Water Quality Screening in the Dakota, Bertrand, and Fishtrap Creek Watersheds Whatcom County, Washington

By
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ABSTRACT

A water quality screening was conducted in the Dakota, Bertrand, and Fishtrap Creek watersheds in February-March 1992. The objective was to identify water quality problem areas during wet season runoff conditions to assist in prioritizing areas for further investigation and targeting of source controls. However, precipitation was low and runoff conditions did not occur during the study period. Nonetheless, areas of poor water quality were identified. Water quality standards violations for fecal coliform bacteria, dissolved oxygen, ammonia, and nitrate appear to be associated with agricultural land use, particularly commercial dairies. All three watersheds have a portion of their drainage area in British Columbia. Consequently, joint efforts by the United States and Canada would likely increase the effectiveness of water quality controls initiated in these watersheds.

INTRODUCTION

A water quality screening was conducted in Dakota, Bertrand, and Fishtrap Creeks in February-March 1992 (Figure 1). The objective was to identify water quality problem areas during wet season runoff conditions. Areas could then be prioritized for further investigation and targeting of source controls by Ecology's Northwest Regional Office.

The study area for the water quality screening was limited to the portion of each watershed in northwest Whatcom County, Washington. It is important to note that all three watersheds also drain areas in British Columbia, Canada. The Dakota Creek watershed has less than one percent of its drainage in Canada. However, both Bertrand and Fishtrap Creeks have approximately half of their watersheds draining from Canada into the United States (Williams, *et al.*, 1975). Identifying sources of water quality degradation originating outside of Whatcom County was not an objective of this study.

Whatcom County has about 380 dairies, the highest concentration of dairy farms in Washington State. Approximately one third of these dairies are located in the study area. The Dakota, Bertrand, and Fishtrap Creek watersheds support approximately 29, 41, and 65 commercial dairy operations, respectively. Water quality impacts from dairies have been a recurring problem in these three watersheds (WCCD, 1987, 1988; WCCD and WCHD, 1990; PSCRBT, 1991). Elevated concentrations of fecal coliform bacteria, ammonia, and nitrate, as well as depressed oxygen levels, can be indicative of nonpoint pollution from dairy waste (Novotny and Chesters, 1986; PSWQA, 1991, Cusimano, 1992). These water quality variables were monitored to prioritize the stream reaches.

METHODS

Water quality sampling was conducted over a three-day period weekly for four weeks: one week in February and three weeks in March, 1992. One watershed was sampled per day due to logistics associated with getting the samples to the laboratory within analytical holding times.

The original sampling design for this survey called for six sampling events to occur during wet weather runoff conditions. However, due to the unusually dry climatic conditions during the winter of 1992, the survey intensity was reduced to four events.

Sampling locations, depicted in Appendix A, were based on information from Mark Schuller (Washington State Department of Fisheries) and John Gillies (Whatcom County Conservation District [WCCD]/USDA Soil Conservation Service) regarding historical water quality problems. Historical sampling sites and logistical concerns, such as accessibility, were also considered.

Sampling methods and QA/QC information are in Appendix B. Parametric coverage, methodology, and detection limits are summarized in Appendix C.

Violation of Class A water quality standards for fecal coliform bacteria (FC), dissolved oxygen (D.O.), and ammonia were used to prioritize the stream reaches for further investigation (Appendix D). The U.S. Public Health criterion established for nitrate in drinking water was also considered (EPA, 1986). Nitrate concentrations in this study were determined as nitrate+nitrite (see Appendix B, QA/QC section).

RESULTS AND DISCUSSION

Laboratory and field data collected in the three watersheds are tabulated in Appendix E. Sampling locations which violated Class A water quality standards for FC, D.O., and ammonia are shown graphically in Figures 2-4. The large dots in these figures represent excursions from the water quality criterion for the associated variable. Appendices F and G further summarize water quality violations.

The data do not represent typical runoff conditions. Using precipitation data from both the Clearbrook and Blaine weather stations (NOAA, 1992), the rainfall in the study area was approximately twenty percent below normal in February and seventy percent below normal in March.

Dakota Creek

Land use in the Dakota Creek watershed study area is mixed agricultural, rural residential, and forest. Water quality violations for FC and D.O. occurred primarily in the South Fork (SF), where agriculture is concentrated (Figures 2 and 3). A potentially toxic concentration of ammonia was found at one site in the North Fork (NF) (Figure 4). Poor water quality was coincident with the presence of commercial dairies and other livestock farms.

Elevated FC counts and low oxygen concentrations were seen in the SF particularly at site D5 (Sunrise and Jess Roads), and downstream at site D9 (Delta Line and Jess Roads). The geometric mean during the study period (GM) for D5 was 310 cfu/100 mL, with a mean D.O. concentration of 6.1 mg/L. Site D9 had a GM 480 cfu/100 mL and a mean D.O. concentration of 6.8 mg/L. The Puget Sound Cooperative River Basin Team also reported poor water quality in the SF near Sunrise Road (PSCRB, 1991).

Water quality in the NF was generally good. There were no violations of the FC criterion. The only site on the NF with a notable problem was at site D2 (Sunrise Road near Burk Road). On February 3, the water sampled at site D2 had an ammonia concentration of 3.47 mg/L, almost twice the chronic 4-day criterion of 1.9 mg/L (Appendix G). This suggests that a potentially toxic condition existed in this tributary.

The best water quality in the Dakota Creek drainage was in the NF at site D1 (Sunrise Road near "H" Street). The GM for FC was 11 cfu/100 mL. Both ammonia and nitrate+nitrite concentrations were generally lower than the rest of the watershed (Appendix E). The low specific conductance observed at this site is also indicative of good water quality. The area upstream of D1 is primarily forested.

Bertrand Creek

Land use in Bertrand Creek watershed is also mixed agricultural, rural residential, and forest. Water quality violations for FC, D.O., and ammonia were found in the eastern portion of the watershed (Figures 2-4), where the majority of commercial dairy operations are concentrated.

Particularly poor water quality was found at sites B8E, B9W and B15 in Duffner Ditch, a main tributary to Bertrand Creek (Appendices E - G). The east and west ditches at Guide Meridian and Badger Road (sites B8E and B9W) are in the upper portion of the Duffner Ditch drainage. Water quality criteria were violated for bacteria and D.O., and potentially toxic ammonia concentrations were present. The water quality in the east ditch was especially poor (the west ditch was dry) on March 17. The FC concentration was 30,000 cfu/100 mL, and the ammonia concentration of 12.4 mg/L, exceeded the chronic 4-day criterion of 1.8 mg/L and approached the acute 1-hour criterion. At the same time, the D.O. in the channel was 3.0 mg/L. These ditches drain an area where dairy farms are concentrated. It appears that manure or wastewater may have been discharged into the water way.

Site B15, the lowermost site on Duffner Ditch, had bacteria levels greater than 200 cfu/100 mL each sampling event (GM = 570 cfu/100 mL). The water quality in the lower portion of Duffner Ditch is influenced by a variety of sources, including agricultural, rural residential, and light industrial. However, the high bacteria concentrations detected at the monitoring site may result primarily from a small confinement of domestic geese located just upstream.

Water quality criteria for FC and D.O. were also violated at site B7 in the tributary along Jackman Road. This tributary is channelized and drains fields associated with dairy farm operations.

Fishtrap Creek

Land use in this watershed is primarily agricultural, with some residential development. Violations of water quality criteria for FC occurred throughout the watershed (Figure 2). Depressed oxygen occurred in the ditches draining the central portion of the study area (Figure 3). Elevated ammonia concentrations were identified along the Double Ditch Road and in the ditch at the intersection of Visser and Depot Roads (Figure 4). The water quality violations occurred primarily in areas with concentrated agriculture, particularly commercial dairy operations.

A major tributary to Fishtrap Creek is diverted into two channels at the U.S./Canada border and runs along either side of Double Ditch Road. The Class A water quality standard for FC was violated in both the east ditch (sites F14E, F9, and F2E) and west ditch (sites F14W, F10, and F3W) along Double Ditch Road (Figure 2 and Appendix F). FC concentrations tended to be higher in the west ditch and, in general, increased downstream. On March 4, concentrations of FC and ammonia were noticeably high in both tributary channels; all sites violated chronic 4-day toxicity criteria for ammonia (Appendix E and G). Poor water quality entering from

Canada is evident, though the sources are not clear from this study. Wastes from dairy operations concentrated along Double Ditch Road are likely the source for increased concentrations of FC and ammonia. Elevated FC concentrations have been a historic problem in this tributary (WCCD and WCHD, 1990).

The most degraded water quality was found at site F13 at the intersection of Vissor and Depot Roads (Appendix E). Violations of Class A criteria were identified for fecal coliform (GM=2,300 cfu/100 mL), D.O. (2.6 mg/L), ammonia (18.3 mg/L), and nitrate+nitrite (12.8 mg/L). This was the only site throughout the three watersheds that violated both the acute 1-hour toxicity criterion for ammonia (Appendix G) and the Public Health Service drinking water standard of 10 mg/L for nitrate (EPA, 1986). These data suggest that manure or wastewater are being discharged into this channel. This site was dry on the last day of sampling.

The FC criteria were also violated in the ditch paralleling Bender Road at sites F8 and F16, and in the mainstem at sites F12, F6, and F1. These areas drain agricultural land.

CONCLUSIONS AND RECOMMENDATIONS

- The objective of the water quality screening conducted in the Dakota, Bertrand, and Fishtrap Creek watersheds was to identify water quality problem areas during wet season runoff conditions. However, due to low precipitation during the collection period, the data do not accurately reflect normal runoff conditions. To more fully characterize the potential of nonpoint pollution to surface waters, additional wet season monitoring should be performed.

- High fecal coliform bacteria concentrations appear to be associated with concentrated commercial dairies and other livestock farms. This is consistent with the results found by the WCCD and WCHD (1990) and PSRBT (1991). To further identify impacts from specific agricultural uses, failing septic systems, and groundwater, intensive studies would be necessary.

- Approximately half of the Bertrand and Fishtrap Creek watersheds are in British Columbia. Sources for water quality impacts originating in Canada are not addressed in this report. However, joint efforts by the United States and Canada would likely increase the effectiveness of water quality controls initiated in these watersheds.

