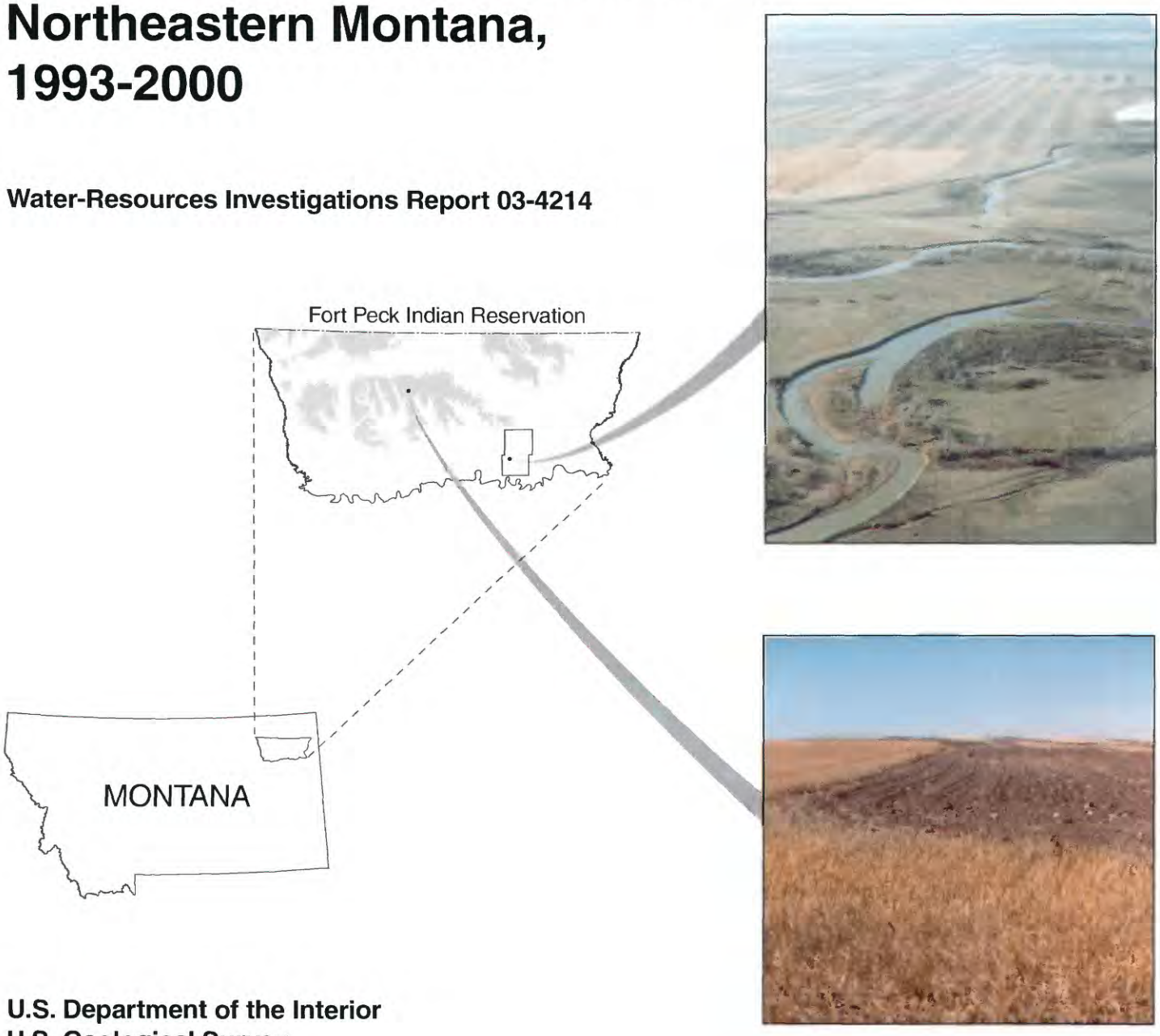
USGS
science for a changing world

In cooperation with the
FORT PECK TRIBES WATER RESOURCES OFFICE and
FORT PECK TRIBES OFFICE OF ENVIRONMENTAL PROTECTION

Ground-Water Quality for Two Areas in the Fort Peck Indian Reservation, Northeastern Montana, 1993-2000

Water-Resources Investigations Report 03-4214



U.S. Department of the Interior
U.S. Geological Survey

Front cover--Photographs showing:

Upper: Looking downstream Poplar River near sec. 8, T. 28 N., R. 51 E., northeastern Montana
Lower: Typical crop-fallow wheat field, northeastern Montana

Photographs by J.N. Thamke, U.S. Geological Survey

U.S. Department of the Interior
U.S. Geological Survey

Ground-Water Quality for Two Areas in the Fort Peck Indian Reservation, Northeastern Montana, 1993-2000

By Joanna N. Thamke and Karen S. Midtlyng

Water-Resources Investigations Report 03-4214

Helena, Montana,
December 2003

In cooperation with the
FORT PECK TRIBES WATER RESOURCES OFFICE and
FORT PECK TRIBES OFFICE OF ENVIRONMENTAL PROTECTION

U.S. Department of the Interior

GALE A. NORTON, Secretary

U.S. Geological Survey

Charles G. Groat, Director

For additional information write to:

District Chief
U.S. Geological Survey
3162 Bozeman Avenue
Helena, MT 59601

Copies of this report may be purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, CO 80225-0286

CONTENTS

ILLUSTRATIONS

TABLES

TABLES--continued

CONVERSION FACTORS, DATUM, ABBREVIATED WATER-QUALITY UNITS, AND ACRONYMS

Multiply	By	To obtain
acre	4,047	square meter
feet (ft)	0.3048	meter
gallon (gal)	3.785	liter
mile (mi)	1.609	kilometer
pound	453.6	gram
square mile (mi^2)	2.59	square kilometer

Temperature can be converted from degrees Celsius (^oC) to degrees Fahrenheit (^oF) by the equation:

$$^oF = 9/5\ (^oC) + 32$$

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27).

Abbreviated water-quality units used in this report:

µS/cm	microsiemens per centimeter at 25 degrees Celsius
mg/L	milligrams per liter
µg/L	micrograms per liter
g/mL	grams per milliliter

Acronyms used in the report:

ASCHM	Astro-Chem Service Laboratory
CHNO	Chen-Northern, Inc.
ELAB	Energy Laboratories, Inc.
FPOEP	Fort Peck Tribes Office of Environmental Protection
IHS	Public Health Service/Indian Health Service-Fort Peck Service Unit
MBMG	Montana Bureau of Mines and Geology
MDA	Montana Department of Agriculture
MDHES	Montana Department of Health and Environmental Sciences, Water Quality Bureau (currently, 2003, Montana Department of Environmental Quality)
MSE	MSE-HKM, Inc.
NALCO	Nalco Chemical Company
PETRO	Petrolite Oil Field Chemicals Group
USGS	U.S. Geological Survey
USEPA	U.S. Environmental Protection Agency
YSB	Yapuncich, Sanderson, and Brown Laboratories, currently (2003) Energy Laboratories, Inc.

Ground-Water Quality for Two Areas in the Fort Peck Indian Reservation, Northeastern Montana, 1993-2000

By Joanna N. Thamke and Karen S. Midtlyng

ABSTRACT

Studies conducted by the U.S. Geological Survey and the Fort Peck Tribes during 1979-96 determined that ground-water quality in two areas of the Fort Peck Indian Reservation had been adversely affected by some land-use activities. During the early- and mid-1990s, saline-water contamination of near-surface Quaternary aquifers in more than 12 square miles in and near the East Poplar oil field was documented and high nitrate concentrations were documented in ground water in a large study area underlain by the Tertiary Flaxville Formation. This report describes additional ground-water-quality investigations for these two areas conducted subsequent to the previous studies.

In the East Poplar oil field study area, the quality of water in the Quaternary deposits is highly variable. Dissolved-solids concentrations increased as much as 29,500 milligrams per liter (mg/L) in ground water beneath a large area during a 9- to 10-year period because saline ground water probably moved into the Quaternary deposits within the area. Dissolved-solids concentrations decreased as much as 40,750 mg/L in ground water beneath a smaller area during a 10-year period because saline ground water in this area probably was diluted by fresh water from the area and because upgradient saline water sources were diminished or terminated. Dissolved-solids concentrations remained constant in areas unaffected by saline water.

In the Flaxville and underlying aquifers study area, data collected during 1997-99 indicated that seasonal and long-term changes in nitrate concentrations were minimal in 15 of the 16 wells sampled. Concentrations of pesticides in water from six sampled wells were less than the minimum reporting level.

INTRODUCTION

Studies conducted by the U.S. Geological Survey (USGS) and Fort Peck Assiniboine and Sioux Tribes during 1979-96 determined that ground-water quality in two areas of the Fort Peck Indian Reservation had been adversely affected by some land-use activities. Areas with saline-water contamination were identified in more than 12 mi^2 of Quaternary deposits in and near the East Poplar oil field (Thamke and Craigg, 1997), and high nitrate concentrations were documented in ground water in a large study area underlain by the Flaxville Formation (Nimick and Thamke, 1998; Thamke and Nimick, 1998).

Saline-water plumes were identified in the East Polar oil field study area by Thamke and Craigg (1997) on the basis of data collected during 1979-93. Dissolved-solids concentrations in water from some privately owned and monitoring wells were greater than the dissolved-solids concentration in seawater. The probable source of the saline water is brine, which is a by-product of the production of crude oil in the East Poplar oil field. Saline water is unusable by residents who are dependent on ground water for domestic supply in this rural area and is a potential ecological threat to the Poplar River, to which the saline ground water discharges. The saline-water plumes could have migrated since 1993, potentially causing increases or decreases in dissolved-solids concentrations in ground water within the plume areas or potentially affecting additional areas that were not contaminated in 1993. Furthermore, the magnitude and extent of volatile organic compounds in ground water in the East Poplar oil field was unknown.

Widespread occurrence of high nitrate concentrations in the Flaxville and underlying aquifers study area was documented by Nimick and Thamke (1998) on the basis of ground-water-quality data collected for 112 wells during 1981-96. Nitrate concentrations in water from more than half of these wells were equal to or greater than 10 mg/L, the maximum contaminant level established by the U.S. Environmental Protection Agency (2002) for public drinking water supplies. Using information on soils, land use, pore- and ground-water chemistry, ground-water age, and stable isotopes, Nimick and Thamke (1998) examined the relation

between extensive dryland farming and nitrate in ground water and determined that crop stubble and livestock waste were the primary sources of the nitrate in ground water. Although the data collected during 1981-96 were sufficient to document the extent and source of the high nitrate concentrations, they were insufficient to determine if nitrate concentrations varied seasonally and if representative concentrations could be determined from relatively infrequent (annual) or one-time sampling. Furthermore, the magnitude and extent of pesticides in ground water of the Flaxville and underlying aquifers study area was unknown.

To increase the understanding of ground-water quality in these two areas, the USGS, in cooperation with the Fort Peck Tribes, conducted additional investigations of ground-water quality during 1995-2000. Data were obtained from field activities of the USGS as well as investigations by other entities during 1993-2000.

Purpose and Scope

The purpose of this report is to describe the information obtained from investigations of ground-water quality conducted in two areas of the Fort Peck Indian Reservation during 1993-2000. For the East Poplar oil field study area, this report presents water-quality data for a variety of chemical constituents collected by the Indian Health Service (IHS) during 1993-97, by the USGS during 1997-99, by the Office of Environmental Protection of the Fort Peck Tribes (FPOEP) during 1999-2000, and by MSE-HKM, Inc. (MSE) during 2000. These data are then compared to published data collected before September 1993 (Thamke and others, 1996). Characteristics of water types and water-quality changes in water from wells sampled between September 1993 and September 2000 in the East Poplar oil field study area are presented in tables 1 and 2 (in section "East Poplar oil field study area"). Water-quality data for this study area are presented in tables 3 through 9 (at back of report).

For the Flaxville and underlying aquifers study area, this report presents physical-property and nitrate-concentration data collected by the USGS during 1997-99 and pesticide concentration data collected by the Montana Department of Agriculture (MDA) and U.S. Environmental Protection Agency (USEPA) during 1999. Interpretations of water-quality trends are based on these and published data collected before 1997 (Nimick and Thamke, 1998). Water-quality data for this study area are presented in tables 10 and 11 (at back of report).

Descriptions of Study Areas

The East Poplar oil field study area encompasses the East Poplar oil field and is northeast of the town of Poplar (fig. 1). The Poplar River flows generally southward through the study area. Throughout most of the study area, shallow Quaternary deposits directly overlie the relatively thick Upper Cretaceous Bearpaw Shale and are the sole developed source of ground water for residents of the study area. Land uses in the study area include dryland farming, livestock ranching, oil production, and residential development. Previous investigations on geologic structure, stratigraphy, and hydrogeology in the East Poplar oil field study area were summarized by Thamke and Craigg (1997).

The Flaxville and underlying aquifers study area is delineated by the boundary of the Tertiary Flaxville Formation within the Fort Peck Indian Reservation (fig. 1). The Flaxville aquifer consists of fluvial sand and gravel of the Flaxville Formation that caps extensive plateaus and topographic benches used for dryland wheat farms and residential development. The Tertiary Fort Union aquifer underlies the Flaxville aquifer in the eastern half of the study area. The upper Cretaceous Fox Hills-lower Hell Creek aquifer underlies the Fort Union aquifer in the eastern half and directly underlies the Flaxville in the western half of the study area. The Flaxville and underlying aquifers are important sources of ground water on the Reservation.

Site-Identification and Well-Naming Systems

Site numbers or location numbers are used to identify wells in the same manner as used in previous investigations (Thamke and Craigg, 1997; Nimick and Thamke, 1998). Site numbers (for the East Poplar oil field study area) or location numbers (for the Flaxville and underlying aquifers study area) are based on the rectangular system for the subdivision of public lands (fig. 2). The number consists of as many as 14 characters and is assigned according to the location of a site within a given township, range, and section. The first three characters specify the township and its position north (N) of the Montana Base Line, whereas the next three characters specify the range and its position

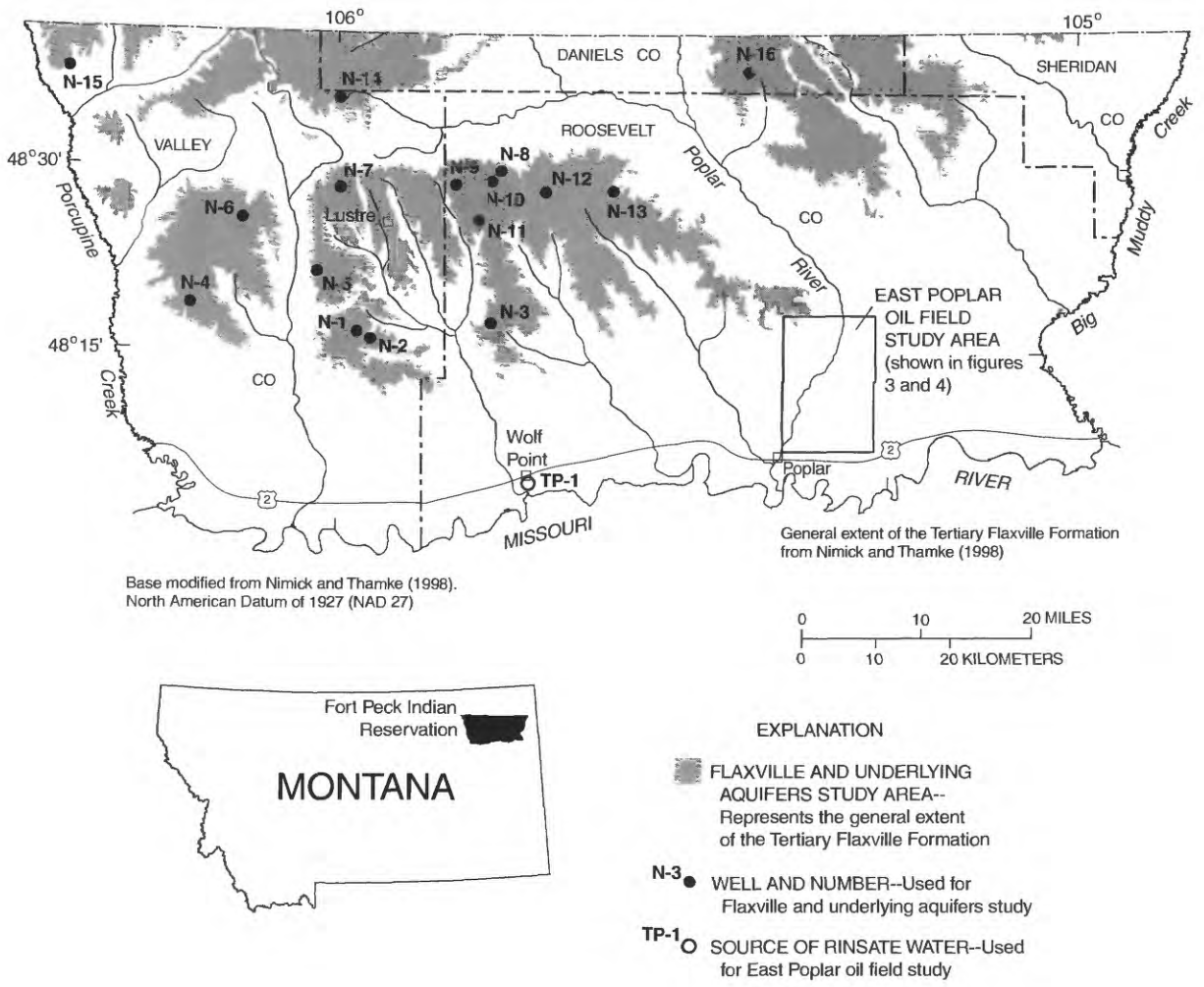


Figure 1. Location of the study areas and selected water-quality monitoring wells, Fort Peck Indian Reservation, northeastern Montana.

east (E) of the Montana Principal Meridian. The next two characters indicate the section; the next four characters indicate the position of the site within the section. The first letter denotes the quarter section (160-acre tract), the second letter denotes the quarter-quarter section (40-acre tract), the third letter denotes the quarter-quarter-quarter section (10-acre tract), and the fourth letter denotes the quarter-quarter-quarter-quarter section (2.5-acre tract). These lettered subdivisions of the section are indicated as A, B, C, and D in a counterclockwise direction beginning in the northeast quadrant. The last two characters form a sequence number based on the order that a site was inventoried in that tract. For example, site number 31N47E16BCAA01 represents the first well inventoried in the NE1/4NE 1/4SW1/4NW1/4 of sec.16, T. 31 N., R. 47 E.

