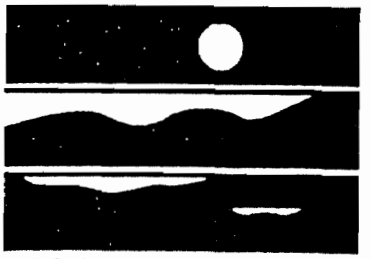

Ground Water Quality Survey near Edaleen Dairy, Whatcom County, Washington

January 1990 to April 1993

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Washington State
Department of Ecology

Ground Water Quality Survey near Edaleen Dairy, Whatcom County, Washington

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by

Dave Garland[1]
and
Denis Erickson[2]

[1]Washington State Department of Ecology
Northwest Regional Office
Water Quality Program - NonPoint Unit
Bellevue, Washington 98008-5442

[2]Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
Toxics, Compliance, and Ground Water Investigations Section
Olympia, Washington 98504-7710

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Abstract

Ground water quality was surveyed over a three-square mile area encompassing a large new dairy in Whatcom County. The ground water survey consisted of periodic sampling and water-level monitoring of 21 domestic and irrigation wells located within a one mile radius(far-field) of the 900-head dairy. This survey was conducted in conjunction with a near-field three-year ground water study which focused on ground water quality impacts of the waste storage lagoon at the new dairy. The dairy lagoon is situated over a shallow, unconfined, outwash aquifer. The purpose of this far-field water quality survey was to 1) define far-field ground water flow conditions in the vicinity surrounding the dairy and lagoon, and, 2) identify changes in ground water quality in local wells potentially affected by dairy lagoon leakage.

The survey began about two months before the initial lagoon filling on March 1, 1990. Ground water monitoring continued for over three years, ending in April 1993. Ground water samples were analyzed for specific conductance, major cations and anions including chloride, nitrite plus nitrate as nitrogen (NO_2+NO_3-N) and ammonia. Ground water quality in the shallow aquifer was generally good, with local occurrences of elevated nitrate concentrations apparently due to local dairy and agricultural practices. Based on the water-level survey results, ground water flows toward the south-southeast. None of the domestic wells sampled are located directly downgradient from the studied dairy lagoon. Statistical analysis of chloride and nitrate data indicates that water quality in the domestic wells was unaffected following three years of Edaleen waste storage lagoon use.

Acknowledgements

Many people contributed to this report and the associated monitoring work near Edaleen Dairy. The authors wish to thank the many well owners in the study area who made the ground water quality survey possible by allowing access to their property and wells. Thanks to Pam Covey, of the Ecology Environmental Laboratory in Manchester, for her helpful and flexible assistance in coordinating the sample analysis work. Tom Culhane, water resource hydrogeologist at Ecology's Northwest Regional Office, and Michael Hepp and Kirk Cook of Ecology's Water Quality Program Ground Water Unit, provided peer review. John Gillies, of the U.S. Soil Conservation Service and Chuck Timblin, of the Whatcom County Conservation District provided input from the land use and farm management perspectives. Phil Kauzloric gave input in light of the new draft Ecology dairy waste permit. Special thanks go to Ed Brandsma, owner of Edaleen Dairy, for his complete cooperation during the ground water investigations at and around his dairy.

Introduction

Background

Ground water was monitored within a one-mile radius of the Edaleen dairy lagoon for a period of over three years. Twenty one domestic and irrigation wells were monitored for water levels and water quality from January 1990 to April 1993. The ground water monitoring consisted of two parts: 1) near-field ground water monitoring at the Edaleen dairy lagoon, and 2) far-field ground water monitoring in domestic and irrigation wells. The first year results of the Edaleen Dairy near-field survey were described by Erickson (1991). The near-field lagoon study included one year of monthly monitoring and two years of quarterly monitoring at seven wells located within 200 feet of the lagoon, and one well located approximately 1700 feet downgradient from the lagoon. The first year report on the near-field monitoring concluded that the dairy waste storage lagoon was leaking and contaminating ground water near the lagoon. The first year report also recommended additional far-field monitoring to verify that no adverse water quality effects occurred in nearby domestic wells.

The far-field survey of local domestic and irrigation wells included water level measurements (average eight per year) and sampling (three per year) from the seven principal domestic wells. The results of the far-field survey are described in this report. Near-field water quality data collected concurrent with this study period are tabulated in Appendix C. This ground water quality survey involved wells within a three square mile area around Edaleen Dairy, in addition to the monitoring well network at the lagoon. The wells were surveyed with respect to the lagoon site to determine local ground water flow direction and to help locate suitable monitoring wells around the lagoon. The two objectives of the far-field ground water survey were to:

- define the far-field ground water quality and flow conditions, and
- determine if leakage from the lagoon adversely affected domestic wells south of the lagoon.

Location and Extent of the Area

The study area is located in a flat glacial outwash plain known as the Lynden Terrace which extends from the City of Lynden to north of the Canadian border (Washington Department of Conservation, 1960). The three square mile study area is situated between Bertrand and Fishtrap Creeks in northwestern Whatcom County and is located one mile north of the City of Lynden (Figures 1 and 2).

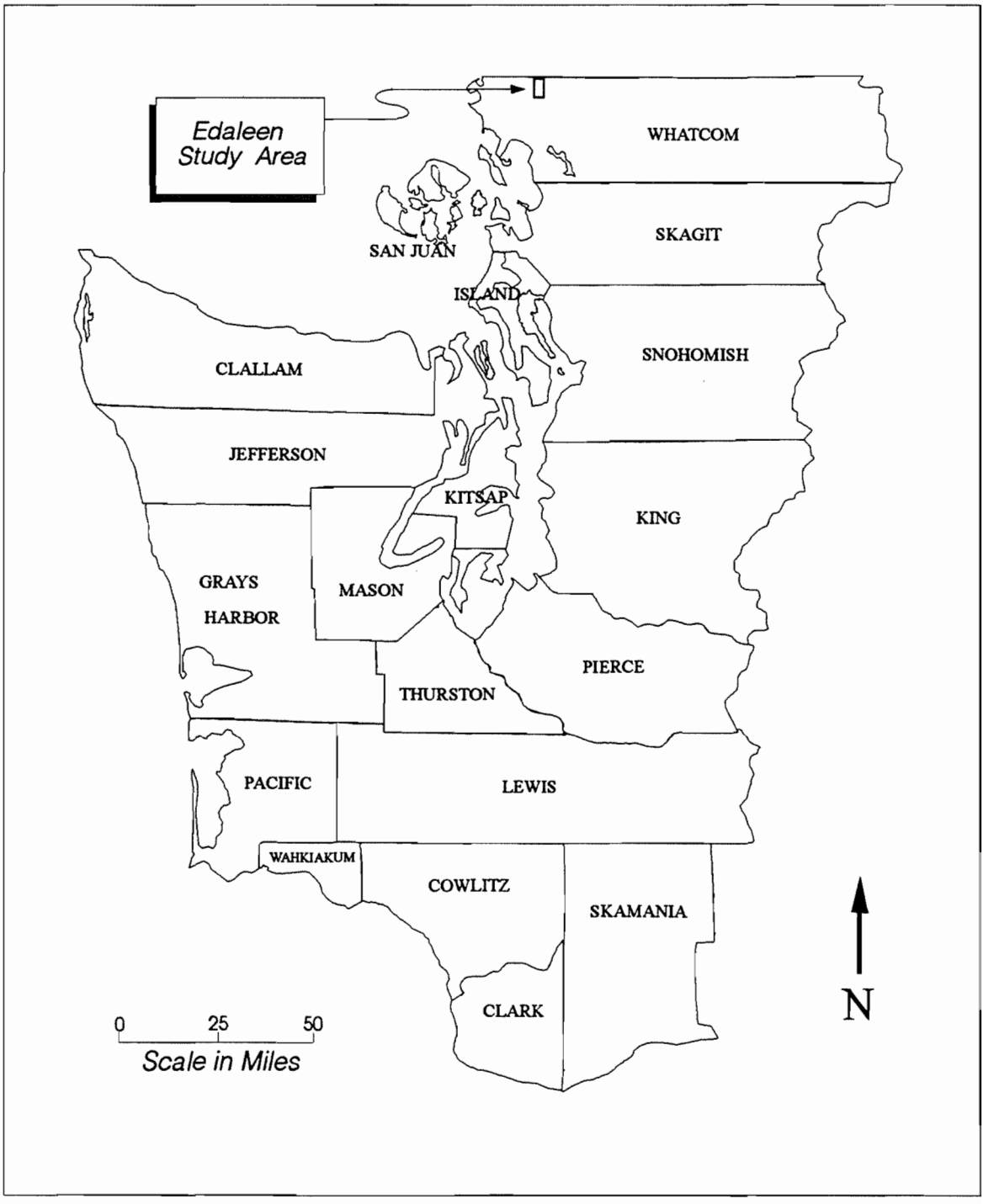

Figure 1. Edaleen study area location

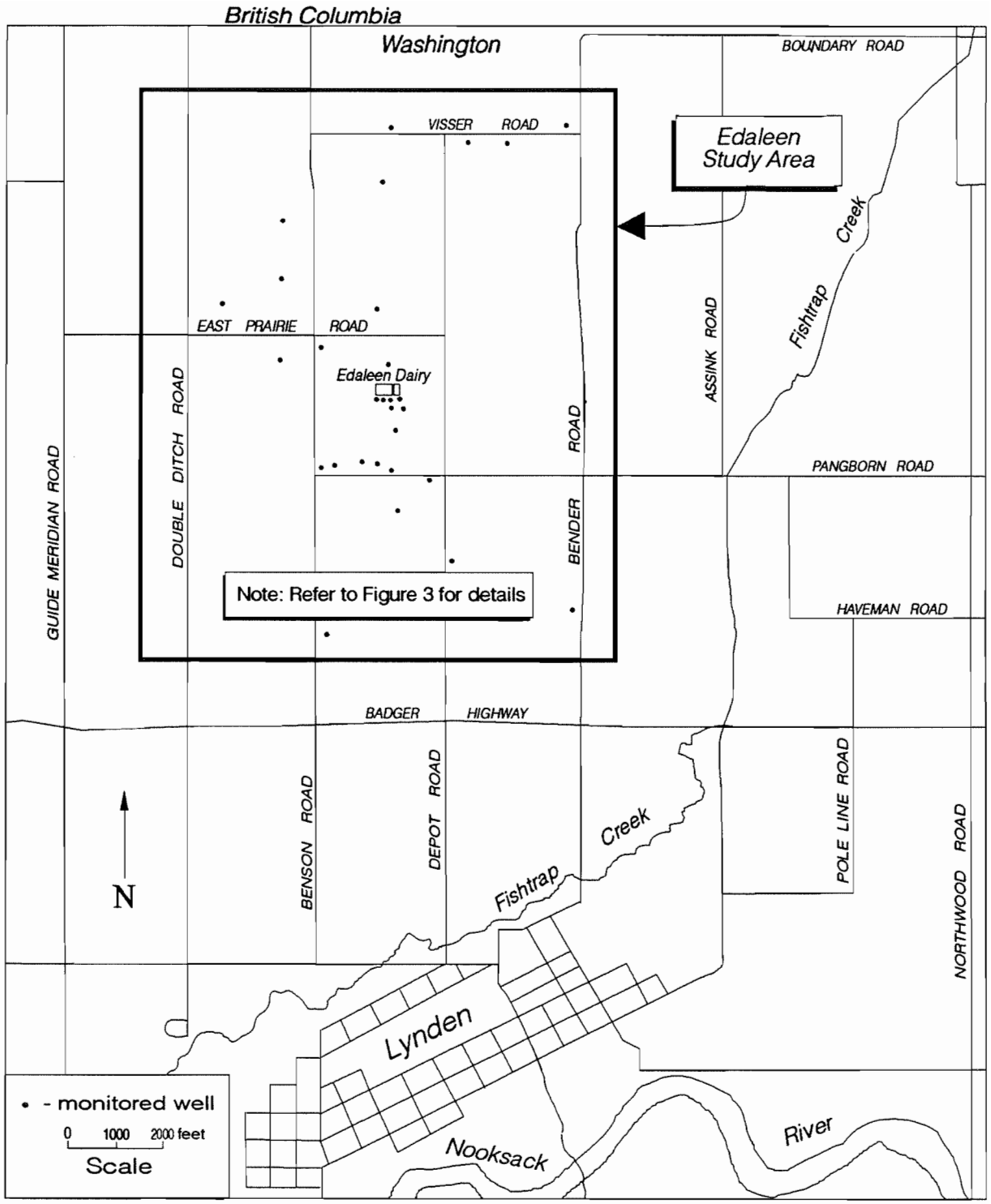

Figure 2. Edaleen study area.

The Edaleen Dairy is centrally located in the study area, 2 miles north of Lynden and about about 1.5 miles south of the U.S.- Canadian border (Figure 2). The domestic and irrigation wells used in the monitoring survey are located within one mile north and south and within one-half mile east and west of the dairy.

Geology and Hydrogeology

Edaleen Dairy is located on the Lynden Terrace, a flat glacial outwash plain that slopes gently toward the Nooksack River floodplain to the south. The surficial geology consists of sand and gravel, with some finer materials and local peat deposits. Most of the Lynden Terrace is mapped geologically as Sumas Outwash which was deposited during the Late Pleistocene Sumas Stade of the Fraser Glaciation (Easterbrook, 1971). During the Sumas Stade, the last phase of the most recent glaciation in the Puget Sound region, glacial ice stood just north of the Canadian Border with a lobe extending southward at Sumas. Meltwater streams flowing southward from the glacier built an outwash plain from Abbotsford to Lynden and from Everson westward nearly to Ferndale. The outwash plain consists of gravel near the glacier margin, grading southward to sand near Lynden and Laurel. Most abandoned meltwater channels and depressions in the outwash have subsequently been filled with peat (Easterbrook, 1971).

The shallow, unconfined aquifer consists of Sumas Outwash deposits which are 40 to 50 feet thick over the study area. Recharge to the Sumas aquifer is derived from precipitation that falls directly on the upland and from incoming streams and ground water flow from Canada to the north. Average annual rainfall over the study area ranges from 40 to 46 inches based on precipitation measurements at Blaine and Clearbrook (NOAA, 1990). The high rainfall and relatively shallow water table in the study area causes a significant portion of precipitation to run off via drainage ditches. The network of drainage ditches north of Lynden generally follows the local road pattern and ultimately discharges to Fishtrap Creek and the Nooksack River.

The ground water flow direction in the shallow aquifer is toward the south-southeast. Dee Molenaar identified a south ground water flow direction in the shallow aquifer of the Lynden Terrace in Water-Supply Bulletin No. 12; "Water Resources of the Nooksack River Basin" (Washington Dept. of Conservation, 1960). A more recent ground water study published by Ecology and Western Washington University indicated a southerly direction of ground water flow near the study area for both March and September of 1987 (Creahan and Kelsey, 1988). Erickson (1991) determined a south-southeast ground water flow direction in the near-field vicinity of the Edaleen Dairy. Erickson estimated the ground water flow velocity to be about one to two feet per day based on chloride travel times in monitoring wells near Edaleen lagoon (Erickson, 1991).

Land Use and Wells

Land use on the Lynden Terrace is mostly agricultural, consisting primarily of dairy production, and growing potatoes, berries and corn. The Lynden Terrace is one of the most productive dairy farming areas in the country. The 900-head Edaleen Dairy is the largest of about 24 dairies in the study area. The one residential community in the study area consists of seven homes on one and two-acre lots located 1400 feet south-southwest of the new dairy lagoon. Part of the study area is served by the City of Lynden Water Department, but there are numerous privately owned domestic and irrigation wells throughout the area. Almost all wells for both irrigation and domestic supply are completed in Sumas Outwash and range in depth from 15 to 35 feet. Typical irrigation wells utilize 36" diameter cylindrical concrete tiles with perforations in the bottom three to six feet of well tiles. Domestic well construction usually consists of six or eight inch diameter steel casing with a screen or perforations near the bottom of the well. The typical well head is finished at or slightly above grade or, less frequently, in a subsurface vault.