- Specific areas where water quality criteria were violated have been prioritized and are listed below by watershed:

Dakota Creek

The South Fork drainage had the worst water quality in the watershed, especially sites D5 (Sunrise and Jess Roads) and D9 (Delta Line and Jess Roads). Identifying sources for the elevated bacteria and low oxygen should be a priority in this watershed.

The North Fork drainage had generally good water quality. Investigation into the cause for elevated ammonia at Site D2 on Sunrise Road is warranted.

Bertrand Creek

The upper drainage area of Duffner Ditch had particularly poor water quality as reflected at sites B8E and B9W located at Guide Meridian and Badger Roads. Identifying discharges into this waterway should be a priority.

Site B15, the lowermost site on Duffner Ditch, and site B7 on the tributary along Jackman Road, had elevated bacteria levels. Further investigation is warranted to identify possible loading sources.

Fishtrap Creek

The tributary along Double Ditch Road has been a problem area historically. Efforts to improve water quality through source controls should be a priority.

Site F13, located at the intersection of Visser and Depot Roads, had the worst water quality throughout the three watershed study area. The impacts to mainstem Fishtrap Creek may be intermittent, but the conditions were so poor at this site that investigation into the source for the water quality degradation should be a priority.

The FC criterion was violated in the ditch paralleling Bender Road at sites F8 and F16, and in the mainstem at sites F12, F6, and F1. Further investigation into the sources of bacteria loading is warranted.

ACKNOWLEDGEMENTS

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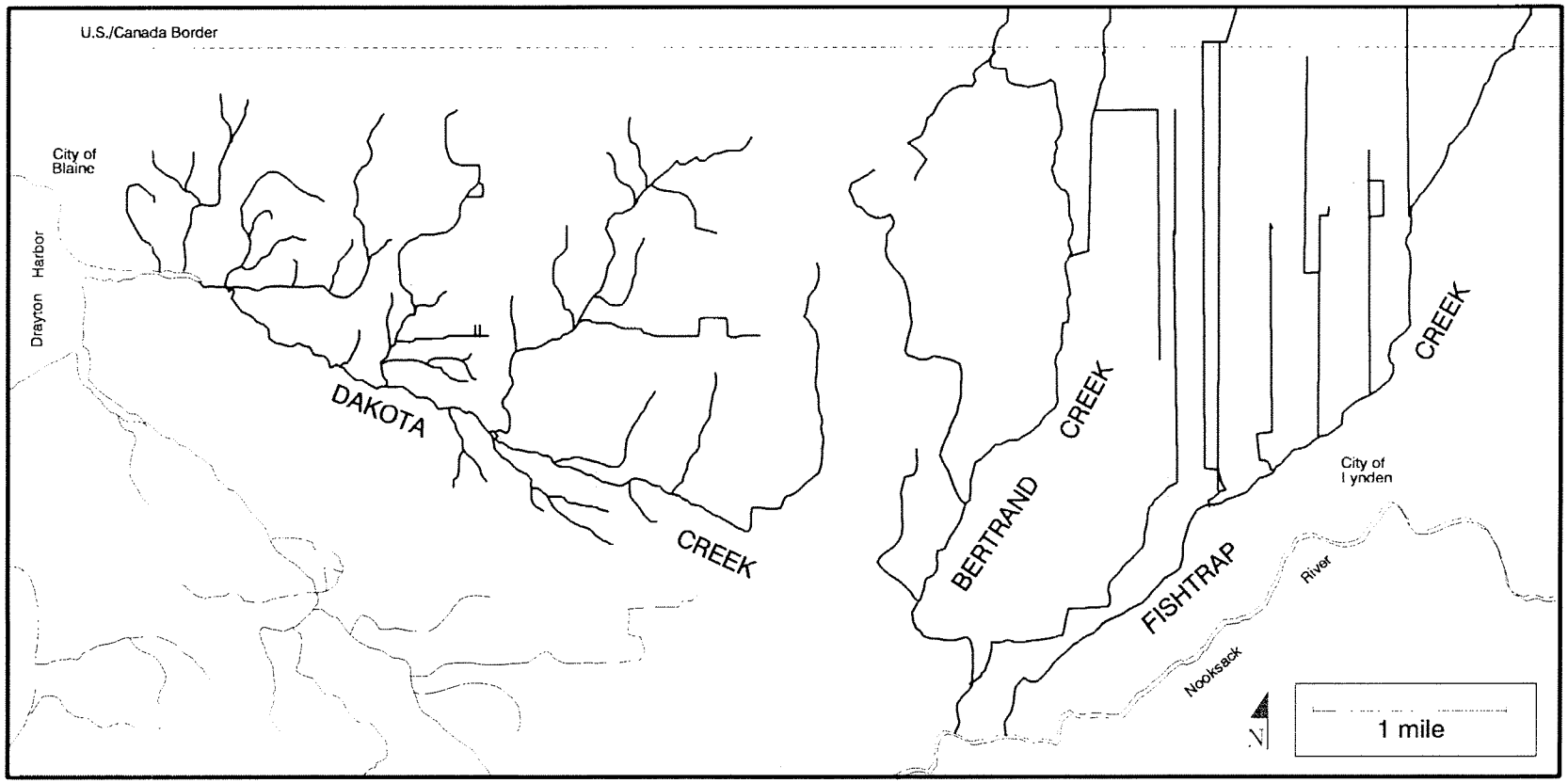

Figure 1. Dakota, Bertrand, and Fishtrap Creeks in northwest Whatcom County, Washington.

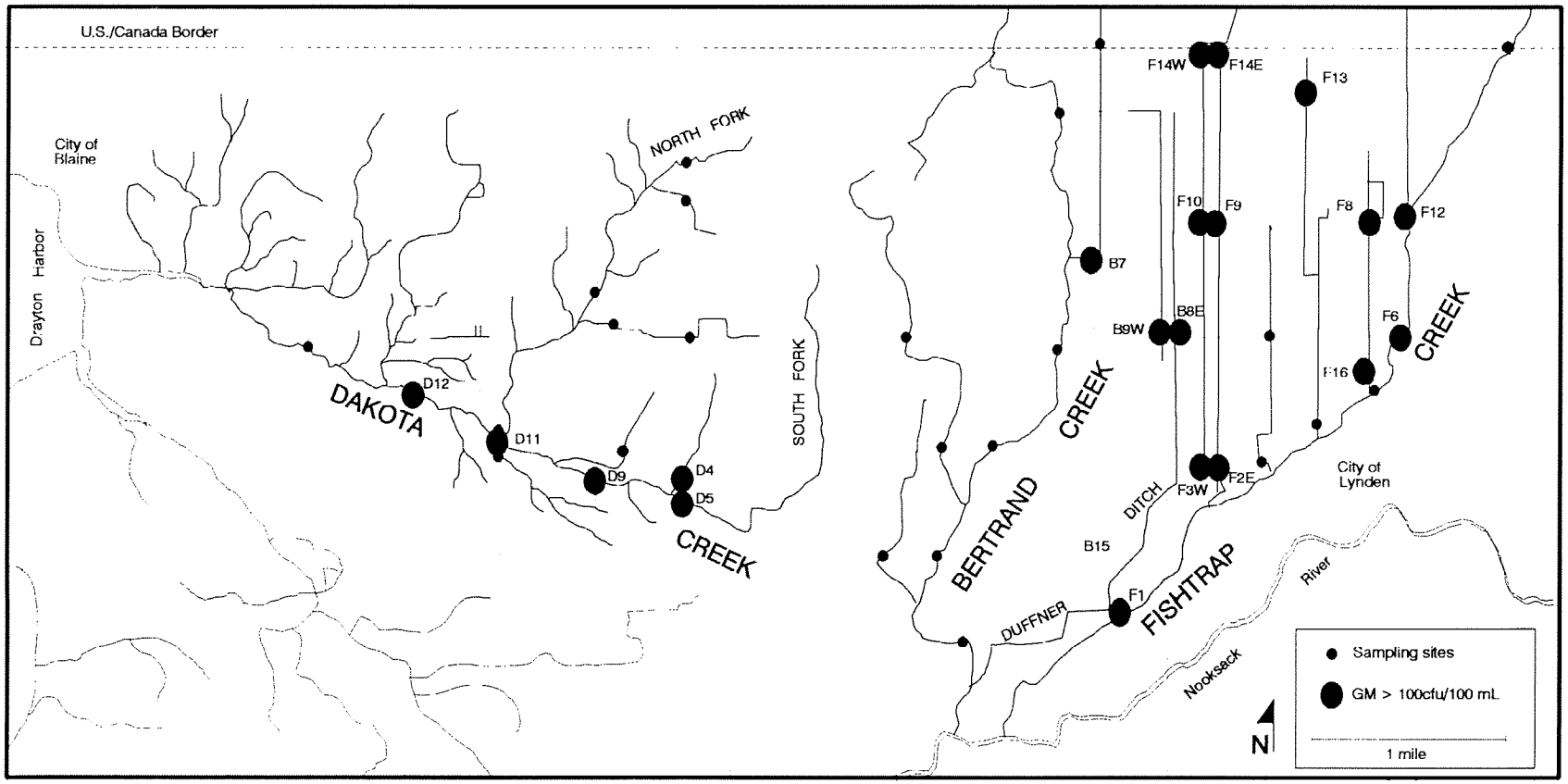

Figure 2. Water quality sampling sites for fecal coliform bacteria on Dakota, Bertrand, and Fishtrap Creeks, February-March 1992. The large markers identify sites where the geometric mean (GM) for the study period was greater than 100 cfu/100 mL.