Wells in the East Poplar oil field study area also are identified by an alpha-numeric well name used by previous investigations (Levings, 1984; Thamke and others, 1996), allowing for ease of cross reference between wells plotted on the illustrations and tables in this report and on illustrations and tables in previous reports. The well name consists of as many as three alpha characters and as many as four numeric charac-

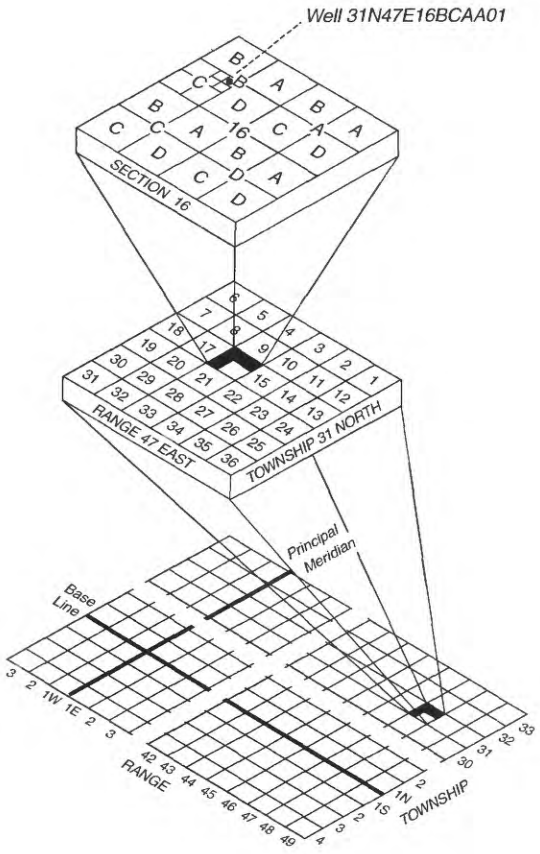


Figure 2. Site-numbering or location-numbering system.

ters and an alpha character to designate the sequence in which wells were drilled. The alpha character denotes the well type: (FPB)--USGS monitoring well inventoried by Thamke and others (1996); (W)--USGS monitoring well or privately owned well inventoried by Levings (1984); and (M)--privately owned well or Montana Bureau of Mines and Geology (MBMG) observation well. The numeric characters for USGS-installed monitoring wells denote the sequence during which wells were drilled; for example, well FPB93-3 is the third well drilled in 1993. The numeric part of well names identified by the letter 'M' is assigned only as a convenient cross reference between relevant illustrations and tables. Four privately owned wells (M-58, M-59, M-60, and M-61) were drilled after September 1993 and not published in Thamke and others (1996); therefore, these wells are numbered sequentially after the last well (M-57) in the original list. Brine-injection wells and oil wells are identified using the name assigned by the particular oil company; for example, Murphy 1-D is a brine-injection well and Murphy 58 is an oil well.

Wells in the Flaxville and underlying aquifers study area also are identified by an alpha-numeric well name, allowing for ease of cross reference between wells presented on the illustrations and tables in this report. All sixteen wells are assigned the alpha character "N." The numeric characters denote the sequence in which the data for wells appear in the table.

Acknowledgments

The Fort Peck Tribes are acknowledged for their support throughout this and previous investigations. Appreciation is given to the FPOEP; IHS; Pioneer Natural Resources, Irving, Texas; and the USEPA for supplying water-quality data for sampled wells in the East Poplar oil field study area. The MDA and the USEPA are acknowledged for collecting water samples

from selected wells completed in the Flaxville and underlying aquifers and analyzing the samples for selected pesticides. Finally, many thanks are extended to the well owners in both study areas who allowed access to their wells for sample collection.

WATER-QUALITY DATA-COLLECTION METHODS, SAMPLING, AND QUALITY CONTROL

East Poplar Oil Field Study Area

Water-quality data were collected in the East Poplar oil field study area between September 1993 and September 2000 by three agencies and one private company. Methods for collection and analysis of water-quality samples by the IHS during 1993-97 are filed with the IHS (Rod Bruner, Indian Health Service, oral commun., 2003). Methods for collection and analysis of water-quality samples by the USGS during 1997-99 are documented and described in Thatcher and others (1977), Thamke and others (1996), and Connor and others (1997). Methods for collection and analysis of water-quality samples by the FPOEP during 1999-2000 are documented and filed with the USEPA (described in "Sampling and Analysis Plans," Nathan Wiser, U.S. Environmental Protection Agency, written commun., 1999 and 2000). Methods for collection and analysis of water-quality samples by MSE during 2000 are described in CH2M Hill (2000).

For samples collected by USGS during 1997-99, methods used included several steps to minimize possible cross-contamination from sampling equipment (Thamke and others, 1996). Disposable 0.45-micron pore-diameter filter assemblies were used at each site. After sample collection at each site, the flow-through sample collection chamber was disassembled and scrubbed using a low-phosphate detergent and then thoroughly rinsed with tap water. The 2-in. portable stainless-steel submersible pump was placed in a 4-in. polyvinylchloride casing that was filled with tap water. The pump was then operated to flush water through the pump and hoses. A low-phosphate detergent was added to the tap water and passed through the pump and hoses. This cleaning procedure step was followed by rinsing the equipment with tap water until the detergent was no longer visually detected. In addition to the cleaning procedures used to minimize possible cross contamination between sample sites, at least three well volumes of water were passed through the sample equipment prior to sample collection.

Water-quality data are presented for 87 wells in the East Poplar oil field study area (table 3). Water samples were collected from 34 of the 87 wells between September 1993 and September 2000. Some of the 34 wells were visited more than once during this time period by various entities. Of the 34 wells, 23 were privately owned wells, 9 were monitoring wells, and 2 were brine-injection wells (fig. 3).

Water samples were collected from 10 privately owned wells by the IHS during 1993-97 (Rod Bruner, written commun., 2003). However, a sample from 1 of the 10 wells was collected after water treatment. Analytical results for the sample from this well is not included in this report. Water samples from 9 of the 10 wells were analyzed for major ions (table 3).

Water samples were collected from 15 water wells by the USGS during 1997-99 for analysis of major ions (table 3) and trace elements (table 4). Water samples were collected by the USGS from four wells during 1999 for analysis of selected fuel ethers and petroleum compounds (table 5). A water sample was collected from one well during 1999 for analysis of radium-226 and radium-228 (table 7).

Water samples were collected from 20 water wells and 2 brine-injection wells by the FPOEP during 1999-2000 (Nathan Wiser, U.S. Environmental Protection Agency, written commun, 1999 and 2000). The FPOEP collected samples at collection points before and after water treatment. Analytical results of samples collected after water treatment are not included in this report. Water samples from 19 of the 20 water wells were analyzed for major ions (table 3). Samples from the 20 water and 2 brine-injection wells were analyzed for volatile organic compounds, semi-volatile organic compounds, total-petroleum hydrocarbons, total-extractable hydrocarbons, diesel range organic compounds, and polynuclear aromatic hydrocarbons. However, only data for constituents with compound concentrations greater than minimum reporting levels are included in this report (table 5 and 6).

Water samples were collected from 14 water wells by MSE during 2000 (CH2M Hill, 2000). However, 8 of the 14 wells were drilled during 2000 for a site-specific investigation, and the analytical results for these 8 wells are not included in this report. Water samples from 6 of the 14 wells were analyzed for major ions (table 3) and selected petroleum compounds (table 5).

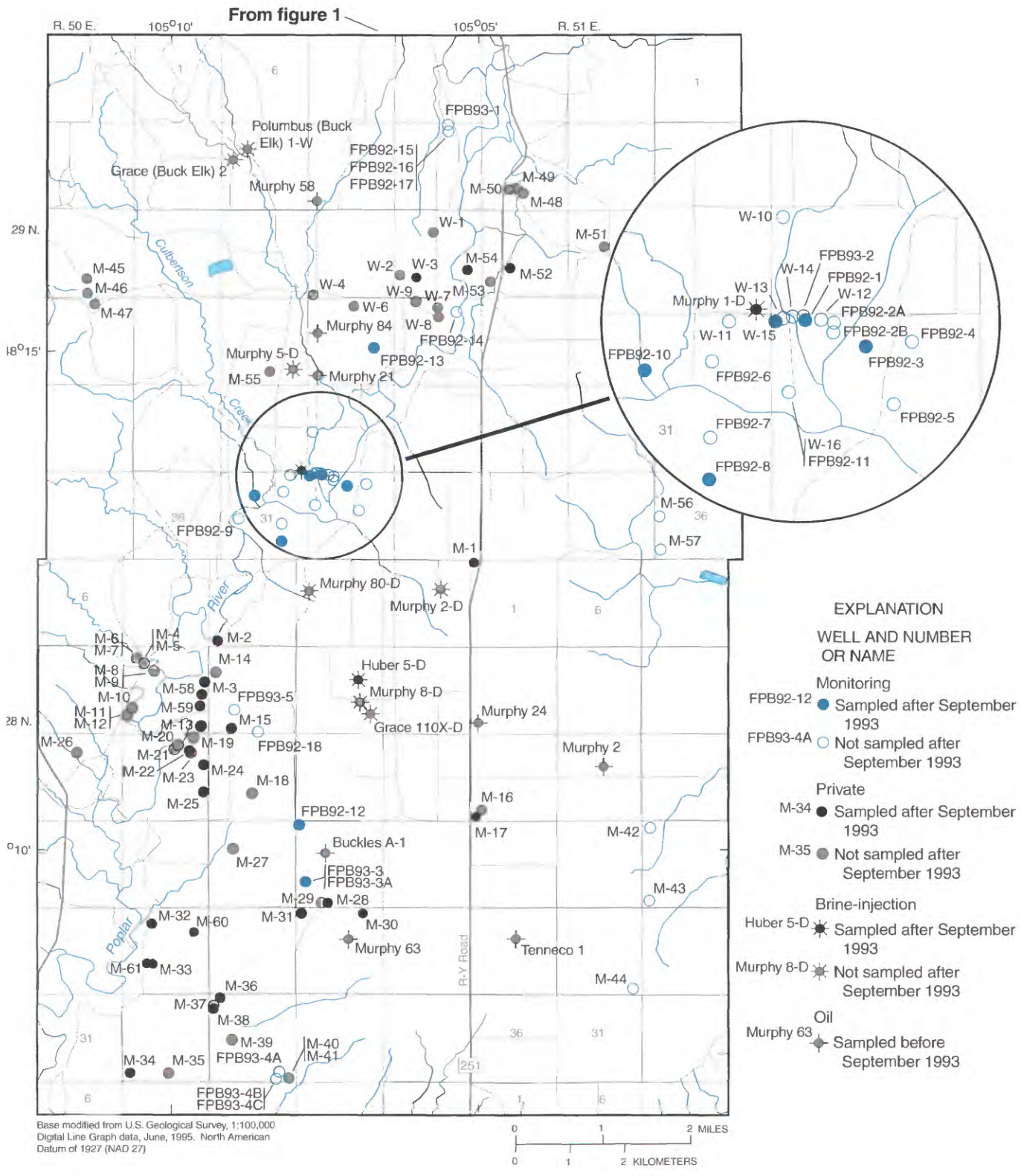


Figure 3. Location of selected water wells, brine-injection wells, and oil wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana.

Quality-control data to document reproducibility of analytical results and possible sample contamination were provided by replicate environmental samples and trip blank samples. A replicate environmental sample is a volume of sampled water split into subsamples in such a manner that the physical and chemical characteristics of each subsample are considered essentially identical in composition. A trip blank is a volume of reagent water carried into the field but not exposed to sample collection equipment or ambient field conditions to test for contamination during shipping and handling.

Replicate samples were collected by the USGS during 1998 and 1999 and by the FPOEP during 1999 and 2000. Four replicate samples were collected between 1998 and 2000 and analyzed for major ions (table 3). Two replicate samples were collected during 1998 and 1999 and analyzed for trace elements (table 4). Seven replicate samples were collected during 1999 and 2000 and analyzed for fuel ethers or petroleum compounds (tables 5 and 6). The relative percent differences of the major-ion concentrations between replicate environmental samples did not exceed 10 percent except for alkalinity in a sample from brine-injection well Huber 5-D (24 percent). The relative percent differences of the trace-element concentrations between replicate environmental samples were less than 2 percent. The relative percent differences of concentrations of selected fuel ethers and petroleum compounds between replicate environmental samples did not exceed 30 percent, except for 1,2,4-trimethylbenzene in a sample from brine-injection well Murphy 1-D (at least 140 percent).

Trip blank samples were collected by the FPOEP during 1999 and 2000 and by MSE during 2000; samples were analyzed for concentrations of volatile organic compounds. Concentrations of volatile organic compounds in all trip blank samples were less than the minimum reporting levels, indicating no contamination during shipping and handling.

Two samples of the rinsate water were collected by the USGS and analyzed for physical properties and major ions (table 8) and for fuel ethers and petroleum compounds (table 9). The rinsate samples were collected after sampling site 29N51E31DBDD01 (FPB92-8) and after sampling site 28N51E22CBCB02 (FPB93-3A), and cleaning the field equipment. Tap water used for routine cleaning of the equipment and for the rinsate samples was obtained from an outside spigot at the Sherman Motor Inn (Wolf Point, Mont.) during 1997 and 1998 or from an outside spigot at the Town Pump Station (Wolf Point, Mont.) during 1999. Nearly all major-ion and trace-element concentrations in water samples collected by the USGS were greater than concentrations in rinsate samples (footnote 7, table 3). However, concentrations of toluene and ethylbenzene in four water samples collected by the USGS during 1999 and concentrations of m- and p-xylene and o-xylene in five water samples collected by the USGS during 1999 were less than concentrations in rinsate samples (footnote 3, table 5), indicating possible cross-contamination of these constituents between sites or from the cleaning procedure. A sample (TP-1) of tap water collected from the outside spigot at the Town Pump Station by the FPOEP in 1999 contained detectable concentrations of ethylbenzene, m- and p-xylene, and o-xylene (table 9).

Flaxville and Underlying Aquifers Study Area

Water-quality data were collected in the Flaxville and underlying aquifers study area during 1997-99 by three agencies. Methods for collection and analysis of water-quality samples by the USGS during 1997-99 are described in Nimick and Thamke (1998). Methods for collection and analysis of water-quality samples by the MDA and the USEPA during 1999 are described in Montana Department of Agriculture (1997).

Water samples were collected from 16 wells by the USGS during 1997-99 for analysis of nitrate (fig. 1, table 10). Generally, wells were sampled once during 1997, four times during 1998, and three times during 1999.

