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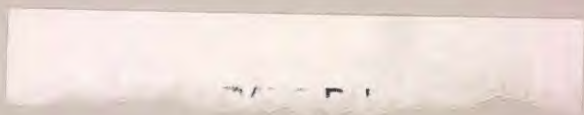
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CHANGES IN QUALITY OF GROUND WATER IN

THE LINCOLN AREA, MONTANA, 1974-79

by Robert B. Leonard, Wayne A. Wood, and Arnold J. Boettcher

Open-File Report 80-1108

Prepared in cooperation with the
Lewis and Clark County Commissioners

Helena, Montana

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CONTENTS

	Page
Metric conversion table	III
Abstract.	1
Introduction.	1
Well-numbering system	3
Methods of investigation.	3
Results	3
References.	9

ILLUSTRATIONS

Figure 1. Map showing location of study area	2
2. Diagram showing well-numbering system.	4
3. Map showing locations of wells and types of analyses for water samples collected during March and June 1979. .	5
4. Graph showing relation of concentrations of nitrite plus nitrate in ground water during March 1979 to con- centrations during May or June 1975 from the same wells .	7
5. Graph showing relation of concentrations of nitrite plus nitrate in ground water during June 1979 to concen- trations during March 1979 from the same wells.	8

TABLES

Table 1. Results of analyses for miscellaneous chemical constit- uents constituents in ground water	10
2. Results of analyses for common chemical constituents in ground water.	14

METRIC CONVERSION TABLE

The following factors can be used to convert inch-pound units to the International System (SI) of metric units.

<u>Multiply inch-pound unit</u>	<u>By</u>	<u>To obtain SI unit</u>
acre	0.4047	square hectometer
foot (ft)	0.3048	meter
mile	1.609	kilometer
acre-foot	1233	cubic meter
ton (short)	0.9072	megagram

temperature, degrees Celsius (°C) = 0.556 (°F-32)

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ABSTRACT

Water samples from representative shallow wells in the vicinity of Lincoln, Montana, were collected during March and June 1979 for analysis to evaluate changes in quality since 1974-75 and possible contamination by domestic or agricultural waste. All samples were suitable for drinking water with respect to the constituents tested. Tests for fecal coliform bacteria were negative. The concentrations of dissolved solids, composed mainly of calcium, magnesium, bicarbonate, and sulfate, were less than 300 milligrams per liter. Concentrations of sodium, potassium, and chloride were 3.5 milligrams per liter or less.

From March to June, the maximum concentration of nitrite plus nitrate as nitrogen decreased from 0.57 to 0.29 milligram per liter and the mean concentrations decreased from 0.16 to 0.11 milligram per liter, probably as a result of dilution of ground water by snowmelt. The concentrations in samples from the same wells generally were less during 1979 than during 1974-75. Isolation of sewage effluent in shallow zones by hardpan, consumption of nutrients by abundant phreatophytes, filtration of bacteria by the soil or aquifer, and dilution by underflow and recharge evidently combine to maintain the quality of the well waters within acceptable limits.

INTRODUCTION

Domestic and public ground-water supplies in the vicinity of Lincoln, Mont. (fig. 1), are obtained chiefly from wells completed in permeable alluvium in which the water table is normally at a depth of less than 8 feet below the land surface (Coffin and Wilke, 1971). Most wells are less than 40 feet deep (Wilke, 1976, sheet 3) and are located near the buildings they serve.

Septic tanks are the principal means of domestic sanitary waste disposal. The drainfields discharge into the alluvium only a few feet above the water table; therefore, contamination of adjacent water supplies with domestic waste effluent is a possibility.

Analyses of water samples collected from selected wells during 1974-75 (Wilke, 1976) revealed that concentrations of common chemical constituents were significantly less than the maximum concentrations recommended by the U.S. Environmental Protection Agency (1977) for drinking water. Whether the analyses

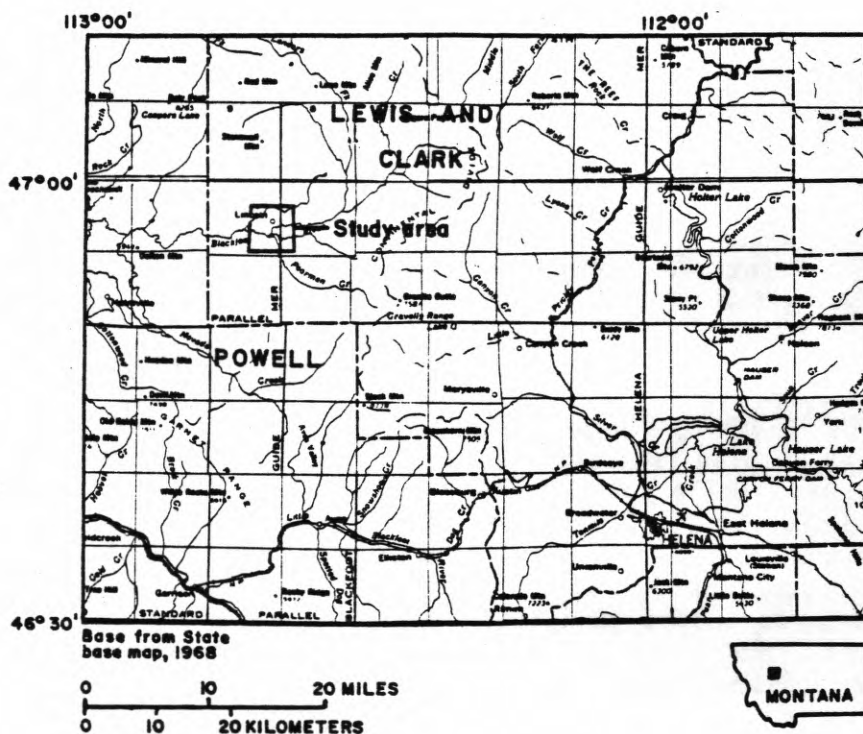


Figure 1.—Location of study area.

represented natural ground water or ground water slightly affected by septic tank waste is unknown.