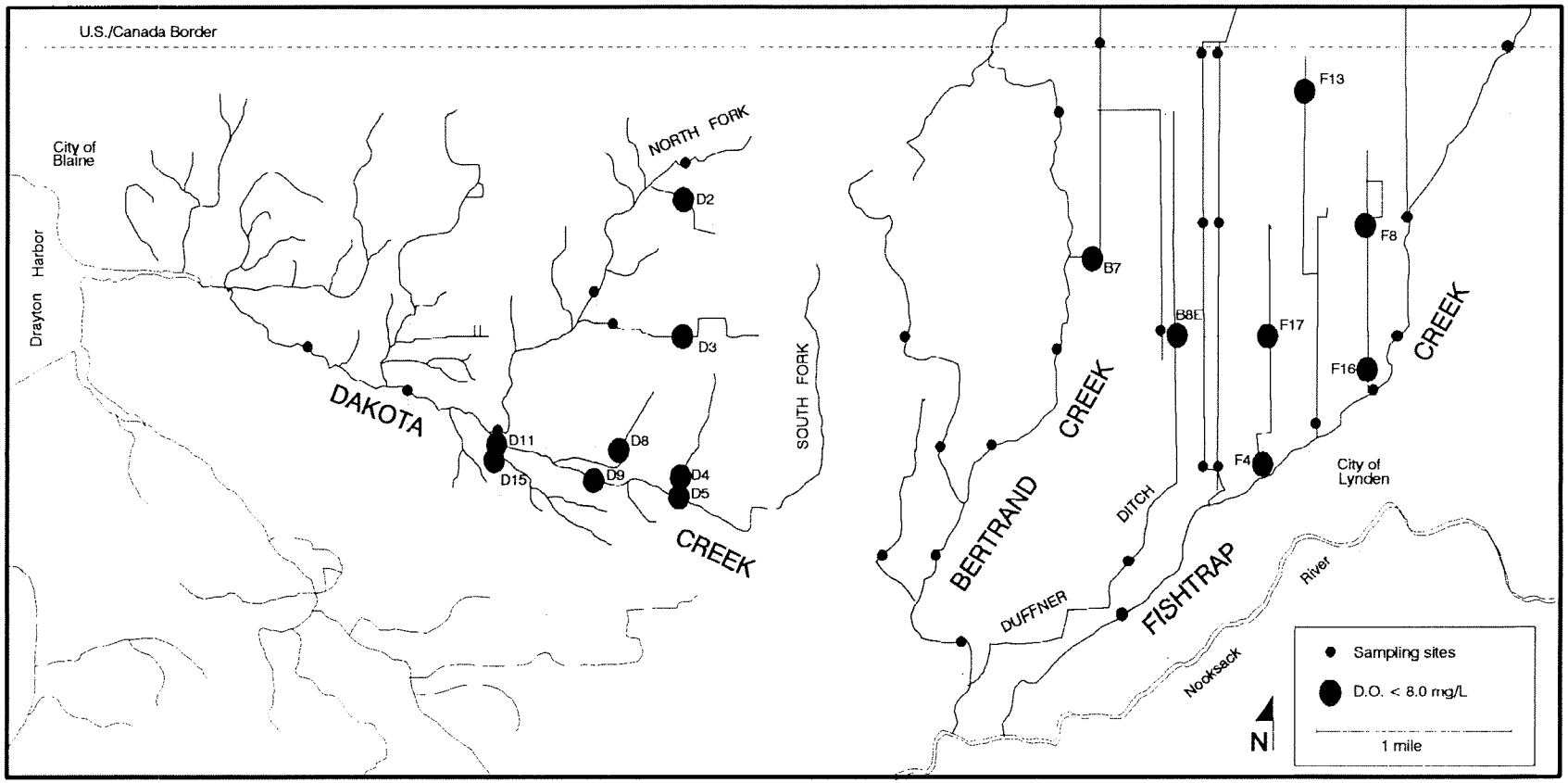

Figure 3. Water quality sampling sites for dissolved oxygen (D.O.) on Dakota, Bertrand, and Fishtrap Creeks, February-March 1992. Large markers identify sites where there was at least one violation of the Class A criterion for D.O..

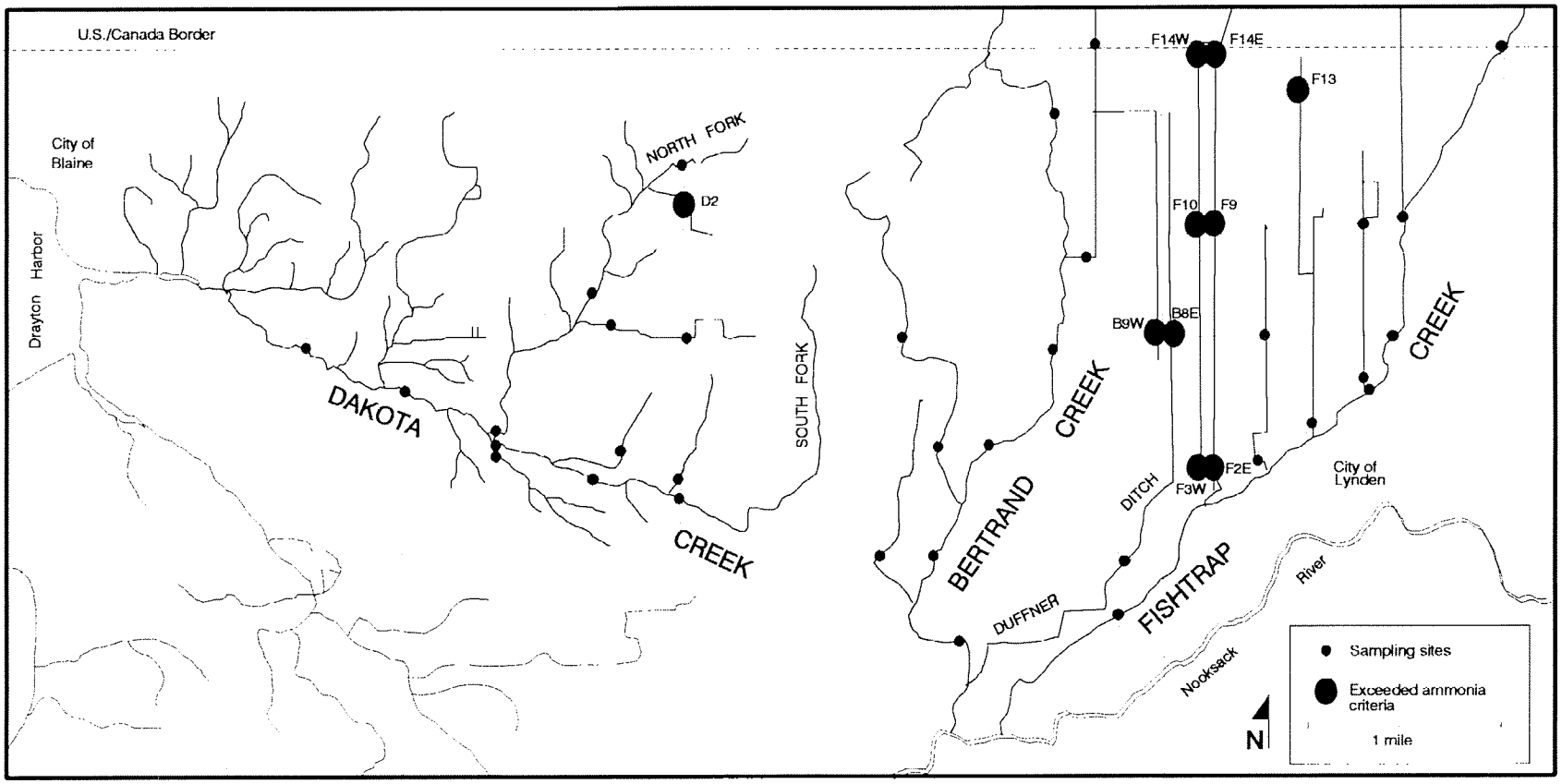

Figure 4. Water quality sampling sites for ammonia on Dakota, Bertrand, and Fishtrap Creeks, February-March 1992. The large markers identify sites where there was at least one violation of the Class A criteria for ammonia.

Appendix A. Locations of sampling sites for the water quality screening study in the Dakota, Bertrand, and Fishtrap Creek watersheds, February-March, 1992.

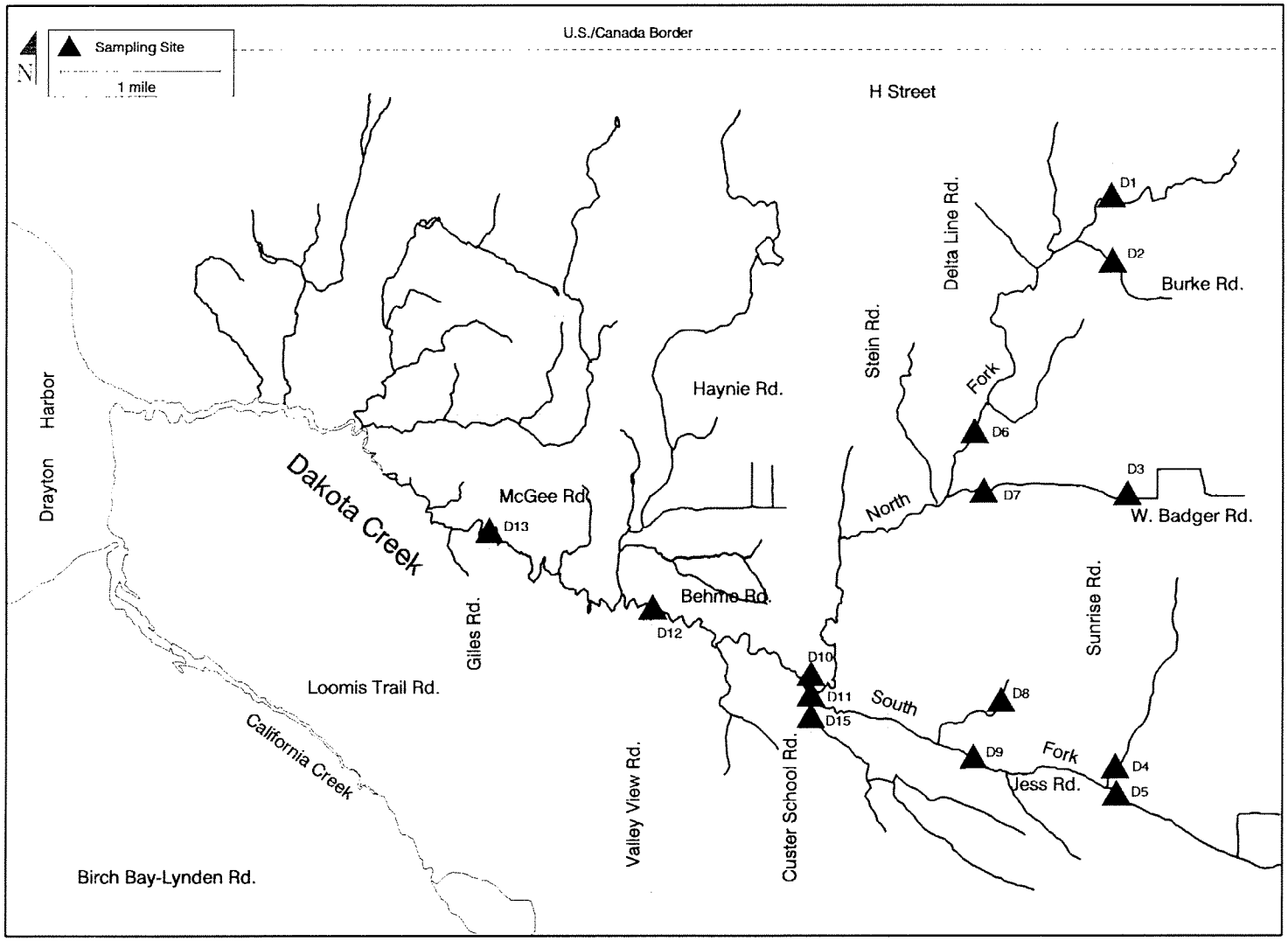

Figure A1. Location of sampling sites on Dakota Creek for the water quality screening study, February - March 1992.