Methods

Twenty-one domestic and irrigation wells were selected for the far-field ground water monitoring. Well locations and the use of wells during the survey are shown in Figure 3. Domestic and irrigation wells are numbered using an abbreviated version of the U.S. Geological Survey well numbering system. The well numbers indicate the section number, the 40-acre subdivision of the section, and the serial number of the well in the particular 40-acre tract. Nine domestic wells and twelve irrigation wells were selected based on location and accessibility for measurement or sampling. Several well owners located south of Edaleen lagoon expressed concern for their well water quality and were included in the monitoring. Five domestic wells, although sampled, were not accessible for water level measurement. Ground water quality samples were regularly taken from six domestic wells along Pangborn Road and a domestic well located about one mile north of the dairy (32Q01). Seven of the domestic wells were sampled about three times yearly. The twelve irrigation wells were used for water level measurement since irrigation pumps were not used most of the year. Infrequent samples were taken from irrigation wells during summer irrigation pumping. Frequency of water level measurements averaged eight times per year. Water levels were measured in wells to within $\pm$ .01 foot using a portable electric wire probe.

The near-field Edaleen lagoon study included monitoring a total of eight wells constructed near the lagoon. Construction reports for monitoring wells 1 - 7A are given in Erickson (1991) and are summarized in Table 1 below. Well construction details for MW-8 are included in Appendix A.

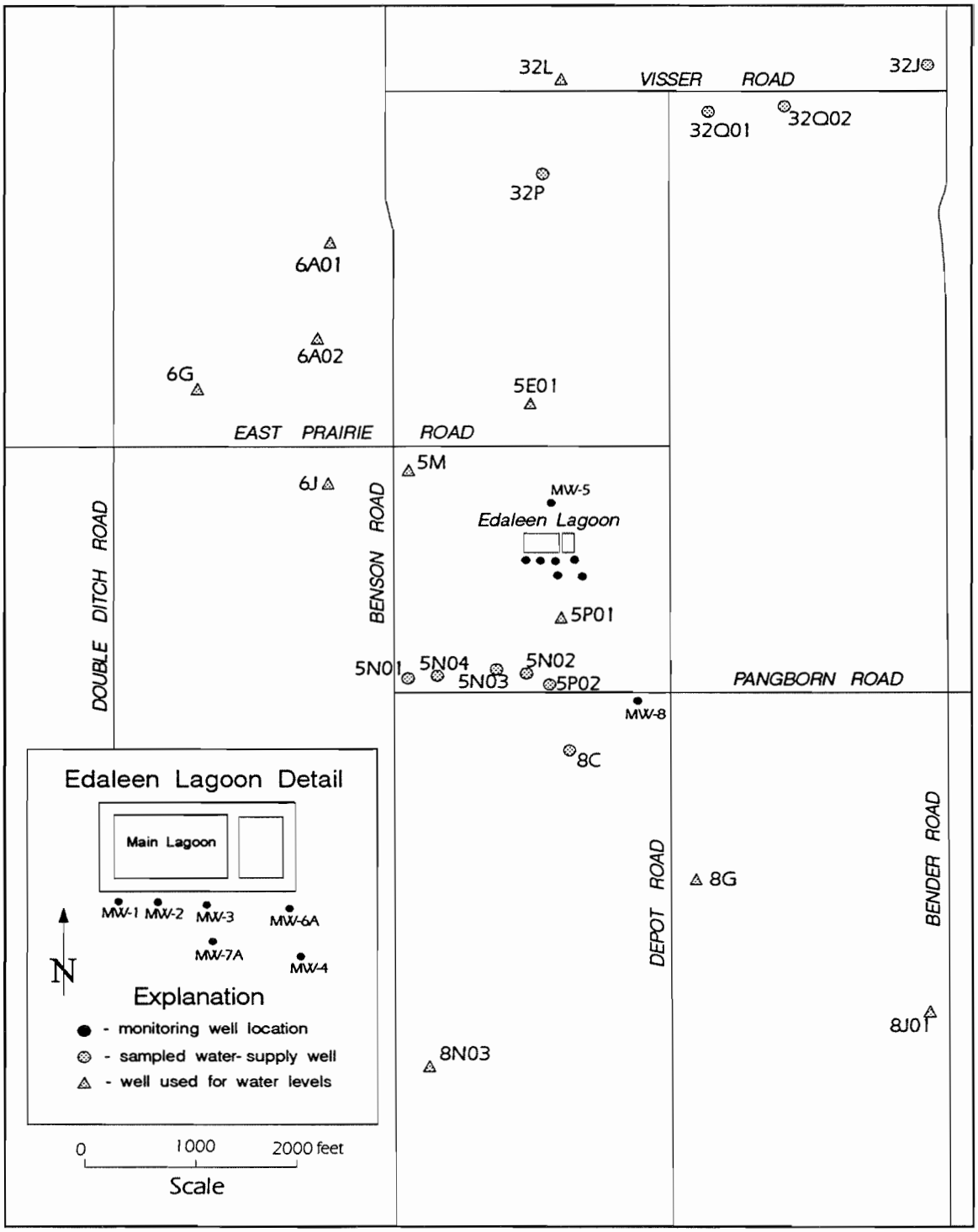

Figure 3. Well locations in the Edaleen study area

Well Number	Well Dimensions	Wellhead Elevation	Well Use	Survey Use
MW-1	1.25" X 15.0'	126.44	mon	wl, wq
MW-2	1.25" X 13.8'	125.19	mon	wl, wq
MW-3	1.25" X 16.6'	126.93	mon	wl, wq
MW-4	1.25" X 13.6'	124.13	mon	wl, wq
MW-5	1.25" X 11.6'	124.84	mon	wl, wq
MW-6a	1.25" X 16.4'	125.64	mon	wl, wq
MW-7a	1.25" X 18.6'	125.97	mon	wl, wq
MW-8	1.25" X 13.5'	110.68	mon	wl, wq
40/03E - 05E01	36" X 33'	127.29	irr	wl
40/03E - 05M	36" X 30'	125.97	irr	wl
40/03E - 05N01	36" X 18'	~123	dom	wq
40/03E - 05N02	6" X 24'	118.00	dom	wl, wq
40/03E - 05N03	6" X 20'		dom	wq
40/03E - 05N04	6" X 25'		dom	wq
40/03E - 05P01	36" X 28'	122.66	irr	wl
40/03E - 05P02	36" X 22'		dom	wq
40/03E - 06A01	36" X 20'	~134	irr	wl
40/03E - 06A02	36" X 19'	~130	irr	wl
40/03E - 06G	36" X 23'	~130	irr	wl
40/03E - 06J	36" X 30'	~127	irr	wl
40/03E - 08C	36" X 21'		dom	wq
40/03E - 08G	36" X 30'	~113	irr	wl
40/03E - 08J01	30" X 26'	~108	irr	wl
40/03E - 08N03	36" X 24'	~108	irr	wl
41/03E - 32J	36" X 20'		dom	wq
41/03E - 32L	36" X 29'	~139	irr	wl
41/03E - 32P	36" X 26'		irr	wq
41/03E - 32Q01	18" X 25'	~138	dom	wl, wq
41/03E - 32Q02	36" X 30'	~135	irr	wq

WL = water levels
WQ = water quality
Datum : original MW-4 assumed = 125.00
irr = irrigation
dom = domestic
mon = monitoring

Table 1. *Information on domestic and irrigation wells measured and/or sampled in Edaleen study area.*

The depth of domestic and irrigation wells used in this survey ranged from 18 to 33 feet (Table 1). Available domestic and irrigation water well reports are provided in Appendix A. Relative wellhead elevations for the eight monitoring wells were measured using a surveying level and rod. In addition to monitoring wells around the lagoon, wellhead elevations were surveyed at three irrigation wells and one domestic well in the vicinity of Edaleen Dairy. Nine other wellhead elevations were estimated from elevation contours on the U.S. Geological Survey 7.5 minute Lynden quadrangle. Water quality samples

from domestic wells were taken at outdoor taps located as close as practical to the wellhead. Samples were collected after running the source tap for at least three minutes until field conductivity stabilized. Samples from irrigation wells were obtained during high discharge pumping.

All water samples were transported to the Ecology Environmental Laboratory in Manchester on the day following sample collection. Ground water samples were analyzed for specific conductance, major cations and anions including chloride, nitrite + nitrate nitrogen (NO_2+NO_3-N) and ammonia. In addition, samples were periodically analyzed for hardness as $CaCO_3$, alkalinity, total dissolved solids, total iron, and total phosphorus. The sampled parameters, analysis methods, and practical quantitation limits(PQLs) are listed below in Table 2.

Parameter	Method	PQL
Specific Conductance	EPA Method 120.1	1.0 umho/cm
Hardness	EPA Method 130.2	1.0 mg/L
Total Dissolved Solids	EPA Method 160.1	1.0 mg/L
Calcium	EPA Method 200.7	0.01 mg/L
Magnesium	EPA Method 200.7	0.01 mg/L
Sodium	EPA Method 200.7	0.07 mg/L
Potassium	EPA Method 200.7	1.0 mg/L
Iron	EPA Method 200.7	0.02 mg/L
Alkalinity	EPA Method 310.1	1.0 mg/L
Chloride	EPA Method 330.0	0.1 mg/L
Sulfate	EPA Method 330.0	0.5 mg/L
Ammonia-N	EPA Method 350.1	0.01 mg/L
Nitrite+Nitrate-N	EPA Method 353.2	0.01 mg/L
Total Phosphorus	EPA Method 365.1	0.01 mg/L

Table 2. *Ground water analysis methods, and practical quantitation limits.* *(Reference: EPA, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.)*

The composition of representative water samples was illustrated using Stiff diagrams. Stiff diagrams depict water quality and water type based on the concentrations of major cations and anions. The milligram per liter (mg/L) concentrations were converted to

percent milliequivalents per liter (% meq/L) and plotted along scaled horizontal axes separated by a vertical zero axis. Cations and anions are shown on opposite sides of the diagram and the points are joined producing an irregular polygonal pattern that is characteristic of the particular water type. Stiff patterns can be a distinctive method of showing water-composition differences and similarities (Hem, 1989). Stiff diagrams were computer plotted using the HC-GRAM program, developed by the Office of Surface Mining (McIntosh and Miller, 1991).

To determine whether ground water quality at residential wells was affected by the lagoon, intra-well comparisons were made using both chloride and nitrate sampling data. Statistical methods applied to chloride and nitrate data were taken from U. S. Environmental Protection Agency Office of Solid Waste (EPA, 1992). Chloride and nitrate data from five domestic wells were normalized using log and square root transformations, respectively. Samples collected from the domestic wells prior to the estimated arrival time from the lagoon were used to characterize background ground water quality. Dairy waste was initially placed in Edaleen lagoon on March 1, 1990. Ground water travel time over the 1400-foot distance between the dairy lagoon and the domestic wells was estimated at 330 days. This 330-day travel time is a conservative estimate based on doubling the estimated ground water flow velocity (two feet/day). Background ground water quality was characterized using domestic well samples collected prior to January 25, 1991 (330 days after initial lagoon use). Statistical tolerance limits were used to test significance of differences in sample populations at 95% coverage and 95% confidence levels. The null hypothesis used for statistical testing postulated that there were no significant differences between samples collected prior to January 25, 1991, and samples collected after that date.

Results

Ground Water Depths and Flow Direction

Typical ground water levels in the Sumas Outwash aquifer range from 0 to 15 feet below land surface and fluctuate seasonally 5 to 10 feet. Hydrographs of water levels in three irrigation wells and two domestic wells are compared in Figures 4 and 5. Maximum 1990-91 ground water levels exceeded maximum levels for 1991-92. This was probably related to unusually high precipitation in 1990. Precipitation at Blaine weather station was 12.3 inches greater in 1990 than in 1991, and was over 9 inches above the annual average for 89 years of record (NOAA, 1990;1991). Water-level measurements for far-field wells are tabulated in Appendix B. The generalized water-table contour map in Figure 6 is based on November 21, 1990 water-level measurements and wellhead elevations.

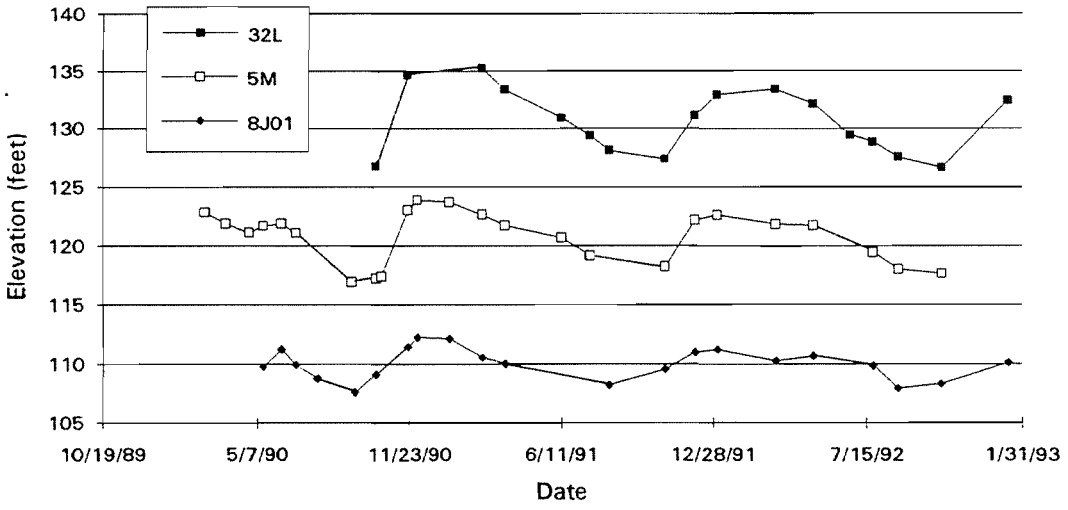

Figure 4. *Hydrographs for irrigation wells near Edaleen Dairy.*

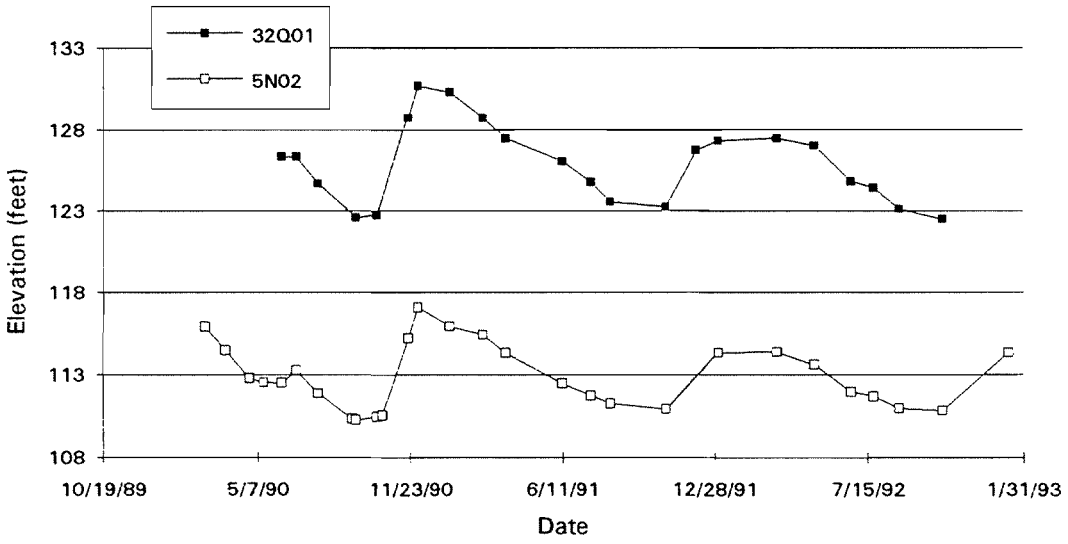

Figure 5. *Hydrographs for domestic wells near Edaleen Dairy.*

Ground-water flow direction was toward the south-southeast. The flow direction was consistently toward the south-southeast throughout the three-year study period.