The presence of sodium, chloride, potassium, and the nutrients nitrogen and phosphorus in concentrations exceeding normal background concentrations in natural ground water would constitute evidence for contamination with human or agricultural waste. Disproportionate increases of the concentrations of those constituents with time and with respect to other constituents, and the presence of fecal coliform bacteria, would substantiate the evidence.

The purpose of this report is to document the changes in water quality from 1974-75 to 1979 in representative shallow wells and to evaluate the extent of contamination, if any, by domestic or agricultural waste. Water samples were collected during 1979 at many of the same sites sampled during 1974-75.

The writers gratefully acknowledge the cooperation of landowners in the Lincoln area who permitted access for the collection of water samples and measurement of water levels. The investigation was funded in part by the Lewis and Clark County Commissioners.

WELL-NUMBERING SYSTEM

In this report, locations are numbered according to geographic position within the rectangular grid system used by the U.S. Bureau of Land Management (fig. 2). The location number consists of 13 characters. The first three characters specify the township and its position north (N) of the Montana Base Line. The next three characters specify the range and its position west (W) of the Montana Principal Meridian. The next two characters are the section number. The next three characters designate the quarter section (160-acre tract), quarter-quarter section (40-acre tract), and quarter-quarter-quarter section (10-acre tract) in which the well is located. The subdivisions of the section are designated A, B, C, and D in a counterclockwise direction, beginning in the northeast quadrant. The last two characters form a sequential number within a 10-acre tract, assigned in order of well inventory. For example, as shown on figure 2, well 14N09W24BAC01 was the first well inventoried in the SW1/4 NE1/4 NW1/4 sec. 24, T. 14 N., R. 9 W.

METHODS OF INVESTIGATION

Water samples were collected from 34 existing systems served by wells (fig. 3) during March 19-21 and June 27-28, 1979, to obtain data representing low and high water levels. The water levels measured during June (3.40 to 8.42 feet below land surface) were higher than in March in corresponding wells; however, landowners reported even higher levels in May due to early runoff from snowmelt and to lack of normal rainfall in June.

The samples were collected from taps or faucets after stabilization of specific conductance and water temperature indicated that flow was representative of the aquifer. Water temperature, pH, and specific conductance were measured, and samples were filtered and otherwise prepared onsite for laboratory analysis. Chemical analyses were made by the U.S. Geological Survey's laboratory in Denver, Colo., according to methods described by Skougstad, Fishman, Friedman, Erdmann, and Duncan (1979). Samples collected at 10 sites were analyzed for fecal coliform bacteria by membrane-filter techniques. (Greeson and others, 1977).

RESULTS

Results of onsite measurements of specific conductance, pH, and temperature and laboratory analyses for sulfate, nitrogen, and phosphorus are included in table 1. Results of more complete analyses including common ions, nutrients, and iron are given in table 2. Results for samples collected from the same sources during 1974 and 1975 (Wilke, 1976) are included for comparison. Fecal coliform bacteria, indicators of contamination by human or other warm-blooded animal waste, were absent from all samples collected at 10 sites (fig. 3) during March and again during June 1979.

The concentrations of dissolved solids, consisting mainly of calcium, magnesium, bicarbonate, and sulfate, were less than 300 mg/L (milligrams per liter).

