek Sample Trips.

Date	Preceding 24 hour rainfall	Preceding 48 hour rainfall
November 8, 1995	0.97"	2.48"
November 28, 1995	1.11"	1.16"
December 10, 1995	0.63"	0.63"
December 19, 1995	0.07"	0.48"
February 6, 1996	1.32"	1.39"

Table 4. Fecal Coliform Results for Beaver Creek.

Site Location	Geometric mean below 100 cfu/100 mL?	10% or less of all samples for calculating GM exceed 200 colonies/100 mL?
BeCM 4.2	No (GM=110)	No, 1 out of 5 samples exceeded 200
BeCM 2.6T	No (GM=240)	No, 2 out of 5 samples exceeded 200
BeCM 2.5	No (GM=7400)	No, 5 out of 5 samples exceeded 200
BeCM 0.1	No (GM=6200)	No, 5 out of 5 samples exceeded 200

Table 5. Geometric Mean Fecal Coliform Critical Loading for the mouth of Beaver Creek.

Year/Study	GM Fecal Coliform Critical Load at Beaver Creek Mouth	Average Previous 48 hour rainfall
Target FC Load	1.31×10^{11}	> 0.50"
1992/1993 (Coots, 1994)	1.58×10^{12}	0.62"
1994/1995 (Sargeant, 1996)	2.60×10^{12}	0.62"
1995/1996	2.66×10^{13}	1.23"