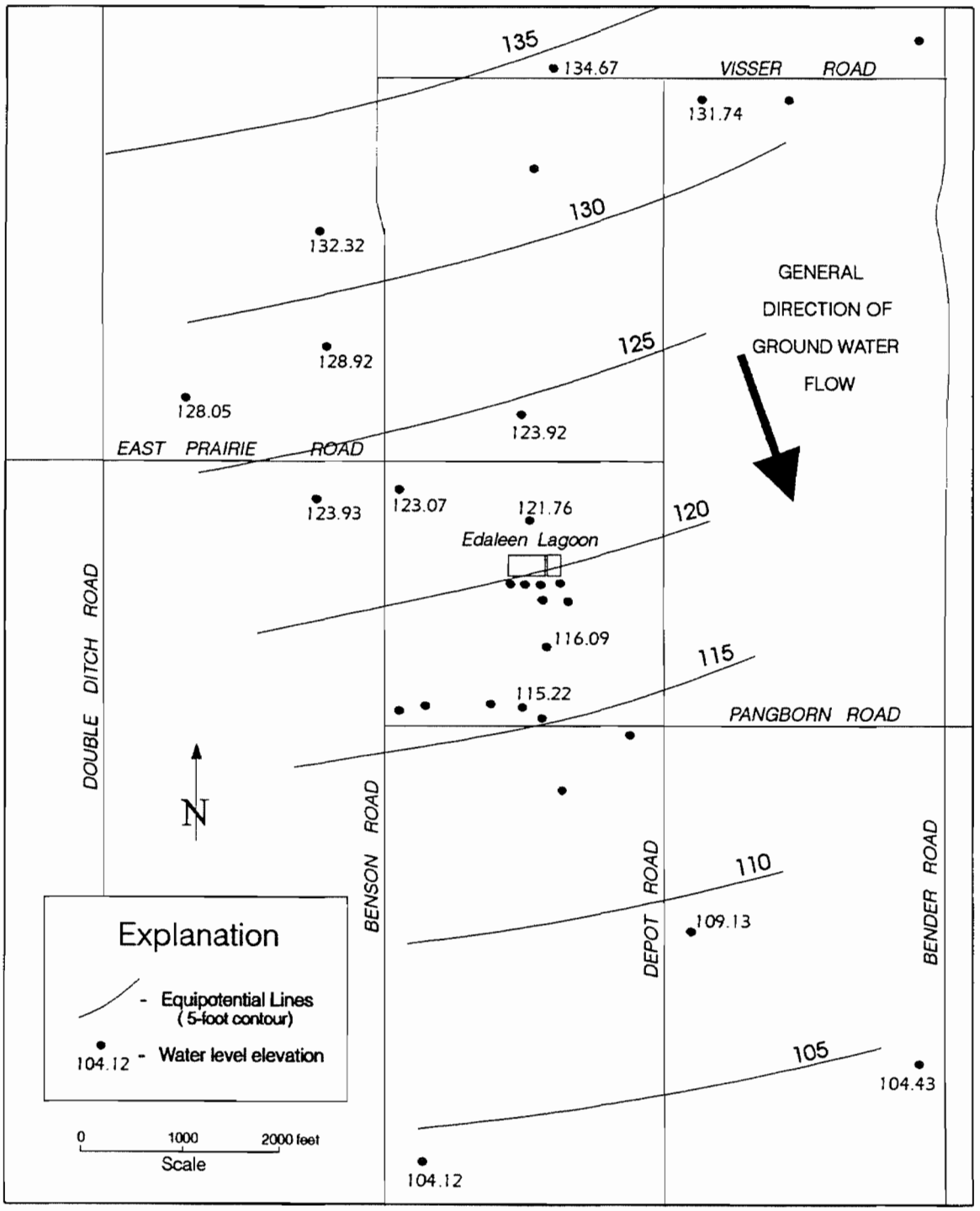

Figure 6. Water-table contours in the Edaleen study area based on well measurements taken Nov. 21, 1990.

Water Quality

Ground water quality in the study area was generally good, except in the immediate vicinity of Edaleen lagoon and local occurrences of elevated chloride and nitrate concentrations. Ground-water quality results for the 21 domestic and irrigation wells sampled are tabulated in Appendix C, Table C-1. Table C-2 shows water quality results for Edaleen lagoon wastewater and monitoring well samples for the period: February 1990 to April 1993. Table C-3 shows bacteriologic and miscellaneous water quality results for the near-field lagoon and monitoring well sampling.

Concentration ranges in the lagoon wastewater for total dissolved solids(TDS) (2890 to 6850 mg/L), chloride (139 to 399 mg/L), ammonia-N (275 to 600 mg/L), and total phosphorus (26 to 133 mg/L) were high (Table C-2). TDS and chloride concentrations in domestic and irrigation wells ranged from 80.0 to 656 mg/L, and 2.2 to 26.7 mg/L, respectively (Table C-1). By comparison, the median TDS in 12 historical ground water samples from Western Whatcom County wells under 100 feet deep was 104 mg/L (Turney, 1986). The median chloride concentration in 35 historical samples from Western Whatcom County wells was 20 mg/L (Turney, 1986). Graphs of chloride concentrations in four domestic wells near Edaleen Dairy are shown below in Figure 7.

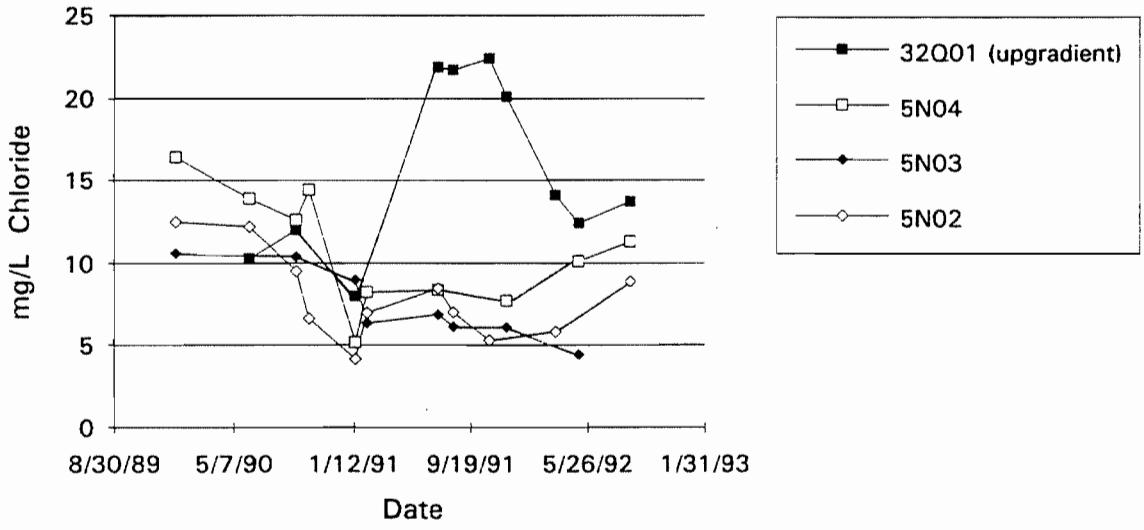

Figure 7. *Chloride in domestic wells near Edaleen Dairy.*

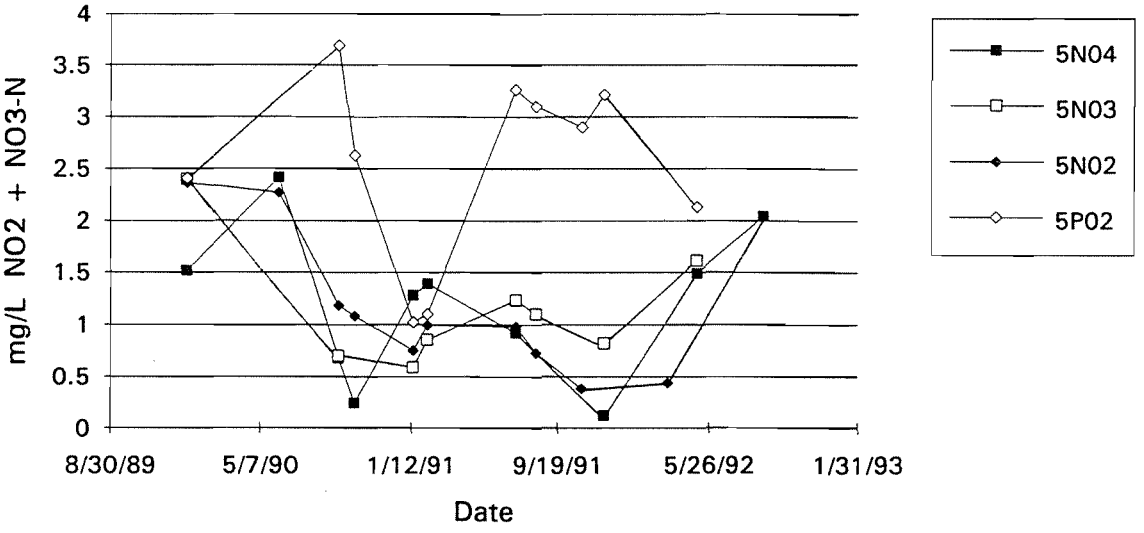

Figure 8. *Nitrate in domestic wells near Edaleen Dairy.*

Nitrite plus nitrate as nitrogen (NO_2+NO_3-N) in domestic and irrigation wells ranged up to 73.0 mg/L , with a median of 2.3 mg/L for 71 samples (Table C-1). The maximum nitrate value in a domestic well sample (73.0 mg/L) occurred in well 32Q01 located upgradient of Edaleen Dairy. The highest nitrate sample collected in a domestic well south of Edaleen Dairy was 6.2 mg/L in well 8C. The median nitrate (NO_2+NO_3-N) concentration in 30 historical samples from Whatcom County wells under 100 feet deep was 0.85 mg/L (Turney, 1986). Graphs of nitrate concentrations in four domestic wells near Edaleen Dairy are shown in Figure 8. Total phosphorus was detected in three of 25 domestic and irrigation well samples. Sulfate(SO_4) was a dominant ion species in domestic and irrigation well water and ranged from 4.9 to 60.6 mg/L.

The composition of ground water quality samples from four domestic wells in the Edaleen study area are graphically depicted by Stiff diagrams in Figure 9. Bicarbonate concentrations were converted from total alkalinity results. Hydroxide and carbonate alkalinity are not expected to be significant because pH in the shallow aquifer is typically below pH 7 (Erickson, 1991).

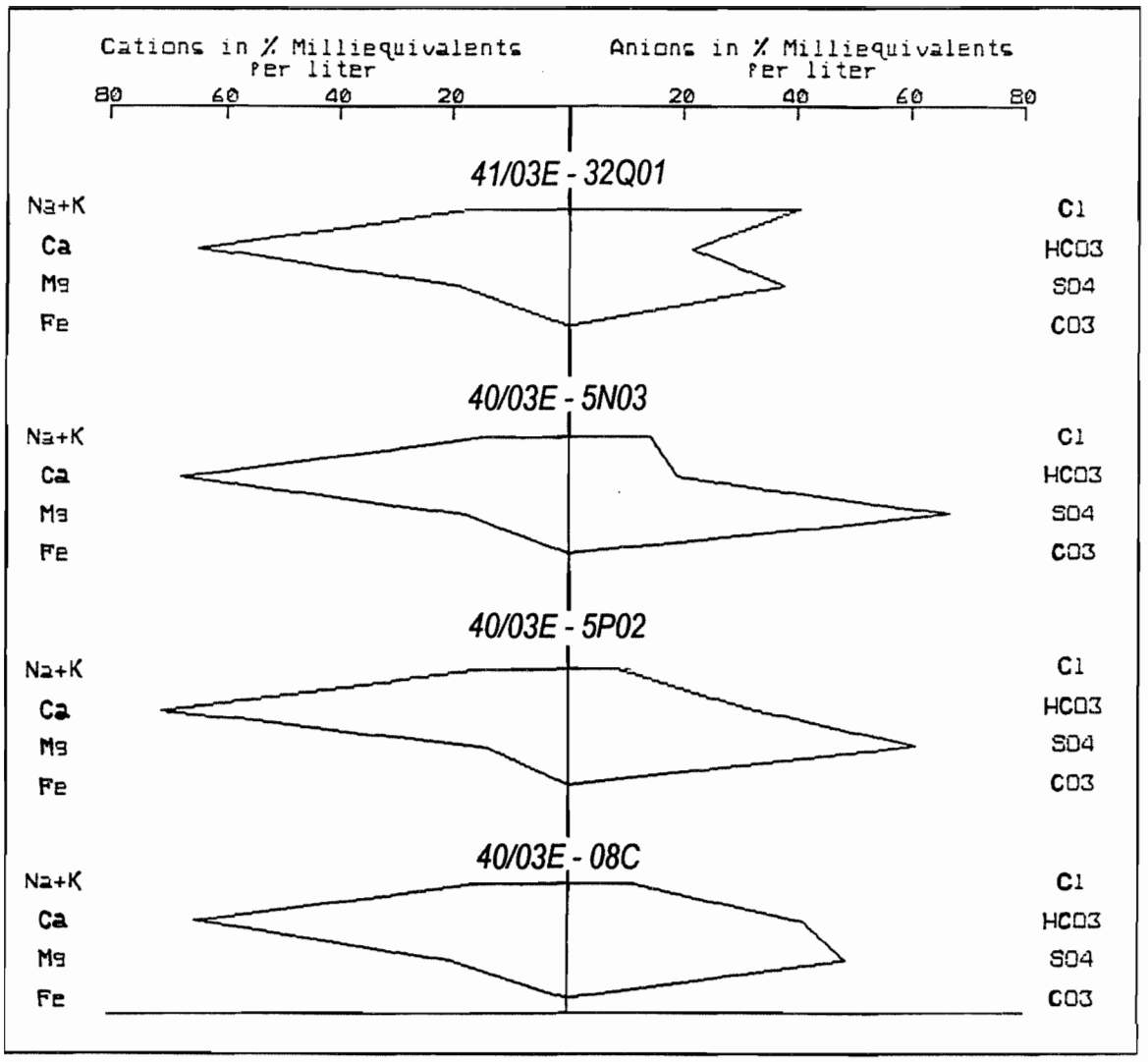

Figure 9. *Comparison of water quality in four domestic wells.*

There was little variation in cationic concentrations while anionic concentrations varied substantially between wells. Chloride concentrations were higher in wells with elevated nitrate concentrations. The unusually high chloride concentration in the sample from well 32Q01 is classified as "mixed" CaCl-$CaSO_4$ type water. Well 32Q01 also had elevated nitrate concentrations. Sample results for the study area indicate that calcium sulfate($CaSO_4$) type water is prevalent in the shallow aquifer, with minor differences between individual wells.

Statistical Evaluation of Domestic Well Water Quality

To determine whether ground water quality at residential wells was affected by the dairy lagoon, intra-well comparisons were made using statistical upper tolerance limits on both chloride and nitrate data. The general formula for the normal upper tolerance limit (*UTL*) is;

$$UTL = m + ks$$

where *m* is the sample mean, 'k' is a tabulated tolerance factor, and '*s*' is the standard deviation (EPA, 1992). There were a total of 47 samples for each of the parameters chloride and nitrate in the five tested domestic wells. Chloride values were determined to be log-normal, and nitrate data were square-root normal. The critical value for testing normality using the probability plot correlation coefficient ($n = 47$, $\alpha = .05$) is $r = 0.979$ (EPA, 1992). Transformed chloride and nitrate sample populations yielded probability plot correlation coefficients of 0.986 and 0.996, respectively. The transformed data were therefore considered normally distributed and normal tolerance interval methods were applied.

The upper tolerance limit method at the 95% coverage and confidence levels was selected (EPA, 1992). Upper tolerance limits were calculated using data collected prior to the estimated earliest potential arrival time of lagoon contaminants. Samples collected up through January 15, 1991 were used to calculate tolerance limits based on background water quality. The calculated upper tolerance limits for chloride and nitrate in five domestic wells are compared with maximum sample values obtained since January 15, 1991 in Table 3 below.