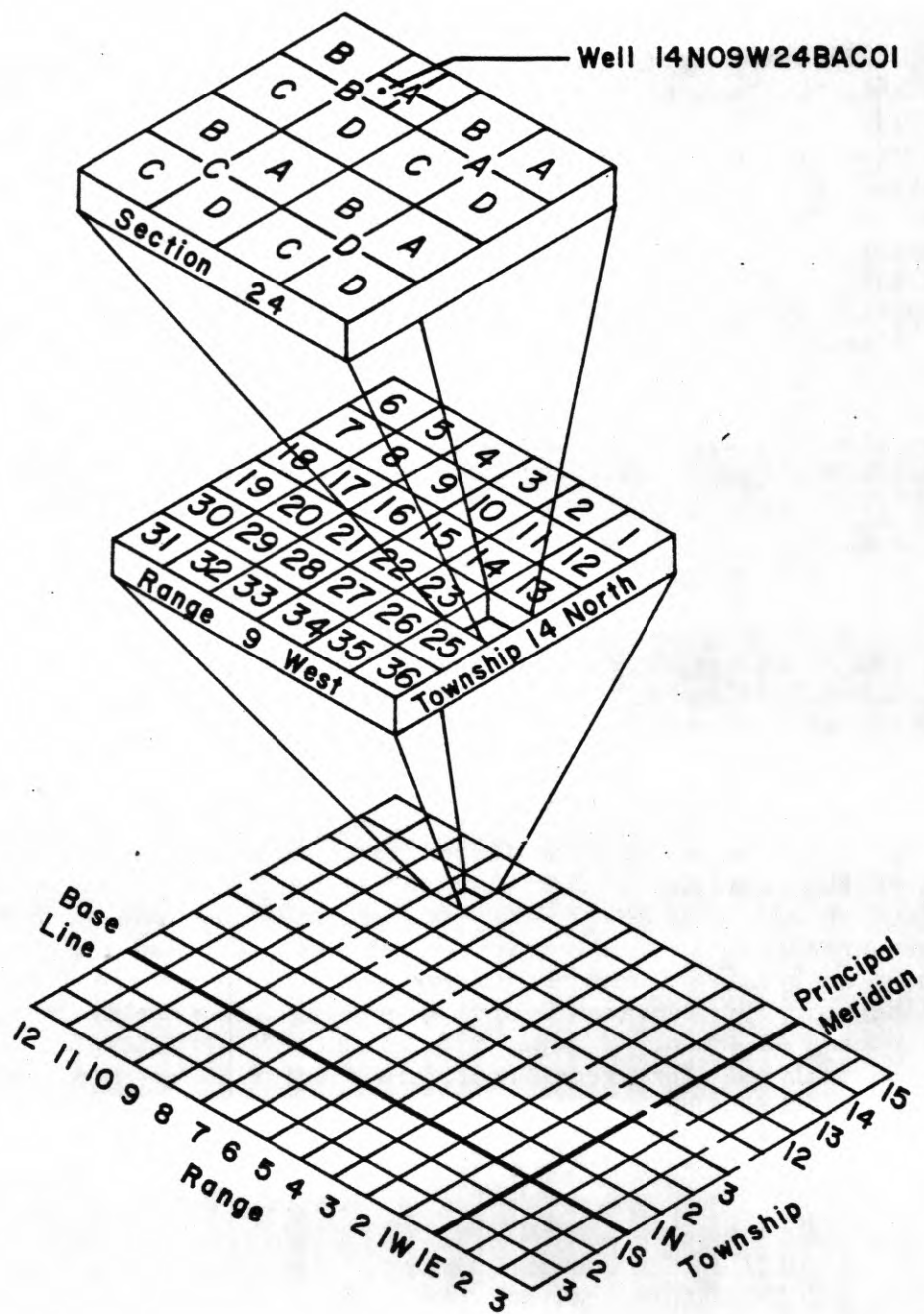


Figure 2.—Well-numbering system.

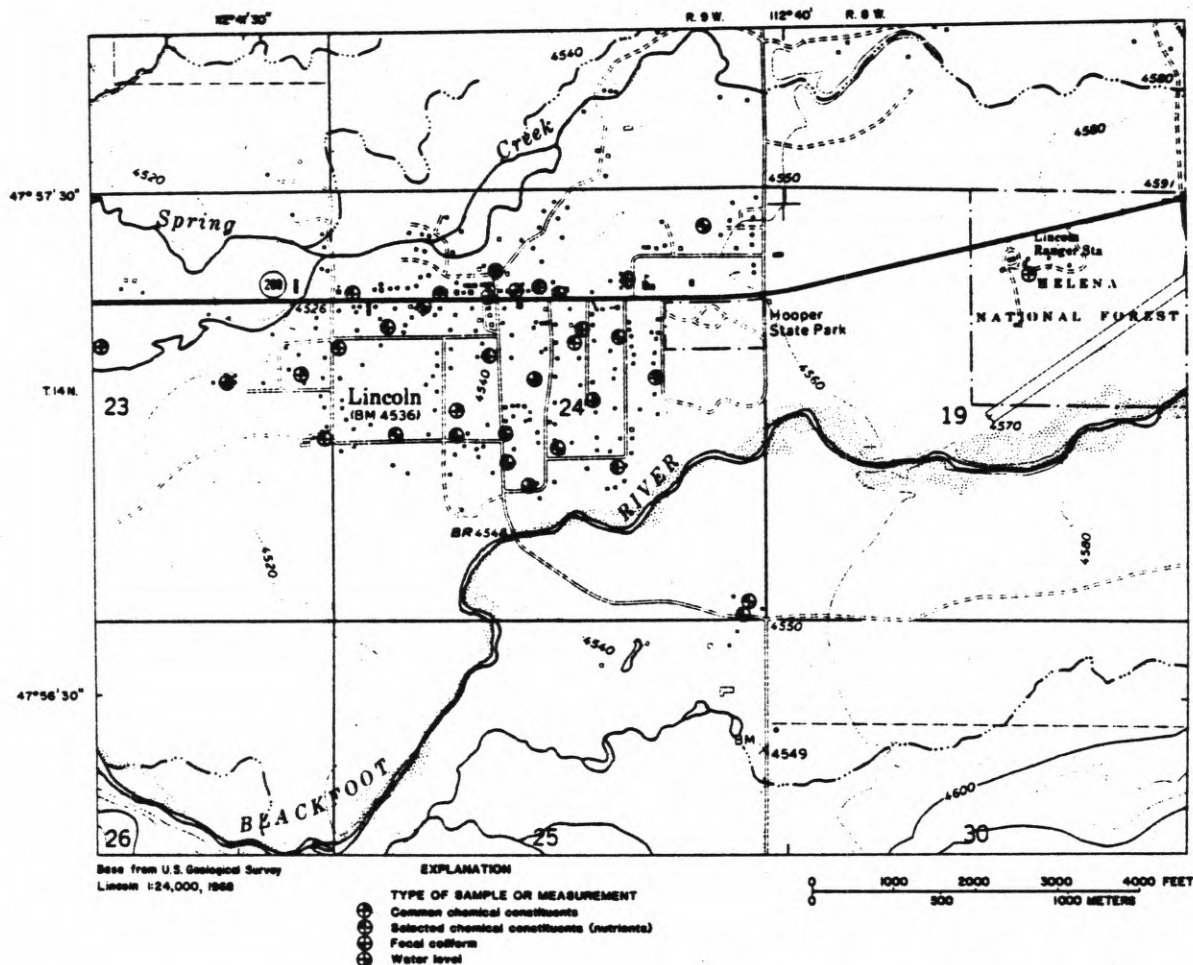


Figure 3.--Locations of wells and types of analyses for water samples collected during March and June 1979.

Changes from sampling to sampling appear to be insignificant and without readily discernable trends. Maximum concentrations of sodium were 3.5 mg/L; potassium, 0.9 mg/L; and chloride, 2.9 mg/L (table 2).