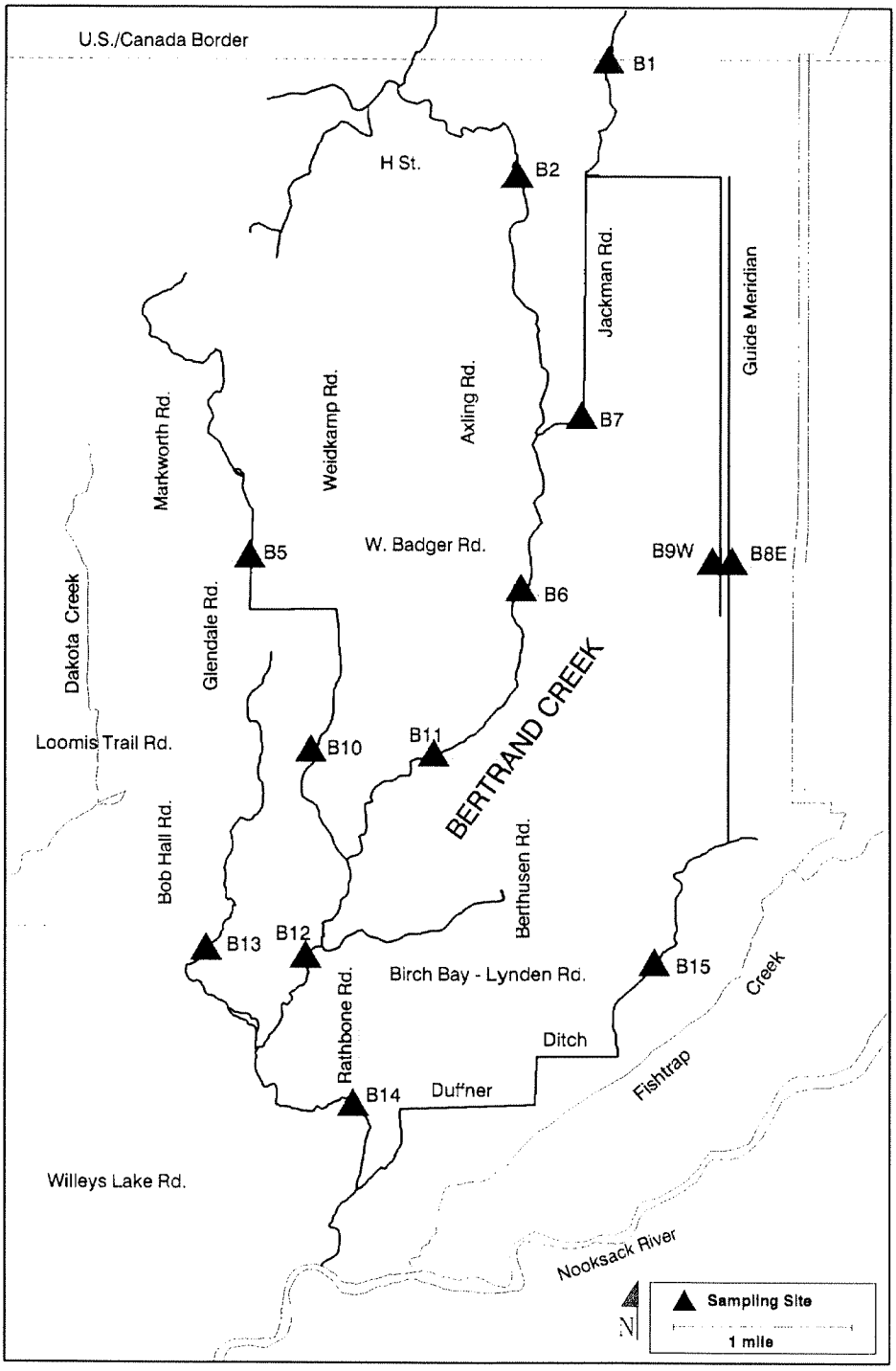

Figure A2. Location of sampling sites on Bertrand Creek for the water quality screening study, February - March 1992.

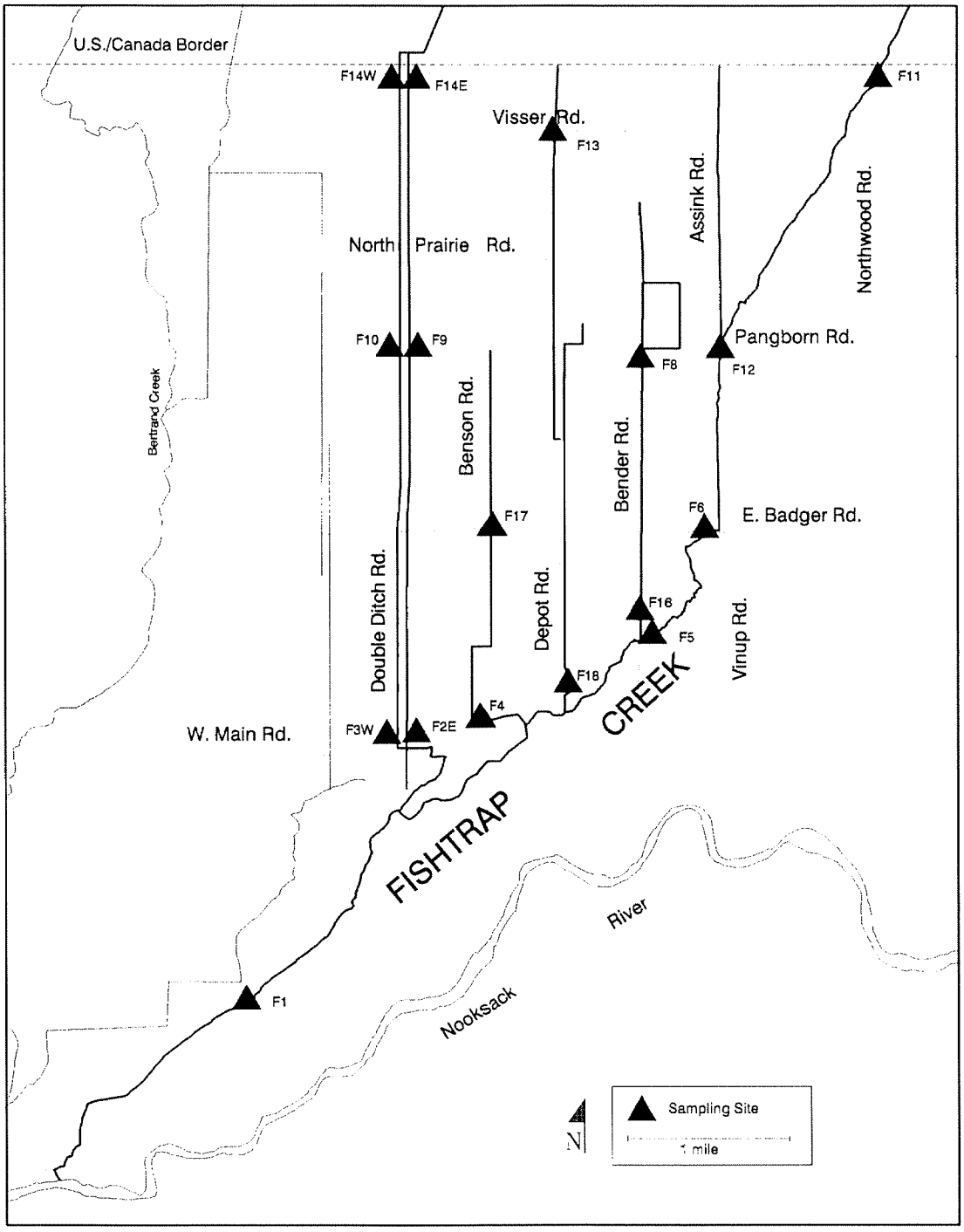

Figure A3. Location of sampling sites on Fishtrap Creek for the water quality screening study, February - March 1992.

Appendix B. Sample collection methodology and QA/QC information for the water quality screening study in the Dakota, Bertrand and Fishtrap Watersheds.

Grab samples were collected mid-channel via wading, or by using specialized sampling equipment on bridges when necessary. Samples to be sent to the laboratory were put immediately in coolers containing ice. On the first two days of sampling the samples were shipped to Olympia via Greyhound bus service; the third day the samples were driven to Olympia. All samples arrived at the Manchester Laboratory the morning following collection. Holding times were met for all analyses.

Samples collected for pH, temperature, and specific conductance were analyzed immediately in the field. Samples collected for D.O. were preserved and analyzed in the Ecology field lab in Olympia.

The chronic 4-day and acute 1-hour ammonia toxicity criteria are calculated using the formula established by EPA (1986). The EPA toxicity criteria are dependent on pH and temperature measurements taken at the site over four days or one hour. Concentrations which exceed the ammonia criteria in this study represent conditions of potential ammonia toxicity.