Well Number	Upper Tolerance Limits for Cl-	max. Cl- value since Jan 15, 1991	Upper Tolerance Limits for NO_3	max. NO_3 value since Jan. 15, 1991
40/03E-05N01	17.5	14.1	6.31	2.84
40/03E-05N02	19.6	8.90	3.08	2.04
40/03E-05N03	11.3	6.86	2.65	1.61
40/03E-05N04	27.2	11.3	3.21	2.04
40/03E-05P02	20.5	4.65	4.62	3.26

Table 3. *Intra-well statistical comparisons in five domestic wells.*

None of the wells exceeded their upper tolerance limits for chloride or nitrate during the study period. As described previously on page 9 of this report, the null hypothesis postulated that no adverse effect occurred in the domestic wells due to lagoon leakage. Once established, the upper tolerance limit should not be exceeded by subsequent samples unless background conditions change. Statistical testing of sample results for chloride and nitrate indicates that the test null hypothesis, (i.e., that no adverse effect occurred in downgradient domestic wells), should be accepted.

Discussion

The results of this ground water sampling survey show that water quality in the Sumas aquifer was generally good, with local occurrences of elevated chloride and nitrate concentrations. Local dairy and agricultural practices other than lagoon leakage apparently caused some elevated chloride and nitrate concentrations in shallow ground water. The results of this ground water survey are indicative of at least local degradation of ground water quality below the root zone. In view of State Ground Water Quality Standards, this situation suggests that improved dairy management practices need to be developed and implemented.

Statistical Results

Statistical analysis of chloride and nitrate data collected during this ground water survey indicated that water quality in five domestic wells was not adversely affected by leakage from the Edaleen Dairy lagoon. The lack of contamination effects in local domestic wells from Edaleen lagoon leakage may be due to the fact that the domestic wells are not directly downgradient of the lagoon. Lagoon contaminants may have been diverted away from the monitored domestic wells by high discharge summer irrigation pumping from well 5P01. The effect on local ground water movement from domestic well pumping was considered negligible.

Data from Erickson (1991) indicate that near-field ground water contamination from dairy waste attenuates rapidly as it moves downgradient. Nitrate and chloride contamination from lagoon leakage may not have been measureable even if the domestic wells were located downgradient of the lagoon. Sample results from monitoring well #8 (MW-8), about 1700 feet downgradient of the lagoon, were comparable or better than background water quality in the Pangborn Road domestic wells (Appendix C, Table C-2). However, since MW-8 was constructed in July 1992, there were no background data to allow an intra-well comparison in MW-8.

Other Contaminant Sources

Leakage from dairy waste storage lagoons is one of several potential sources of ground water quality degradation. Some other potential sources of contamination are land application of agricultural or industrial wastewater, fertilizer and pesticide use, land application of sludge (biosolids), onsite septic systems, road salting, and leachate from silage bunkers. The highest nitrate and chloride levels measured in this survey occurred in ground water upgradient from Edaleen lagoon in or near areas where dairy wastes are land applied.

Chloride in well 32Q01, located one mile north of Edaleen Dairy, increased between January and July 1991 from around 10 mg/L to over 20 mg/L and remained elevated for over five months. This increase was accompanied by a fourfold increase in nitrate concentration in well 32Q01 which reached a maximum 73.0 mg/L in a sample taken on August 13, 1991. The dairy owner upgradient of well 32Q01 indicated that dairy waste was applied to his fields in spring of 1991. Contamination in well 32Q01 may have been partly due to prior applications of municipal sewage sludge to the 60-acre field immediately north and upgradient from the well. Biosolids were applied to the 60-acre field for approximately 3 years ending in 1990. Degradation of ground water quality has been noted as a potential negative impact from land application of sludge (Freeze and Cherry, 1979). The quality of ground water moving south across the Canadian border into the study area is unknown.

The highest nitrate concentration in the near-field vicinity of Edaleen Dairy was 98.7 mg/L in monitoring well #5 (MW-5). MW-5 is located upgradient from the main Edaleen lagoon about 200 feet from its northern edge. This ground water sample, collected in MW-5 on January 22, 1991, was probably affected by land application of wastes and heavy precipitation (Erickson, 1991). Two years later, nitrate in MW-5 was 75.2 mg/L in a sample collected on January 12, 1993 (Appendix C, Table C-2). In addition to land application of liquid manure wastes, dairy manure solids were periodically tilled into the field surrounding MW-5.

These instances of elevated nitrate and chloride concentrations in ground water were apparently caused by local land application of dairy waste. Dairy wastewater contains high concentrations of nitrogen compounds and chloride (Appendix C, Table C-2). The rate and timing of wastewater application are critical factors with regard to ground water quality protection. Excessive or ill-timed land application of dairy waste may cause elevated chloride and nitrate concentrations in ground water. Since land application of dairy waste occurs over large areas, land application has a high potential to contaminate ground water.

Ground Water Quality Standards

The Washington Department of Ecology (Ecology) is responsible for the protection and management of ground water in the State of Washington. Under authority of the Water Pollution Control Act (RCW 90.48), Ecology adopted "Water Quality Standards for Ground Waters of the State of Washington"; Chapter 173-200 WAC in December, 1990. The standards apply a policy of antidegradation to all ground waters of the state that occur in a saturated zone or stratum beneath the land surface or below a surface water body (Ecology, 1990). Contaminant concentrations found in saturated soils where contaminants have been applied at agronomic rates for agricultural purposes, and where contaminants have been applied at approved rates and under approved methods of land treatment, are exempt from the standards if the contaminants will not cause pollution of any ground waters below the root zone.

Chloride and nitrate (converted from ammonium) are among the most mobile and persistent chemical parameters found in ground water (Hem, 1989). Since dairy waste contains high concentrations of nitrogen compounds and chloride, nitrate and chloride are useful indicators of dairy-related ground water contamination. According to Washington State Ground Water Quality Standards, chloride is defined as a contaminant at concentrations above background levels and is considered pollution at concentrations above the state ground water quality criteria of 250 mg/L. Nitrate is defined as a contaminant at concentrations above background levels and is considered pollution at levels above the ground water quality criteria of 10 mg/L (Ecology, 1990).

In view of existing state regulations, agricultural practices which may be causing ground water quality degradation should be studied further. Where necessary, best management practices protective of ground water should be developed and implemented in order to preserve and enhance the quality of ground water resources in Washington State.

Conclusions and Recommendations

Conclusions from this three-year ground water monitoring survey are as follows:

1. Shallow ground water in the study area flows south-southeast toward the Nooksack River. This flow direction was unchanged by seasonal water-level fluctuations.

2. Water-levels in the shallow aquifer of the study area fluctuated seasonally from 5 to 10 feet.

3. Calcium sulfate($CaSO_4$) type water is prevalent in the shallow unconfined aquifer of the study area.

4. Ground water quality in five domestic wells located generally south of the Edaleen Lagoons remained good, and was statistically unaffected by leakage from the dairy wastewater lagoons.

5. Near-field monitoring at Edaleen Dairy shows that lagoon leakage is contaminating ground water in the immediate vicinity of Edaleen lagoon. Far-field monitoring indicates that agricultural activities, including land application of dairy waste, are contributing nitrate contamination to shallow ground water. In two instances, nitrate contamination in wells exceeded the Washington State Ground Water Quality Criteria of 10 mg/L.

The following recommendations would help determine best dairy and agricultural management practices with respect to ground water quality protection:

1. A study of ground water quality impacts of dairy waste land application is needed. The study should include determination of land use, contaminant loading estimates, precipitation, and surface water and ground water monitoring including flow and quality. Such a study should be conducted in conjunction with current ongoing studies by the WSU Cooperative Extension, Whatcom County Conservation District, and U.S. Soil Conservation Service.

2. Ground water quality surveys similar to this one should be undertaken in selected areas of Washington State to establish baseline ground water quality. Priority survey sites might be selected on the basis of proposed startup locations for new intensive dairy or other agricultural land uses. Such surveys will help characterize seasonal variability of water levels, flow directions, ground water quality and will assist in identifying water quality changes associated with land use.

References

1. Creahan, Kathy, and Harvey M. Kelsey. Hydrogeology and Groundwater Flow near Lynden, Washington. Western Washington University, September, 1988.

2. Department of Ecology. Chapter 173-200 WAC, Water Quality Standards for Ground Waters of the State of Washington. December, 1990.

3. Easterbrook, Don J. Geology and Geomorphology of Western Whatcom County. Western Washington University Dept. of Geology, 1971, 68 pp.

4. Erickson, Denis. Edaleen Dairy Lagoon Ground Water Quality Assessment, February 1990 to February 1991. Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, 1991, 33 pp.

5. Freeze, R.A. and J.A. Cherry. Groundwater. Prentice-Hall Inc., Englewood Cliffs, N.J., 1979, 604 pp.

6. Hem, John D. Study and Interpretation of Chemical Characteristics of Natural Water. U. S. Geological Survey Water-Supply Paper 2254, third printing 1989, 263 pp.

7. McIntosh, Gary, and Kevin P. Miller. HC-GRAM : HydroChemical Graphic Representation Analysis Methods. Department of Interior, Office of Surface Mining, Denver, version 3.01.3, April, 1992.

8. NOAA (National Oceanic and Atmospheric Administration). Climatological Data Annual Summary, Washington. U.S. Department of Commerce, Volume 94, Number 13 (1990), Volume 95, Number 13 (1991).

9. Turney, G. L. Quality of Ground Water in the Puget Sound Region, Washington, 1981. U.S. Geological Survey, Water Resources Investigations Report 84-4258, 1986, 170 pp.

10. U.S. Environmental Protection Agency. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance. Office of Solid Waste, Permits and State Programs Division, Washington, D.C., June 1992, 83 pp.

11. Washington Dept. of Conservation, Water Supply Bulletin No. 12. Water Resources of the Nooksack River Basin., Division of Water Resources, 1960, 187 pp.

Appendix A

Well Reports

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy 40/3E/05/E

WATER WELL REPORT

STATE OF WASHINGTON

Application No. 40/03-05E

Permit No. .....

(1) OWNER: Name 40/03E - 05E01 Address 9558 Benson Rd Lynden Wash

(2) LOCATION OF WELL: County Whatcom SW ¼ NW ¼ Sec. 5 T. 40 N., R. 3E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 2
New well ☒ Method: Dug ☒ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 36 inches.
Drilled 32 ft. Depth of completed well 33 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 36" Diam. from 0 ft. to 33 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☐ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☐
Type of perforator used ...
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☐
Manufacturer's Name ...
Type ... Model No ...
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: Pea
Gravel placed from 4 ft. to 33 ft.

Surface seal: Yes ☒ No ☐ To what depth? 4 ft.
Material used in seal Concrete
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ... Depth of strata ...
Method of sealing strata off ...

(7) PUMP: Manufacturer's Name ...
Type: ... H.P. ...

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 4 ft. below top of well Date 6-11-74
Artesian pressure ... lbs. per square inch Date ...
Artesian water is controlled by ... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? ...
Yield: ... gal./min. with ... ft. drawdown after ... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ...
Bailer test 170 gal./min. with 2½ ft. drawdown after 1 hrs.
Artesian flow ... g.p.m. Date ...
Temperature of water ... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Top Soil	0	2
Clay with rocks	2	4
Gravel	4	14
Coarse Sand	14	33

Work started 6-11, 19 74 Completed 6-11, 19 74

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Snowden Well Digging
(Person, firm, or corporation) (Type or print)

Address 3325 S. E. Camino Dr. Camano

[Signed] Theodore R. Snowden
(Well Driller)

License No. 0464 Date 6-12, 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG No. Appli. #4104

Date March 30, 1956

Record by Don Mulka

Source driller's record

Location: State of WASHINGTON

County Whatcom

Area

Map

NW ¼ SW ¼ sec. 5 T. 40 N., R. 3 E. W.

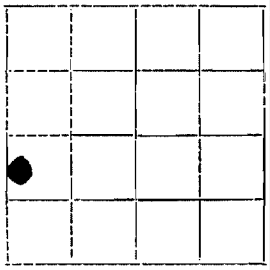

Diagram of Section

Drilling Co. Don Mulka

Address Sumas, Washington

Method of Drilling dug - hydraulic Date Mar. 30, 1956

Owner 40/03E - 05M

Address Lynden, Wash.

Land surface, datum ft above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Red clay loam	3	3
	Gravel	23	26
	Sand	4	30
	Dim. 30'x36"		
	SWL: 5 ft.		
	DD: 5 ft.		
	Yield: 200 g.p.m. Temp. 46°		
	CASING:		
	36" diam. concrete pipe from top to 20 ft.		
	36" diam. wooden screen from 20 to 30 ft.		
	PERFORATIONS: 250 - 1x¼" from 20 to 30 ft.		

Turn up

Sheet ..... of ..... sheets

40/03-5N01

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name 40/03E - 05N01 Address 510 Pang Born Rd.

(2) LOCATION OF WELL: County W Whatcom — SE ¼ SE ¼ Sec. 5 T. 40 N., R. 3E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well ☑ Method: Dug ☑ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well ..... inches.
Drilled ..... ft. Depth of completed well 18 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 36 " Diam. from -18 ft. to -6 ft.
Threaded ☐ 30 " Diam. from -18 ft. to -8 ft.
Welded ☐ 8 " Diam. from -8 ft. to +1 ft.

Perforations: Yes ☐ No ☑
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☐ No ☑
Manufacturer's Name .....
Type ..... Model No .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☑ No ☐ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☑ No ☐ To what depth? pad. ft.
Material used in seal .....
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level ..... ft.
Static level 8 ft. below top of well Date 2 May 84
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☑ No ☐ If yes, by whom? Driller
Yield: 26 gal./min. with 1/4 ft. drawdown after 5 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test ..... gal./min. with ..... ft. drawdown after ..... hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
TopSoil Black	0	-1
Brown sand	-1	-3
Brown sand + Gravel	-3	-6
Water Blue grey sand H_2O and gravel some cobbles	-6	-18
Set Foot valve 15-16 ft.		
Completed WAC 173-160-180(2)		
6" Concrete Pad. at 6 feet		

RECEIVED MAY 30 1984 DEPARTMENT OF ECOLOGY

Work started April 28, 19 84 Completed 2 May 3, 1984

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME A America Water Wells Inc.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 220 Everson, WA.

[Signed] Lewis Walker
(Well Driller)

License No. 0940 Date May 3, 1984

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG No. Appli. 3512
Cert. 2685-A

Date September 3, 19 56

Record by well driller

Source driller's record

Location: State of WASHINGTON

County Whatcom

Area

~~xxx~~ Government Lot 4

~~xxx~~/4 ~~xxxxx~~/4 sec. 5 T. 40 N., R. 3 E. ~~xx~~

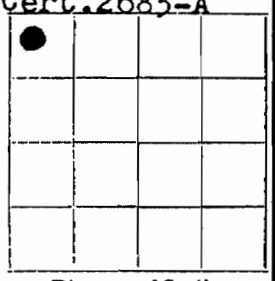

Diagram of Section

Drilling Co. G. A. Wetzel

Address Lynden, Wash.

Method of Drilling Date Aug. 6, 19 54

Owner. 40/03E - 06A01

Address Lynden, Wash.

Land surface, datum ft. above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Top soil	12	12
	Coarse gravel	8	20
	PUMP TEST		
	Diam. 20'x36"		
	SWL: 5 ft. 10/8/59: 7.15 fm T.C. (6" above DML		
	DD: 3 ft.		
	Yield: 120 g.p.m.		
	Type & size of pump :centrifugal		
	" " " " motor: Deming 5 h.p. electric		
	PERFORATIONS: 420 per foot		
	6 - 1x1/8" from 12 ft. to 20 ft.		

Turn up

Sheet ... of ... sheets

STATE OF WASHINGTO
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT Appli. #6626

WELL LOG No...../.....-.....