Results of analyses for phosphorus and nitrogen, common constituents of sewage and fertilizers, are the most abundant and amenable to statistical comparison. However, phosphorus is readily precipitated by the calcium and magnesium in soil water; therefore, excessive concentrations would not be expected even in samples from contaminated wells. The maximum concentration of phosphorus was 0.06 mg/L (table 1); most variations were within the range of laboratory precision. Conversely, nitrogenous wastes normally are rapidly oxidized by soil bacteria to soluble nitrite and nitrate, which are readily transported by ground water.

To facilitate comparison, concentrations of soluble nitrogen in samples collected during March 1979 were plotted versus concentrations at the same sites during May or June 1975 (fig. 4). If the concentration between the two sampling periods was unchanged, the regression would define a line inclined at 45° through the origin with a slope equal to 1.0. Data points above the line indicate increases in concentration and those below the line indicate decreases. The maximum concentrations of 0.75 mg/L for 1975 and 0.57 mg/L for 1979 in samples from well 14N09W24BAD02 (table 1), were anomalously large for the area, but were significantly less than the maximum of 10 mg/L recommended by the U.S. Environmental Protection Agency (1976) for drinking water. The background concentration of nitrogen in pristine ground water in the area is unknown, but probably does not exceed 0.2 mg/L. The corresponding mean concentrations of 0.23 mg/L for 1975 and 0.16 mg/L for 1979, as well as the slope of the regression line (0.47), indicate a general decrease in concentration from the spring 1975 to the spring 1979. Concentrations decreased slightly in 14 of the 25 sampled sources.

The plot for June 1979 versus March 1979 (fig. 5) also shows an apparent general decrease in concentration with time. For the March and June surveys, the maximum concentrations were 0.57 mg/L during March and 0.29 mg/L during June in samples from 14N09W24BAD02 (table 1) and the mean values were 0.16 mg/L for March and 0.11 mg/L for June. Concentrations decreased in 23 of the 28 samples. The relatively small coefficient of determination (0.40) between the March and June 1979 regressions (fig. 5) compared with that (0.59) between the May or June 1975 and March 1979 regression (fig. 4), as well as the decrease in concentration, probably reflects the effect of non-uniform dilution by snowmelt of the ground water sampled during June 1979.

The changes in concentration of nitrogen with time were substantiated using statistical comparison tests (Paul Woods, U.S. Geological Survey, written commun., July 1980). However, the small apparent decreases in the uniformly small concentrations of nitrogen and other ions could represent differences in laboratory or onsite techniques. In any event, the results clearly indicate no significant deterioration in the quality of the sampled waters with respect to the constituents for which the analyses were made. All samples were suitable for drinking water with respect to the constituents tested.

A resistant "hardpan," reportedly penetrated near the water table during installation of driven wells, may locally isolate the upper part of the aquifer from the shallow soil water. If the aquifer is not isolated, the absence of fecal coliform bacteria indicates that the soil or the aquifer is an effective filter. Abundant phreatophytes probably use a significant part of the waste-derived nutrients in the shallow ground water. Finally, recharge to the aquifer and lateral movement of fresh water within it are evidently adequate to dilute significantly any waste that enters near the supplies tested. These factors combine to diminish and obscure the effects of percolation of sewage effluent into the aquifer.

The results of this study do not necessarily indicate that the water from all wells in the Lincoln area is suitable for domestic use. Even for the limited number of wells tested, increased pumpage might accelerate percolation of deleterious waste into the aquifer.