QA/QC

Randomly selected replicate samples were taken at 10-20 percent of the sites to assess both field and laboratory variability. The average of the replicated values was reported when appropriate and used in subsequent calculations. Replicate pairs were compared by determining the relative percent difference (RPD), which is the difference between two replicates expressed as a percentage of their mean. The results are illustrated in Figure B1 using box plots. All values were acceptable. The variability seen with the replicate samples for FC was expected due to the natural variability of bacteria in the environment.

Replicate specific conductance readings taken at site F13 on February 5 had a difference of 39 μmhos/cm. After reviewing both field and laboratory data it was not clear whether these data were erroneous or represented variability in the environment. Both values were reported as estimates.

Replication was poor (7.0 S.U. and 8.0 S.U.) for the pH values collected at site D5 on March 9. After reviewing both field and laboratory data, it was not clear whether these data were erroneous or represented variability in the environment. Both values were reported as estimates.

The maps used in this report were digitized using USGS maps (1972 photo revised) and a map from the Whatcom County Department of Public Works (1991). Ditches not shown on these base maps, but necessary to show sampling site locations, were hand drawn based on field observations.

Nitrate+nitrite concentrations were assumed to be wholly nitrate for the purpose of this report. This decision was made for logistical reasons and deemed acceptable since nitrite in surface waters is rapidly converted to nitrate and generally present only in trace quantities (Goldman and Horne, 1983).

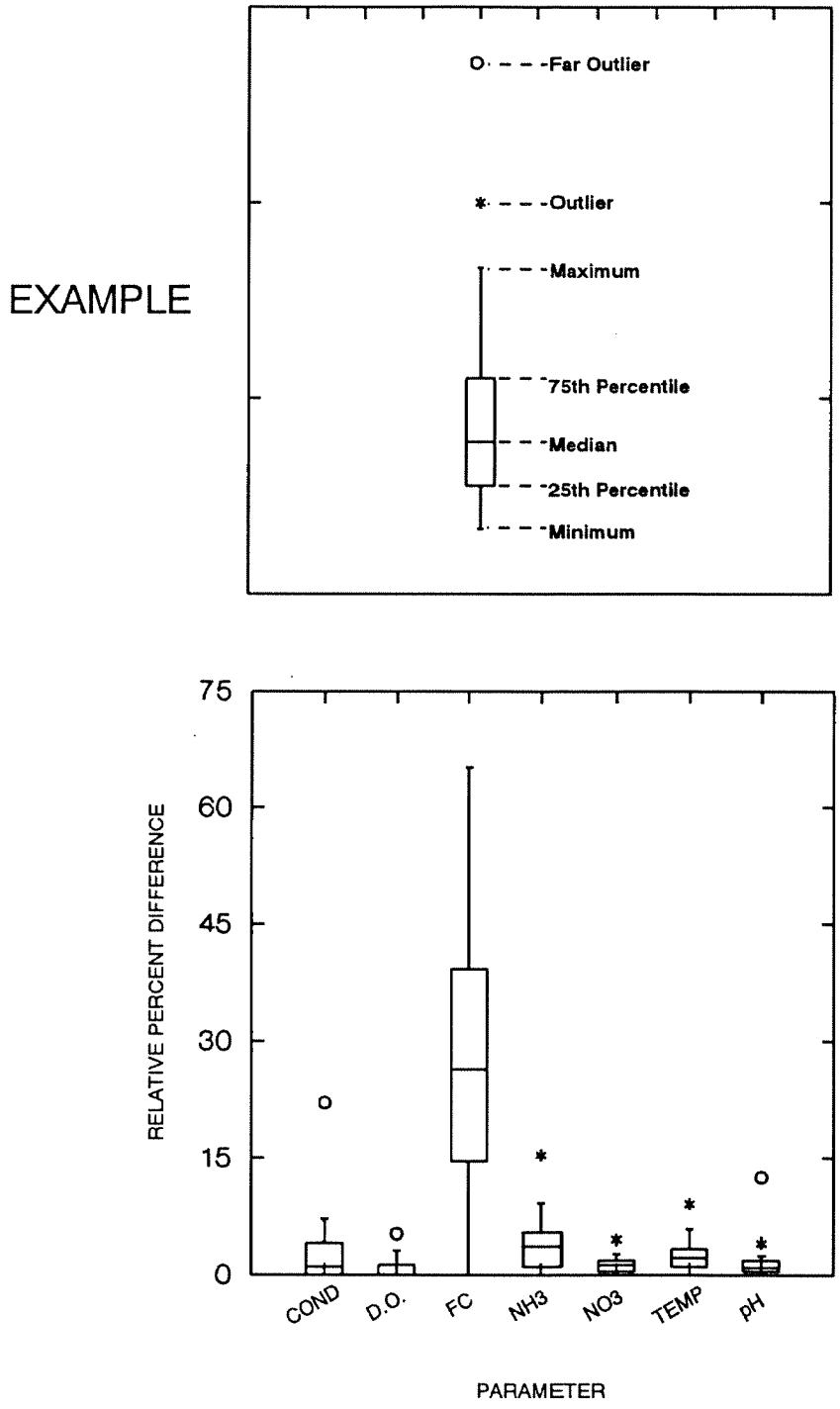

Figure B1. Relative percent difference of replicate samples for the water quality screening study in the Dakota, Bertrand, and Fishtrap Creek watersheds.

Appendix C. Parametric coverage and analytical methods for the Dakota, Bertrand, and and Fishtrap Creek water quality screening.

Parameter	Method of Analysis	Method (1) Reference	Detection Limit
Field			
pH	Beckman Meter	-	0.1 Std. units
Temperature	Beckman Thermistor	-	0.5 C°
Specific Conductance	Beckman Meter	-	1 μmhos/cm
Dissolved Oxygen	Iodometric, Azide Modified	SM421A	0.1 mg/L
Laboratory			
Fecal Coliform	Membrane Filter	SM909C	1 cfu/100 mL
Ammonia-N	Phenate	EPA 350.1	0.01 mg/L
Nitrate+Nitrite-N	Cadmium Reduction	EPA 353.2	0.01 mg/L

(1) SM: APHA,1989
EPA: EPA, 1983

Appendix D. Class A (excellent) freshwater quality standards and characteristic uses (WAC 173-201-045).

General Characteristics:	Shall meet or exceed the requirements for all or substantially all uses.
Characteristic uses:	Shall include, but not be limited to, the following: domestic, industrial, and agricultural water supply; stock watering; salmonid and other fish migration, rearing, spawning, and harvesting; wildlife habitat; primary contact recreation, sport fishing, boating, and aesthetic enjoyment; and commerce and navigation.
Water Quality Criteria	
Fecal Coliform:	Shall not exceed a geometric mean value of 100 organisms/100 mL, with not more than 10% of samples exceeding 200 organisms/100 mL.
Dissolved Oxygen:	Shall exceed 8.0 mg/L.
Temperature:	Shall not exceed 18.0°C due to human activities. When natural conditions exceed 18°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C. Increases from nonpoint sources shall not exceed 2.8°C with a maximum of 18.3°C.
pH:	Shall be within the range of 6.5 to 8.5 with a man-caused variation within a range of less than 0.5 units.
Ammonia:	Chronic 4-day and acute 1-hour toxicity are based on pH and temperature. The calculations follow those established by EPA (1986).
Toxic, Radioactive, or Deleterious material:	Shall be below concentrations which may adversely affect characteristic water uses, cause acute or chronic conditions to aquatic biota, or adversely affect public health.
Aesthetic Values:	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#		Site Location	Time	Temp (°C)	pH (S.U.)		Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)
DAKOTA CREEK WATERSHED													
02/03/92	D1		Sunrise Rd and "H" St	1340	8.6	7.4		30	10.5	90	31	0.599	0.017
03/02/92	D1		Sunrise Rd and "H" St	1220	9.7	7.5		35	10.1	89	1	0.225	0.010
03/09/92	D1		Sunrise Rd and "H" St	1130	6.6	7.4		36	11.4	93	9	0.168	0.012
03/16/92	D1		Sunrise Rd and "H" St	1120	10.4	7.4		43	10.2	91	51	0.198	0.018
03/16/92	D1	R	Sunrise Rd and "H" St	1125	9.5	7.3		40	10.3	90	68	0.196	0.019
02/03/92	D2	R	Sunrise Rd and Burk Rd	1325	9.3	7.1		152	7.9	69	21	3.21	3.44
02/03/92	D2		Sunrise Rd and Burk Rd	1325	9.6	7.1		160	7.9	69	31	3.24	3.50
03/02/92	D2		Sunrise Rd and Burk Rd	1230	10.2	7.5		110	9.3	83	73	1.87	0.062
03/09/92	D2		Sunrise Rd and Burk Rd	1145	6.8	7.3		110	10.6	87	11	1.41	0.051
03/16/92	D2		Sunrise Rd and Burk Rd	1140	10.3	6.8		108	10.1	90	12	0.516	0.040
02/03/92	D3		Sunrise Rd and W. Badger Rd	1310	9.0	7.1		155	9.7	84	61	6.49	0.021
03/02/92	D3		Sunrise Rd and W. Badger Rd	1245	10.6	7.3		162	8.5	76	12	3.87	0.017
03/09/92	D3		Sunrise Rd and W. Badger Rd	1200	7.4	7.3		240	9.2	77	130	2.85	0.011
03/16/92	D3		Sunrise Rd and W. Badger Rd	1200	10.8	6.5		190	7.3	66	3	2.12	0.016
02/03/92	D4		Sunrise Rd and Loomis Rd	1255	8.9	7.2		170	7.5	65	490	2.27	0.206
03/02/92	D4		Sunrise Rd and Loomis Rd	1300	10.7	7.2		210	7.4	67	230	2.03	0.223
03/09/92	D4		Sunrise Rd and Loomis Rd	1210	ND	7.2		230	9.1	62	37	2.07	ND
03/16/92	D4		Sunrise Rd and Loomis Rd	1210	10.7	6.7		ND	8.6	77	84	1.86	0.041
02/03/92	D5		Sunrise Rd and Jess Rd	1240	9.2	7.1		200	5.9	51	200	1.78	0.128
03/02/92	D5		Sunrise Rd and Jess Rd	1310	11.0	7.0		267	6.0	54	46	1.61	0.315
03/09/92	D5		Sunrise Rd and Jess Rd	1215	9.0	7.0	E	274	6.5	56	140	1.48	0.331
03/09/92	D5	R	Sunrise Rd and Jess Rd	1220	8.9	8.0	E	273	6.4	55	140	1.46	0.331
03/16/92	D5		Sunrise Rd and Jess Rd	1230	11.1	6.7		300	5.7	52	1900	2.05	1.17
02/03/92	D6		Delta Line Rd and Haynie Rd	1220	8.6	7.3		57	11.4	98	53	1.46	0.161
03/02/92	D6		Delta Line Rd and Haynie Rd	1150	9.6	7.7		65	9.8	86	25	0.954	0.017
03/09/92	D6		Delta Line Rd and Haynie Rd	1119	7.1	7.5		70	11.7	97	7	0.800	0.016
03/16/92	D6		Delta Line Rd and Haynie Rd	1110	10.1	6.9		75	10.9	97	21	0.701	0.015