Water samples were collected from 6 of the 16 wells by the MDA and USEPA during 1999 for analysis of pesticides (table 11) (Donna Rise, Montana Department of Agriculture, written commun., 1999). The six wells were in areas where known land-use activities included application of pesticides.

Quality-control data to document reproducibility of analytical results were provided by replicate environmental samples. A replicate environmental sample is a volume of sampled water split into subsamples in such a manner that the physical and chemical characteristics of each subsample are considered essentially identical in composition. Eight replicate samples were collected and submitted for laboratory analysis of nitrate concentrations between 1997 and 1999 (table 10). The differences in the concentration of nitrate

between the replicates ranged from 0.0 mg/L to 1.0 mg/L, indicating acceptable reproducibility of analytical results.

GROUND-WATER QUALITY

East Poplar Oil Field Study Area

The quality of water in Quaternary deposits in the East Poplar Oil field study area is highly variable and is dependent on location relative to sources of saline water. Saline-water plumes were delineated using data collected during the early 1990s (Thamke and Craigg, 1997). Four principal water types in the study area also were described by Thamke and Craigg (1997); the dissolved-solids and chloride concentration ranges of these water types have been updated for this report using data collected between September 1993 and September 2000 (table 1). Comparisons of previous to more recent concentrations of dissolved solids and chloride in water from wells can be used to indicate possible changes in water quality, and thus, also indicate if saline-water plumes in the study area have moved (table 2). Recently, plume movement has been documented for the southern part of the East Poplar oil field (Land and Water Consulting, Inc., 2003); although a rate of ground-water movement estimated by the same company differs substantially from a rate estimated by Montana Department of Environmental Quality (2002). Changes in ground-water quality can be substantial, depending on the chemical characteristics of the saline water, quantity of saline water, proximity to the source, and ground-water flow characteristics in the area. The following sets of examples show substantial changes in ground-water quality in three areas during a 9- to 10-year period and describe additional data collected during recent investigations.

In the first set of examples, moderately contaminated ground water (Type 2) in the early 1990s became considerably contaminated (Type 3) by 1995 to 2000 near the west-central part of Area 2 (fig. 4). During a 9-year period, dissolved-solids concentrations increased as much as 13,950 mg/L (457 percent) in water from well M-24 (tables 2 and 3). Most concentrations of fuel ethers and petroleum compounds were less than minimum reporting levels in water from well M-24 (table 5); however, samples were collected from the kitchen tap or outside faucet after the water had passed through the household plumbing system, increasing the possibility of volatilization. Similar water-quality conditions and changes occurred at privately owned wells M-13, M-15, and M-22 (tables 2, 3, and 5), located in the same part of Area 2 as well M-24 (fig. 4). In the early 1990s, these four privately owned wells were located within a confirmed Type 2 plume and downgradient from confirmed and possible Type 3 plumes (fig. 4). In these wells, the dissolved-solids concentrations probably were increasing because Type 3 saline water was moving into the Quaternary glacial deposits near these wells.

In the second set of examples, considerably contaminated ground water (Type 3) in the early 1990s became more contaminated by 2000 near the south-central part of Area 2 (fig. 4). During a 9-year period, dissolved-solids concentrations increased as much as 29,500 mg/L (194 percent) in water from well M-28

Table 1. Characteristics of water types in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana

[Dissolved-solids and chloride concentration ranges modified from table 3 of Thamke and Craigg (1997) using additional data collected between September 1993 and September 2000. Dissolved-solids and chloride concentrations reported in milligrams per liter]

Water type	Domestic water use	Concentration range	
		Dissolved solids	Chloride
Type 1--Uncontaminated ground water	Suitable for most domestic purposes	427-2,870	4-260
Type 2--Moderately contaminated ground water	Suitable for some domestic purposes; generally not used for drinking water	1,170-9,250	330-4,800
Type 3--Considerably contaminated ground water	Unsuitable for any domestic purposes	9,640-91,100	5,200-58,000
Type 4--Brine (from oil production)	Unused	47,700-201,000	27,000-120,000

Table 2. Changes in dissolved-solids and chloride concentrations in water from privately owned wells and monitoring wells that were either sampled or resampled between September 1993 and September 2000, East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana

[Water type: Type 1, uncontaminated ground water; Type 2, moderately contaminated ground water; Type 3, considerably contaminated ground water. Abbreviation: mg/L, milligrams per liter; M, monitoring well; P, privately owned well]

Well name	Well type	Sample date	Dissolved-solids concentration (mg/L)			Chloride concentration (mg/L)			Water type
			Concentration in sample	Change over time	Percent increase (+) or decrease (-)	Concentration in sample	Change over time	Percent increase (+) or decrease (-)	
Sites at which dissolved-solids concentration increased more than 200 mg/L									
M-1	P	07-20-91	2,540			36			1
		09-28-00	2,870	+330	+13	37	+1	+3	1
M-3	P	08-25-90	1,220			260			1
		09-21-00	2,460	+1,240	+102	1,040	+780	+300	2
M-13	P	08-25-90	4,950			2,800			2
		09-11-95	10,114	+5,164	+104	5,813	+3,013	+108	3
M-58	P	07-21-97	3,190			1,739			2
		09-21-00	5,860	+2,670	+84	2,810	+1,071	+62	2
M-15	P	07-19-91	1,950			780			2
		09-20-00	9,850	+7,900	+405	5,950	+5,170	+663	3
M-22	P	08-26-90	5,280			3,000			2
		09-20-00	16,100	+10,820	+205	8,840	+5,840	+195	3
M-24	P	07-16-91	3,050			1,400			2
		09-20-00	17,000	+13,950	+457	9,430	+8,030	+574	3
M-25	P	08-25-90	2,300			1,100			2
		09-21-00	5,840	+3,540	+154	2,990	+1,890	+172	2
FPB93-3	M	07-21-93	58,700			35,000			3
		06-01-00	67,000	+8,300	+14	39,800	+4,800	+14	3
FPB93-3A	M	07-20-93	63,500			38,000			3
		04-21-99	74,800	+11,300	+18	40,000	+2,000	+5	3
M-28	P	07-20-91	15,200			7,900			3
		06-01-00	44,700	+29,500	+194	25,800	+17,900	+226	3
M-30	P	04-15-92	1,100			22			1
		09-29-00	1,740	+640	+58	36	+14	+64	1
M-31	P	07-23-93	51,900			32,000			3
		06-01-00	60,800	+8,900	+17	36,000	+4,000	+12	3
M-60	P	11-04-94	1,170			220			1
		09-20-00	2,120	+950	+81	855	+635	+289	2
M-32	P	08-17-93	1,170			330			2
		11-09-99	1,730	+560	+48	736	+406	+123	2
M-36	P	08-24-90	2,120			40			1
		09-29-00	2,640	+520	+25	159	+119	+298	1
M-38	P	03-16-89	1,700			34			1
		09-29-00	2,660	+960	+56	151	+117	+344	1

Table 2. Changes in dissolved-solids and chloride concentrations in water from privately owned wells and monitoring wells that were either sampled or resampled between September 1993 and September 2000, East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Well name	Well type	Sample date	Dissolved-solids concentration (mg/L)			Chloride concentration (mg/L)			Water type
			Concentration in sample	Change over time	Percent increase (+) or decrease (-)	Concentration in sample	Change over time	Percent increase (+) or decrease (-)	
Sites at which dissolved-solids concentration increased more than 200 mg/L (Continued)									
M-52	P	07-19-91	1,160			8.8			1
		09-20-00	1,580	+420	+36	11	+2.2	+25	1
M-54	P	08-23-90	1,020			13			1
		09-28-00	1,370	+350	+34	15	+2	+15	1
FPB92-13	M	08-15-93	7,060			4,100			2
		06-25-98	7,960	+900	+13	4,600	+500	+12	2
Sites at which dissolved-solids concentration decreased more than 200 mg/L									
M-2	P	08-25-90	1,480			420			2
		09-28-00	1,100	-380	-26	117	-303	-72	1
FPB92-10	M	08-10-93	4,960			2,100			2
		06-25-98	2,800	-2,160	-44	860	-1,240	-59	2
FPB92-8	M	08-12-93	18,000			10,000			3
		08-28-97	11,700	-6,300	-35	6,600	-3,400	-34	3
FPB92-3	M	08-14-93	20,800			12,000			3
		07-26-97	3,250	-17,550	-84	1,300	-10,700	-89	2
FPB92-1	M	07-25-93	91,100			58,000			3
		04-21-99	80,800	-10,300	-11	46,000	-12,000	-21	3
W-15	M	07-23-89	50,000			30,000			3
		04-21-99	9,250	-40,750	-82	4,700	-25,300	-84	2
Sites at which dissolved-solids concentration changed less than 200 mg/L									
M-17	P	08-22-90	2,190			20			1
		09-20-00	2,190	0	0	22	+2	+10	1
FPB92-12	M	07-24-93	2,470			15			1
		06-01-00	2,330	-140	-6	11	-4	-27	1
M-34	P	11-10-99	761			37			1
		09-20-00	785	+24	+3	51	+14	+38	1
W-3	M	07-18-91	750			13			1
		09-20-00	849	+99	+13	13	0	0	1

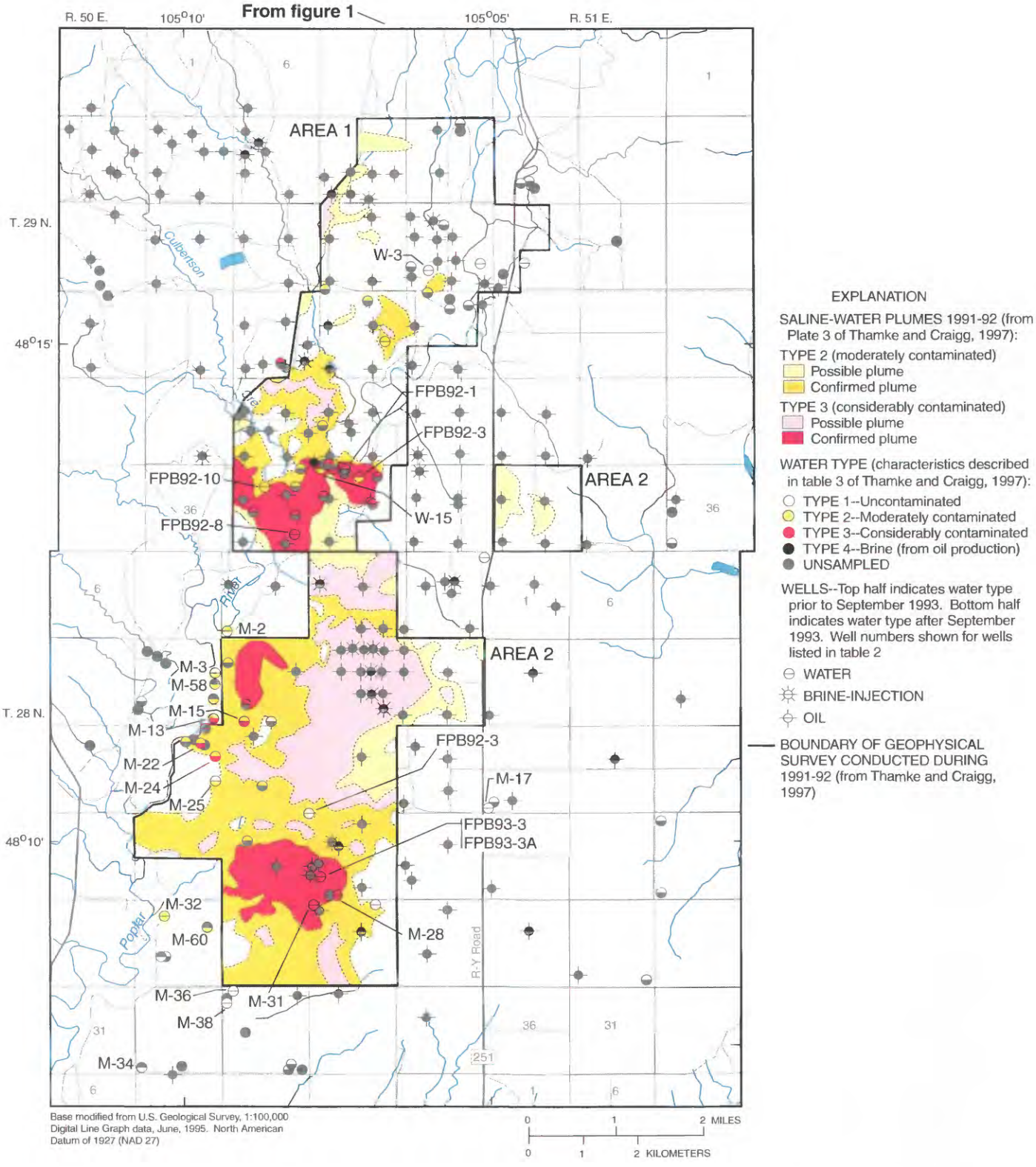


Figure 4. Location of possible and confirmed saline-water plumes, known brine-injection wells, and oil wells, and change of water type in wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana.

(tables 2 and 3). The benzene concentration was 14 µg/L in this privately owned well (table 5). Similar water-quality conditions and changes occurred at monitoring wells FPB93-3 and FPB93-3A and privately owned well M-31. All four wells were located within a confirmed Type 3 plume that likely contained at least one active source of contamination during 2000 (Thamke and Craigg, 1997, p. 26; CH2M Hill, 2000, p. 9). Water temperatures in monitoring wells FPB93-3 and FPB93-3A increased from 18-19 °C in 1993 to about 25 °C in 1999 and 2000, which is approximately twice the 10-12 °C temperature range for most ground water in the area. Water temperatures of brine prior to injection can be as much as 80 °C (table 3); thus, temperatures of crude oil and brine directly from oil-production wells probably can be higher. In 2001, a local oil-production well within the confirmed Type 3 plume, Biere 1-22 (Pioneer Natural Resources USA, Inc., 2000), was sealed, and temperature data collected from nearby monitoring wells during 2001-02 indicate that ground-water temperature was decreasing (Nathan Wiser, U.S. Environmental Protection Agency, oral commun., 2002).

In the third set of examples, considerably contaminated ground water (Type 3) in the late 1980s to early 1990s became less contaminated by the late 1990s in the southern part of Area 1 (fig. 4). During a 10-year period, dissolved-solids concentrations decreased as much as 40,750 mg/L (82 percent) in water from well W-15 (table 2 and 3). Concentrations of selected fuel ethers and petroleum compounds in well W-15 were small or less than minimum reporting levels (table 5). Concentrations of radium-226 and radium-228 in well W-15 were small (table 7). Similar water-quality conditions and changes occurred at monitoring wells FPB92-10, FPB92-8, FPB92-3, and FPB92-1. All five wells were located within confirmed Type 2 and Type 3 plumes. Wells FPB92-10, FPB92-3, FPB92-1, and W-15, were located on the upgradient edges of the plumes; well FPB92-8 was located within a Type 3 plume. The dissolved-solids concentrations in water from these wells probably were diluted by fresh water as the saline-water plumes moved towards the Poplar River and upgradient saline-water sources diminished or were terminated (Thamke and Craigg, 1997).

Changes in water quality were less substantial in the remaining 17 privately owned and monitoring wells that were sampled during 1994-2000. Analyses of water collected from these 17 wells (table 2 and 3) indicate that dissolved-solids concentrations increased in 12 wells, decreased in 1 well, and remained constant in 4 wells. Most of the 12 wells that contained water with increased dissolved-solids concentrations are located in or near the western part of Area 2 (wells M-3, M-58, M-25, M-60, M-32, M-36, M-38), either downgradient from or near saline-water plumes (fig. 4). The one well that contained water with decreased dissolved-solids concentrations (well M-2) was located on the upgradient boundary of Area 2. Wells that contain water with generally constant dissolved-solids concentrations (wells M-17, FPB92-12, M-34, W-3) were in areas unaffected by saline water.

Flaxville and Underlying Aquifers Study Area

Water samples from 16 wells in the Flaxville and underlying aquifers study area were collected during three time periods: once during the 1980s for 3 wells, once or twice during the mid-1990s for all 16 wells, and then quarterly over a 2-year period during the late 1990s for all 16 wells (table 10). The temporal changes in nitrate concentrations in water from the 16 wells are shown in figure 5.