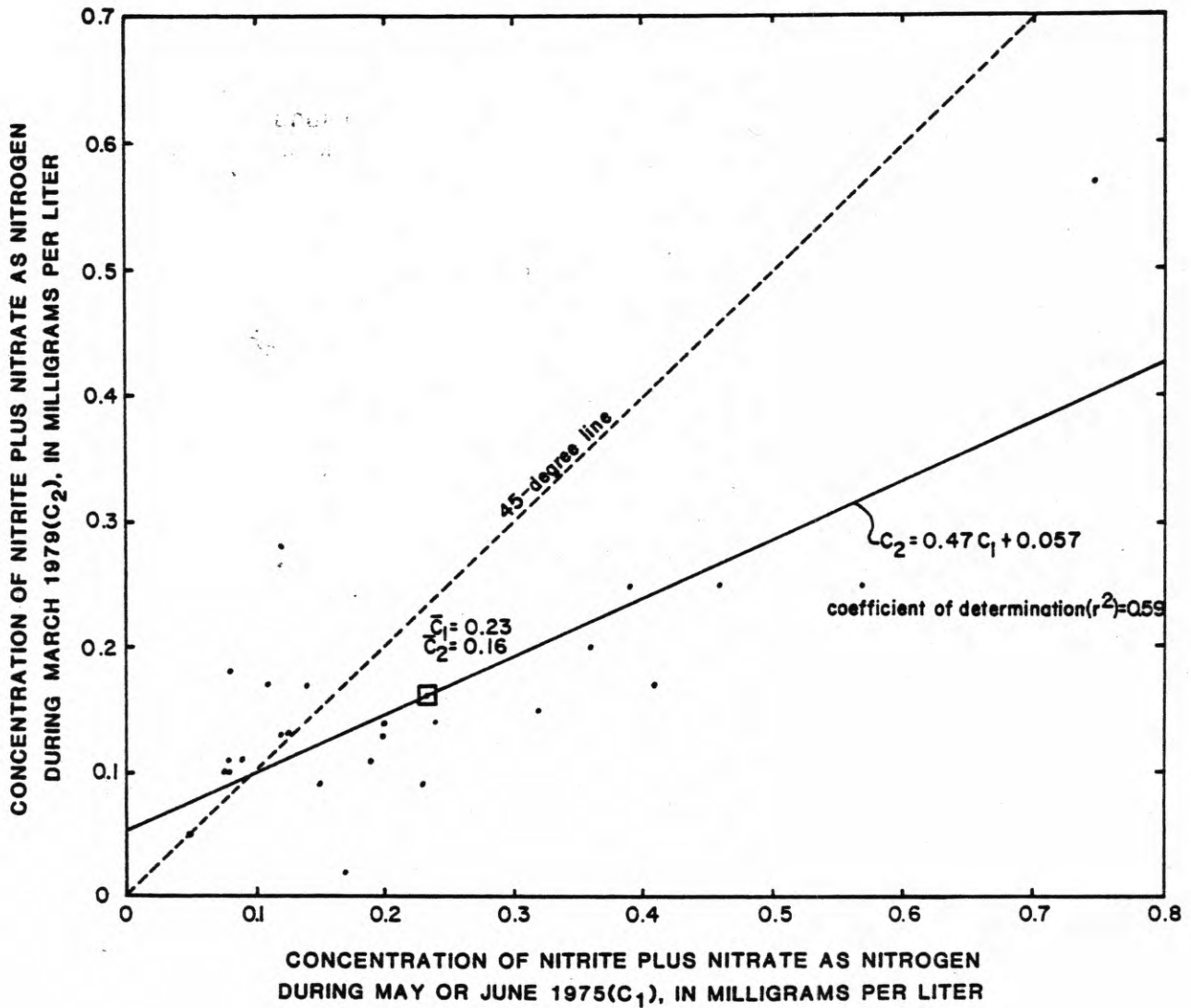


Figure 4.—Relation of concentrations of nitrite plus nitrate in ground water during March 1979 to concentrations during May or June 1975 from the same wells.

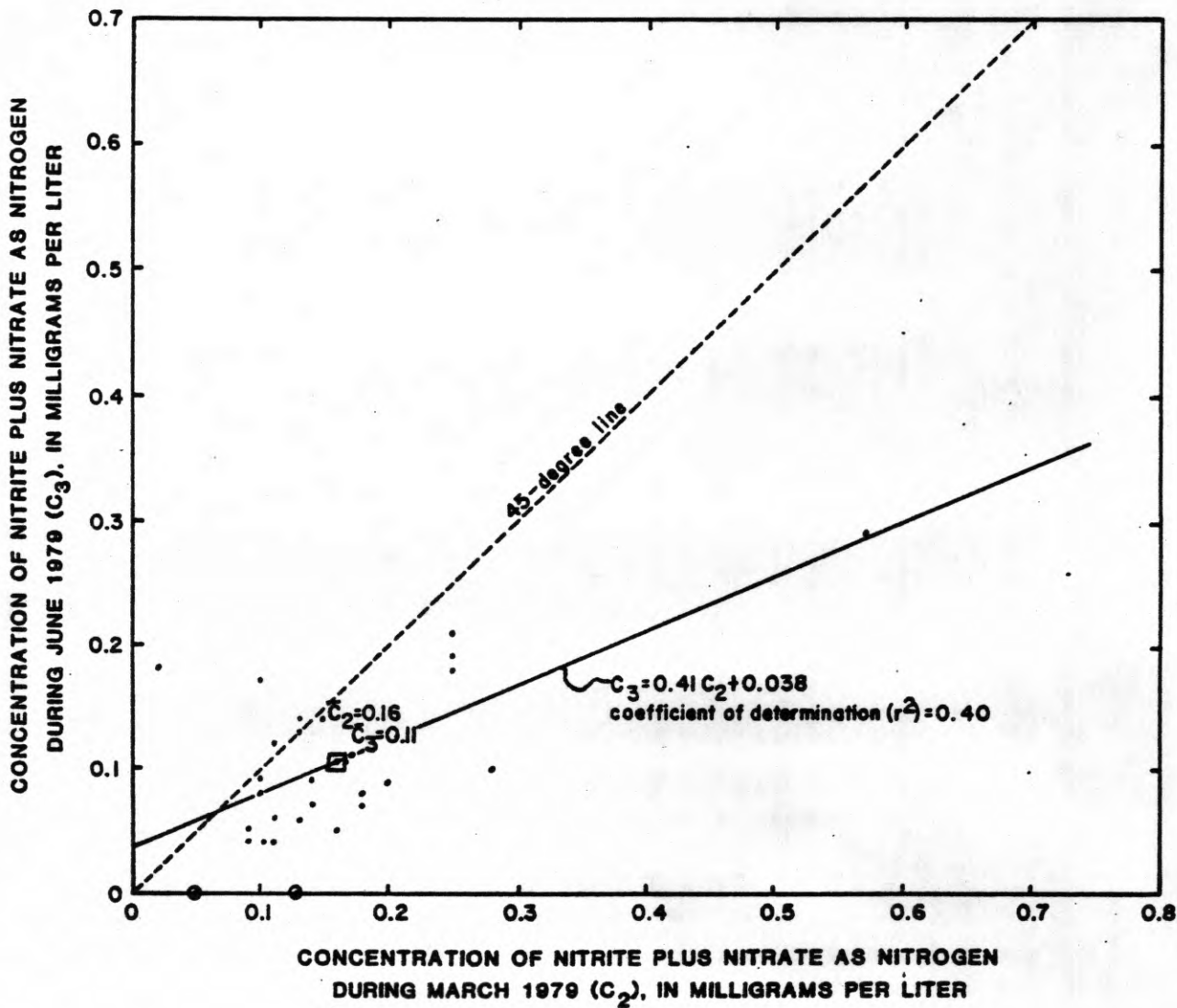


Figure 5.—Relation of concentrations of nitrite plus nitrate in ground water during June 1979 to concentrations during March 1979 from the same wells.