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#		Site Location	Time	Temp (°C)	pH (S.U.)	Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)
02/03/92	D7		Delta Line Rd and W. Badger	1200	8.7	7.1	150	9.8	84	36	3.56	0.052
03/02/92	D7		Delta Line Rd and W. Badger	1140	10.3	7.4	186	9.3	83	28	3.02	0.028
03/09/92	D7		Delta Line Rd and W. Badger	1050	8.0	7.5	190	10.2	86	29	2.85	0.031
03/16/92	D7		Delta Line Rd and W. Badger	1055	10.7	7.1	200	9.5	86	200	2.68	0.037
03/02/92	D8		Loomis Trail Rd E. of Delta Rd	1100	10.4	7.4	248	9.1	81	27	3.34	0.084
03/09/92	D8		Loomis Trail Rd E. of Delta Rd	1015	7.0	7.4	240	9.6	79	17	2.72	0.197
03/16/92	D8		Loomis Trail Rd E. of Delta Rd	1035	10.7	7.1	200	8.0	72	49	1.80	0.654
02/03/92	D9		Delta Line Rd N. of Jess Rd, bridge	1130	8.8	7.1	180	6.3	54	120	2.23	0.111
03/02/92	D9		Delta Line Rd N. of Jess Rd, bridge	1045	10.6	7.2	242	6.5	58	6100	2.24	0.258
03/09/92	D9		Delta Line Rd N. of Jess Rd, bridge	1010	8.2	7.2	247	7.6	64	240	2.21	0.218
03/16/92	D9		Delta Line Rd N. of Jess Rd, bridge	1025	10.8	6.9	215	6.6	60	310	2.45	0.308
02/03/92	D10		Custer School Rd on the NF	1100	7.9	7.2	79	11.3	95	81	2.90	0.158
03/02/92	D10		Custer School Rd on the NF	1020	9.2	7.6	110	10.2	89	40	1.79	0.020
03/09/92	D10		Custer School Rd on the NF	0945	7.2	7.6	108	11.0	91	14	1.62	0.021
03/16/92	D10		Custer School Rd on the NF	1005	9.1	7.3	125	10.2	88	21	1.94	0.026
02/03/92	D11		Custer School Rd on the SF	1110	8.6	7.0	164	8.4	72	32	2.31	0.076
03/02/92	D11		Custer School Rd on the SF	1013	9.7	7.4	223	8.3	73	88	2.15	0.035
03/09/92	D11		Custer School Rd on the SF	0940	7.2	7.4	230	9.2	76	240	1.98	0.032
03/16/92	D11		Custer School Rd on the SF	0955	9.6	7.3	250	7.7	68	470	2.05	0.165
03/02/92	D12		Valley View Rd and Behme Rd	0940	9.6	7.7	165	9.5	83	160	1.88	0.035
03/09/92	D12		Valley View Rd and Behme Rd	0915	7.0	7.5	170	10.4	86	74	1.69	0.031
03/16/92	D12		Valley View Rd and Behme Rd	0920	9.4	7.7	190	9.3	81	280	1.78	0.295
02/03/92	D13		Giles Rd and McGee Rd	1035	8.4	7.6	112	10.3	88	150	1.93	0.103
03/02/92	D13		Giles Rd and McGee Rd	0918	9.1	7.8	153	9.8	85	29	1.74	0.028
03/09/92	D13	R	Giles Rd and McGee Rd	0855	7.2	7.6	155	10.6	88	72	1.49	0.030
03/09/92	D13		Giles Rd and McGee Rd	0850	7.2	7.6	155	10.6	88	59	1.49	0.030
03/16/92	D13		Giles Rd and McGee Rd	0900	9.6	8.1	170	9.9	87	170	1.56	0.036

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#		Site Location	Time	Temp (°C)	pH (S.U.)	Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)	
03/02/92	D15	R	Custer School Rd trib to SF	1000	9.1	7.3	116	7.4	64	9	0.369	0.019	
03/02/92	D15		Custer School Rd trib to SF	1000	9.3	7.4	118	7.8	68	6	0.375	0.018	
03/09/92	D15		Custer School Rd trib to SF	0930	6.9	7.4	130	8.3	68	9	0.338	0.020	
03/16/92	D15	R	Custer School Rd trib to SF	0940	9.0	7.3	140	7.6	66	57	0.311	0.035	
03/16/92	D15		Custer School Rd trib to SF	0935	9.1	7.4	140	7.6	66	29	0.313	0.030	
BERTRAND CREEK WATERSHED													
03/03/92	B1		Jackman Rd at Canadian border	1200	9.1	7.2	126	9.9	86	290	2.80	0.041	
03/10/92	B1		Jackman Rd at Canadian border	1045	7.9	7.0	130	10.8	91	18	2.72	0.031	
03/17/92	B1		Jackman Rd at Canadian border	1030	10.5	6.8	125	10.0	90	26	2.31	0.029	
02/04/92	B2		"H" St E. of Axling Rd	1255	7.6	7.3	105	11.1	93	57	2.55	0.059	
03/03/92	B2		"H" St E. of Axling Rd	1215	9.0	7.6	130	10.8	93	51	2.19	0.020	
03/10/92	B2		"H" St E. of Axling Rd	1100	8.0	7.3	140	12.2	103	49	2.10	0.011	
03/17/92	B2		"H" St E. of Axling Rd	1100	11.0	6.8	160	12.5	113	280	2.10	0.01	U
02/04/92	B5		W. Badger Rd and Glendale Rd	1210	7.5	7.3	125	10.2	85	49	3.68	0.029	
03/03/92	B5		W. Badger Rd and Glendale Rd	1040	9.1	7.3	147	9.6	83	40	2.60	0.035	
03/10/92	B5		W. Badger Rd and Glendale Rd	0930	7.1	6.9	148	11.2	92	10	2.29	0.021	
03/17/92	B5		W. Badger Rd and Glendale Rd	0905	10.5	7.0	150	10.2	91	170	1.89	0.020	
02/04/92	B6		Berthusen Park	1155	7.6	7.1	148	10.4	87	23	2.64	0.153	
03/03/92	B6		Berthusen Park	1055	8.9	7.1	177	9.4	81	37	2.32	0.141	
03/03/92	B6	R	Berthusen Park	1055	8.9	7.1	177	9.4	81	28	2.29	0.137	
03/10/92	B6		Berthusen Park	0945	7.2	6.6	185	10.2	84	44	2.33	0.108	
03/17/92	B6		Berthusen Park	0930	10.4	6.5	200	9.2	82	170	2.23	0.196	E
02/04/92	B7		Jackman Rd at bridge	1140	7.8	7.0	248	7.0	59	60	3.10	0.466	
02/04/92	B7	R	Jackman Rd at bridge	1140	7.6	6.7	248	7.2	60	63	3.09	0.465	
03/03/92	B7		Jackman Rd at bridge	1140	9.3	6.9	224	8.0	70	1100	2.69	0.609	
03/10/92	B7		Jackman Rd at bridge	1020	7.7	6.7	212	9.5	80	160	2.56	0.203	
03/10/92	B7	R	Jackman Rd at bridge	1025	7.5	6.7	209	9.8	82	100	2.61	0.204	
03/17/92	B7		Jackman Rd at bridge	1020	10.6	6.5	208	8.8	79	190	2.55	0.294	

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#		Site Location	Time	Temp (°C)	pH (S.U.)	Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)
02/04/92	B8E		Guide Meridian and Badger Rd (east)	1120	7.5	6.7	210	8.6	72	220	2.17	0.607
03/03/92	B8E		Guide Meridian and Badger Rd (east)	1120	9.5	7.3	199	4.1	36	400	2.92	0.230
03/10/92	B8E	R	Guide Meridian and Badger Rd (east)	1005	6.5	6.9	265	9.1	74	230	1.08	1.82
03/10/92	B8E		Guide Meridian and Badger Rd (east)	1000	6.6	7.1	267	9.1	74	280	1.13	1.66
03/17/92	B8E	R	Guide Meridian and Badger Rd (east)	1005	11.6	7.1	428	3.1	29	28000	0.020	12.5
03/17/92	B8E		Guide Meridian and Badger Rd (east)	1000	11.8	7.0	425	3.0	28	33000	0.021	12.4
02/04/92	B9W		Guide Meridian and Badger Rd (west)	1115	7.6	6.9	222	10.7	89	80	1.58	0.082
03/03/92	B9W		Guide Meridian and Badger Rd (west)	1115	8.7	7.0	268	9.4	81	4000	1.18	1.85
03/10/92	B9W		Guide Meridian and Badger Rd (west)	no flo	–	–	–	–	–	–	–	–
03/17/92	B9W		Guide Meridian and Badger Rd (west)	no flo	–	–	–	–	–	–	–	–
02/04/92	B10		Loomis Trail Rd W. of Weidkamp Rd	1040	6.9	7.2	160	9.5	78	46	2.63	0.132
03/03/92	B10		Loomis Trail Rd W. of Weidkamp Rd	1005	9.3	7.0	190	9.1	79	28	2.37	0.041
03/10/92	B10		Loomis Trail Rd W. of Weidkamp Rd	0915	7.4	6.8	193	10.0	83	17	2.39	0.034
03/17/92	B10		Loomis Trail Rd W. of Weidkamp Rd	0900	10.3	6.7	200	8.9	79	96	2.48	0.038
02/04/92	B11		Loomis Trail Rd W. of Berthusen Rd	1050	7.1	7.2	148	10.6	88	66	2.56	0.161
03/03/92	B11		Loomis Trail Rd W. of Berthusen Rd	0955	9.1	7.2	177	9.8	85	40	2.33	0.125
03/10/92	B11		Loomis Trail Rd W. of Berthusen Rd	0900	7.5	7.3	190	10.5	88	47	2.18	0.090
03/17/92	B11		Loomis Trail Rd W. of Berthusen Rd	0845	10.6	6.7	195	9.6	86	210	2.36	0.082
02/04/92	B12		Birch Bay–Lynden Rd W. of Berthusen Rd	0945	6.9	7.2	148	10.6	87	52	2.59	0.141
03/03/92	B12		Birch Bay–Lynden Rd W. of Berthusen Rd	0935	9.1	7.4	182	9.7	84	53	2.48	0.090
03/10/92	B12		Birch Bay–Lynden Rd W. of Berthusen Rd	0840	7.5	7.2	190	10.7	89	180	2.55	0.067
03/17/92	B12		Birch Bay–Lynden Rd W. of Berthusen Rd	0830	10.5	6.6	200	10.0	90	220	2.73	0.050
02/04/92	B13		Birch Bay–Lynden Rd E. of Bob Hall Rd	0935	7.1	7.2	143	10.2	84	180	2.84	0.058
03/03/92	B13		Birch Bay–Lynden Rd E. of Bob Hall Rd	0920	9.6	7.2	200	9.4	82	92	3.46	0.041
03/10/92	B13		Birch Bay–Lynden Rd E. of Bob Hall Rd	0820	8.5	7.4	200	9.8	84	54	3.41	0.023
03/17/92	B13		Birch Bay–Lynden Rd E. of Bob Hall Rd	0810	11.4	6.8	200	9.5	87	56	3.58	0.019
02/04/92	B14		Willeys Lake Rd and Rathbone Rd	0910	6.9	7.3	148	10.7	88	88	2.65	0.121
03/03/92	B14		Willeys Lake Rd and Rathbone Rd	0900	9.4	7.4	185	10.0	87	110	2.69	0.085
03/10/92	B14		Willeys Lake Rd and Rathbone Rd	0750	7.5	7.1	190	10.7	89	60	2.61	0.049
03/17/92	B14		Willeys Lake Rd and Rathbone Rd	0800	10.7	6.9	200	10.0	90	190	2.90	0.040