During 1997-99, nearly all temporal changes in nitrate concentrations were small (less than 20 percent deviation) compared to the average concentration at each well. Although the overall range of variation during those 2 years was small (fig. 5), the temporal changes in nitrate concentrations in water from some wells have a slight seasonal pattern with small increases in late spring. This seasonal pattern was observed in 12 of the 16 wells (wells N-3, N-4, N-5, N-6, N-7, N-8, N-9, N-10, N-11, N-13, N-14, N-15), although the precise cause of the pattern cannot be determined from the available data. The slight seasonal pattern could be observed in water from wells completed in various aquifers, at various well depths, and with various types of surrounding land use. Temporal changes in nitrate concentrations were erratic and large in only 1 of the 16 wells (N-16). Nitrate concentrations in water from well N-16 ranged from 1.6 to 8.7 mg/L (table 10). The nitrogen-isotope ratio of water

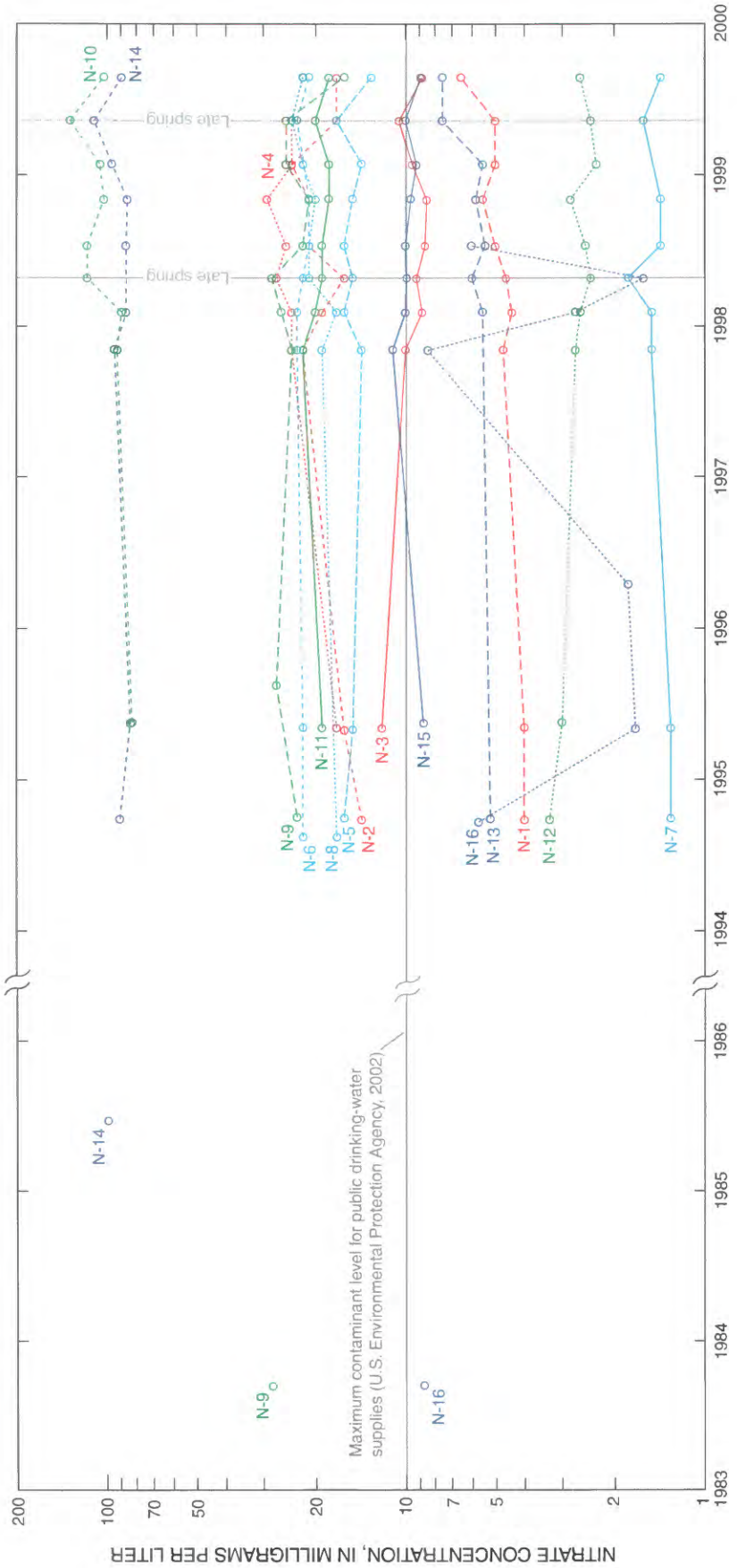


Figure 5. Temporal changes in nitrate concentrations in water from wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, 1983-99.

sampled from N-16 during 1995 and the winter confinement of livestock adjacent to the well indicate that livestock waste is likely a major source of nitrate to water from this well (Nimick and Thamke, 1998).

Long-term changes in nitrate concentrations in water from 22 wells were evaluated previously by Nimick and Thamke (1998). The wells were sampled once during 1981-85 or 1989 and again during 1994-95. From these data, Nimick and Thamke determined that significant long-term changes in nitrate concentrations had not occurred. Three of the 22 wells evaluated by Nimick and Thamke (1998) were sampled again during 1997-99 (wells N-9, N-14, and N-16; table 10). The ranges of nitrate concentrations during 1997-99 for these three wells were similar to the earlier ranges.

During 1999, 6 wells (N-1, N-4, N-6, N-9, N-10, and N-13) were selected from the 16 monitoring wells to determine if pesticides were present in ground water in the study area (table 11). Selection of these six wells was based on well depth equal to or less than 65 feet, nitrate concentrations equal to or greater than 4 mg/L, and nearby land use that included application of pesticides. Even though the pesticides selected for analysis (table 11) are commonly used in the study area, concentrations of these compounds in all water samples were less than the minimum reporting levels.

SUMMARY AND CONCLUSIONS

Studies conducted by the U.S. Geological Survey and Fort Peck Assiniboine and Sioux Tribes during 1979-96 determined that ground-water quality in two areas of the Fort Peck Indian Reservation had been adversely affected by some land-use activities. This report describes investigations of ground-water-quality for both areas subsequent to these earlier studies.

In the East Poplar oil field study area, the quality of water in Quaternary deposits is highly variable. Of 30 water wells that were sampled more than once with at least one sample collected between September 1993 and September 2000, the dissolved-solids concentrations increased by as much as 29,500 mg/L in water from 20 wells, decreased as much as 40,750 mg/L in water from 6 wells, and remained constant in water from 4 wells. Dissolved-solids concentrations increased in ground water in a large area within and downgradient from the west-central part of Area 2 because Type 2 and Type 3 saline water probably is moving into the Quaternary glacial deposits near these wells. Dissolved-solids concentrations decreased in a smaller area within or upgradient from a Type 3 plume in the southern part of Area 1. The dissolved-solids concentrations in water from wells in this area probably were diluted by fresh water as the Type 2 and Type 3 saline water moved away from this area and upgradient sources diminished or were terminated. Dissolved-solids concentrations were constant in areas unaffected by saline water.

In the Flaxville and underlying aquifers study area, nearly all temporal changes in nitrate concentrations in water were small compared to the average concentration at each well. Although the overall range of variation of nitrate concentrations was small in water from nearly all wells, the temporal changes in 12 of the 16 wells have a slight seasonal pattern with small increases in late spring. The slight seasonal pattern was observed in water from wells completed in various aquifers, at various well depths, and with various types of surrounding land use. Concentrations of all selected pesticides in water samples from six wells were less than the minimum reporting levels.

Even though these investigations have described temporal and spatial changes of ground-water quality for two areas in the Fort Peck Indian Reservation, future investigations are needed. In the East Poplar oil field, substantial changes in ground-water quality indicate that the previous delineation of saline water in part of the study area might not accurately represent current (2003) conditions. A comprehensive delineation of saline water throughout the entire East Poplar oil field could be compared to the early 1990s partial delineation to determine contaminant movement rates that would subsequently aid in clarifying ground-water movement in the area and aid in management efforts. In the Flaxville and underlying aquifers study area, although crop stubble and livestock waste were identified as the primary sources of nitrate, decreases in nitrate concentrations in ground water due to modifications of land-use have not been documented. Several site-specific investigations to compare nitrate concentrations in ground water before and after land-use modifications would be useful to resource managers in making land-management decisions.

REFERENCES CITED

Childress, C.J.O., Foreman, W.T., Connor, B.F., Maloney, T.J., 1999, New reporting procedures based on long-term method detection levels and some considerations for interpretations of water-quality data provided by the U.S. Geological Survey National Water Quality Laboratory: U.S. Geological Survey Open-File Report 99-193, 19 p.

CH2M Hill, 2000, Field investigation Biere well evaluation, Poplar, Montana: Boise, Idaho, prepared for Pioneer Natural Resources, Irving, Texas [variously paged].

Connor, B.F., Rose, D.L., Noriega, M.C., Murtagh, L.K., and Abney, S.R., 1997, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory--Determination of 86 volatile organic compounds in water by gas chromatography/mass spectrometry, including detections less than reporting limits: U.S. Geological Survey Open-File Report 97-829, 78 p.

Donovan, J.J., and Bergantino, R.N., 1987, Groundwater resources of the Fort Peck Indian Reservation, with emphasis on aquifers of the preglacial Missouri River valley [Montana]: Montana Bureau of Mines and Geology Open-File Report 178, 106 p.

Furlong, E.T., Vaught, D.G., Merten, L.M., Foreman, W.T., and Gates, P.M., 1996, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory--Determination of semivolatile organic compounds in bottom sediment by solvent extraction, gel permeation chromatographic fractionation, and capillary-column gas chromatography/mass spectrometry: U.S. Geological Survey Open-File Report 95-719, 67 p.

Land and Water Consulting, Inc., 2003, Public water supply well threat study, East Poplar oil field, Roosevelt County, Montana: Missoula, Mont., prepared for Murphy Exploration and Petroleum Company, Pioneer Natural Resources, Marathon Ashland Petroleum, and Samson [variously paged].

Levings, G.W., 1984, Reconnaissance evaluation of contamination in the alluvial aquifer in the East Poplar oil field, Roosevelt County, Montana: U.S. Geological Survey Water-Resources Investigations Report 84-4174, 29 p.

Montana Department of Agriculture, 1997, Ambient groundwater program Standard Operating Procedure: Helena, Montana Department of Agriculture, Agricultural Sciences Division, Technical Services Bureau, Ambient Groundwater Program [variously paged].

Montana Department of Environmental Quality, 2002, Source water delineation and assessment report, city of Poplar: Helena, Mont., PWSID 00310, 39 p.

Nimick, D.A., and Thamke, J.N., 1998, Extent, magnitude, and sources of nitrate in the Flaxville and underlying aquifers, Fort Peck Indian Reservation, northeastern Montana: U.S. Geological Survey Water-Resources Investigations Report 98-4079, 45 p.

Pioneer Natural Resources USA, Inc., 2000, Proposed Biere 1-22 Well Response Action Plan: Irving, Texas [variously paged].

Thamke, J.N., and Craigg, S.D., 1997, Saline-water contamination in Quaternary deposits and the Poplar River, East Poplar oil field, northeastern Montana: U.S. Geological Survey Water-Resources Investigations Report 97-4000, 37 p.

Thamke, J.N., Craigg, S.D., and Mendes, T.M., 1996, Hydrologic data for the East Poplar oil field, Fort Peck Indian Reservation, northeastern Montana: U.S. Geological Survey Open-File Report 95-749, 92 p.

Thamke, J.N., and Nimick, D.A., 1998, Dryland farming and livestock as sources of nitrate in ground water: U.S. Geological Survey Fact Sheet FS-018-98, 4 p.

Thatcher, L.L., Janzer, V.J., and Edwards, K.W., 1977, Methods for determination of radioactive substances in water and fluvial substances: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A5, 95 p.

U.S. Environmental Protection Agency, 2002, 2002 Edition of the drinking water standards and health advisories: Washington, D.C., Office of Water, EPA 822-R-02-038, 18 p.

DATA

Table 3. Physical and chemical characterisitcs of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana

Bold type--indicates data collected after September 1993 and not reported in Thamke and others (1996).
Site number and well name--described in text.
Geologic unit (in which well is completed; for brine-injection wells, indicates unit that is the source of the brine)--

- Qal - Alluvium (Quaternary)
- Qt - Glacial till (Pleistocene)
- Qgo - Glacial outwash (Pleistocene)
- Qw - Wiota Gravel (Pleistocene)
- Kb - Bearpaw Shale (Upper Cretaceous)
- Kjr - Judith River Formation (Upper Cretaceous)
- Mh - Heath Formation (Upper Mississippian)
- Mk - Kibbey Formation (Upper Mississippian)
- Mm - Madison Group (Mississippian)
  - Mc - Charles Formation of Madison Group
  - Mmc - Mission Canyon Limestone of Madison Group
- Dn - Nisku Formation (Upper Devonian).

Depth of well--in feet below land surface.
Depth to water--in feet below land surface.
Collecting agency and analyzing laboratory:

- ASCHM, Astro-Chem Service Laboratory;
- CHNO, Chen-Northern, Inc.;
- ELAB, Energy Laboratories, Inc.;
- FPOEP, Fort Peck Tribes Office of Environmental Protection;
- IHS, Public Health Service/Indian Health Service-Fort Peck Service Unit;
- MBMG, Montana Bureau of Mines and Geology;
- MDHES, Montana Department of Health and Environmental Sciences, Water Quality Bureau;
- MSE, MSE-HKM, Inc.;
- NALCO, Nalco Chemical Company;
- PETRO, Petrolite Oil Field Chemicals Group;
- USEPA, U.S. Environmental Protection Agency;
- USGS, U.S. Geological Survey;
- YSB, Yapuncich, Sanderson, and Brown Laboratories, currently (2003) Energy Laboratories, Inc.

Constituents are dissolved, except as indicated.
Abbreviations: µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; g/mL, grams per milliliter; mg/L, milligrams per liter. Symbols: <, less than minimum reporting level; --, no data; (?), uncertain.
Water type--Characteristics originally described in table 3 of Thamke and Craigg (1997) and modified in table 1 of this report. Type 1 is uncontaminated ground water. Type 2 is moderately contaminated ground water. Type 3 is considerably contaminated ground water. Type 4 is brine.

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
28N51E01BBBB01	Qt	153	--	07-21-82	USGS	USGS	2,820	7.2	12.0	110
M-1			--	07-20-91	USGS	USGS	3,930	6.7	12.0	170
			--	**09-28-00**	**FPOEP**	**ELAB**	--	--	--	**142**
28N51E02ACDB01	Mm[3]	834	--	09-14-64	--	--	173,000	8.1	--	970
Murphy 2-D										
28N51E03BCAC01	Mh,Mm[4]	3,575	--	[5]09-22-89	--	NALCO	--	[1]5.9	--	920
Murphy 80-D										
28N51E04CCCD01	Qt	50	--	08-25-90	USGS	USGS	2,650	7.6	10.0	69
M-2			--	**09-11-95**	**IHS**	**ASCHM**	**[1]2,113**	**[1]8.31**	--	**24**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**43**
			--	**01-04-00**	**FPOEP**	**USEPA**	**[1]2,020**	**[1]5.82**	--	**40.8**
			--	**09-28-00**	**FPOEP**	**ELAB**	--	--	--	**38**
28N51E08ADDA01	Qal	52	13.50	08-23-90	USGS	USGS	[1]2,050	7.7	11.0	48
M-3			--	**09-11-95**	**IHS**	**ASCHM**	**[1]2,755**	**[1]8.02**	--	**79**
			12.58	**09-03-97**	**USGS**	**USGS**	**3,420**	**7.6**	**10.0**	**100**
			--	**11-02-99**	**FPOEP**	**ELAB**	--	--	--	**121**
			--	**09-21-00**	**FPOEP**	**ELAB**	--	--	--	**145**
28N51E08CCBB01	Qal	22	--	11-08-88	--	CHNO	[1]1,500	7.6	--	99
M-10										
28N51E08DDDB01	Qt	102	57.25	08-25-90	USGS	USGS	8,120	7.1	10.0	400
M-13			--	**09-11-95**	**IHS**	**ASCHM**	**[1]17,387**	**[1]7.41**	--	**436**
28N51E08DAAC01	**Qal**	**55**	--	**07-21-97**	**IHS**	**ASCHM**	**[1]10,486**	--	--	**268**
M-58			--	**11-02-99**	**FPOEP**	**ELAB**	--	--	--	**347**
			--	**09-21-00**	**FPOEP**	**ELAB**	--	--	--	**367**
28N51E08DADC01	**Qal**	**54**	--	**07-21-97**	**IHS**	**ASCHM**	**[1]10,058**	--	--	**254**
M-59										
28N51E09BCBB01	Qt	90	70.59	07-17-91	USGS	USGS	2,610	7.5	18.0	61
M-14										
28N51E09CCDD01	Qt	117	--	04-07-89	--	CHNO	[1]2,910	[1]7.3	--	100
M-15			--	08-16-89	--	CHNO	[1]3,220	[1]7.2	--	100
			70.80	07-19-91	USGS	USGS	[1]3,180	7.3	11.5	120
			--	**09-11-95**	**IHS**	**ASCHM**	**[1]6,634**	**[1]8.09**	--	**[6]18**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**58**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**69**
28N51E09CDBB01	Qt	104	52.77	[8]08-12-93	USGS	USGS	18,300	6.9	11.0	870
FPB93-5			52.77	[8]08-12-93	USGS	USGS	18,300	6.9	11.0	890
28N51E09DCCC01	Qt	93	--	08-13-93	USGS	USGS	1,400	7.4	10.0	120
FPB92-18										
28N51E10ACCA01	**Dn**	--	--	**[8]09-29-00**	**FPOEP**	**ELAB**	--	--	--	**952**
Huber 5-D[9]			--	**[8]09-29-00**	**FPOEP**	**ELAB**	--	--	--	**897**