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Table 1.--Results of analyses for miscellaneous chemical constituents
in ground water

[Except as indicated otherwise, constituents are dissolved and values are reported in milligrams per liter. Analysis by: MDHES, Montana Department of Health and Environmental Sciences; USGS, U.S. Geological Survey. Water level below land surface and water temperature: R, reported. Micromhos, micromhos per centimeter at 25 degrees Celsius; °C, degrees Celsius]

Well number	Location		Date	Time	Water level below land surface (feet)	Specific conductance (micromhos)
	Latitude	Longitude				
14N09W23DAA01	465702	1124121	10-09-74	--	4.5	--
			05-28-75	--	--	--
			03-19-79	1145	--	335
14N09W24AAB01	465728	1124022	10-09-74	--	--	--
			05-28-75	--	--	--
			03-20-79	1500	--	380
			06-28-79	1115	5.14	336
14N09W24ABC02	465720	1124039	10-09-74	--	--	--
			05-28-75	--	--	--
			03-19-79	1000	4.89	300
			06-27-79	1010	3.40	330
14N09W24ABD02	465721	1124028	10-09-74	--	--	--
			05-28-75	--	--	--
			03-19-79	1520	--	360
			06-27-79	0950	--	331
14N09W24ACA03	465713	1124030	10-09-74	--	--	--
			05-28-75	--	--	--
			03-19-79	1455	7.13	295
			06-28-79	1605	5.24	309
14N09W24ACB03	465717	1124037	10-09-74	--	--	--
			05-28-75	--	--	--
			03-20-79	1315	--	335
			06-27-79	1145	--	319
14N09W24ACB04	465713	1124037	10-09-74	--	--	--
			05-28-75	--	--	--
			03-21-79	0945	--	305
			06-28-79	1655	--	314
14N09W24BAC01	465720	1124100	10-09-74	--	7.3	--
			05-28-75	--	--	--
			03-19-79	1030	--	310
			06-28-79	1215	--	326
14N09W24BAC03	465723	1124052	10-09-74	--	--	--
			05-28-75	--	--	--
			03-20-79	1055	--	345
			06-27-79	1100	--	320
14N09W24BAD02	465720	1124044	10-09-74	--	--	--
			05-27-75	--	--	--
			03-19-79	1255	--	375
			06-28-79	1155	--	343

Onsite pH (units)	Water tem- pera- ture (°C)	Sul- fate (SO ₄)	Nitrogen NO ₂ + NO ₃ as N	Ammo- nia, total as N	Phos- phorus as P	Analysis by
--	--	--	0.14	--	--	MDHES
--	--	--	.41	<0.01	0.004	MDHES
7.7	10.0	8.6	.17	--	.01	USGS
--	--	--	.10	--	--	MDHES
--	--	--	.12	<.01	.001	MDHES
--	8.0	6.9	.13	--	.01	USGS
7.7	7.0	11	.14	--	.00	USGS
--	--	--	.24	--	--	MDHES
--	--	--	.57	<.01	.001	MDHES
--	7.0	10	.25	--	.00	USGS
7.5	7.0	9.6	.18	--	.00	USGS
--	9R	--	.15	--	--	MDHES
--	--	--	.46	<.01	.002	MDHES
--	7.0	8.2	.25	--	.00	USGS
8.0	7.0	10	.21	--	.00	USGS
--	--	--	.13	--	--	MDHES
--	--	--	.19	.01	.001	MDHES
--	12.0	8.4	.11	--	.01	USGS
7.5	7.5	12	.06	--	.00	USGS
--	--	--	.12	--	--	MDHES
--	--	--	.20	<.01	.005	MDHES
--	8.0	9.2	.14	--	.01	USGS
7.6	7.0	11	.07	--	.00	USGS
--	--	--	.11	--	--	MDHES
--	--	--	.08	<.01	.002	MDHES
--	7.0	8.2	.18	--	.01	USGS
7.4	7.0	12	.07	--	.06	USGS
--	--	--	.21	--	--	MDHES
--	--	--	.12	<.01	.002	MDHES
--	9.0	8.9	.13	--	.00	USGS
7.8	7.0	11	.13	--	.00	USGS
--	--	--	.20	--	--	MDHES
--	--	--	.12	<.01	.002	MDHES
--	9.0	8.5	.28	--	.01	USGS
7.6	8.0	10	.10	--	.00	USGS
--	--	--	.53	--	--	MDHES
--	--	--	.75	<.01	.003	MDHES
--	7.0	9.1	.57	--	.00	USGS
7.5	8.0	12	.29	--	.00	USGS

Table 1.--Results of analyses for miscellaneous chemical constituents
ground water--Continued

Well number	Location		Date	Time	Water level below land surface (feet)	Specific conduc- tance (micro- mhos)
	Latitude	Longitude				
14N09W24BBC01	465720	1124116	10-09-74	--	6.9	--
			05-28-75	--	--	--
			06-28-79	1240	--	368
14N09W24BCA03	465715	1124110	10-09-74	--	--	--
			05-28-75	--	--	--
			03-21-79	1300	--	350
14N09W24BCA04	465717	1124104	10-09-74	--	--	--
			05-28-75	--	--	--
			03-21-79	1325	5.82	300
			06-28-79	1225	5.19	333
14N09W24BCB01	465712	1124119	10-09-74	--	7R	--
			05-28-75	--	--	--
			03-19-79	1120	--	320
			06-28-79	1345	--	335
14N09W24BDC01	465712	1124055	10-09-74	--	4R	--
			05-28-75	--	--	--
			03-19-79	1330	--	320
			06-27-79	1110	--	317
14N09W24CAA02	465703	1124049	10-09-74	--	--	--
			05-28-75	--	--	--
			03-21-79	1440	8.81	340
			06-28-79	1420	7.10	328
14N09W24CAB04	465702	1124058	10-09-74	--	--	--
			05-28-75	--	--	--
			03-19-79	1230	7.05	355
			06-27-79	1210	5.58	339
14N09W24CAD04			10-09-74	--	--	--
			05-28-75	--	--	--
			03-19-79	1255	9.95	325
			06-28-79	1435	8.42	326
14N09W24CBA01	465703	1124108	10-09-74	--	8R	--
			05-28-75	--	--	--
			03-21-79	1505	--	330
			06-28-79	1800	4.34	307
14N09W24DBB03	465700	1124039	10-09-74	--	--	--
			05-28-75	--	--	--
			03-19-79	1415	--	345
			06-28-79	1550	6.44	191
14N09W24DBD01	465759	1124029	10-09-74	--	7.5	--
			05-28-75	--	--	--
			03-19-79	1435	--	345
			06-27-79	1335	--	270