Date April 23, 1963

Record by Driller

Source Driller's Record

Location: State of WASHINGTON

County Whatcom

Area

Map

SW ¼ NE ¼ sec. 6 T. 40N., R. 3 E. XX

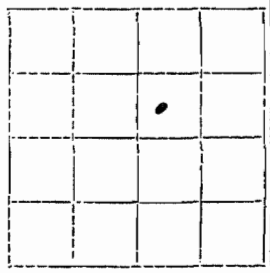

Diagram of Section

Drilling Co. Herman Ellingson

Address Route 2, Lynden, Washington

Method of Drilling Jetted Date May 24, 1962

Owner 40/03E-06G

Address Route 1, Lynden, Washington

Land surface, datum ..... ft. above / below .....

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Top soil peat	0	2
	Sand	2	4
	Gravel	4	23
	Casing: 36" from 0 to 3'		
	36" from 3 to 15'		
	36" from 15 to 23'		
	(o to 3', plain ;tile, 3 to 15' perforated		
	tile; 15 to 23', perforated wood.)		
	Perforated from 3 to 23'		
	Screens installed from 15 to 23'		
	Gravel packed from 0 to 23'		

(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)

Turn up

Sheet ..... of ..... sheets

RESOURCE PROTECTION WELL REPORT

START CARD NO. 078215

PROJECT NAME: Edaleen Dairy Lagoon
WELL IDENTIFICATION NO. MW-8
DRILLING METHOD: Driven
DRILLER: Denis Erickson
FIRM: Dept of Ecology
SIGNATURE: Denis R. Erickson
CONSULTING FIRM: NONE
REPRESENTATIVE: NONE

COUNTY: Whatcom
LOCATION NE ¼ NW ¼ Sec 8 Twn ~~40N~~ R ~~3E~~ 3E
STREET ADDRESS OF WELL: 1405 Dept Road Lynden, WA
~~WATER LEVEL~~ WELL HEAD ELEVATION: ~~116~~ 110.68
GROUND SURFACE ELEVATION: ~~116~~ 110
INSTALLED: 7/13/92
DEVELOPED: 7/15/92

40/03E - 08C

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
+0.45	Locking Cap	
	Bentonite Seal	Dark Brown Topsoil
		Brown Peat
4.0		Dark gray SAND, wet to saturated
	1¼" Galvanized Casing	
11.5 / 13.5	Stainless Steel Screen 6062	
		Bottom of Hole 13.5 feet

0
5
10
15

SCALE: 1" = 5 feet

PAGE 1 OF 1

ECY 050-12 (Rev. 11/89)

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG

No. Appli. #2407
Cert. #1145A

Date April 2, 1952

Record by Don Mulka

Source Driller record

Location: State of WASHINGTON

County Whatcom

Area

Map

SE ¼ SW ¼ sec. 32 T. 41 N., R. 3 E. W.

DIAGRAM OF SECTION

Drilling Co. Don Mulka

Address Sumas, Washington

Method of Drilling Date Apr. 2 1952

Owner. 41/03E - 32P

Address Route 3, Box 107; Lynden, Wn.

Land surface, datum ft. above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Soil	2	2
	Sand	8	10
	Gravel	16	26
	Pump test:		
	Dim: 26' x 36"		
	SWL: 3'		
	D.D. 6'		
	Yield 200 g.p.m.		
	Casing: 36" dia. concrete tile from top to 18'. 36" dia. Wooden filter from 18 to 26'.		
	Perforations: 250 ½" x 1" from 18 to 26'.		

(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)

Turn up

Sheet of sheets

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG No. Appli. #5617

Date 8-22, 1960

Record by well driller

Source driller's record

Location: State of WASHINGTON

County Whatcom

Area

Map

W½ ~~¼~~ SW¼ sec. 8 T. 40 N., R. 3 ~~E.~~ W.

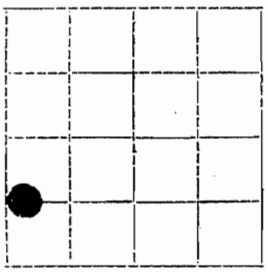

Diagram of Section

Drilling Co. Don Mulka

Address Sumas, Wash.

Method of Drilling dug Date 5-18, 1960

Owner 40/03E - 08N03

Address Lynden, Wash.

Land surface, datum ft. above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Red clay loam	2	2
	Gravel	16	18
	Sand	6	24
	PUMP TEST:		
	Dim. 24'x36"		
	SWL: 6 ft.		
	DD: 14 ft.		
	~~Yield: 160 g.p.m.~~		
	~~Type & size of pump: 5" air pump.~~		
	Type & size of engine: 41 h.p.gas		
	CASING:		
	36" diam. concrete pipe from top to 16 ft.		
	36" " wooden filter from 16 to 24 ft.		
	~~PERFORATIONS:~~		
	~~250 - 1"x3/8" from 16 to 20 ft.~~		

(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)

Turn up

Sheet ... of ... sheets

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy 40/3E/8/G

WATER WELL REPORT
STATE OF WASHINGTON

40/03-08G
Application No. G122419
Permit No. G1-22419P

(1) OWNER: Name 40/03E-08G Address 9184 Depot Rd. disw¼ NE¼ i

(2) LOCATION OF WELL: County Whatcom S3 1/3 Rods of the NW¼ SE¼ Sec. 8 T40 N., R3 E W.M. R

Bearing and distance from section or subdivision corner 150 Feet E. And 1200 FT North of the center of Sec 8

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 36 inches.
Drilled 30 ft. Depth of completed well 30 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 36 " Diam. from 0 ft. to 36 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used
SIZE of perforations 3/8 in. by 3/8 in.
perforations from 9 ft. to 30 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: 3/8"
Gravel placed from 6 ft. to 30 ft.

Surface seal: Yes ☒ No ☐ To what depth? 6 ft.
Material used in seal 6 sack concrete
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Berkeley
Type: H.P. 25

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 41 ft. below top of well Date 10-74
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom?
Yield: 450 gal./min. with 9 ft. drawdown after 1 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
Recovers	completely in 5 minutes				

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	2'
Hack peat	2'	4'
sand & gravel strata coarse	4'	30'

Work started Oct 15, 1974 Completed Oct 20, 1974

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B & K Water Wells
(Person, firm, or corporation) (Type or print)

Address 432 W. King Tut Rd Bellingham

[Signed] Jeff Kenbrough
(Well Driller)

License No. 0256 Date 10-28, 1976

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG

No. Appli. 4354
Cert. 2671-A

Date July, 1938.

Record by owner

Source driller's record

Location: State of WASHINGTON

County Whatcom

Area

Map

NE ¼ SE ¼ sec. 8 T. 40 N., R. 3 E. W.

Diagram of Section

Drilling Co. owner

Address Frank Okker

Method of Drilling dug / with air jet Date July, 1938

Owner 40/03E - 08J01

Address Lynden, Wash.

Land surface, datum ft above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Black loam	1	1
	Clay	3	4
	Coarse sand	10	14
	Coarse gravel	12	26
	PUMP TEST:		
	26'x30" (Diam.)		
	SWL: 5 ft.		
	DD: 5 ft.		
	Yield: 150 g.p.m.		
	Type & size of pump: 2" centrifugal		
	" " " " engine: 5 h.p. electri		
	PERFORATIONS:		
	3/16" x1¼" slots - perforated wood		
	casing 21 to 26 ft.		
	Concrete tile: 21 ft. to top		

Turn up

Sheet ____ of ____ sheets

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 41/03-32Q
Permit No. GI-22464P

(1) OWNER: Name 41/03E - 32Q02 Address 719 VISSER RD.; LYNDEN, WN. 98264

(2) LOCATION OF WELL: County WHATCOM SW ¼ SE ¼ Sec 32 T 41 N., R 3E W.M.

Bearing and distance from section or subdivision corner 1200' N & 1250' E FROM S¼ COR OF SEC. 32.

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)....
New well ☐ Method: Dug ☒ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 36" inches.
Drilled ..... ft. Depth of completed well 30' ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 36" Diam. from 0 ft. to 30 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☐ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type ... Model No
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☒ No ☐ Size of gravel:
Gravel placed from ... ft. to ... ft.

Surface seal: Yes ☒ No ☐ To what depth? 9 ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: 3 PHASE ... H.P. 15

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 9 ft. below top of well Date
Artesian pressure ... lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? A & K
Yield: 300 gal./min. with ... ft. drawdown after ... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Baller test ... gal./min. with ... ft. drawdown after ... hrs.
Artesian flow ... g.p.m. Date
Temperature of water ... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
TOPSOIL (SOD) ..	0	1
COARSE SAND & GRAVEL	1	30

INFO FROM OWNER BY PHONE 3-10-78

Work started ..., 19... Completed NOV., 1974

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME A & K DRILLER
(Person, firm, or corporation) (Type or print)

Address

[Signed]
(Well Driller)

License No. ... Date ..., 19...

(USE ADDITIONAL SHEETS IF NECESSARY)

Appendix B

Far Field
Ground-Water Levels

Appendix B

Groundwater Levels near Edaleen Dairy

Well / depth	Wellhead Elevation	Date	water level	Status	water level elevation
40/03E - 05E01	124.29	2/27/90	0.70		123.59
33' deep		3/26/90	1.98		122.31
north irrig. well		4/26/90	3.52		120.77
		5/14/90	3.72		120.57
		5/15/90	3.77		120.52
		6/7/90	3.02		121.27
		6/26/90	3.17		121.12
		7/25/90	4.70		119.59
		9/7/90	6.93		117.36
		10/9/90	6.99	from top	117.30
		10/16/90	6.78		117.51
		11/21/90	0.37		123.92
		12/4/90	-1.19	flooded	125.48
		2/27/91	1.00		123.29
		3/29/91	2.30		121.99
new m.p. ref.=	127.29	6/11/91	6.73		120.56
		10/25/91	9.24		118.05
		12/4/91	5.33		121.96
		1/2/92	4.82		122.47
		3/17/92	5.18		122.11
		5/6/92	5.54		121.75
		6/23/92	7.68		119.61
		7/13/92	8.22		119.07
		8/25/92	14.90	pumping	112.39
		10/19/92	9.82		117.47
		1/12/93	5.59		121.70
40/03E - 05M	125.97	2/27/90	3.10		122.87
30' deep		3/26/90	4.05		121.92
irrigation		4/26/90	4.83		121.14
		5/14/90	5.24		120.73
		6/7/90	4.07		121.90
		6/26/90	4.85		121.12
		7/25/90	pumping		
		9/7/90	9.05		116.92
		10/9/90	8.72		117.25
		10/16/90	8.55		117.42
		11/21/90	2.90		123.07
		12/4/90	2.05		123.92
		1/15/91	2.23		123.74
		2/27/91	3.30		122.67
		3/29/91	4.20		121.77
		6/11/91	5.27		120.70
		7/18/91	6.80		119.17
		10/25/91	7.77		118.20

Appendix B

Groundwater Levels near Edaleen Dairy (Continued)

Well / depth	Wellhead Elevation	Date	water level	Status	water level elevation
40/03E - 05M	(continued)	12/4/91	3.78		122.19
		1/2/92	3.34		122.63
		3/17/92	4.08		121.89
		5/6/92	4.22		121.75
		6/23/92	11.08	pumping	114.89
		7/13/92	6.50		119.47
		8/25/92	7.94		118.03
		10/19/92	8.32		117.65
40/03E - 05N02	118.00	2/28/90	2.10		115.90
24' deep		3/26/90	3.53		114.47
domestic		4/26/90	5.23		112.77
		5/14/90	5.49		112.51
		6/7/90	5.52		112.48
		6/26/90	4.76		113.24
		7/25/90	6.14		111.86
		9/7/90	7.67		110.33
		9/12/90	7.76		110.24
		10/9/90	7.57		110.43
		10/16/90	7.50		110.50
		11/21/90	2.78		115.22
		12/4/90	0.90		117.10
		1/15/91	2.05		115.95
		2/8/91	2.65		115.35
		2/27/91	2.58		115.42
		3/29/91	3.70		114.30
		6/11/91	5.54		112.46
		7/18/91	6.27		111.73
		8/13/91	6.75		111.25
		10/25/91	7.10		110.90
		1/2/92	3.68		114.32
		3/18/92	3.64		114.36
		5/6/92	4.40		113.60
		6/23/92	6.04		111.96
		7/13/92	6.31		111.69
		8/25/92	7.03		110.97
		10/19/92	7.18		110.82
		1/12/93	3.67		114.33
40/03E - 05P01	122.66	2/27/90	5.72		116.94
28' deep		3/26/90	7.22		115.44
irrigation		4/26/90	9.07		113.59
		5/14/90	9.30		113.36
		6/7/90	9.54		113.12
		6/26/90	8.66		114.00
		7/25/90	18.30	pumping	104.36

Appendix B

Groundwater Levels near Edaleen Dairy (Continued)

Well / depth	Wellhead Elevation	Date	water level	Status	water level elevation
40/03E - 05P01	(continued)	7/30/90	10.50		112.16
		9/7/90	11.99		110.67
		10/9/90	11.88		110.78
		10/16/90	11.78		110.88
		11/21/90	6.57		116.09
		2/27/91	6.23		116.43
		3/29/91	7.48		115.18
		6/11/91	9.46		113.20
		7/18/91	10.29		112.37
		10/25/91	11.32		111.34
		12/4/91	8.49		114.17
		1/2/92	7.68		114.98
		3/18/92	7.50		115.16
		8/25/92	11.14		111.52
40/03E - 06A01	134	6/7/90	3.98		130.02
20' deep		6/26/90	4.67		129.33
irrigation		9/12/90	9.34		124.66
		11/21/90	1.68		132.32
		3/29/91	3.60		130.40
40/03E - 06A02	130	3/26/90	2.38		127.62
19' deep		4/26/90	3.52		126.48
irrigation		5/15/90	4.04		125.96
		6/7/90	2.25		127.75
		6/26/90	3.52		126.48
		7/25/90	pumping		
		11/21/90	1.08		128.92
40/03E - 06G	130	3/26/90	3.64		126.36
23' deep		5/15/90	4.90		125.10
irrigation		6/7/90	2.65		127.35
		6/26/90	4.53		125.47
		7/25/90	pumping		
		9/12/90	8.26		121.74
		10/9/90	7.70		122.30
		11/21/90	1.95		128.05
40/03E - 06J	127	3/26/90	4.77	inner lip	122.23
30' deep		4/26/90	5.65	"	121.35
irrigation		5/14/90	6.00	"	121.00
		6/7/90	4.47	"	122.53
		6/26/90	5.55	"	121.45

Groundwater Levels near Edaleen Dairy (Continued)

Well / depth	Wellhead Elevation	Date	water level	Status	water level elevation
40/03E - 06J	(continued)	7/25/90	pumping		
		9/12/90	9.75	inner lip	117.25
		10/9/90	9.34	"	117.66
		10/16/90	9.15	"	117.85
		11/21/90	3.07	"	123.93
		12/4/90	2.15	"	124.85
		2/27/91	4.04	"	122.96
		3/29/91	4.97	"	122.03
		6/11/91	5.91	"	121.09
		7/18/91	7.44	"	119.56
		10/25/91	8.29	"	118.71
		12/4/91	4.11	"	122.89
		1/2/92	4.05	"	122.95
		3/17/92	4.85	"	122.15
		5/6/92	4.70	"	122.30
		6/23/92	13.19	pumping	113.81
		7/13/92	6.92	inner lip	120.08
		8/25/92	8.57	"	118.43
		10/19/92	8.72	"	118.28
		1/12/93	4.74	"	122.26
40/03E - 08G	108	5/15/90	4.80		103.20
30' deep		6/7/90	4.25		103.75
irrigation		6/26/90	5.18		102.82
		9/7/90	5.53		102.47
		10/9/90	5.04		102.96
		11/21/90	3.87		104.13
		12/4/90	2.93		105.07
		8/13/91	5.15		102.85
		10/25/91	4.73		103.27
40/03E - 08J01	108	5/15/90	5.21		102.79
26' deep		6/7/90	3.77		104.23
irrigation		6/26/90	5.02		102.98
		7/25/90	6.19		101.81
		9/12/90	7.39		100.61
		10/9/90	5.83		102.17
		11/21/90	3.57		104.43
		12/4/90	2.73		105.27
		1/15/91	2.86		105.14
		2/27/91	4.42		103.58
		3/29/91	4.94		103.06
		8/13/91	6.75		101.25
		10/25/91	5.40		102.60
		12/4/91	4.02		103.98
		1/2/92	3.77		104.23
		3/18/92	4.73		103.27