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#		Site Location	Time	Temp (°C)	pH (S.U.)	Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)	
02/04/92	B15		Birch Bay-Lynden Rd and Flynn Rd	0850	7.2	7.1	189	10.7	89	490	3.58	0.149	
03/03/92	B15		Birch Bay-Lynden Rd and Flynn Rd	0845	8.9	7.0	278	9.6	83	870	1.41	0.829	
03/10/92	B15		Birch Bay-Lynden Rd and Flynn Rd	0735	7.1	7.4	265	10.2	84	430	1.42	0.592	
03/17/92	B15		Birch Bay-Lynden Rd and Flynn Rd	0745	10.6	6.5	250	9.4	84	570	1.54	0.574	
FISHTRAP CREEK WATERSHED													
02/05/92	F1		Flynn Rd	0835	6.5	7.0	205	10.6	86	260	3.65	0.113	
03/04/92	F1		Flynn Rd	0810	8.7	7.5	220	10.4	89	1200	3.68	0.401	
03/11/92	F1		Flynn Rd	0825	7.7	7.2	220	11.2	94	140	3.77	0.054	
03/18/92	F1		Flynn Rd	0820	9.2	6.2	210	10.8	94	140	3.64	0.044	E
02/05/92	F2E		E. Main St and Double Ditch Rd (east)	0910	5.4	7.2	153	10.5	83	88	2.88	0.124	
03/04/92	F2E		E. Main St and Double Ditch Rd (east)	0825	8.4	7.7	236	8.9	76	>2000	2.33	6.10	
03/11/92	F2E	R	E. Main St and Double Ditch Rd (east)	0845	6.7	7.5	171	11.3	92	66	2.94	0.056	
03/11/92	F2E		E. Main St and Double Ditch Rd (east)	0840	7.0	7.5	180	11.3	93	85	2.98	0.053	
03/18/92	F2E		E. Main St and Double Ditch Rd (east)	0840	8.8	6.6	170	11.0	95	200	2.97	0.046	
03/18/92	F2E	R	E. Main St and Double Ditch Rd (east)	0845	8.3	6.7	170	10.9	93	250	2.89	0.044	
02/05/92	F3W		E. Main St and Double Ditch Rd (west)	0915	5.8	7.2	178	10.5	84	890	3.20	0.169	
03/04/92	F3W		E. Main St and Double Ditch Rd (west)	0830	8.4	7.7	210	9.6	82	11000	2.43	2.91	
03/11/92	F3W		E. Main St and Double Ditch Rd (west)	0850	6.6	7.1	190	11.5	94	440	2.57	0.056	
03/18/92	F3W		E. Main St and Double Ditch Rd (west)	0850	8.2	6.8	180	11.1	94	1000	2.57	0.113	
02/05/92	F4		Benson Rd betw E. Main and E. Badger	0930	6.6	6.9	254	8.0	65	100	1.63	0.359	
03/04/92	F4		Benson Rd betw E. Main and E. Badger	0845	8.6	7.3	260	8.7	75	52	0.930	0.412	
03/11/92	F4		Benson Rd betw E. Main and E. Badger	0905	6.9	7.3	240	9.6	79	19	0.310	0.404	
03/18/92	F4		Benson Rd betw E Main and E. Badger	0900	8.0	6.6	260	10.1	85	280	0.255	0.377	
02/05/92	F5		Bender Rd south of E. Badger	0945	7.2	6.8	198	9.7	80	100	5.18	0.086	
03/04/92	F5		Bender Rd south of E. Badger	0910	9.0	7.6	217	9.7	84	110	5.05	0.027	
03/11/92	F5		Bender Rd south of E. Badger	0930	8.0	7.4	215	10.7	90	48	5.19	0.028	
03/18/92	F5	R	Bender Rd south of E. Badger	0930	8.9	6.7	215	10.4	90	110	4.83	0.021	
03/18/92	F5		Bender Rd south of E. Badger	0925	9.2	6.7	215	10.4	90	100	4.83	0.022	

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#		Site Location	Time	Temp (°C)	pH (S.U.)	Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)	
02/05/92	F6		E. Badger Rd and Vinnup Rd	1005	7.1	6.8	202	9.1	75	270	5.22	0.124	
03/04/92	F6		E. Badger Rd and Vinnup Rd	0925	9.0	6.9	210	9.1	79	140	5.19	0.034	
03/11/92	F6		E. Badger Rd and Vinnup Rd	1000	8.6	6.9	216	10.2	87	120	5.00	0.035	
03/11/92	F6	R	E. Badger Rd and Vinnup Rd	1005	8.3	6.9	213	10.2	87	77	5.09	0.037	
03/18/92	F6		E. Badger Rd and Vinnup Rd	0945	9.9	6.6	210	10.0	88	390	5.00	0.028	
02/05/92	F8		Pangborn Rd and Bender Rd	1230	8.1	6.7	268	5.5	47	92	2.48	0.286	
03/04/92	F8		Pangborn Rd and Bender Rd	1110	9.3	6.8	273	5.9	51	>2000	2.34	0.377	
03/11/92	F8		Pangborn Rd and Bender Rd	1115	9.5	6.6	270	8.1	71	230	2.89	0.162	
03/18/92	F8		Pangborn Rd and Bender Rd	1100	10.1	6.4	270	8.7	77	770	3.11	0.255	E
02/05/92	F9		Double Ditch Rd, 1 mile N. of E. Badger Rd (east)	1120	6.1	7.0	152	11.0	89	240	3.40	0.100	
03/04/92	F9		Double Ditch Rd, 1 mile N. of E. Badger Rd (east)	1015	8.7	7.6	195	9.5	82	8200	2.58	3.93	
03/11/92	F9		Double Ditch Rd, 1 mile N. of E. Badger Rd (east)	1020	7.8	7.3	170	11.9	100	43	3.08	0.040	
03/18/92	F9		Double Ditch Rd, 1 mile N. of E. Badger Rd (east)	1010	9.2	6.7	170	11.4	99	140	3.19	0.024	
02/05/92	F10		Double Ditch Rd, 1 mile N. of E. Badger Rd (west)	1115	6.9	7.0	157	10.8	89	52	3.28	0.075	
03/04/92	F10		Double Ditch Rd, 1 mile N. of E. Badger Rd (west)	1020	9.0	7.4	204	9.8	85	>2000	2.51	4.21	
03/11/92	F10		Double Ditch Rd, 1 mile N. of E. Badger Rd (west)	1025	8.9	7.2	180	12.5	108	330	2.94	0.055	
03/18/92	F10		Double Ditch Rd, 1 mile N. of E. Badger Rd (west)	1020	10.0	6.7	180	11.7	104	1400	2.95	0.055	
02/05/92	F11		Boundary Rd and Northwood Rd at bridge	1250	8.0	7.0	188	8.8	74	37	5.00	0.089	
03/04/92	F11		Boundary Rd and Northwood Rd at bridge	1135	ND	7.1	190	9.8	85	20	4.72	ND	
03/11/92	F11		Boundary Rd and Northwood Rd at bridge	1140	9.7	6.7	200	10.6	93	5	4.91	0.022	
03/18/92	F11		Boundary Rd and Northwood Rd at bridge	1130	10.4	6.7	200	10.4	93	13	4.92	0.015	
02/05/92	F12		Pangborn Rd and Assink Rd	1235	7.9	6.9	202	9.0	76	56	5.52	0.096	
03/04/92	F12		Pangborn Rd and Assink Rd	1120	9.2	7.2	210	9.0	78	5700	5.23	0.068	
03/11/92	F12		Pangborn Rd and Assink Rd	1125	9.3	6.8	220	10.3	90	37	5.25	0.031	
03/18/92	F12		Pangborn Rd and Assink Rd	1115	10.2	6.6	220	10.1	90	84	5.11	0.029	
02/05/92	F13		Visser Rd and Depot Rd	1155	6.9	6.9	153	E	9.2	76	5000	9.27	0.150
02/05/92	F13	R	Visser Rd and Depot Rd	1155	6.8	6.9	191	E	9.2	75	5200	9.27	0.147
03/04/92	F13		Visser Rd and Depot Rd	1100	8.8	7.3	380		2.6	22	16000	5.44	18.3
03/11/92	F13		Visser Rd and Depot Rd	1105	7.3	6.8	240		7.7	64	150	12.8	0.137
03/18/92	F13		Visser Rd and Depot Rd	no flo	–	–	–		–	–	–	–	–

Appendix E. Summary of data collected in the Dakota, Bertrand, and Fishtrap Watersheds during February–March, 1992.