Onsite pH (units)	Water tem- pera- ture (°C)	Sul- fate (SO ₄)	Nitrogen NO ₂ + NO ₃ as N	Ammo- nia, total as N	Phos- phorus as P	Analysis by
--	--	--	0.09	--	--	MDHES
--	--	--	.05	<0.01	.002	MDHES
7.5	7.5	11	.05	--	.00	USGS
--	--	--	.14	--	--	MDHES
--	--	--	.14	< .01	.001	MDHES
--	7.0	7.9	.17	--	.01	USGS
--	--	--	.19	--	--	MDHES
--	--	--	.17	< .01	.001	MDHES
--	12.0	7.3	.02	--	.00	USGS
7.6	7.0	12	.18	--	.00	USGS
--	--	--	.12	--	--	MDHES
--	--	--	.09	< .01	.002	MDHES
--	10.0	8.5	.11	--	.00	USGS
7.7	10.0	12	.12	--	.01	USGS
--	--	--	.11	--	--	MDHES
--	--	--	.24	< .01	.001	MDHES
--	12.0	9.2	.14	--	.00	USGS
7.5	6.5	10	.09	--	.00	USGS
--	--	--	.08	--	--	MDHES
--	--	--	.36	< .01	.002	MDHES
--	9.0	7.5	.20	--	.01	USGS
7.5	8.5	12	.09	--	.01	USGS
--	--	--	.16	--	--	MDHES
--	--	--	.32	< .01	.001	MDHES
--	8.5	9.4	.15	--	.00	USGS
7.6	6.5	11	.14	--	.00	USGS
--	--	--	.12	--	--	MDHES
--	--	--	.15	< .01	.002	MDHES
--	7.5	8.8	.09	--	.00	USGS
7.6	6.0	12	.05	--	.01	USGS
--	--	--	.11	--	--	MDHES
--	--	--	.08	< .01	.002	MDHES
--	7.5	7.9	.10	--	.01	USGS
7.6	7.0	12	.09	--	.00	USGS
--	--	--	.09	--	--	MDHES
--	--	--	.23	< .01	.001	MDHES
--	6.0	9.8	.09	--	.00	USGS
7.5	6.5	12	.04	--	.00	USGS
--	--	--	.07	--	--	MDHES
--	--	--	.05	< .01	.001	MDHES
--	6.0	10	.05	--	.00	USGS
7.8	6.5	9.6	.00	--	.00	USGS

Table 2.--Results of analyses for common chemical constituents in ground water

[Except as indicated otherwise, pH data are onsite values, constituents are dissolved, and values are reported in milligrams per liter. Micromhos, micromhos per centimeter at 25 degrees Celsius; °C, degree Celsius; µg/L, micrograms per liter]

Location			Date	Time	Water level below land surface (feet)	Specific conductance micro-mhos	pH (units)	Water temperature (°C)	Hardness as CaCO ₃
Well number	Latitude	Longitude							
14N08W19ABD01	465722	1123916	09- -74	--	11.20	--	--	--	--
			03-20-79	1530	--	345	7.8 ¹	5.0	160
			06-28-79	1045	--	286	8.1	9.0	150
14N09W23ADC03	465709	1124137	06- -75	--	--	336	--	--	180
			03-21-79	1040	4.04	335	7.8 ¹	6.0	170
			06-27-79	1355	3.68	329	7.7	8.0	180
14N09W24ACC03	465707	1124033	09- -74	--	--	--	--	--	--
			05- -75	--	--	--	--	--	--
			03-20-79	1355	5.25	315	7.6 ¹	8.0	150
			06-28-79	1720	4.01	318	7.6	6.5	160
14N09W24ACD02	465709	1124023	09- -74	--	5.50	--	--	--	--
			06- -75	--	3.20	321	--	--	160
			03-20-79	1420	6.51	325	7.8 ¹	11.0	--
			06-28-79	1630	--	305	7.6	9.5	160
14N09W24BAC04	465720	1124052	09- -74	--	--	--	--	--	--
			05- -75	--	--	--	--	--	--
			03-20-79	1035	--	335	7.8 ¹	9.0	170
			06-27-79	1045	--	321	7.7	8.0	170
14N09W24BAD03	465720	1124047	06- -75	--	--	335	--	--	180
			03-20-79	1005	--	325	7.7 ¹	9.0	160
			06-27-79	1025	--	337	7.6	--	--
14N09W24BDD01	465709	1124044	09- -74	--	5.10	--	--	--	--
			05- -75	--	3.40	--	--	--	--
			03-20-79	1200	--	345	7.6 ¹	7.0	--
			06-28-79	1945	4.37	300	7.5	7.0	160
14N09W24CAB02	465705	1124058	09- -74	--	5.90	--	--	--	--
			06- -75	--	--	351	--	--	180
			06-28-79	1815	--	347	7.5	6.5	170
14N09W24CAD05	465657	1124045	03-20-79	1245	9.03	350	7.9 ¹	7.0	180
			06-28-79	1530	7.12	303	7.6	6.5	150

¹Laboratory determination.