Groundwater Levels near Edaleen Dairy (Continued)

Well / depth	Wellhead Elevation	Date	water level	Status	water level elevation
40/03E - 08J01	(continued)	5/6/92	4.31		103.69
		7/13/92	5.10		102.90
		8/25/92	7.02		100.98
		10/19/92	6.64		101.36
		1/12/93	4.89		103.11
40/03E - 08N03	108	5/14/90	5.98		102.02
24' deep		6/7/90	5.60		102.40
irrigation		6/26/90	5.78		102.22
		7/25/90	6.17		101.83
		9/12/90	6.50		101.50
		10/9/90	6.07		101.93
		11/21/90	3.88		104.12
		12/4/90	2.31		105.69
		1/15/91	2.90		105.10
		2/27/91	4.73		103.27
		3/29/91	5.36		102.64
		6/11/91	5.90		102.10
		7/18/91	6.12		101.88
		8/13/91	6.19		101.81
		10/25/91	6.01		101.99
		12/4/91	4.84		103.16
		1/2/92	4.77		103.23
		3/18/92	5.16		102.84
		5/6/92	5.12		102.88
		7/13/92	5.80		102.20
		10/19/92	5.85		102.15
41/03E - 32L	139	10/9/90	12.23		126.77
29' deep		11/21/90	4.33		134.67
irrigation		2/27/91	3.74		135.26
		3/29/91	5.63		133.37
		6/11/91	8.10		130.90
		7/18/91	9.59		129.41
		8/13/91	10.90		128.10
		10/25/91	11.60		127.40
		12/4/91	7.89		131.11
		1/2/92	6.09		132.91
		3/17/92	5.58		133.42
		5/6/92	6.85		132.15
		6/23/92	9.55		129.45
		7/13/92	10.15		128.85
		8/25/92	11.43		127.57
		10/19/92	12.35		126.65
		1/12/93	6.60		132.40

Appendix B

Groundwater Levels near Edaleen Dairy (Continued)

Well / depth	Wellhead Elevation	Date	water level	Status	water level elevation
41/03E - 32Q01	138	6/7/90	8.69		129.31
25' deep		6/26/90	8.69		129.31
domestic		7/25/90	10.35		127.65
		9/12/90	12.41		125.59
		10/9/90	12.24		125.76
		11/21/90	6.26		131.74
		12/4/90	4.28		133.72
		1/15/91	4.70		133.30
		2/27/91	6.28		131.72
		3/29/91	7.52		130.48
		6/11/91	8.98		129.02
		7/18/91	10.25		127.75
		8/13/91	11.45		126.55
		10/25/91	11.77		126.23
		12/4/91	8.25		129.75
		1/2/92	7.68		130.32
		3/17/92	7.53		130.47
		5/6/92	8.00		130.00
		6/23/92	10.2		127.80
		7/13/92	10.6		127.40
		8/25/92	11.88		126.12
		10/19/92	12.49		125.51

Appendix C

Water Quality Results

Table C-1. Far-Field Ground Water Quality in Domestic and Irrigation Wells near Edaleen Dairy. (Units = mg/L).

Well 40/3E-05E01	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos
8/25/92	284	22.9	2.50	0.05	36.4					72.3	176	53.8	0.05
40/3E-05M	**umhos**	**Cl-**	**NO2+ NO3-N**	**NH3-N**	**SO4-**	**Ca++**	**Mg++**	**Na+**	**K+**	**Hardness (CaCO3)**	**TDS**	**Alkalinity**	**Total Phos**
7/25/90	288	20.7			43.1	29.3	6.30	9.8					
7/10/91	346	26.7	.01u	0.92	50.9	28.8	6.56	12.1		111		79.8	
40/3E-05N01	**umhos**	**Cl-**	**NO2+ NO3-N**	**NH3-N**	**SO4-**	**Ca++**	**Mg++**	**Na+**	**K+**	**Hardness (CaCO3)**	**TDS**	**Alkalinity**	**Total Phos**
1/5/90	211	7.7	4.58		20.5	18.1	5.08	7.7					
6/7/90	175	5.0	1.64		24.4	14.6	3.89	6.4					
9/12/90	276	15.5	0.03		33.6	21.9	6.29	9.6					
1/15/91	200	5.9	1.38		24.3	18.0	4.60	7.4		64.1	169		
7/10/91	233	13.0	0.64	0.41	24.7	18.1	5.53	9.7		75.6		62.5	
8/13/91	239	13.6	0.35	0.38	24.5	17.4	5.15	9.0		79.0	209	67.0	
12/4/91	245	14.1	0.23	.01u	27.8	21.6	6.11	7.8	14	83.3	184	67.5	0.01
5/6/92	192	7.9	2.84	.01u	23.2	15.3	4.24	6.2	13	55.7	127	41.1	.01u
40/3E-05N04	**umhos**	**Cl-**	**NO2+ NO3-N**	**NH3-N**	**SO4-**	**Ca++**	**Mg++**	**Na+**	**K+**	**Hardness (CaCO3)**	**TDS**	**Alkalinity**	**Total Phos**
1/5/90	191	16.4	1.52		47.5	22.8	5.41	5.9					
6/7/90	199	13.9	2.42		44.9	20.1	4.88	5.9					
9/12/90	205	12.6	0.68		53.6	20.1	4.63	5.6					
10/9/90	210	14.4	0.24		59.8	24.0	5.48	5.7		79.0	135		
1/15/91	139	5.2	1.28		31.2	15.5	2.92	3.8		54.1	132		
2/8/91	189	8.2	1.39										
7/10/91	181	8.4	0.92	0.05	49.8	17.7	4.35	5.3		71.6		12.6	
12/4/91	178	7.7	0.12	0.08	50.9	19.0	4.51	5.6	0.8	66.9	145	19.9	0.04
5/6/92	220	10.1	1.49	0.11	54.1	19.8	4.88	6.1	0.6	74.1	135	23.3	.01u
8/25/92	211	11.3	2.04	0.10	50.4	18.2	3.84	8.0	1.6	79.1	156	23.2	.01u

Continued.

40/3E-05N03	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
1/5/90	158	10.6	2.40		26.8	20.6	2.73	3.6					
9/12/90	154	10.4	0.70		36.6	15.9	2.47	3.6					
1/15/91	154	9.0	0.59		38.1	18.9	2.72	3.5		59.1	140		
2/8/91	145	6.3	0.85										
7/10/91	144	6.9	1.23	0.04	35.6	16.1	2.57	3.6		59.0		11.7	
8/13/91	143	6.1	1.10	<0.04	34.9	14.0	2.10	3.0		58.0	116	11.6	
12/4/91	146	6.1	0.82	0.05	39.1	17.1	2.72	3.6	1.0	56.4	137	11.6	0.02
5/6/92	144	4.4	1.61	0.03	34.7	17.2	2.55	3.4	0.8	54.7	117	15.4	.01u

40/3E-05N02	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
1/5/90	144	12.5	2.37		24.3	17.8	2.62	3.7					
6/7/90	160	12.2	2.27		29.0	42.7	.002u	32.3					
9/12/90	138	9.5	1.18		30.9	15.2	2.20	3.3					
10/9/90	131	6.6	1.08		32.6	17.5	2.30	3.1		49.8	124		
1/15/91	118	4.1	0.75		30.4	14.9	1.93	2.8		44.8	124		
2/8/91	138	7.0	0.99										
7/10/91	139	8.5	0.98	0.27	35.5	15.7	2.54	3.4		52.9		8.9	
8/13/91	138	7.0	0.73	<0.04	34.7	12.7	2.01	2.8		48.0	103	7.6	
10/29/91	130	5.3	0.38	<0.04	35.6	13.8	2.12	2.9		46.2	96	9.2	
3/18/92	142	5.8	0.44	0.03	40.0	16.2	2.59	3.3		55.2	109	9.7	.01u
8/25/92	161	8.9	2.04	0.05	40.6	38.3	9.09	12.4	3.0	62.6	117	8.4	.01u

40/3E-05P01	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
7/25/90	257	17.1			60.6	26.4	5.84	11.1					

Continued.

40/3E-05P02	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
1/5/90	130	9.2	2.41		17.0	17.0	2.18	3.6					
9/12/90	158	11.1	3.69		24.0	18.2	2.38	3.6					
10/9/90	153	10.0	2.63		22.6	20.2	2.44	3.5		58.9	108		
1/15/91	100	2.9	1.02		18.4	13.1	1.42	3.0		37.1	90		
2/8/91	90	3.3	1.10										
7/10/91	128	4.7	3.26	.01u	25.9	15.4	2.03	3.4		50.4		12.5	
8/13/91	134	3.6	3.10	<0.04	26.8	14.2	1.70	3.0		52.0	116	13.6	
10/29/91	139	3.7	2.90	<0.04	28.3	16.2	2.11	3.9		52.3	129	14.6	
12/4/91	139	2.8	3.21	.01u	29.6	17.2	2.04	3.6	1.0	56.4	118	16.1	.01u
5/6/92	117	2.2	2.13	.01u	27.1	14.2	1.86	3.3	0.6	41.8	150	13.5	.01u

40/3E-06J	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
7/25/90	243	11.8			53.1	28.0	5.84	7.3					

40/3E-08C	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
7/10/91	135	7.6	6.16	.01u	13.4	15.3	2.91	3.5		53.4		14.1	
8/13/91	140	7.3	5.60	<0.04	14.5	13.4	2.41	3.0		55.0	111	14.7	
10/29/91	122	4.0	4.10	<0.04	17.6	13.8	2.49	3.1		47.9	151	16.2	
12/4/91	113	2.5	3.86	.01u	16.6	13.0	2.47	3.0	0.5	41.9	113	14.6	.01u
3/18/92	101	2.9	4.07	.01u	11.9	11.3	2.14	2.8		35.1	109	12.9	.01u
5/6/92	102	2.7	3.80	.01u	13.3	11.5	2.32	2.8	0.4	36.1	80	13.3	.01u
8/25/92	126	4.8	2.89	.01u	21.5					47.6	86	13.8	.01u

41/3E-32J	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
5/6/92	80.3	2.2	4.24	.01u	4.9	8.5	1.77	2.3	0.4	27.8	84	12.1	.01u

Continued.

41/3E-32P	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
3/17/92	188	5.1	5.59	.01u	23.1	19.5	3.91	8.0		64.7	127	33.9	.01u
5/6/92	172	6.2	4.46	.01u	23.2	18.2	3.69	7.2	1.5	61.6	142	32.3	.01u
8/25/92	180	4.9	4.52	.01u	25.1	22.5	5.25	5.8	0.9	66.0	117	30.8	.01u

41/3E-32Q01	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
6/7/90	306	10.3	16.1		41.4	34.2	6.02	10.4					
9/12/90	341	12.0	21.1		37.9	35.0	6.45	10.9					
1/15/91	288	8.0	15.6		26.4	32.2	5.22	9.3		101	213		
7/10/91	675	21.9	62.8	0.01	29.8	84.3	13.9	16.4		263		17.6	
8/13/91	713	21.7	73.0	<0.04	28.2	66.2	15.4	17.7		276	656	17.0	
10/29/91	704	22.4	66.0	<0.04	27.0	69.0	14.9	18.3		269	511	16.2	
12/4/91	564	20.1	48.4	.01u	25.3	67.9	12.1	16.7	4.2	211	360	15.0	.01u
3/17/92	572	14.1	43.1	.01u	34.0	64.4	12.0	17.4		200	392	16.2	.01u
5/6/92	546	12.4	50.5	.01u	32.2	63.1	11.7	16.2	4.8	194	424	15.4	.01u
8/25/92	625	13.7	50.8	0.01	35.4	71.7	14.1	19.2	3.7	225	515	13.2	.01u

41/3E-32Q02	umhos	Cl-	NO2+ NO3-N	NH3-N	SO4-	Ca++	Mg++	Na+	K+	Hardness (CaCO3)	TDS	Alkalinity	Total Phos.
8/25/92	352	18.3	15.7	.01u	42.0	18.3	3.17	3.6	1.0	130	290	26.5	.01u

Table C-2. Near-Field Edaleen Dairy Water Quality Results February 1990 to April 1993. (Units = mg/L).

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
Lagoon 1	158027	04/10/90	2890	4400	1630	275	0.06	26	139
Lagoon 1	318025	07/31/90	4120 J	7070	2280	322	0.08	89 J	145
Lagoon 1	438047	10/22/90	3770	1300	1620	275	0.61	71.5	148
Lagoon 1	048059	01/22/91	3530	3100	1310	508	1.3 J	35.4	146
Lagoon 1	338174	08/14/91	NT	6170	1390	589	1.2	83	225
Lagoon 1	448096	10/29/91	NT	3400	974	500	0.62	49	188
Lagoon 1	188119	04/28/92	NT	7800	2100	600 J	0.67 J	80.4	285
Lagoon 1	298146	07/15/92	NT	NT	NT	NT	NT	NT	315
Lagoon 1	188171	04/27/93	6850	14600	2880	582	0.45 J	133	399
MW1	098060	02/28/90	411	10	13.8	0.05	8.5	0.12	5.8
MW1	158021	04/10/90	226	6.8	29.6	0.05	7.6	0.01	8.1
MW1	208072	05/16/90	201	12.4	6.1	0.04	2.2	0.09	13.8
MW1	258031	06/19/90	680	449	95	0.01	0.01	0.04	51.2
MW1	318024	07/31/90	318	88	38.4	0.01 U	0.01 U	0.05 J	24.9
MW1	358073	08/27/90	1040	578	225	0.02	0.11	0.16	84.8
MW1	398032	09/25/90	980	650	244	2.8	0.05	0.12	
MW1	438044	10/22/90	864	255	175	11	0.10	0.26	60.8
MW1	488034	11/27/90	710	160	61.1	7.5	0.01 U	0.02	67.4
MW1	518064	12/18/90	505	120	42.3	9.7	0.2 J	0.1	40.3
MW1	048055	01/22/91	613	120	202	31	0.04 J	0.12	52.5
MW1	098044	02/26/91	941	260	140	52	0.10	0.03	80.2
MW1	338170	08/14/91	333	52	18.5	45	0.02 U	0.08	34.3
MW1	448092	10/29/91	353	33	11.7	30	0.02 U	0.02	46.4
MW1	188114	04/28/92	407	67	23.9	13	0.01 U	0.018	32.4
MW1	298142	07/15/92	516	140	27.0	50	0.05 U	0.17	57.1
MW1	438091	10/20/92	344	52	15.6	26	0.3	0.1	35.9
MW1	038116	01/12/93	520	5 U	3.0	32	54	0.021 J	34.5
MW1	188167	04/27/93	537	14.3	5.4	18	47	0.014	32.0
MW2	098061	02/28/90	245	8.4	26.7	0.05	16	0.01	10.8