Date	Site#	Site Location	Time	Temp (°C)	pH (S.U.)	Specific Conductance (μmhos/cm)	D.O. (mg/L)	D.O. (%sat)	FC (cfu/100mL)	NO3+NO2-N (mg/L)	NH3-N (mg/L)	
02/05/92	F14	Before creek splits along Double Ditch Rd, Canada	1140	6.1	7.1	142	10.6	85	43	3.54	0.036	
03/04/92	F14E	Double Ditch Rd and E. Boundary Rd (east)	1040	8.7	7.4	182	9.2	79	3500	2.57	2.95	
03/11/92	F14E	Double Ditch Rd and E. Boundary Rd (east)	1050	8.3	6.9	165	11.3	96	60	3.16	0.032	
03/18/92	F14E	Double Ditch Rd and E. Boundary Rd (east)	1030	9.2	6.8	170	9.5	83	160	3.24	0.019	
03/04/92	F14W	Double Ditch Rd and E. Boundary Rd (west)	1035	8.8	7.1	184	9.0	77	5600	2.86	3.05	
03/11/92	F14W	Double Ditch Rd and E. Boundary Rd (west)	1045	8.5	6.8	165	11.1	95	86	3.41	0.062	
03/18/92	F14W	Double Ditch Rd and E. Boundary Rd (west)	1025	9.4	6.7	170	10.4	91	190	3.33	0.050	
02/05/92	F16	Bender Rd south of E. Badger (ditch)	0955	7.4	6.8	274	8.0	67	4600	1.70	0.278	
03/04/92	F16	Bender Rd south of E. Badger (ditch)	0915	8.9	7.4	280	9.1	79	680	2.11	0.161	
03/11/92	F16	Bender Rd south of E. Badger (ditch)	0935	7.9	7.3	270	10.6	89	440	2.32	0.089	
03/18/92	F16	Bender Rd south of E. Badger (ditch)	0935	8.9	6.8	270	10.5	91	370	2.72	0.124	
02/05/92	F17	E. Badger Rd and Benson Rd	1030	7.2	6.6	270	6.3	52	9	1.99	0.404	
03/04/92	F17	E. Badger Rd and Benson Rd	0955	8.9	6.9	265	7.0	60	8	1.14	0.451	
03/04/92	F17	R E. Badger Rd and Benson Rd	1000	8.9	6.7	273	7.0	60	11	1.11	0.444	
03/11/92	F17	E. Badger Rd and Benson Rd	1010	7.6	6.8	285	7.7	64	3	0.305	0.562	
03/18/92	F17	E. Badger Rd and Benson Rd	1000	8.5	6.3	280	8.2	70	5	0.158	0.583	E
03/04/92	F18	Depot Rd at Park, betw E. Main and E. Badger Rd	0855	8.9	7.6	215	9.9	85	110	4.79	0.030	
03/11/92	F18	Depot Rd at Park, betw E. Main and E. Badger Rd	0920	7.8	7.5	220	10.8	91	51	4.89	0.029	
03/18/92	F18	Depot Rd at Park, betw E. Main and E. Badger Rd	0915	8.9	6.7	210	10.6	91	100	4.65	0.024	

U– value below detection limit
J– laboratory estimate
BOF– bottle too full for adequate mixing
JF– estimate due to ice formation
S– estimate, FC colonies masked by other bacteria
E– estimate
ND– no data
R–replicate

Appendix F. Summary of Class A water quality violations found in the Dakota, Bertrand, and Fishtrap Creek Watersheds (February-March 1992). The number of samples violating the criteria for D.O., pH and ammonia are provided. Data is also summarized for the two-part fecal coliform criterion.

SITE#	SITE LOCATION	SAMPLE SIZE	D.O. (< 8.0 mg/L)	pH (<6.5 S.U.)	NH3-N (exceeds criteria)	FC (GM >100 CFU/100 mL)	FC (>200 cfu/100mL)
Dakota Creek							
D1	Sunrise Rd and "H" St	4	-	-	-	-	-
D2	Sunrise Rd and Burk Rd	4	1	-	1	-	-
D3	Sunrise Rd and W Badger Rd	4	1	-	-	-	-
D4	Sunrise Rd and Loomis Trail Rd	4	2	-	-	140	2
D5	Sunrise Rd and Jess Rd	4	4	-	-	220	2
D6	Delta Line Rd and Haynie Rd	4	-	-	-	-	-
D7	Delta Line Rd and W Badger	4	-	-	-	-	-
D8	Loomis Trail Rd E of Delta Line Rd	3	1	-	-	-	-
D9	Delta Line Rd N of Jess Rd, Bridge	4	4	-	-	480J	3
D10	Custer School Rd on the NF	4	-	-	-	-	-
D11	Custer School Rd on the SF	4	1	-	-	130J	2
D12	Valley View Rd and Behme Rd	3	-	-	-	280J	1
D13	Giles Rd and McGee Rd	4	-	-	-	-	-
D15	Custer School Rd trib to SF	3	2	-	-	-	-
Bertrand Creek							
B1	Jackman Rd at Canadian Border	3	-	-	-	-	1
B2	"H" St E of Axling Rd	4	-	-	-	-	1
B5	W Badger Rd and Glendale Rd	4	-	-	-	-	-
B6	Berthusen Park	4	-	-	-	-	-
B7	Jackman Rd at bridge	4	2	-	-	200J	1
B8E	Guide Meridian and Badger Rd (east)	4	2	-	1	910J	4
B9W	Guide Meridian and Badger Rd (west)	2	-	-	1	570	1
B10	Loomis Trail Rd W of Weidkamp Rd	4	-	-	-	-	-
B11	Loomis Trial Rd W of Berthusen Rd	4	-	-	-	-	1
B12	Birch Bay-Lynden Rd W of Berthusen Rd	4	-	-	-	-	1
B13	Birch Bay-Lynden Rd E of Bob Hall Rd	4	-	-	-	-	-
B14	Willeys Lake Rd and Rathbone Rd	4	-	-	-	-	-
B15	Birch Bay-Lynden Rd and Flynn Rd	4	-	-	-	570	4

Appendix F. Summary of Class A water quality violations found in the Dakota, Bertrand, and Fishtrap Creek Watersheds (February-March 1992). The number of samples violating the criteria for D.O., pH and ammonia are provided. Data is also summarized for the two-part fecal coliform criterion.

SITE#	SITE LOCATION	SAMPLE SIZE	D.O. (< 8.0 mg/L)	pH (<6.5 S.U.)	NH3-N (exceeds criteria)	FC (GM >100 CFU/100 mL)	FC (>200 cfu/100mL)
Fishtrap Creek							
F1	Flynn Rd	4	-	1	-	280J	2
F2E	E Main St and Double Ditch Rd (east)	4	-	-	1	320J	2
F3W	E Main St and Double Ditch Rd (west)	4	-	-	1	1700J	4
F4	Benson Rd betw E Main and E Badger Rd	4	1	-	-	-	1
F5	Bender Rd south of E Badger Rd	4	-	-	-	-	-
F6	E Badger Rd and Vinnup Rd	4	-	-	-	190	2
F8	Pangborn Rd and Bender Rd	4	2	1	-	420J	3
F9	Double Ditch Rd 1 mile N of E Badger Rd (east)	4	-	-	1	330	2
F10	Double Ditch Rd 1 mile N of E Badger Rd (west)	4	-	-	1	470J	3
F11	Boundary Rd and Northwood Rd at bridge	4	-	-	-	-	-
F12	Pangborn Rd and Assink Rd	4	-	-	-	180	1
F13	Visser Rd and Depot Rd	3	2	-	1	2300	2
F14	Before creek splits along Double Ditch Rd, Canada	1	-	-	-	-	-
F14E	Double Ditch Rd and E Boundary Rd (east)	3	-	-	1	320	1
F14W	Double Ditch Rd and E Boundary Rd (west)	3	-	-	1	450	1
F16	Bender Rd S of E Badger (ditch)	4	1	-	-	840J	4
F17	E Badger Rd and Benson Rd	4	4	1	-	-	-
F18	Depot Rd at Park, betw E Main and E Badger Rd	3	-	-	-	-	-

J- laboratory estimate

Appendix G. Ammonia data from Dakota, Bertrand, and Fishtrap Creek Watersheds compared to EPA chronic 4-day and acute 1-hour criteria. Only those data that exceed or closely approach the criteria are provided.

Date	ite#	Site Location	NH3-N (mg/L)		NH3-N chronic 4-day criteria	NH3-N acute 1-hour criteria
Dakota Creek						
02/03/92	D2	Sunrise Rd and Burk Rd	3.47	*C	1.9	19
Bertrand Creek						
03/10/92	B8E	Guide Meridian and Badger Rd (east)	1.74		1.9	21
03/17/92	B8E	Guide Meridian and Badger Rd (east)	12.4	*C	1.8	19
03/03/92	B9W	Guide Meridian and Badger Rd (west)	1.85	*C	1.9	21
Fishtrap Creek						
03/04/92	F2E	E Main St and Double Ditch Rd (east)	6.10	*C	1.9	9.6
03/04/92	F3W	E Main St and Double Ditch Rd (west)	2.91	*C	1.8	9.5
03/04/92	F9	Double Ditch Rd 1 mile N of E Badger Rd (east)	3.93	*C	1.9	11
03/04/92	F10	Double Ditch Rd 1 mile N of E Badger Rd (west)	4.21	*C	1.9	15
03/04/92	F13	Visser Rd and Depot Rd	18.3	*A	1.9	16
03/04/92	F14E	Double Ditch Rd and E Boundary Rd (east)	2.95	*C	1.9	15
03/04/92	F14W	Double Ditch Rd and E Boundary Rd (west)	3.05	*C	1.9	19

*C - Exceeds EPA chronic toxicity criterion

*A - Exceeds EPA acute toxicity criterion