Date	Hardness, noncarbonate, as CaCO ₃	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Percent sodium	Sodium adsorption ratio (SAR)	Sodium + potassium (as Na)	Potassium (K)
09- -74	--	--	--	--	--	--	--	--
03-20-79	50	41	14	2.3	3	0.1	--	0.9
06-28-79	10	37	14	2.2	3	.1	3	.9
06- -75	--	46	15	3.1	--	.1	--	.6
03-21-79	0	43	15	2.0	3	.1	--	.7
06-27-79	7	46	15	2.0	2	.1	3	.8
09- -74	--	--	--	--	--	--	--	--
05- -75	--	--	--	--	--	--	--	--
03-20-79	1	39	13	1.8	3	.1	--	.7
06-28-79	0	40	14	2.1	3	.1	3	.8
09- -74	--	--	--	--	--	--	--	--
06- -75	--	43	15	2.6	--	.1	--	.6
03-20-79	--	--	--	--	--	--	--	--
06-28-79	8	40	14	2.0	3	.1	3	.9
09- -74	--	--	--	--	--	--	--	--
05- -75	--	--	--	--	--	--	--	--
03-20-79	0	43	14	2.2	3	.1	--	.9
06-27-79	10	45	14	2.1	3	.1	3	.8
06- -75	--	49	14	3.5	--	.1	--	.7
03-20-79	20	41	14	2.2	3	.1	--	.8
06-27-79	--	--	--	--	--	--	--	--
09- -74	--	--	--	--	--	--	--	--
05- -75	--	--	--	--	--	--	--	--
03-20-79	--	--	--	--	--	--	--	--
06-28-79	4	41	15	2.2	3	.1	3	.8
09- -74	--	--	--	--	--	--	--	--
06- -75	--	53	12	3.1	--	.1	--	.6
06-28-79	4	45	15	2.5	3	.1	3	.9
03-20-79	28	48	14	2.2	3	.1	3	.8
06-28-79	8	38	13	2.0	3	.1	3	.7

Date	Bicar- bonate (HCO ₃)	Car- bonate (CO ₃)	Alka- linity, total as CaCO ₃	Sulfate (SO ₄)	Chlo- ride (Cl)	Fluo- ride (F)	Silica (SiO ₂)	Dis- solved solids, residue at 180°C
09- -74	--	--	--	--	--	--	--	--
03-20-79	--	--	110	13	1.3	0.1	11	154
06-28-79	--	--	140	10	.7	.1	12	162
06- -75	210	0	180	8.9	1.0	.1	--	--
03-21-79	--	--	170	8.1	.8	.1	12	183
06-27-79	--	--	170	10	.8	.1	9.9	183
09- -74	--	--	--	--	--	--	--	--
05- -75	--	--	--	--	--	--	--	--
03-20-79	--	--	150	9.3	.7	.1	10	167
06-28-79	--	--	160	11	.6	.1	11	174
09- -74	--	--	--	--	--	--	--	--
06- -75	200	0	160	9.0	1.8	.1	--	--
03-20-79	--	--	160	--	--	--	--	--
06-28-79	--	--	150	10	.8	.1	12	170
09- -74	--	--	--	--	--	--	--	--
05- -75	--	--	--	--	--	--	--	--
03-20-79	--	--	170	9.1	1.1	.1	11	174
06-27-79	--	--	160	11	1.1	.1	9.7	181
06- -74	220	0	180	7.8	2.0	.1	--	--
03-20-79	--	--	170	11	2.9	.1	10	182
06-27-79	--	--	170	--	--	--	--	--
09- -74	--	--	--	--	--	--	--	--
05- -75	--	--	--	--	--	--	--	--
03-20-79	--	--	160	9.6	.9	.1	9.8	172
06-28-79	--	--	160	11	.6	.1	11	177
06- -75	--	--	--	--	1.0	.1	--	--
03-20-79	220	0	180	6.1	--	--	--	--
06-28-79	--	--	170	11	1.4	.1	11	190
03-20-79	--	--	150	10	.8	.1	9.7	170
06-28-79	--	--	140	9.4	.5	.1	10	165

Date	Dis- solved solids, sum of consti- tuents	Dis- solved solids (tons per acre- foot)	Nitrogen, NO ₂ + NO ₃ as N	Ammo- nia, total as N	Phos- pho- rus as P	Iron (Fe) (µg/L)	Analysis by
09- -74	--	--	0.11	--	--	--	MDHES
03-20-79	150	0.21	.16	--	0.01	--	USGS
06-28-79	161	.22	.05	--	--	--	USGS
06- -75	288	--	.08	<0.01	.001	--	MDHES
03-21-79	184	.25	.11	--	.01	20	USGS
06-27-79	187	.25	.04	--	--	10	USGS
09- -74	--	--	.09	--	--	--	MDHES
05- -75	--	--	.20	--	.001	--	MDHES
03-20-79	165	.23	.13	--	.00	20	USGS
06-28-79	176	.24	.06	--	--	--	USGS
09- -74	--	--	--	--	--	--	MDHES
06- -75	273	--	.08	<.01	.002	--	MDHES
03-20-79	--	--	.10	--	.00	--	USGS
06-28-79	171	.23	.17	--	--	--	USGS
09- -74	--	--	.16	--	--	--	MDHES
05- -75	--	--	.11	--	.002	--	MDHES
03-20-79	184	.24	.17	--	.01	20	USGS
06-27-79	181	.25	.11	--	--	10	USGS
06- -74	296	--	.39	.01	.005	--	MDHES
03-20-79	167	.25	.25	--	.01	10	USGS
06-27-79	--	--	.19	--	--	--	USGS
09- -74	--	--	--	--	--	--	MDHES
05- -75	--	--	--	--	--	--	MDHES
03-20-79	--	.23	.18	--	.01	--	USGS
06-28-79	178	.24	.08	--	--	--	USGS
06- -75	294	--	.39	<.01	.003	--	MDHES
03-20-79	--	--	--	--	--	--	USGS
06-28-79	190	.26	.17	--	--	--	USGS
03-20-79	176	.23	.13	--	.01	10	USGS
06-28-79	158	.22	.00	--	--	--	USGS