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
200	310	4.1	[1]886	590	29	0.4	--	--	1,900	1	28N51E01BBBB01
320	350	4.6	893	1,100	36	.4	0.34	0.034	2,540	1	M-1
301	**326**	**4**	**[1,2]976**	**1,160**	**37**	--	--	--	**2,870**	**1**	
120	73,000	500	170	2,200	110,000	--	--	--	190,000	4	28N51E02ACDB01 Murphy 2-D
170	56,000	--	[1]360	510	88,000	--	--	--	146,000	4	28N51E03BCAC 01 Murphy 80-D
58	410	8.1	434	230	420	.2	.27	.023	1,480	2	28N51E04CCCD01
47	**386**	**8**	**[1,2]571**	**233**	**200**	--	--	--	**1,596**	**1**	M-2
34	**354**	**6**	**[1]574**	**240**	**154**	--	--	--	**1,170**	**1**	
32.7	**328**	**5.16**	**[6]146**	**272**	**[6]463**	--	--	--	**1,260**	--	
31	**324**	**6**	**[1,2]572**	**237**	**117**	--	--	--	**1,100**	**1**	
38	360	6.1	436	230	260	.2	.16	.020	1,220	1	28N51E08ADDA01
50	**441**	**8**	**[1,2]440**	**233**	**476**	--	--	--	**1,824**	**2**	M-3
71	**470**	**8.1**	**[1,7]442**	**[7]240**	**660**	**<.1**	--	--	**1,830**	**2**	
99	**545**	**9**	**[1]434**	**249**	**999**	--	--	--	**2,390**	**2**	
108	**589**	**10**	**[1]478**	**254**	**1,040**	--	--	--	**2,460**	**2**	
46	170	8	[1]395	390	32	.3	--	--	1,370	1	28N51E08CCBB01 M-10
280	980	15	286	260	2,800	.2	1.4	.200	4,950	2	28N51E08DDDB01
378	**2,780**	**40**	**[1,2]260**	**349**	**5,813**	--	--	--	**10,114**	**3**	M-13
161	**770**	**13**	--	**223**	**1,739**	--	--	--	**3,190**	**2**	**28N51E08DDDB02**
249	**977**	**15**	**[1]359**	**268**	**2,550**	--	--	--	**5,120**	**2**	**M-58**
260	**1,090**	**16**	**[1]360**	**255**	**2,810**	--	--	--	**5,860**	**2**	
191	**741**	**13**	--	**226**	**1,649**	--	--	--	**3,088**	**2**	**28N51E08DADC01 M-59**
55	400	7.2	461	300	430	.4	.25	.031	1,550	2	28N51E09BCBB01 M-14
69	450	9	[1]366	210	670	.2	--	--	1,720	2	28N51E09CCDD01
75	460	9	[1]359	190	690	.2	--	--	1,740	2	M-15
84	500	7.6	373	210	780	.3	.30	.029	1,950	2	
[6]8	**1,410**	**6**	**[1,2]340**	**192**	**1,904**	--	--	--	**3,953**	**2**	
29	**3,270**	**9**	**[1]287**	**179**	**4,720**	--	--	--	**8,350**	**2**	
40	**3,690**	**6**	**[1]367**	**197**	**5,950**	--	--	--	**9,850**	**3**	
590	2,000	20	269	340	6,300	.2	.67	.360	10,300	3	28N51E09CDBB01
600	2,000	19	269	300	6,100	.2	.60	.380	10,100	3	FPB93-5
61	65	1.4	[1]367	340	25	.4	--	--	856	1	28N51E09DCCC01 FPB92-18
132	**34,100**	**492**	**[1]274**	**1,670**	**57,000**	--	--	--	**85,900**	**4**	**28N51E10ACCA01**
122	**32,600**	**484**	**[1]216**	**1,660**	**56,800**	--	--	--	**87,500**	**4**	**Huber 5-D[9]**

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
28N51E10DADC01 Grace 110X-D	Mc,Dn[10]	7,000	--	08-24-84	--	NALCO	--	[1]5.8	--	1,600
28N51E10DBAD01 Murphy 8-D	Mm[3]	780(?)	--	07-24-89	USGS	USGS	[1]124,000	6.4	80.0	950
			--	[5]12-11-89	--	NALCO	--	[1]5.8	--	1,000
			--	08-29-90	USGS	USGS	117,000	[1]7.0	61.5	700
28N51E12CCBD01 Murphy 24	Mm	[11]5,910-5,920	--	12-09-54	USGS	USGS	--	--	--	1,000
28N51E13CCCA01 M-16	Qt	33	14.06	08-22-90	USGS	USGS	3,600	7.4	11.0	240
28N51E13CCCC01 M-17	Qw	150	131.46	08-22-90	USGS	USGS	3,000	7.3	12.0	110
			--	**11-22-99**	**FPOEP**	**ELAB**	--	--	--	**116**
			--	**01-04-00**	**FPOEP**	**USEPA**	**[1]3,040**	**[1]6.41**	--	**120**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**120**
28N51E16DBCB01 M-18	Qt	104	79.72	07-23-89	USGS	USGS	10,000	7.3	10.0	580
			78.91	07-21-91	USGS	USGS	12,700	7.3	13.5	700
28N51E17ABDC01 M-20	Qal	36	11.84	08-26-90	USGS	USGS	7,000	7.3	11.0	350
28N51E17ABDD01 M-22	Qt	40	24.10	[8]08-26-90	USGS	USGS	8,600	7.2	10.0	480
			24.10	[8]08-26-90	USGS	USGS	8,600	7.2	10.0	480
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**1,090**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**1,060**
28N51E17ADAD01 M-24	Qt	130	62.80	07-16-91	USGS	USGS	5,380	7.2	10.5	240
			--	**11-02-93**	**IHS**	**ELAB**	--	**[1]7.3**	--	**365**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**1,240**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**1,360**
28N51E17DADA01 M-25	Qt	102	--	02-10-75	IHS	YSB	[1]1,080	[1]7.2	--	34
			66.09	08-25-90	USGS	USGS	4,400	7.4	10.5	160
			--	**10-08-93**	**IHS**	**ELAB**	**[1]2,670**	**[1]7.9**	--	**149**
			--	**05-20-94**	**IHS**	**ELAB**	--	**[1]7.7**	--	**187**
			--	**09-11-95**	**IHS**	**ASCHM**	**[1]4,708**	**[1]8.48**	--	**186**
			66.62	**09-03-97**	**USGS**	**USGS**	**5,770**	**7.4**	**10.5**	**230**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**362**
			--	**09-21-00**	**FPOEP**	**ELAB**	--	--	--	**442**
28N51E21BDBC01 M-27	Qt	91	66.74	08-26-90	USGS	USGS	5,820	7.4	10.0	330
28N51E22BBBB01 FPB92-12	Qt	68	--	07-24-93	USGS	USGS	3,050	7.3	11.0	280
			14.52	**06-24-98**	**USGS**	**USGS**	**2,120**	**7.5**	**12.0**	**170**
			--	**06-01-00**	**MSE**	**ELAB**	**[1]2,580**	**[1]7.9**	**10.8**	**240**
28N51E22BDCA01 Buckles A-1	Mc	5,872	--	[5]04-30-81	--	ASCHM	[1]120,000	[1]7.3	--	4,000

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
150	49,000	--	[1]210	1,600	78,000	--	--	--	130,000	4	28N51E10DADC01 Grace 110X-D
140	39,000	500	[1]183	1,800	60,000	5.6	12	.880	103,000	4	28N51E10DBAD01
360	43,000	--	[1]360	840	69,000	--	--	--	114,000	4	Murphy 8-D
130	36,000	470	[1]204	1,900	60,000	13	16	1.1	99,500	4	
140	[12]77,000	--	[13]196	2,600	120,000	--	--	--	201,000	4	28N51E12CCBD01 Murphy 24
270	110	18	610	210	200	.8	.45	.012	2,420	1	28N51E13CCCA01 M-16
130	440	8.1	1,040	820	20	.4	.13	.057	2,190	1	28N51E13CCCC01
130	**425**	**8**	[1]**966**	**862**	**17**	--	--	--	**2,130**	**1**	M-17
138	**410**	**7.96**	[1,6]**568**	**838**	[6]**319**	--	--	--	**2,304**	--	
133	**409**	**7**	[1]**1,000**	**810**	**22**	--	--	--	**2,190**	**1**	
360	940	16	307	490	3,100	.1	.77	.049	5,810	2	28N51E16DBCB01
440	1,200	18	309	580	3,700	.4	1.0	.061	7,070	2	M-18
240	750	14	304	230	2,300	<.1	.67	.130	4,100	2	28N51E17ABDC01 M-20
320	1,000	17	282	250	3,000	<.4	1.6	.190	5,280	2	28N51E17ABDD01
320	990	17	282	250	3,100	<.1	1.7	.210	5,370	2	M-22
718	**3,010**	**32**	[1]**215**	**400**	**8,370**	--	--	--	**14,600**	**3**	
697	**3,220**	**30**	[1]**227**	**348**	**8,840**	--	--	--	**16,100**	**3**	
170	620	9.9	320	390	1,400	.5	.59	.076	3,050	2	28N51E17ADAD01
239	[6]**11**	**11**	[1]**265**	**259**	**2,280**	--	--	--	**5,230**	**2**	M-24
783	**2,490**	**26**	[1]**272**	**269**	**8,100**	--	--	--	**14,300**	**3**	
849	**2,920**	**27**	[1]**187**	**285**	**9,430**	--	--	--	**17,000**	**3**	
22	220	--	[1]380	180	64	.4	--	--	757	1	28N51E17DADA01
120	530	8.7	342	150	1,100	.2	.37	.068	2,300	2	M-25
53	[6]**141**	**8**	[1,2,6]**637**	[6]**870**	[6]**23**	--	--	--	**2,010**	--	
122	**592**	**10**	[1]**379**	**254**	**1,240**	--	--	--	**2,550**	**2**	
113	**610**	**10**	[1,2]**365**	**236**	**1,233**	--	--	--	**2,835**	**2**	
145	**660**	**11**	**316**	**200**	**1,400**	**<.1**	--	--	**2,900**	**2**	
240	**848**	**13**	[1]**317**	**192**	**2,330**	--	--	--	**4,450**	**2**	
290	**974**	**14**	[1]**294**	**208**	**2,990**	--	--	--	**5,840**	**2**	
200	590	12	314	330	1,700	.2	.46	.048	3,390	2	28N51E21BDBC01 M-27
270	100	13	445	1,500	15	.6	.19	.007	2,470	1	28N51E22BBBB01
190	**75**	**9.6**	[1]**365**	**923**	**14**	**.5**	--	--	**1,630**	**1**	FPB92-12
260	**95**	**14**	[1]**389**	**1,410**	**11**	--	--	--	**2,330**	**1**	
970	26,000	--	--	2,300	50,000	--	--	--	83,400	4	28N51E22BDCA01 Buckles A-1

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
28N51E22CBCB01	Qt	81	36.79	07-21-93	USGS	USGS	98,600	6.6	18.0	1,200
FPB93-3			**35.27**	**08-28-97**	**USGS**	**USGS**	**96,700**	**6.7**	**22.5**	**1,100**
			36.65	[8]**06-24-98**	**USGS**	**USGS**	**94,500**	**6.6**	**24.5**	**1,100**
			36.65	[8]**06-24-98**	**USGS**	**USGS**	**94,500**	**6.6**	**24.5**	**1,100**
			34.09	[8]**04-21-99**	**USGS**	**USGS**	[1]**88,900**	**6.5**	**24.0**	**1,400**
			34.09	[8]**04-21-99**	**USGS**	**USGS**	[1]**88,900**	**6.5**	**24.0**	**1,400**
			--	**06-01-00**	**MSE**	**ELAB**	[1]**87,000**	[1]**7.1**	**24.8**	**1,080**
28N51E22CBCB02	Qt	49	36.49	07-20-93	USGS	USGS	97,200	6.5	19.0	1,300
FPB93-3A			**34.76**	**08-27-97**	**USGS**	**USGS**	**95,000**	**6.6**	**23.5**	**870**
			36.49	**06-24-98**	**USGS**	**USGS**	**92,500**	**6.7**	**25.5**	**920**
			34.06	**04-21-99**	**USGS**	**USGS**	**95,200**	**6.5**	**25.0**	**1,100**
28N51E22CDCC01	Qt	85	--	07-09-85	--	ELAB	[1]4,010	[1]7.1	--	300
M-28			--	07-20-89	USGS	USGS	13,000	6.8	11.0	920
			59.25	07-20-91	USGS	USGS	26,500	6.3	12.5	1,600
			--	**06-01-00**	**MSE**	**ELAB**	[1]**58,900**	[1]**7.1**	**11.4**	**1,530**
28N51E25ACBC01	Mk	[11]5,350-5,380	--	01-09-67	USGS	USGS	73,200	7.1	--	810
Tenneco 1	Mc	[11]5,640-5,680	--	01-09-67	USGS	USGS	160,000	6.8	--	1,000
28N51E27ABAA01	Qt	135	--	[5]10-11-89	--	ASCHM	[1]1,310	[1]8.2	--	44
M-30			--	[5]11-09-89	--	ASCHM	[1]1,550	[1]7.6	--	95
			--	12-15-89	IHS	ELAB	[1]1,760	[1]7.5	--	32
			120.27	[8]08-24-90	USGS	USGS	1,120	7.2	17.5	71
			120.27	[8]08-24-90	USGS	USGS	1,120	7.2	17.5	72
			--	09-16-91	USGS	USGS	--	--	--	--
			--	04-15-92	USGS	USGS	1,550	7.2	7.0	89
			--	**09-03-97**	**USGS**	**USGS**	**2,490**	**7.3**	**15.5**	**120**
			--	**06-25-98**	**USGS**	**USGS**	**2,370**	**7.5**	**12.0**	**110**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**121**
			--	**11-22-99**	**FPOEP**	**ELAB**	--	--	--	**115**
			--	[14]**01-03-00**	**FPOEP**	**USEPA**	[1]**2,440**	[1]**6.44**	--	**124**
			--	[14]**01-03-00**	**FPOEP**	**USEPA**	[1]**2,710**	[1]**5.97**	--	**126**
			--	**06-01-00**	**MSE**	**ELAB**	[1]**2,380**	[1]**8.0**	**9.8**	**126**
			--	**09-29-00**	**FPOEP**	**ELAB**	--	--	--	**126**
28N51E27ACDB01	Mh	[11]4,960-4,970	--	01-24-56	USGS	USGS	--	6.6	--	1,400
Murphy 63										
28N51E27BBBB01	Qt	68	--	05-23-85	--	ELAB	[1]3,470	[1]7.6	--	250
M-31			--	11-21-88	--	CHNO	[1]15,400	[1]6.7	--	1,230
			--	03-10-89	--	ASCHM	--	--	--	1,500
			32.50	07-24-89	USGS	USGS	25,000	6.8	10.5	1,800
			42.43	08-27-90	USGS	USGS	48,000	6.5	11.5	2,800
			42.42	01-31-91	USGS	USGS	[1]52,700	5.8	7.0	2,900
			42.30	05-08-91	USGS	USGS	51,400	[1]6.7	11.5	2,900
			41.53	[8]07-22-91	USGS	USGS	63,000	6.3	10.0	2,900
			41.53	[8]07-22-91	USGS	USGS	63,000	6.3	10.0	3,000
			42.20	04-15-92	USGS	USGS	50,000	6.5	11.0	2,800
			41.52	07-23-93	USGS	USGS	81,500	6.6	10.5	2,800
			41.84	**08-28-97**	**USGS**	**USGS**	**89,800**	**6.8**	**11.0**	**2,000**
			--	**06-25-98**	**USGS**	**USGS**	**88,500**	**6.8**	**11.0**	**1,800**
			--	**06-01-00**	**MSE**	**ELAB**	[1]**80,500**	[1]**7.1**	**11.0**	**1,760**