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
MW5	318020	07/31/90	156	16	5.6	0.02	3.2	0.01 J	2.4
MW5	438041	10/22/90	155	5 U	6.8	0.07	2.5	0.31	2.4
MW5	488031	11/27/90	384	10 U	1.5 B	0.02	42	0.01 U	9.3
MW5	518061	12/18/90	675	24	2.0 B	0.005 U	80 J	0.005 U	33.6
MW5	048051	01/22/91	744	10 U	4.0 B	0.05 U	99 J	0.005 U	46.7
MW5	098041	02/26/91	385	10 U	4.7	0.012	43	0.011	22.9
MW5	338166	08/14/91	227	0.1 U	2.0	0.04 U	17	0.01 U	14.6
MW5	448088	10/29/91	237	5.2	2.0	0.04 U	18	0.01 U	19.4
MW5	188111	04/28/92	370	3 U	1.4	0.011	38	0.01 U	15.0
MW5	298138	07/15/92	408	5 U	1.6	0.08 U	29	0.05	20.9
MW5	438087	10/20/92	592	5	1.3	0.5	46	0.02 U	26.4
MW5	038112	01/12/93	601	5 U	1.3	0.011	75	0.01 U	35.6
MW5	188163	04/27/93	851	5 U	1.7	0.012	91	0.01 U	52.0
MW6	098065	02/28/90	781	103	93	29	0.01 U	0.01	49.0
MW6	108018	03/07/90	937	135	112	33	0.02	0.01	54.8
MW6	158026	04/10/90	645	80	26.6	14	0.01 U	0.01	37.5
MW6A	318028	08/01/90	1340	870	359	89.7	0.01 U	0.09 J	88.6
MW6A	488037	11/27/90	775	47	86.9	69	0.04	0.01 U	88.9
MW6A	518067	12/18/90	803	270	71.8	91	0.21 J	0.2	68.9
MW6A	048058	01/22/91	547	79	56.7	81	0.03 J	0.08	47.1
MW6A	098047	02/26/91	580	88	31.6	46	0.01	0.02	50.4
MW6A	338173	08/14/91	816	120	43.6	101	0.02 U	0.12	67.7
MW6A	448095	10/29/91	1130	190	68.7	160	0.02 U	0.03	105
MW6A	188118	04/28/92	701	110	48.0	103	0.01 U	0.041	60.3
MW6A	298145	07/15/92	732	111	35.7	74	0.05 U	0.046	72.8
MW6A	438094	10/20/92	1160	300	84.4	184	0.2 U	0.15	102
MW6A	038119	01/12/93	1080	239	82.6	157	0.01 U	0.053 J	94.2
MW6A	188170	04/27/93	783	124	49.2	108	0.01 U	0.023	72.7
MW7A	518068	12/18/90	486	64	19.3	0.06	0.08 J	0.17	45.2
MW7A	048054	01/22/91	627	29	151	0.02	0.03 J	0.05	60.2
MW7A	098043	02/26/91	636	56	67.0	0.016	0.01 U	0.017	72.0

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
MW7A	338169	08/14/91	484	53	20.8	4.2	0.02 U	0.01	40.5
MW7A	448091	10/29/91	949	160	52.6	23	0.02 U	0.04	84.5
MW7A	188113	04/28/92	441	40	16.5	17	0.01 U	0.034	30.3
MW7A	298140	07/15/92	530	54	14.1	15	0.05 U	0.046	36.2
MW7A	438090	10/20/92	642	67	21.7	4.1	12	0.05	46.2
MW7A	038115	01/12/93	530	46	18.0	14	0.01 U	0.012 J	41.4
MW7A	188165	04/27/93	410	22	8.4	6.8	0.01 U	0.019	27.4
MW8	298137	07/15/92	275	5 U	1.6	0.39	0.05 U	0.082	18.8
MW8	438096	10/20/92	237	14	1.5	6.1	0.2 U	0.03	16.9
MW8	038111	01/12/93	254	5 U	1.2	0.29	0.01 U	0.01 U	17.6
MW8	188162	04/26/93	220	5 U	1.4	0.25	0.01 U	0.01 U	18.1

J= Estimated value.

U= Analyte not detected above value listed.

B= Analyte detected in blank.

Table C-3. Near-Field Edaleen Bacteriologic and Miscellaneous Water Quality Results.
(Units= mg/L unless shown otherwise.)

Site Name	ID #	Date	Total Coliforms (CFU/100mL)	Fecal Coliforms (CFU/100mL)	Iron, Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
Lagoon 1	158027	04/10/90	440000	230000					575
Lagoon 1	318025	07/31/90	7400000 J	1000000 J					925
Lagoon 1	438047	10/22/90	8600000	5800000					
Lagoon 1	048059	01/22/91	3300000	2100000			0.01 U		1590
Lagoon 1	338174	08/14/91	230000	200000					
Lagoon 1	188119	04/28/92	2100000 S	1200000				8220	
Lagoon 1	298146	07/15/92	NT	NT		3.5		20900	
Lagoon 1	188171	04/27/93	NT	NT				11800	
MW1	098060	02/28/90	3 U	3 U					
MW1	158021	04/10/90	1 U	1 U					
MW1	208072	05/16/90	1	1 U					
MW1	258031	06/19/90	1 U	1 U					
MW1	318024	07/31/90	1 U	1 U					
MW1	358073	08/27/90	3 U	3 U					
MW1	398032	09/25/90	1 U	1 U					
MW1	438044	10/22/90	1 U	1 U					
MW1	488034	11/27/90	1 U	1 U			10.3		
MW1	518064	12/18/90	H	H			3.6		
MW1	048055	01/22/91	1 U	1 U			11.4		
MW1	098044	02/26/91	1 U	1 U			3.7		
MW1	338170	08/14/91	1 U	1 U					
MW1	448092	10/29/91	1 U	1 U					
MW1	188114	04/28/92	1 U	1 U					
MW1	298142	07/15/92	2	1 U		58.1			
MW1	438091	10/20/92	1 U	1 U					
MW1	038116	01/12/93	1 U	1 U					
MW2	098061	02/28/90	3 U	3 U					
MW2	158022	04/10/90	1 U	1 U					

Site Name	ID #	Date	Total Coliforms (CFU/100mL)	Fecal Coliforms (CFU/100mL)	Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW2	208073	05/16/90	3 U	3 U					
MW2	258032	06/19/90	3 U	3 U					
MW2	318026	08/01/90	3 U	3 U					
MW2	358074	08/27/90	3 U	3 U					
MW2	398033	09/25/90	1 U	1 U					
MW2	438045	10/22/90	1 U	1 U					
MW2	488035	11/27/90	1 UX	1 U			31.8		
MW2	518065	12/18/90	H	H			13.9		
MW2	048056	01/22/91	148 J	7 J			20.6		
MW2	098045	02/26/91	1 U	1 U			18.0		
MW2	338171	08/14/91	1	1 U					
MW2	448093	10/29/91	5 X	1 U					
MW2	188115	04/28/92	1 UX	1 U					
MW2	298143	07/15/92	1 UX	1 U		15.7			
MW2	438092	10/20/92	1 U	1 U					
MW2	038117	01/12/93	1 U	1 U					
MW3	098062	02/28/90	3 U	3 U					
MW3	158023	04/10/90	1 U	1 U					
MW3	208074	05/16/90	3 U	3 U					
MW3	258033	06/19/90	3 U	3 U					
MW3	318027	08/01/90	3 U	3 U					
MW3	358075	08/27/90	3 U	3 U					
MW3	398034	09/25/90	1 U	1 U					
MW3	438046	10/22/90	1 U	1 U					
MW3	488036	11/27/90	1 U	1 U			15.9		
MW3	518066	12/18/90	H	H			7.3		
MW3	048057	01/22/91	3 U	3 U			0.01 U		
MW3	098046	02/26/91	1 UX	1 U			12.9		
MW3	338172	08/14/91	1 U	1 U					
MW3	448094	10/29/91	1 U	1 U					
MW3	188116	04/28/92	1 UX	1 UX					

Site Name	ID #	Date	Total Coliforms (CFU/100mL)		Fecal Coliforms (CFU/100mL)		Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW3	298144	07/15/92	1	UX	1	U		35.4			
MW3	438093	10/20/92	1	U	1	U					
MW3	038118	01/12/93	1	U	1	U					
MW3	188169	04/27/93	NT		NT		20.6				
MW4	098063	02/28/90	3	U	3	U					
MW4	108016	03/07/90	1	U	1	U					
MW4	158025	04/10/90	1	U	1	U					
MW4	208075	05/16/90	1	U	1	U					
MW4	258034	06/19/90	1	U	1	U					
MW4	318022	07/31/90	1	U	1	U					
MW4	358071	08/27/90	1	U	1	U					
MW4	398030	09/25/90	1	U	1	U					
MW4	438042	10/22/90	1	U	1	U					
MW4	488032	11/27/90	1	UX	1	U			2.8		
MW4	518062	12/18/90		H		H			11.1		
MW4	048052	01/22/91	1	U	1	U			27		
MW4	098042	02/26/91	1	U	1	U			0.62		
MW4	338167	08/14/91	1	U	1	U					
MW4	448089	10/29/91	1	U	1	U					
MW4	188112	04/28/92	1	U	1	U					
MW4	298139	07/15/92	1	U	1	U		3.2			
MW4	438088	10/20/92	1	U	1	U					
MW4	038113	01/12/93	1	U	1	U					
MW5	108015	03/07/90	1	U	1	U					
MW5	158020	04/10/90	1	U	1	U					
MW5	208071	05/16/90	1	U	1	U					
MW5	258030	06/19/90	2		1	U					
MW5	318020	07/31/90	1	U	1	U					
MW5	438041	10/22/90	1	U	1	U					
MW5	488031	11/27/90	1	U	1	U			41		
MW5	518061	12/18/90		H		H			89		

Site Name	ID #	Date	Total Coliforms (CFU/100mL)		Fecal Coliforms (CFU/100mL)		Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW5	048051	01/22/91	1	U	1	U			175		
MW5	098041	02/26/91	1	U	1	U			42		
MW5	338166	08/14/91	1	U	1	U					
MW5	448088	10/29/91	1	U	1	U					
MW5	188111	04/28/92	1	U	1	U					
MW5	298138	07/15/92	1	U	1	U		0.27			
MW5	438087	10/20/92	1	U	1	U					
MW5	038112	01/12/93	1	U	1	U					
MW5	188163	04/27/93	NT		NT		0.088				
MW6	098065	02/28/90	3	U	3	U					
MW6	158026	04/10/90	1	U	1	U					
MW6A	318028	08/01/90	3	U	3	U					
MW6A	488037	11/27/90	1	UX	1	U			69		
MW6A	518067	12/18/90		H		H			17		
MW6A	048058	01/22/91	3	U	3	U			23		
MW6A	098047	02/26/91	1	U	1	U			17		
MW6A	338173	08/14/91	1	U	1	U					
MW6A	448095	10/29/91	1	U	1	U					
MW6A	188118	04/28/92	1	U	1	U					
MW6A	298145	07/15/92	1	U	1	U		36.5			
MW6A	438094	10/20/92	1	U	1	U					
MW6A	038119	01/12/93	1	U	1	U					
MW7A	048054	01/22/91	1	U	1	U			0.13		
MW7A	098043	02/26/91	1	U	1	U			2.2		
MW7A	338169	08/14/91	1	U	1	U					
MW7A	448091	10/29/91	1	U	1	U					
MW7A	188113	04/28/92	1	U	1	U					
MW7A	298140	07/15/92	1	U	1	U		249			
MW7A	438090	10/20/92	1	U	1	U					
MW7A	038115	01/12/93	1	U	1	U					
MW7A	188165	04/27/93	NT		NT		12.6				

Site Name	ID #	Date	Total Coliforms (CFU/100mL)	Fecal Coliforms (CFU/100mL)	Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW8	298137	07/15/92	1 U	1 U		6.1			
MW8	438096	10/20/92	1 U	1 U					
MW8	038111	01/12/93	1 U	1 U					

U= Analyte not detected above listed value.

X= Many background organisms.

S= Spreader.

NT= Not Tested.

CFU= Colony forming unit.

Table C-2. Near-Field Edaleen Dairy Water Quality Results February 1990 to April 1993. (Units = mg/L).

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
Lagoon 1	158027	04/10/90	2890	4400	1630	275	0.06	26	139
Lagoon 1	318025	07/31/90	4120 J	7070	2280	322	0.08	89 J	145
Lagoon 1	438047	10/22/90	3770	1300	1620	275	0.61	71.5	148
Lagoon 1	048059	01/22/91	3530	3100	1310	508	1.3 J	35.4	146
Lagoon 1	338174	08/14/91	NT	6170	1390	589	1.2	83	225
Lagoon 1	448096	10/29/91	NT	3400	974	500	0.62	49	188
Lagoon 1	188119	04/28/92	NT	7800	2100	600 J	0.67 J	80.4	285
Lagoon 1	298146	07/15/92	NT	NT	NT	NT	NT	NT	315
Lagoon 1	188171	04/27/93	6850	14600	2880	582	0.45 J	133	399
MW1	098060	02/28/90	411	10	13.8	0.05	8.5	0.12	5.8
MW1	158021	04/10/90	226	6.8	29.6	0.05	7.6	0.01	8.1
MW1	208072	05/16/90	201	12.4	6.1	0.04	2.2	0.09	13.8
MW1	258031	06/19/90	680	449	95	0.01	0.01	0.04	51.2
MW1	318024	07/31/90	318	88	38.4	0.01 U	0.01 U	0.05 J	24.9
MW1	358073	08/27/90	1040	578	225	0.02	0.11	0.16	84.8
MW1	398032	09/25/90	980	650	244	2.8	0.05	0.12	
MW1	438044	10/22/90	864	255	175	11	0.10	0.26	60.8
MW1	488034	11/27/90	710	160	61.1	7.5	0.01 U	0.02	67.4
MW1	518064	12/18/90	505	120	42.3	9.7	0.2 J	0.1	40.3
MW1	048055	01/22/91	613	120	202	31	0.04 J	0.12	52.5
MW1	098044	02/26/91	941	260	140	52	0.10	0.03	80.2
MW1	338170	08/14/91	333	52	18.5	45	0.02 U	0.08	34.3
MW1	448092	10/29/91	353	33	11.7	30	0.02 U	0.02	46.4
MW1	188114	04/28/92	407	67	23.9	13	0.01 U	0.018	32.4
MW1	298142	07/15/92	516	140	27.0	50	0.05 U	0.17	57.1
MW1	438091	10/20/92	344	52	15.6	26	0.3	0.1	35.9
MW1	038116	01/12/93	520	5 U	3.0	32	54	0.021 J	34.5
MW1	188167	04/27/93	537	14.3	5.4	18	47	0.014	32.0
MW2	098061	02/28/90	245	8.4	26.7	0.05	16	0.01	10.8

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
MW2	158022	04/10/90	413	10	2.3 B	0.2	38	0.01	14.8
MW2	208073	05/16/90	196	76	28.6	0.02	1.4	0.06	19.6
MW2	258032	06/19/90	495	196	38.5	0.01	0.18	0.1	48.4
MW2	318028	08/01/90	1110	533	236	0.09	0.01 U	0.06 J	87.6
MW2	358074	08/27/90	1640	1064	429	1.8	0.01 U	0.13	111
MW2	398033	09/25/90	1300	800	304	7.6	0.02	0.14	
MW2	438045	10/22/90	1200	120	217	8.4	0.01 U	0.27	89.8
MW2	488035	11/27/90	1140	240	93.1	31	0.01 U	0.06	72.9
MW2	518065	12/18/90	1060	300	100	59	0.16 J	0.28	81.3
MW2	048056	01/22/91	536	120	84.5	71	0.04 J	0.16	35.7
MW2	098045	02/26/91	822	1760	88.7	102	0.14	0.14	77.3
MW2	338171	08/14/91	856	240	69.2	142	0.02 U	0.23	79.0
MW2	448093	10/29/91	616	140	55.8	130	0.02 U	0.12	52.1
MW2	188115	04/28/92	548	93	39.8	58	0.011	0.138	44.6
MW2	298143	07/15/92	640	106	31.9	64	0.05 U	0.17	52.7
MW2	438092	10/20/92	515	110	37.4	56	0.2 U	0.19	42.8
MW2	038117	01/12/93	481	83	31.0	68	0.015	0.097 J	42.3
MW2	188168	04/27/93	372	62	21.5	62	0.01 U	0.092	43.9
MW3	098062	02/28/90	184	10	18.3	0.03	14	0.01	16.0
MW3	158023	04/10/90	381	12	2.8 B	0.2	43	0.01 U	16.4
MW3	208074	05/16/90	196	7.7	4.6	0.02	0.68	0.08	12.9
MW3	258033	06/19/90	540	189	46.1	0.01	0.1	0.1	56.5
MW3	318026	08/01/90	730	340	133	0.02	0.01 U	0.03 J	54.1
MW3	358075	08/27/90	911	436	201	0.31	0.01 U	0.14	67.4
MW3	398034	09/25/90	865	365	169	24	0.02	0.12	
MW3	438046	10/22/90	525	35	77.4	30	0.01 U	0.28	54.1
MW3	488036	11/27/90	460 J	47	26.3	16	0.01 U	0.01	58.3
MW3	518066	12/18/90	592	140	48.2	14	0.17 J	0.11	78.1
MW3	048057	01/22/91	1240	170	214	74	0.04 J	0.17	121
MW3	098046	02/26/91	592	130	60.4	53	0.11	0.08	44.4
MW3	338172	08/14/91	622	120	47.0	42	0.02 U	0.12	51.9