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
320	20,000	290	539	1,500	35,000	--	6.0	.440	58,700	3	28N51E22CBCB01
260	**24,000**	**400**	[1,7]**444**	**1,600**	**37,000**	--	--	--	**64,400**	**3**	FPB93-3
250	**24,000**	**430**	[1,7]**438**	**1,500**	**40,000**	**<.1**	--	--	**67,900**	**3**	
250	**24,000**	**400**	[1,7]**438**	**1,500**	**40,000**	**<.1**	--	--	**67,100**	**3**	
320	**30,000**	**400**	[1,7]**427**	**1,600**	**41,000**	**.2**	**13**	**.750**	**74,800**	**3**	
320	**30,000**	**440**	[1,7]**431**	**1,500**	**41,000**	**.2**	**12**	**.787**	**74,600**	**3**	
257	**23,400**	**403**	[1,7]**396**	**1,730**	**39,800**	--	--	--	**67,000**	**3**	
290	22,000	280	571	1,200	38,000	--	5.9	.440	63,500	3	28N51E22CBCB02
230	**23,000**	**400**	[1]**528**	**950**	**40,000**	--	--	--	**65,700**	**3**	FPB93-3A
230	**24,000**	**430**	[1]**522**	**880**	**39,000**	**<.1**	--	--	**65,300**	**3**	
290	**29,000**	**510**	[1]**502**	**830**	**40,000**	**.4**	**12**	**.790**	**74,800**	**3**	
270	410	5	[1]952	1,700	66	--	--	--	3,370	1	28N51E22CDCC01
790	870	15	713	1,400	4,100	.2	3.5	.560	8,640	2	M-28
1,400	2,200	20	708	1,600	7,900	.5	4.8	.510	15,200	3	
749	**14,200**	**62**	[1]**600**	**1,910**	**25,800**	--	--	--	**44,700**	**3**	
85	22,000	650	[13]360	1,800	35,000	--	--	--	60,800	4	28N51E25ACBC01
150	63,000	500	[13]310	1,500	98,000	--	--	--	164,000	4	Tenneco 1
41	220	8	[1]395	150	[1]60	--	--	--	856	--	28N51E27ABAA01
80	335	8	[1]886	380	24	--	--	--	1,445	1	M-30
54	320	11	[1]788	230	11	.5	--	--	1,110	1	
54	100	4.9	530	81	11	.4	.04	.006	671	1	
55	110	4.6	530	80	11	.5	.04	.007	684	1	
--	200	--	--	--	27	--	--	--	--	1	
74	200	6.1	[1]750	220	22	.4	.10	.016	1,100	1	
100	**310**	**6.9**	[1]**951**	**440**	[7]**23**	--	--	--	**1,600**	**1**	
110	**300**	**6.3**	[1]**962**	**420**	[7]**30**	**.4**	--	--	**1,590**	**1**	
113	**308**	**7**	[1]**1,020**	**455**	**31**	--	--	--	**1,630**	**1**	
106	**289**	**6**	[1]**946**	**502**	**29**	--	--	--	**1,620**	**1**	
113	**321**	**6.81**	[1,6]**661**	**503**	[6]**266**	--	--	--	**1,964**	--	
115	**323**	**7.03**	[1,6]**310**	**480**	[6]**552**	--	--	--	**1,828**	--	
118	**329**	**7**	[1]**1,040**	**539**	**38**	--	--	--	**1,760**	**1**	
118	**325**	**7**	[1]**1,020**	**501**	**36**	--	--	--	**1,740**	**1**	
230	[12]22,000	--	[11]390	1,400	36,000	--	--	--	61,400	4	28N51E27ACDB01 Murphy 63
240	370	6	[1]753	1,500	85	--	--	--	2,930	1	28N51E27BBBB01
1,100	970	20	[1]499	1,300	5,200	.3	--	--	10,100	3	M-31
1,300	1,200	19	[1]526	950	6,700	--	--	--	12,300	3	
1,600	1,700	28	510	1,200	9,700	<.1	5.8	.066	16,400	3	
2,200	5,400	41	404	1,000	21,000	<.1	8.7	.150	32,800	3	
2,100	6,900	44	[1]449	1,200	22,000	5.1	9.6	<.110	35,500	3	
2,200	8,200	50	[1]446	1,400	25,000	8.2	9.2	.092	40,100	3	
2,000	9,000	52	466	1,200	23,000	1.9	8.1	.072	38,500	3	
2,100	9,200	49	466	1,300	25,000	1.9	9.0	.074	41,000	3	
1,800	11,000	61	[1]416	1,800	29,000	3.2	9.6	.087	46,800	3	
1,300	14,000	57	511	1,300	32,000	--	7.4	.110	51,900	3	
840	**19,000**	**100**	[1]**505**	**1,600**	**36,000**	--	--	--	**60,200**	**3**	
850	**20,000**	**110**	[1]**494**	**1,600**	**35,000**	**<.1**	--	--	**59,400**	**3**	
783	**20,200**	**122**	**461**	**1,690**	**36,000**	--	--	--	**60,800**	**3**	

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
28N51E29AACC01	**Qal**	**72**	--	**11-04-94**	**IHS**	**ASCHM**	[1]**1,846**	[1]**7.7**	--	**95**
M-60			--	[5]**02-09-95**	**IHS**	**ASCHM**	--	[1]**8.1**	--	**56**
			22.19	**08-27-97**	**USGS**	**USGS**	[1]**2,690**	[1]**7.6**	--	**100**
			--	**04-20-99**	**USGS**	**USGS**	[1]**3,170**	**7.6**	**10.0**	**120**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**124**
			--	**01-03-00**	**FPOEP**	**USEPA**	[1]**3,030**	[1]**7.02**	--	**124**
			--	**05-31-00**	**MSE**	**ELAB**	[1]**3,220**	[1]**8.2**	**10.1**	**133**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**141**
28N51E29BACA01	Qal	50	--	08-17-93	USGS	USGS	2,090	7.5	10.5	88
M-32			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**118**
28N51E29CACB01	Qal	32	27.89	08-23-90	USGS	USGS	690	7.8	11.5	46
M-33										
28N51E29CACB02	**Qal**	**42**	--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**61**
M-61			--	**01-03-00**	**FPOEP**	**USEPA**	[1]**872**	[1]**5.99**	--	**55.1**
			--	**09-21-00**	**FPOEP**	**ELAB**	--	--	--	**55**
28N51E32CCCB01	Qt	120	--	**11-10-99**	**FPOEP**	**ELAB**	--	--	--	**36**
M-34			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**36**
28N51E33BBBB01	Qt	120	--	03-17-89	--	CHNO	[1]2,630	[1]7.4	--	120
M-36			90.05	08-24-90	USGS	USGS	2,670	7.1	11.0	140
			88.79	**09-03-97**	**USGS**	**USGS**	**3,330**	**7.3**	**9.5**	**170**
			--	**04-20-99**	**USGS**	**USGS**	[1]**3,320**	**7.2**	**10.0**	**200**
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**184**
			--	**09-29-00**	**FPOEP**	**ELAB**	--	--	--	**196**
28N51E33BBBC02	Qt	120	--	03-16-89	IHS	CHNO	[1]2,480	[1]7.4	--	100
M-38			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**204**
			--	**09-29-00**	**FPOEP**	**ELAB**	--	--	--	**207**
28N51E33DDCC03	Qw	65	41.55	08-17-93	USGS	USGS	3,820	7.4	10.0	180
FBP93-4A										
28N52E18ACCA01	Mmc	[11]6,020-6,080	--	05-17-52	USGS	USGS	60,000	7.4	--	890
Murphy 2										
28N52E20BBBB01	Qw	100	72.60	10-06-85	MBMG	MBMG	1,780	[1]7.3	10.0	74
M-42										
28N52E20CCCC01	Qw	128	95.06	08-21-90	USGS	USGS	2,240	7.8	13.0	25
M-43										
28N52E30DDDD01	Qw	170	140.65	10-05-85	MBMG	MBMG	2,950	8.0	10.0	25
M-44										
29N51E07BCDB01	Mc[3]	5,933	--	07-06-79	--	NALCO	--	[1]7.0	--	4,400
Grace (Buck Elk) 2										
29N51E07BDBD01	Mm[3]	1,207	--	02-03-82	--	NALCO	--	[1]6.4	--	4,800
Polumbus (Buck Elk) 1-W										

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
II	**300**	**7**	**410**	**300**	**220**	--	--	--	**1,170**	**1**	**28N51E29AACC0I**
37	**291**	**5**	[1]**363**	**243**	**250**	--	--	--	**1,200**	**1**	**M-60**
65	**380**	**6.7**	[1,7]**364**	[7]**260**	**520**	**.2**	--	--	**1,570**	**2**	
80	**430**	**8.9**	[1]**339**	**250**	**660**	**.3**	**.28**	**.035**	**1,780**	**2**	
82	**429**	**8**	[1]**376**	**256**	**728**	--	--	--	**1,920**	**2**	
81.5	**445**	**7.62**	[1]**363**	**241**	**764**	--	--	--	**1,970**	**2**	
88	**432**	**8**	[1]**352**	**279**	**794**	--	--	--	**1,970**	**2**	
93	**445**	**7**	[1]**357**	**270**	**855**	--	--	--	**2,120**	**2**	
57	290	5.4	339	180	330	.4	.13	.016	1,170	2	28N51E29BACA01
78	**387**	**8**	[1]**349**	**162**	**736**	--	--	--	**1,730**	**2**	M-32
36	47	5.2	254	47	7.3	.4	.040	.002	427	1	28N51E29CACB01 M-33
50	**37**	**5**	[1]**339**	**31**	**4**	--	--	--	**435**	**1**	**28N51E29CACB02**
45.8	**45.5**	**5.06**	[1,6]**153**	**35.3**	[6]**141**	--	--	--	**467**	--	**M-61**
47	**38**	**5**	[1]**309**	**31**	**28**	--	--	--	**433**	**1**	
21	**221**	**4**	[1]**453**	**170**	**37**	--	--	--	**761**	**1**	28N51E32CCCB01
21	**210**	**3**	[1]**451**	**168**	**51**	--	--	--	**785**	**1**	M-34
87	380	8	[1]604	810	47	.3	--	--	1,810	1	28N51E33BBBB01
100	400	6.4	660	1,000	40	.3	1.6	.190	2,120	1	M-36
120	**430**	**6.9**	[1]**642**	**1,100**	**76**	**<.1**	--	--	**2,370**	**1**	
140	**470**	**14**	[1]**612**	**1,200**	**88**	**.3**	**.40**	**.058**	**2,500**	**1**	
134	**434**	**8**	[1]**692**	**1,210**	**98**	--	--	--	**2,520**	**1**	
144	**461**	**8**	[1]**628**	**1,270**	**159**	--	--	--	**2,640**	**1**	
75	380	8	[1]558	770	34	.2	--	--	1,700	1	28N51E33BBBC02
129	**434**	**8**	[1]**674**	**1,170**	**120**	--	--	--	**2,590**	**1**	M-38
131	**437**	**7**	[1]**647**	**1,270**	**151**	--	--	--	**2,660**	**1**	
130	610	6.4	775	1,200	62	.5	.18	.058	2,680	1	28N51E33DDCC03 FBP93-4A
130	[12]18,000	--	[13]215	2,400	28,000	--	--	--	50,000	4	28N52E18ACCA01 Murphy 2
50	330	7	[1]738	360	15	.2	--	--	1,330	1	28N52E20BBBB01 M-42
20	520	4.3	810	460	20	.5	.060	.029	1,560	1	28N52E20CCCC01 M-43
15	800	4	[1]1,205	580	34	.7	--	--	2,200	1	28N52E30DDDD01 M-44
1,500	28,000	--	[1]152	810	54,000	--	--	--	88,500	4	29N51E07BCDB01 Grace (Buck Elk) 2
1,400	22,000	--	[1]360	700	46,000	--	--	--	75,700	4	29N51E07BDBD01 Polumbus (Buck Elk) 1-W

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
29N51E08CCCA01 Murphy 58	Mc	5,970	--	01-24-56	--	--	62,200	6.5	--	1,200
29N51E09ABBA04 FPB93-1	Qal	36	7.42	08-16-93	USGS	USGS	1,260	7.7	9.0	33
29N51E10CDAB01 M-49	Qt	60	--	05-14-85	IHS	ELAB	[1]1,940	[1]7.6	--	93
29N51E10CDBA01 M-50	Qt	90	--	07-21-82	USGS	USGS	1,360	7.4	9.0	87
29N51E15CACA01 M-52	Qal	62	--	07-19-91	USGS	USGS	1,710	7.3	11.5	85
			--	**11-02-99**	**FPOEP**	**ELAB**	--	--	--	**113**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**104**
29N51E16BDAA01 W-1	Qal	53	--	07-20-91	USGS	USGS	1,550	8.1	10.5	6.1
29N51E16CBCC01 W-2	Qal	25	--	07-23-79	MDHES	MDHES	[1]1,610	[1]8.0	--	47
			--	07-26-82	USGS	USGS	900	7.9	9.0	30
29N51E16CCAA01 W-3	Qal	23	--	07-20-82	USGS	USGS	1,140	7.7	9.5	27
			10.51	[8]07-18-91	USGS	USGS	1,220	7.6	11.5	27
			10.51	[8]07-18-91	USGS	USGS	1,220	7.6	11.5	27
			--	**11-09-99**	**FPOEP**	**ELAB**	--	--	--	**34**
			--	**09-20-00**	**FPOEP**	**ELAB**	--	--	--	**35**
29N51E16DACA01 M-54	Qal	25	--	[5]03-08-90	--	ASCHM	[1]1,220	[1]7.7	--	80
			6.25	08-23-90	USGS	USGS	1,520	7.5	16.5	72
			--	**11-10-99**	**FPOEP**	**ELAB**	--	--	--	**134**
			--	**01-04-00**	**FPOEP**	**USEPA**	**[1]2,210**	**[1]5.92**	--	**121**
			--	**09-28-00**	**FPOEP**	**ELAB**	--	--	--	**93**
29N51E17CCCC01 W-4	Qal or Kb	87	--	07-23-79	MDHES	MDHES	[1]1,070	[1]7.5	--	40
			--	07-27-82	USGS	USGS	[1]11,500	7.4	9.5	700
			56.90	07-22-89	USGS	USGS	9,500	7.4	10.5	600
29N51E19DCAC01 M-55	Kjr	740	--	07-22-82	USGS	USGS	17,000	7.6	--	91
29N51E19DDBA01 Murphy 5-D	Mm[4]	3,583	--	07-22-82	USGS	USGS	130,000	6.4	--	1,500
			--	12-11-89	--	NALCO	--	[1]5.8	--	2,000
29N51E20ABBA02 W-6	Qal	44	--	07-23-79	MDHES	MDHES	[1]7,300	[1]7.4	--	340
			--	07-26-82	USGS	USGS	[1]7,430	7.5	--	290
29N51E20BCDB01 Murphy 84	Mm	5,773	--	[5]03-01-76	--	YSB	[1]62,500	[1]7.9	--	800
29N51E20CCDB01 Murphy 21	Mm	5,750	--	[5]03-01-76	--	YSB	[1]62,500	[1]7.7	--	840

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
300	[12]20,000	--	119	120	33,000	--	--	--	54,300	4	29N51E08CCCA01 Murphy 58
18	230	3.3	443	210	8.7	.4	.050	.007	787	1	29N51E09ABBA04 FPB93-1
36	338	3	--	590	11	--	--	--	1,070	1	29N51E10CDAB01 M-49
30	180	3.6	[1]338	280	9.4	.3	--	--	809	1	29N51E10CDBA01 M-50
52	210	3.7	288	610	8.8	.4	.070	.014	1,160	1	29N51E15CACA01
68	**295**	**4**	[1]**308**	**914**	[6]**2,550**	--	--	--	**1,610**	--	M-52
61	**287**	**4**	[1]**300**	**886**	**11**	--	--	--	**1,580**	**1**	
2.8	330	1.9	581	97	110	.7	.48	.470	906	1	29N51E16BDAA01 W-1
35	230	--	[1]319	120	230	--	--	--	850	1	29N51E16CBCC01
18	130	3.8	[1]250	94	34	.5	--	--	488	1	W-2
22	220	4.1	[1]473	160	18	.4	--	--	752	1	29N51E16CCAA01
22	210	4.3	461	200	13	.4	.070	.005	772	1	W-3
22	200	4.1	461	190	13	.4	.090	.005	750	1	
29	**240**	**5**	[1]**504**	**200**	**13**	--	--	--	**820**	**1**	
28	**226**	**4**	[1]**523**	**203**	**13**	--	--	--	**849**	**1**	
36	215	4.0	[1]381	440	16	--	--	--	1,250	1	29N51E16DACA01
37	220	4.0	384	430	13	.3	.090	.008	1,020	1	M-54
81	**349**	**4**	[1]**487**	**929**	**18**	--	--	--	**1,840**	**1**	
72.1	**274**	**3.3**	[1,6]**157**	**851**	[6]**223**	--	--	--	**1,646**	--	
52	**311**	**5**	[1,2]**494**	**613**	**15**	--	--	--	**1,370**	**1**	
17	130	--	--	64	240	--	--	--	530	1	29N51E17CCCC01
320	1,400	12	[1]234	1,300	3,300	.1	--	--	7,210	2	W-4
270	1,300	12	348	1,400	3,000	.1	3.3	.048	7,750	2	
18	3,900	10	[1]198	<5.0	6,500	.6	--	--	10,600	3	29N51E19DCAC01 M-55
200	33,000	550	[1]76	1,500	61,000	4.4	--	--	97,900	4	229N51E19DDBA01
390	42,000	--	[1]440	740	68,000	--	--	--	113,000	4	Murphy 5-D
240	790	--	[1]254	230	2,200	--	--	--	3,950	2	29N51E20ABBA02
220	890	11	[1]213	260	2,300	.2	--	--	4,120	2	W-6
160	17,000	--	--	1,600	27,000	--	--	--	47,700	4	29N51E20BCDB01 Murphy 84
170	19,000	--	--	1,500	30,000	--	--	--	52,300	4	29N51E20CCDB01 Murphy 21

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
29N51E20DABB01	Qal	56	15.76	08-15-93	USGS	USGS	14,200	7.5	--	500
FPB92-13			**16.40**	**06-25-98**	**USGS**	**USGS**	**13,000**	**7.5**	**10.0**	**350**
29N51E21ABCC01	Qal	12	--	07-23-79	MDHES	MDHES	[1]1,240	[1]8.0	--	38
W-8			--	07-20-82	USGS	USGS	1,200	7.6	9.5	36
			11.32	07-18-91	USGS	USGS	1,520	7.4	10.5	47
29N51E21ABDA01	Qal	33	11.42	08-15-93	USGS	USGS	1,500	7.5	10.5	28
FPB92-14										
29N51E21BBAA01	Qal	17	--	07-23-79	MDHES	MDHES	[1]3,070	7.8	--	39
W-9			--	07-26-82	USGS	USGS	3,100	7.5	--	39
			11.85	07-22-89	USGS	USGS	4,600	7.7	8.5	55
29N51E29CBBB01	Qal	45	--	11-03-82	USGS	USGS	10,000	6.9	10.0	750
W-10										
29N51E30DDDD01	Mm[4]	3,431	--	07-23-79	USGS	MDHES	[1]100,000	--	--	1,500
Murphy 1-D			--	07-22-82	USGS	USGS	170,000	6.6	--	2,000
			--	11-29-89	--	PETRO	--	[1]6.7	--	3,300
			--	[8]**09-29-00**	**FPOEP**	**ELAB**	--	--	--	**1,330**
			--	[8]**09-29-00**	**FPOEP**	**ELAB**	--	--	--	**1,340**
29N51E31AABB01	Qal	54	--	11-03-82	USGS	USGS	17,000	7.1	10.0	670
W-11			20.79	07-23-89	USGS	USGS	13,500	8.1	10.0	790
29N51E31ABDD01	Qal	43	14.46	08-10-93	USGS	USGS	15,100	7.0	13.5	700
FPB92-6										
29N51E31BDBA01	Qal	40	--	08-10-93	USGS	USGS	8,900	6.9	16.5	520
FPB92-10			**17.20**	**06-25-98**	**USGS**	**USGS**	**4,420**	**7.4**	**12.0**	**240**
29N51E31CABB01	Qal	33	7.10	08-11-93	USGS	USGS	24,500	6.9	13.0	910
FPB92-9										
29N51E31DBAD01	Qal	37	9.22	08-11-93	USGS	USGS	[1]26,300	7.1	11.0	320
FPB92-7										
29N51E31DBDD01	Qal	33	--	08-12-93	USGS	USGS	31,500	7.2	9.5	450
FPB92-8			**7.79**	**08-28-97**	**USGS**	**USGS**	**20,500**	**7.6**	**11.5**	**290**
29N51E32ABAC01	Qal	41	22.89	08-13-93	USGS	USGS	25,600	7.0	10.5	620
FPB92-4										
29N51E32ACCA01	Qal	30	22.85	08-14-93	USGS	USGS	18,600	7.5	24.0	160
FPB92-5										
29N51E32BAAD01	Qal	39	--	08-14-93	USGS	USGS	35,400	7.3	12.0	380
FPB92-3			**8.15**	**08-26-97**	**USGS**	**USGS**	**5,800**	**8.4**	**9.5**	[7]**19**
29N51E32BABB01	Qal	46	5.14	07-26-93	USGS	USGS	102,000	6.9	17.0	1,100
FPB92-2A										

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
280	1,900	15	[1]381	170	4,100	<.1	--	--	7,060	2	29N51E20DABB01
410	**2,000**	**35**	[1,7]**332**	[7]**170**	**4,600**	**.4**	**3.6**	**.300**	**7,960**	**2**	FPB92-13
24	220	--	[1]454	150	34	--	--	--	734	1	29N51E21ABCC01
22	220	4.1	[1]474	160	30	.4	--	--	773	1	W-8
29	240	5.0	554	250	32	.4	.12	.003	952	1	
24	290	5.1	568	190	15	.5	.030	.013	916	1	29N51E21ABDA01 FPB92-14
32	530	--	[1]312	180	630	--	--	--	1,600	2	29N51E21BBAA01
30	510	6.1	[1]323	190	620	.4	--	--	1,610	2	W-9
40	820	9.3	442	170	1,100	.3	1.2	.110	2,630	2	
400	870	12	[1]246	630	3,400	.1	--	--	6,250	2	29N51E29CBBB01 W-10
140	70,000	--	[1]140	1,700	110,000	--	--	--	--	4	2951E30DDDD01
250	56,000	910	[1]153	1,200	100,000	4.6	--	--	161,000	4	Murphy 1-D
110	37,000	--	[1]150	1,400	62,000	--	--	--	103,000	4	
175	**46,600**	**671**	[1]**243**	**1,460**	**81,100**	--	--	--	**120,000**	**4**	
172	**45,900**	**705**	[1]**223**	**1,560**	**82,200**	--	--	--	**120,000**	**4**	
210	4,100	20	[1]395	1,000	7,500	.2	--	--	13,800	3	29N51E31AABB01
350	1,800	15	334	740	4,800	.1	3.7	.150	8,860	2	W-11
300	1,900	18	308	640	4,600	.5	1.6	.180	8,400	2	29N51E31ABDD01 FPB92-6
220	950	12	263	980	2,100	.3	1.0	.024	4,960	2	29N51E31BDBA01
94	**590**	**8.1**	[1,7]**310**	**800**	**860**	**.2**	--	--	**2,800**	**2**	FPB92-10
290	3,900	19	330	650	7,700	.6	0.66	.450	13,700	3	29N51E31CABB01 FPB92-9
110	5,900	34	388	560	9,100	.7	1.3	.430	16,300	3	29N51E31DBAD01 FPB92-7
200	6,300	29	396	490	10,000	.7	0.74	.380	18,000	3	29N51E31DBDD01
120	**4,000**	**23**	[1]**398**	**420**	**6,600**	**.1**	--	--	**11,700**	**3**	FPB92-8
420	3,900	42	[1]212	320	8,500	.5	--	--	13,900	3	29N51E32ABAC01 FPB92-4
61	3,800	32	428	290	5,800	1.6	1.1	.130	10,400	3	29N51E32ACCA01 FPB92-5
260	7,100	57	453	710	12,000	.8	1.4	.270	20,800	3	29N51E32BAAD01
[7]**13**	**1,200**	**12**	[1]**616**	**350**	**1,300**	**.6**	--	--	**3,250**	**2**	FPB92-3
2,900	5,200	340	279	1,300	35,000	--	8.7	.690	46,100	3	29N51E32BABB01 FPB92-2A

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Geologic unit	Depth of well (feet)	Depth to water (feet)	Sample and water-level date	Collecting agency	Analyzing laboratory	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Water temperature, onsite (°C)	Calcium (mg/L as Ca)
29N51E32BBAA01 W-12	Qal	42	8.12	11-02-82	USGS	USGS	70,000	6.8	12.0	1,300
29N51E32BBBA02 W-14	Qal	47	9.69	11-02-82	USGS	USGS	58,000	6.7	10.5	1,400
29N51E32BBBA03 FPB92-1	Qal	53	10.78 **10.56**	07-25-93 **04-21-99**	USGS **USGS**	USGS **USGS**	127,000 **111,000**	6.7 **6.9**	11.0 **9.5**	3,300 **3,300**
29N51E32BBBA04 FPB93-2	Qal	27	8.59 8.59	[5]07-25-93 [5]07-25-93	USGS USGS	USGS USGS	12,300 12,300	7.5 7.5	12.0 12.0	170 160
29N51E32BBBB01 W-15	Qal	49	-- 9.60 **11.20** **8.86**	11-03-82 07-23-89 **08-26-97** **04-21-99**	USGS USGS **USGS** **USGS**	USGS USGS **USGS** **USGS**	120,000 65,000 **15,300** **20,200**	6.6 6.7 **7.5** **7.1**	25.0 16.0 **14.0** **12.5**	2,500 1,500 **430** **460**
29N51E32BCCA01 W-16	Qal	40	8.81	11-02-82	USGS	USGS	70,000	6.8	10.0	4,100
29N51E32BCCA02 FPB92-11	Qal	45	--	08-11-93	USGS	USGS	41,700	7.3	12.0	1,000
29N51E36CCCC01 M-57	Qgo	30	6.85	10-05-85	MBMG	MBMG	658	[1]7.5	10.0	40

[1]Laboratory measurement.
[2]Determined by multiplying bicarbonate value by conversion factor 0.8202.
[3]Brine-injection well completed in Upper Cretaceous Judith River Formation. Original source of water is shown.
[4]Brine-injection well completed in Lower Cretaceous Fall River ("Dakota") Sandstone. Original source of water is shown.
[5]Date analyzed.
[6]Value questionable compared to other samples at this site. No rerun value available. Value not used in interpretations.
[7]For samples collected by the USGS, concentration of constituent in rinsate sample (table 7) greater than value of constituent for this sample.
[8]Replicate samples.
[9]Reported as Murphy 5 in Thamke and Craigg (1997).
[10]Brine-injection well completed in Mission Canyon Limestone of Madison Group. Original source of water is shown.
[11]Depth of perforated interval; well depth unavailable.
[12]Value represents the concentrations of sodium plus potassium.
[13]Determined by onsite fixed-endpoint titration.
[14]Samples collected on same date, but from different residences that share well.

Table 3. Physical and chemical characteristics of water samples collected from privately owned wells, monitoring wells, oil wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, onsite (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Water type	Site number and well name (fig. 3)
350	25,000	250	[1]245	840	42,000	<.1	--	--	69,900	3	29N51E32BBAA01 W-12
300	19,000	89	[1]301	800	34,000	<.1	--	--	55,800	3	29N51E32BBBA02 W-14
750	28,000	1.6	217	720	58,000	--	4.5	1.5	91,100	3	29N51E32BBBA03
910	**29,000**	**75**	[1,7]**108**	**640**	**46,000**	**.2**	**13**	**3.0**	**80,800**	**3**	FPB92-1
58	2,200	15	449	510	3,200	.7	1.7	.210	6,450	2	29N51E32BBBA04
54	2,200	13	449	500	3,100	.5	1.8	.210	6,310	2	FPB93-2
380	43,000	150	[1]172	1,100	67,000	<.1	--	--	114,000	4	29N51E32BBBB01
290	17,000	83	323	770	30,000	.1	9.2	1.1	50,000	3	W-15
163	**3,000**	**20**	[1,7]**245**	**450**	**5,400**	**.2**	--	--	**9,640**	**3**	
180	**2,800**	**34**	[1,7]**311**	**320**	**4,700**	**.2**	**2.2**	**.22**	**9,250**	**2**	
1,300	23,000	97	[1]126	440	46,000	<.1	--	--	75,100	3	29N51E32BCCA01 W-16
400	8,000	37	407	530	14,000	.8	1.4	.270	24,300	3	29N51E32BCCA02 FPB92-11
40	60	4.5	[1]296	85	1.5	.6	--	--	435	1	29N51E36CCCC01 M-57

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana

Bold type--indicates data collected since September 1993 and not reported in Thamke and others (1996).
Site number and well name--described in text.
Collecting agency and analyzing laboratory:

ASCHM, Astro-Chem Service Laboratory;
CHNO, Chen-Northern, Inc.;
ELAB, Energy Laboratories, Inc.;
MBMG, Montana Bureau of Mines and Geology;
USGS, U.S. Geological Survey;
YSB, Yapuncich, Sanderson, and Brown Laboratories, currently (2003) Energy Laboratories, Inc.

Constituents are dissolved, except as indicated.
Abbreviations: mg/L, micrograms per liter; mg/L, milligrams per liter; per mil, parts per thousand. D/H, deuterium/hydrogen; O-18/O-16, oxygen-18/oxygen-16. Symbols: <, less than minimum reporting level; --, no data; (?), uncertain.

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
28N51E01BBBB01	USGS	USGS	07-21-82	--	--	40	--	430	--	--	--	--
M-1	USGS	USGS	07-20-91	<100	760	20	270	520	3,400	2.9	-143.0	-18.65
28N51E04CCCD01 M-2	USGS	USGS	08-25-90	<100	870	390	120	670	910	3.8	--	--
28N51E08ADDA01	USGS	USGS	08-23-90	<100	800	2,800	110	160	550	3.5	-125.0	-15.05
M-3	**USGS**	**USGS**	**09-03-97**	--	**740**	**5,000**	--	--	--	--	--	--
28N51E08CCBB01 M-10	--	CHNO	11-08-88	--	--	2,400	--	790	--	--	--	--
28N51E08DDDB01 M-13	USGS	USGS	08-25-90	200	810	18,000	250	930	4,500	3.9	--	--
28N51E09BCBB01 M-14	USGS	USGS	07-17-91	<100	790	2,200	130	190	850	2.2	--	--
28N51E09CCDD01	--	CHNO	04-07-89	--	--	7,500	--	490	--	--	--	--
M-15	--	CHNO	08-16-89	--	--	6,500	--	360	--	--	--	--
	USGS	USGS	07-19-91	<100	640	6,100	150	260	1,500	2.4	-127.0	-15.70
28N51E09CDBB01	USGS	USGS	[1]08-12-93	300	640	3,500	300	1,100	9,300	--	--	--
FPB93-5	USGS	USGS	[1]08-12-93	300	680	--	290	970	9,100	--	--	--
29N51E09DCCC01 FPB92-18	USGS	USGS	08-13-93	--	240	16	--	--	--	--	--	--
28N51E10DBAD01	USGS	USGS	07-24-89	590	20,000	690	5,200	240	54,000	7.0	-138.5	-16.25
Murphy 8-D	USGS	USGS	08-29-90	1,000	22,000	1,300	100	270	47,000	8.5	-133.0	-16.20