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
MW3	448094	10/29/91	531	80	32.8	54	0.02 U	0.07	34.2
MW3	188116	04/28/92	514	86	38.1	37	0.01 U	0.112	38.0
MW3	298144	07/15/92	802	146	45.9	56	0.05 U	0.248	66.7
MW3	438093	10/20/92	569	150	54.9	88	0.2 U	0.33	48.6
MW3	038118	01/12/93	396	61	22.7	50	0.01 U	0.034 J	41.0
MW3	188169	04/27/93	564	112	38.7	55	0.01 U	0.121	67.9
MW4	098063	02/28/90	140	8.1	7.1	0.02	6.0	0.02	2.2
MW4	108016	03/07/90	137	7.5	6.6	0.03	8.3	0.01 U	3.9
MW4	158025	04/10/90	149	7.1	3.0 B	0.02	4.7	0.01 U	3.8
MW4	208075	05/16/90	207	6.7	9.7	0.06	2.9	0.02	12.9
MW4	258034	06/19/90	176	5.1	0.50 U	0.05	2.5	0.01	14.3
MW4	318022	07/31/90	183	13	8.7	0.07	0.48	0.01 J	20.2
MW4	358071	08/27/90	323	11	17.9	0.13	0.01 U	0.05	42.9
MW4	398030	09/25/90	390	19	18.8	0.13	0.23	0.04	
MW4	438042	10/22/90	417	22	70.0	0.23	0.01 U	0.25	69.7
MW4	488032	11/27/90	390	29	40.0	0.12	2.0	0.03	56.6
MW4	518062	12/18/90	311	38	7.9	0.22	12 J	0.03	13.6
MW4	048052	01/22/91	384	10 U	26.0	0.21	25 J	0.005 U	14.1
MW4	098042	02/26/91	474	10 U	22.1	0.15	0.23	0.02	21.4
MW4	338167	08/14/91	856	114	44.4	0.55	0.12	0.06	88.6
MW4	448089	10/29/91	934	145	54.0	77	0.02	0.04	96.6
MW4	188112	04/28/92	836	92	39.5	43	0.01	0.04	61.1
MW4	298139	07/15/92	726	108	29.7	82	0.051	0.064	64.5
MW4	438088	10/20/92	721	115	44.0	83	0.02 U	0.07	66.4
MW4	038113	01/12/93	638	93	42.8	79	0.44	0.028 J	47.3
MW4	188164	04/27/93	840	114	44.4	78	0.01 U	0.036	60.6
MW5	098066	02/28/90	159	6.2	6.5	0.02	7.7	0.05	4.3
MW5	108015	03/07/90	141	8.2	4.7	3.6	7.0	0.03	3.8
MW5	158020	04/10/90	138	9.3	8.4	0.06	5.9	0.01 U	3.3
MW5	208071	05/16/90	135	11	8.3	0.03	3.7	0.01	11.1
MW5	258030	06/19/90	150	15	0.50 U	0.01	2.5	0.005 U	1.8

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
MW5	318020	07/31/90	156	16	5.6	0.02	3.2	0.01 J	2.4
MW5	438041	10/22/90	155	5 U	6.8	0.07	2.5	0.31	2.4
MW5	488031	11/27/90	384	10 U	1.5 B	0.02	42	0.01 U	9.3
MW5	518061	12/18/90	675	24	2.0 B	0.005 U	80 J	0.005 U	33.6
MW5	048051	01/22/91	744	10 U	4.0 B	0.05 U	99 J	0.005 U	46.7
MW5	098041	02/26/91	385	10 U	4.7	0.012	43	0.011	22.9
MW5	338166	08/14/91	227	0.1 U	2.0	0.04 U	17	0.01 U	14.6
MW5	448088	10/29/91	237	5.2	2.0	0.04 U	18	0.01 U	19.4
MW5	188111	04/28/92	370	3 U	1.4	0.011	38	0.01 U	15.0
MW5	298138	07/15/92	408	5 U	1.6	0.08 U	29	0.05	20.9
MW5	438087	10/20/92	592	5	1.3	0.5	46	0.02 U	26.4
MW5	038112	01/12/93	601	5 U	1.3	0.011	75	0.01 U	35.6
MW5	188163	04/27/93	851	5 U	1.7	0.012	91	0.01 U	52.0
MW6	098065	02/28/90	781	103	93	29	0.01 U	0.01	49.0
MW6	108018	03/07/90	937	135	112	33	0.02	0.01	54.8
MW6	158026	04/10/90	645	80	26.6	14	0.01 U	0.01	37.5
MW6A	318028	08/01/90	1340	870	359	89.7	0.01 U	0.09 J	88.6
MW6A	488037	11/27/90	775	47	86.9	69	0.04	0.01 U	88.9
MW6A	518067	12/18/90	803	270	71.8	91	0.21 J	0.2	68.9
MW6A	048058	01/22/91	547	79	56.7	81	0.03 J	0.08	47.1
MW6A	098047	02/26/91	580	88	31.6	46	0.01	0.02	50.4
MW6A	338173	08/14/91	816	120	43.6	101	0.02 U	0.12	67.7
MW6A	448095	10/29/91	1130	190	68.7	160	0.02 U	0.03	105
MW6A	188118	04/28/92	701	110	48.0	103	0.01 U	0.041	60.3
MW6A	298145	07/15/92	732	111	35.7	74	0.05 U	0.046	72.8
MW6A	438094	10/20/92	1160	300	84.4	184	0.2 U	0.15	102
MW6A	038119	01/12/93	1080	239	82.6	157	0.01 U	0.053 J	94.2
MW6A	188170	04/27/93	783	124	49.2	108	0.01 U	0.023	72.7
MW7A	518068	12/18/90	486	64	19.3	0.06	0.08 J	0.17	45.2
MW7A	048054	01/22/91	627	29	151	0.02	0.03 J	0.05	60.2
MW7A	098043	02/26/91	636	56	67.0	0.016	0.01 U	0.017	72.0

Site Name	ID #	Date	Total Dissolved Solids	Chemical Oxygen Demand	Total Organic Carbon	Ammonia-N	Nitrate+ Nitrite as N	Total Phosphorus	Chloride
MW7A	338169	08/14/91	484	53	20.8	4.2	0.02 U	0.01	40.5
MW7A	448091	10/29/91	949	160	52.6	23	0.02 U	0.04	84.5
MW7A	188113	04/28/92	441	40	16.5	17	0.01 U	0.034	30.3
MW7A	298140	07/15/92	530	54	14.1	15	0.05 U	0.046	36.2
MW7A	438090	10/20/92	642	67	21.7	4.1	12	0.05	46.2
MW7A	038115	01/12/93	530	46	18.0	14	0.01 U	0.012 J	41.4
MW7A	188165	04/27/93	410	22	8.4	6.8	0.01 U	0.019	27.4
MW8	298137	07/15/92	275	5 U	1.6	0.39	0.05 U	0.082	18.8
MW8	438096	10/20/92	237	14	1.5	6.1	0.2 U	0.03	16.9
MW8	038111	01/12/93	254	5 U	1.2	0.29	0.01 U	0.01 U	17.6
MW8	188162	04/26/93	220	5 U	1.4	0.25	0.01 U	0.01 U	18.1

J= Estimated value.

U= Analyte not detected above value listed.

B= Analyte detected in blank.

Table C-3. Near-Field Edaleen Bacteriologic and Miscellaneous Water Quality Results.
(Units= mg/L unless shown otherwise.)

Site Name	ID #	Date	Total Coliforms (CFU/100mL)	Fecal Coliforms (CFU/100mL)	Iron, Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
Lagoon 1	158027	04/10/90	440000	230000					575
Lagoon 1	318025	07/31/90	7400000 J	1000000 J					925
Lagoon 1	438047	10/22/90	8600000	5800000					
Lagoon 1	048059	01/22/91	3300000	2100000			0.01 U		1590
Lagoon 1	338174	08/14/91	230000	200000					
Lagoon 1	188119	04/28/92	2100000 S	1200000				8220	
Lagoon 1	298146	07/15/92	NT	NT		3.5		20900	
Lagoon 1	188171	04/27/93	NT	NT				11800	
MW1	098060	02/28/90	3 U	3 U					
MW1	158021	04/10/90	1 U	1 U					
MW1	208072	05/16/90	1	1 U					
MW1	258031	06/19/90	1 U	1 U					
MW1	318024	07/31/90	1 U	1 U					
MW1	358073	08/27/90	3 U	3 U					
MW1	398032	09/25/90	1 U	1 U					
MW1	438044	10/22/90	1 U	1 U					
MW1	488034	11/27/90	1 U	1 U			10.3		
MW1	518064	12/18/90	H	H			3.6		
MW1	048055	01/22/91	1 U	1 U			11.4		
MW1	098044	02/26/91	1 U	1 U			3.7		
MW1	338170	08/14/91	1 U	1 U					
MW1	448092	10/29/91	1 U	1 U					
MW1	188114	04/28/92	1 U	1 U					
MW1	298142	07/15/92	2	1 U		58.1			
MW1	438091	10/20/92	1 U	1 U					
MW1	038116	01/12/93	1 U	1 U					
MW2	098061	02/28/90	3 U	3 U					
MW2	158022	04/10/90	1 U	1 U					

Site Name	ID #	Date	Total Coliforms (CFU/100mL)		Fecal Coliforms (CFU/100mL)		Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW2	208073	05/16/90	3	U	3	U					
MW2	258032	06/19/90	3	U	3	U					
MW2	318026	08/01/90	3	U	3	U					
MW2	358074	08/27/90	3	U	3	U					
MW2	398033	09/25/90	1	U	1	U					
MW2	438045	10/22/90	1	U	1	U					
MW2	488035	11/27/90	1	UX	1	U			31.8		
MW2	518065	12/18/90		H		H			13.9		
MW2	048056	01/22/91	148	J	7	J			20.6		
MW2	098045	02/26/91	1	U	1	U			18.0		
MW2	338171	08/14/91	1		1	U					
MW2	448093	10/29/91	5	X	1	U					
MW2	188115	04/28/92	1	UX	1	U					
MW2	298143	07/15/92	1	UX	1	U		15.7			
MW2	438092	10/20/92	1	U	1	U					
MW2	038117	01/12/93	1	U	1	U					
MW3	098062	02/28/90	3	U	3	U					
MW3	158023	04/10/90	1	U	1	U					
MW3	208074	05/16/90	3	U	3	U					
MW3	258033	06/19/90	3	U	3	U					
MW3	318027	08/01/90	3	U	3	U					
MW3	358075	08/27/90	3	U	3	U					
MW3	398034	09/25/90	1	U	1	U					
MW3	438046	10/22/90	1	U	1	U					
MW3	488036	11/27/90	1	U	1	U			15.9		
MW3	518066	12/18/90		H		H			7.3		
MW3	048057	01/22/91	3	U	3	U			0.01	U	
MW3	098046	02/26/91	1	UX	1	U			12.9		
MW3	338172	08/14/91	1	U	1	U					
MW3	448094	10/29/91	1	U	1	U					
MW3	188116	04/28/92	1	UX	1	UX					

Site Name	ID #	Date	Total Coliforms (CFU/100mL)		Fecal Coliforms (CFU/100mL)		Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW3	298144	07/15/92	1	UX	1	U		35.4			
MW3	438093	10/20/92	1	U	1	U					
MW3	038118	01/12/93	1	U	1	U					
MW3	188169	04/27/93	NT		NT		20.6				
MW4	098063	02/28/90	3	U	3	U					
MW4	108016	03/07/90	1	U	1	U					
MW4	158025	04/10/90	1	U	1	U					
MW4	208075	05/16/90	1	U	1	U					
MW4	258034	06/19/90	1	U	1	U					
MW4	318022	07/31/90	1	U	1	U					
MW4	358071	08/27/90	1	U	1	U					
MW4	398030	09/25/90	1	U	1	U					
MW4	438042	10/22/90	1	U	1	U					
MW4	488032	11/27/90	1	UX	1	U			2.8		
MW4	518062	12/18/90		H		H			11.1		
MW4	048052	01/22/91	1	U	1	U			27		
MW4	098042	02/26/91	1	U	1	U			0.62		
MW4	338167	08/14/91	1	U	1	U					
MW4	448089	10/29/91	1	U	1	U					
MW4	188112	04/28/92	1	U	1	U					
MW4	298139	07/15/92	1	U	1	U		3.2			
MW4	438088	10/20/92	1	U	1	U					
MW4	038113	01/12/93	1	U	1	U					
MW5	108015	03/07/90	1	U	1	U					
MW5	158020	04/10/90	1	U	1	U					
MW5	208071	05/16/90	1	U	1	U					
MW5	258030	06/19/90	2		1	U					
MW5	318020	07/31/90	1	U	1	U					
MW5	438041	10/22/90	1	U	1	U					
MW5	488031	11/27/90	1	U	1	U			41		
MW5	518061	12/18/90		H		H			89		

Site Name	ID #	Date	Total Coliforms (CFU/100mL)	Fecal Coliforms (CFU/100mL)	Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW5	048051	01/22/91	1 U	1 U			175		
MW5	098041	02/26/91	1 U	1 U			42		
MW5	338166	08/14/91	1 U	1 U					
MW5	448088	10/29/91	1 U	1 U					
MW5	188111	04/28/92	1 U	1 U					
MW5	298138	07/15/92	1 U	1 U		0.27			
MW5	438087	10/20/92	1 U	1 U					
MW5	038112	01/12/93	1 U	1 U					
MW5	188163	04/27/93	NT	NT	0.088				
MW6	098065	02/28/90	3 U	3 U					
MW6	158026	04/10/90	1 U	1 U					
MW6A	318028	08/01/90	3 U	3 U					
MW6A	488037	11/27/90	1 UX	1 U			69		
MW6A	518067	12/18/90	H	H			17		
MW6A	048058	01/22/91	3 U	3 U			23		
MW6A	098047	02/26/91	1 U	1 U			17		
MW6A	338173	08/14/91	1 U	1 U					
MW6A	448095	10/29/91	1 U	1 U					
MW6A	188118	04/28/92	1 U	1 U					
MW6A	298145	07/15/92	1 U	1 U		36.5			
MW6A	438094	10/20/92	1 U	1 U					
MW6A	038119	01/12/93	1 U	1 U					
MW7A	048054	01/22/91	1 U	1 U			0.13		
MW7A	098043	02/26/91	1 U	1 U			2.2		
MW7A	338169	08/14/91	1 U	1 U					
MW7A	448091	10/29/91	1 U	1 U					
MW7A	188113	04/28/92	1 U	1 U					
MW7A	298140	07/15/92	1 U	1 U		249			
MW7A	438090	10/20/92	1 U	1 U					
MW7A	038115	01/12/93	1 U	1 U					
MW7A	188165	04/27/93	NT	NT	12.6				

Site Name	ID #	Date	Total Coliforms (CFU/100mL)	Fecal Coliforms (CFU/100mL)	Iron Dissolved	Iron, Total Recoverable	Total Persulfate Nitrogen	Total Solids	Total Suspended Solids
MW8	298137	07/15/92	1 U	1 U		6.1			
MW8	438096	10/20/92	1 U	1 U					
MW8	038111	01/12/93	1 U	1 U					

U= Analyte not detected above listed value.

X= Many background organisms.

S= Spreader.

NT= Not Tested.

CFU= Colony forming unit.