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
28N51E13CCCA01 M-16	USGS	USGS	08-22-90	300	630	30	230	130	1,800	--	--	--
28N51E13CCCC01 M-17	USGS	USGS	08-22-90	<100	810	7,800	150	60	2,100	6.3	--	--
28N51E16DBCB01 M-18	USGS	USGS	07-23-89	140	680	24,000	320	3,300	5,500	1.4	-139.5	-17.40
	USGS	USGS	07-21-91	<100	680	28,000	300	3,600	7,400	4.6	-137.0	-17.50
28N51E17ABDC01 M-20	USGS	USGS	08-26-90	300	800	18,000	230	1,300	3,800	--	-132.0	-16.45
28N51E17ABDD01 M-22	USGS	USGS	[1]08-26-90	<100	800	24,000	260	1,300	5,100	--	-131.0	-16.50
	USGS	USGS	[1]08-26-90	<100	800	25,000	260	1,300	4,900	4.2	--	--
28N51E17ADAD01 M-24	USGS	USGS	07-16-91	<100	630	9,500	210	290	2,600	1.2	--	--
28N51E17DADA01 M-25	--	YSB	02-10-75	--	--	2,500	--	--	--	--	--	--
	USGS	USGS	08-25-90	100	670	7,500	160	360	1,900	3.9	-128.0	-15.65
	USGS	**USGS**	**09-03-97**	--	**620**	**9,300**	--	--	--	--	--	--
28N51E21BDBC01 M-27	USGS	USGS	08-26-90	100	720	14,000	220	2,100	3,100	--	-138.0	-17.65
28N51E22BBBB01 FPB92-12	USGS	USGS	07-24-93	<100	220	<10	230	20	2,000	--	--	--
	USGS	**USGS**	**06-24-98**	--	**210**	**<30**	--	--	--	--	--	--

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
28N51E22CBCB01	USGS	USGS	07-21-93	200	15,000	50	3,500	310	48,000	--	--	--
FPB93-3	**USGS**	**USGS**	**08-28-97**	--	**13,000**	**<300**	--	--	--	--	--	--
	USGS	**USGS**	**[1]06-24-98**	--	**13,000**	**<750**	--	--	--	--	--	--
	USGS	**USGS**	**[1]06-24-98**	--	**13,000**	**<750**	--	--	--	--	--	--
	USGS	**USGS**	**[1]04-21-99**	--	**16,000**	**1,000**	**5,200**	--	--	--	--	--
	USGS	**USGS**	**[1]04-21-99**	--	**16,000**	**1,000**	**5,100**	--	--	--	--	--
28N51E22CBCB02	USGS	USGS	07-20-93	200	14,000	50	3,300	310	44,000	--	--	--
FPB93-3A	**USGS**	**USGS**	**08-27-97**	--	**12,000**	**<300**	--	--	--	--	--	--
	USGS	**USGS**	**06-24-98**	--	**13,000**	**<750**	--	--	--	--	--	--
	USGS	**USGS**	**04-21-99**	--	**15,000**	**<500**	**5,200**	--	--	--	--	--
28N51E22CDCC01	--	ELAB	07-09-85	--	--	460	--	--	--	--	--	--
M-28	USGS	USGS	07-20-89	52	660	430	560	6,600	13,000	5.5	-141.5	-18.35
	USGS	USGS	07-20-91	<100	710	5,900	530	5,000	28,000	18	--	--
28N51E27ABAA01	--	ASCHM	[2]10-11-89	--	--	100	--	--	--	--	--	--
M-30	--	ASCHM	[2]11-09-89	--	--	200	--	--	--	--	--	--
	--	ELAB	12-15-89	--	--	70	--	160	--	--	--	--
	USGS	USGS	[1]08-24-90	41	570	17	52	97	1,000	7.6	-151.0	-19.75
	USGS	USGS	[1]08-24-90	42	560	22	53	97	1,000	7.6	-153.0	-19.80
	USGS	USGS	04-15-92	43	610	17	92	67	1,400	--	--	--
	USGS	**USGS**	**09-03-97**	--	**630**	**4,400**	--	--	--	--	--	--
	USGS	**USGS**	**06-25-98**	--	**610**	**4,200**	--	--	--	--	--	--

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
28N51E27BBBB01	--	ELAB	05-23-85	--	--	<30	--	--	--	--	--	--
M-31	--	CHNO	11-21-88	--	--	700	--	1,100	--	--	--	--
	--	ASCHM	03-10-89	--	--	100	--	--	--	--	--	--
	USGS	USGS	07-24-89	78	670	1,100	880	940	29,000	6.5	-135.0	-17.70
	USGS	USGS	08-27-90	<100	760	4,000	1,200	1,600	41,000	--	-133.0	-17.40
	USGS	USGS	01-31-91	200	770	3,500	680	1,600	44,000	--	--	--
	USGS	USGS	05-08-91	300	620	2,700	720	1,800	--	--	--	--
	USGS	USGS	[1]07-22-91	<100	680	2,400	760	1,700	47,000	2.7	--	--
	USGS	USGS	[1]07-22-91	200	--	2,400	270	1,700	52,000	1.2	--	--
	USGS	USGS	04-15-92	200	670	17,000	870	1,900	42,000	--	--	--
	USGS	USGS	07-23-93	200	540	3,100	2,300	1,400	49,000	--	--	--
	USGS	**USGS**	**08-28-97**	--	**3,300**	**2,600**	--	--	--	--	--	--
	USGS	**USGS**	**06-25-98**	--	**3,600**	**3,700**	--	--	--	--	--	--
28N51E29AACC01	**USGS**	**USGS**	**08-27-97**	--	**710**	**3,600**	--	--	--	--	--	--
M-60	**USGS**	**USGS**	**04-20-99**	--	**700**	**4,100**	**140**	--	--	--	--	--
28N51E29BACA01 M-32	USGS	USGS	08-17-93	<100	630	800	110	250	670	--	--	--
28N51E29CACB01 M-33	USGS	USGS	08-23-90	86	180	6	24	<1	290	1.7	--	--
28N51E33BBBB01	--	CHNO	03-17-89	--	--	1,400	--	220	--	--	--	--
M-36	USGS	USGS	08-24-90	<100	730	11,000	220	510	1,700	3.7	-144.0	-18.95
	USGS	**USGS**	**09-03-97**	--	**680**	**12,000**	--	--	--	--	--	--
	USGS	**USGS**	**04-20-99**	--	**730**	**15,000**	**270**	--	--	--	--	--
28N51E33BBBC02 M-38	--	CHNO	03-16-89	--	--	1,400	--	220	--	--	--	--

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
28N51E33DDCC03 FPB93-4A	USGS	USGS	08-17-93	<100	890	<10	220	860	2,300	--	--	--
28N52E20BBBB01 M-42	MBMG	MBMG	10-06-85	--	--	2,300	--	64	--	--	--	--
28N52E20CCCC01 M-43	USGS	USGS	08-21-90	<100	960	1,100	110	60	460	--	--	--
28N52E30DDDD01 M-44	MBMG	MBMG	10-05-85	--	--	1,200	--	23	--	--	--	--
29N51E09ABBA04 FPB93-1	USGS	USGS	08-16-93	45	670	1,500	100	92	360	--	--	--
29N51E10CDBA01 M-50	USGS	USGS	07-21-82	--	--	1,600	--	190	--	--	--	--
29N51E15CACA01 M-52	USGS	USGS	07-19-91	24	400	<3	170	13	780	--	--	--
29N51E16BDAA01 W-1	USGS	USGS	07-20-91	74	1,900	18	78	23	150	--	--	--
29N51E16CBCC01 W-2	USGS	USGS	07-26-82	--	--	27	--	27	--	--	--	--
29N51E16CCAA01 W-3	USGS	USGS	07-20-82	--	--	470	--	170	--	--	--	--
	USGS	USGS	[1]07-18-91	43	670	1,500	66	160	360	3.5	-133.0	-16.75
	USGS	USGS	[1]07-18-91	43	650	1,500	65	160	360	3.6	--	--

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
29N51E16DACA01 M-54	USGS	USGS	08-23-90	25	510	170	92	100	620	8.0	-130.0	-16.75
29N51E17CCCC01	USGS	USGS	07-27-82	--	--	17,000	--	1,800	--	--	--	--
W-4	USGS	USGS	07-22-89	15	500	26,000	480	1,500	5,500	4.5	-135.5	-17.00
29N51E19DCAC01 M-55	USGS	USGS	07-22-82	--	--	30	--	80	--	--	--	--
29N51E19DDBA01 Murphy 5-D	USGS	USGS	07-22-82	--	--	730	--	160	--	--	--	--
29N51E20ABBA02 W-6	USGS	USGS	07-26-82	--	--	270	--	1,200	--	--	--	--
29N51E20DABB01	USGS	USGS	08-15-93	500	690	16,000	280	1,800	5,800	--	--	--
FPB92-13	**USGS**	**USGS**	**06-25-98**	--	**680**	**17,500**	--	--	--	--	--	--
29N51E21ABCC01	USGS	USGS	07-20-82	--	660	5	--	3	--	--	--	--
W-8	USGS	USGS	07-18-91	53	760	33	77	1	520	3.5	--	--
29N51E21ABDA01 FPB92-14	USGS	USGS	08-15-93	64	1,100	1,700	88	680	390	--	--	--
29N51E21BBAA01	USGS	USGS	07-26-82	--	--	2,800	--	460	--	--	--	--
W-9	USGS	USGS	07-22-89	89	1,600	5,400	190	230	710	3.0	-138.5	-17.05
29N51E29CBBB01 W-10	USGS	USGS	11-03-82	--	--	22,000	--	1,800	--	--	--	--
29N51E30DDDD01 Murphy 1-D	USGS	USGS	07-22-82	--	--	1,400	--	300	--	--	--	--

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
29N51E31AABB01	USGS	USGS	11-03-82	--	--	9,500	--	1,500	--	--	--	--
W-11	USGS	USGS	07-23-89	67	730	27,000	550	2,000	12,000	5.0	-134.0	-16.80
29N51E31ABDD01 FPB92-6	USGS	USGS	08-10-93	<100	1,900	19,000	450	1,400	13,000	--	--	--
29N51E31BDBA01	USGS	USGS	08-10-93	<100	490	20	390	320	4,600	--	--	--
FPB92-10	**USGS**	**USGS**	**06-25-98**	--	**400**	**<30**	--	--	--	--	--	--
29N51E31CABB01 FPB92-9	USGS	USGS	08-11-93	<100	510	16,000	460	2,400	11,000	--	--	--
29N51E31DBAD01 FPB92-7	USGS	USGS	08-11-93	<100	5,900	18,000	600	710	7,800	--	--	--
29N51E31DBDD01	USGS	USGS	08-12-93	200	1,200	13,000	530	760	9,800	--	--	--
FPB92-8	**USGS**	**USGS**	**08-28-97**	--	**2,000**	**7,500**	--	--	--	--	--	--
29N51E32ABAC01 FPB92-4	USGS	USGS	08-13-93	--	1,100	60	--	--	--	--	--	--
29N51E32ACCA01 FPB92-5	USGS	USGS	08-14-93	200	3,300	20	350	620	2,700	--	--	--
29N51E32BAAD01	USGS	USGS	08-14-93	200	1,400	13,000	840	980	8,200	--	--	--
FPB92-3	**USGS**	**USGS**	**07-26-97**	--	**1,900**	**64**	--	--	--	--	--	--
29N51E32BABB01 FPB92-2A	USGS	USGS	07-26-93	300	13,000	35,000	3,200	2,500	49,000	--	--	--
29N51E32BBAA01 W-12	USGS	USGS	11-02-82	--	--	49,000	--	3,300	--	--	--	--

Table 4. Trace-element and organic-carbon concentrations and stable-isotope ratios in water samples collected from privately owned wells, monitoring wells, and brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana (Continued)

Site number and well name (fig. 3)	Collecting agency	Analyzing laboratory	Date sample collected	Barium (µg/L as Ba)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)	Manganese (µg/L as Mn)	Strontium (µg/L as Sr)	Carbon, organic (mg/L as C)	D/H stable-isotope ratio (permil)	O-18/O-16 stable-isotope ratio (permil)
29N51E32BBBA02 W-14	USGS	USGS	11-02-82	--	--	21,000	--	3,200	--	--	--	--
29N51E32BBBA03 FPB92-1	USGS	USGS	07-25-93	200	2,900	71,000	2,600	6,600	110,000	--	--	--
	USGS	**USGS**	**04-21-99**	--	**3,800**	**79,000**	**3,500**	--	--	--	--	--
29N51E32BBBA04 FPB93-2	USGS	USGS	[1]07-25-93	<100	2,000	2,100	350	420	4,900	--	--	--
	USGS	USGS	[1]07-25-93	<100	2,000	2,200	350	420	5,000	--	--	--
29N51E32BBBB01 W-15	USGS	USGS	11-03-82	--	--	33,000	--	6,900	--	--	--	--
	USGS	USGS	07-23-89	150	5,500	21,000	2,300	6,400	52,000	7.0	-122.0	-16.15
	USGS	**USGS**	**08-26-97**	--	**2,000**	**5,500**	--	--	--	--	--	--
	USGS	**USGS**	**04-21-99**	--	**1,800**	**6,200**	**490**	--	--	--	--	--
29N51E32BCCA01 W-16	USGS	USGS	11-02-82	--	--	55,000	--	14,000	--	--	--	--
29N51E32BCCA02 FPB92-11	USGS	USGS	08-11-93	300	860	17,000	610	3,000	23,000	--	--	--
29N51E36CCCC01 M-57	MBMG	MBMG	10-05-85	--	--	36	--	--	--	--	--	--

[1]Replicate analyses.
[2]Date of analysis.
[3]Brine-injection well completed in Lower Cretaceous Fall River ("Dakota") Sandstone.

Table 5. Concentrations of selected fuel ethers and petroleum compounds in water samples collected from privately owned wells and monitoring wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, 1999-2000

[Concentrations reported in micrograms per liter. Abbreviations: ELAB, Energy Laboratories, Inc.; FPOEP, Fort Peck Tribes Office of Environmental Protection; MSE, MSE-HKM, Inc.; USEPA, U.S. Environmental Protection Agency; USGS, U.S. Geological Survey. Symbols: <, less than minimum reporting level; --, no data; E, estimated value containing less certainty than values without "E"]

Site number and well name	Collecting agency	Analyzing laboratory	Date sample collected	1,4-Dichlorobenzene	Benzene	Chloroform	Diisopropyl ether	Ethylbenzene	m- and p-Xylene	o-Xylene	Naphthalene	tert-Butyl ethyl ether	tert-Butyl methyl ether	tert-Pentyl methyl ether	Toluene
				USEPA Maximum Contaminant Level[1]											
				75	5	80 (under review)	--	700	10,000 (sum of Xylenes)		--	--	--	--	1,000
28N51E01BBBB01 M-1	FPOEP	ELAB	09-28-00	<0.50	<0.05	<0.50	--	<0.50	<0.50	<0.50	<0.50	--	<0.50	--	<0.50
28N51E04CCCD01	FPOEP	ELAB	11-09-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-2	FPOEP	USEPA	01-04-00	<.50	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-28-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E08ADDA01	FPOEP	ELAB	11-02-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-3	FPOEP	ELAB	09-21-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E08DAAC01	FPOEP	ELAB	11-02-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-58	FPOEP	ELAB	[2]09-21-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	[2]09-21-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E09CCDD01	FPOEP	ELAB	11-09-99	<.50	<.50	E.36	--	<.50	<.50	<.50	E.42	--	<.50	--	<.50
M-15	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	E.39	--	<.50	--	<.50
28N51E13CCCC01	FPOEP	ELAB	11-22-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-17	FPOEP	USEPA	01-04-00	.83	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	[2]09-20-00	<.50	<.50	6.1	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	[2]09-20-00	<.50	<.50	5.5	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50

Table 5. Concentrations of selected fuel ethers and petroleum compounds in water samples collected from privately owned wells and monitoring wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, 1999-2000 (Continued)

Site number and well name	Collecting agency	Analyzing laboratory	Date sample collected	1,4-Dichlorobenzene	Benzene	Chloroform	Diisopropyl ether	Ethylbenzene	m- and p-Xylene	o-Xylene	Naphthalene	tert-Butyl ethyl ether	tert-Butyl methyl ether	tert-Pentyl methyl ether	Toluene
28N51E17ABDD01	FPOEP	ELAB	11-09-99	<.50	<.50	E.28	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-22	FPOEP	USEPA	01-03-00	.58	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E17ADAD01	FPOEP	ELAB	11-09-99	<.50	<.50	E.37	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-24	FPOEP	USEPA	01-03-00	.68	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E17DADA01	FPOEP	ELAB	06-30-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-25	FPOEP	ELAB	11-09-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	USEPA	01-03-00	.56	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-21-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E22BBBB01	MSE	ELAB	[2]06-01-00	--	<.50	--	--	<.50	<.50	<.50	--	--	--	--	E.30
FPB92-12	MSE	ELAB	[2]06-01-00	--	<.50	--	--	<.50	<.50	<.50	--	--	--	--	E.26
28N51E22CBCB01	USGS	USGS	[2]04-21-99	--	4.7	--	<0.098	[3]<.03	[3]E.02	[3]E.05	--	<0.054	<.17	<0.11	[3]E.04
FPB93-3	USGS	USGS	[2]04-21-99	--	4.9	--	<.098	[3]E.007	[3]E.02	[3]E.05	--	<.054	<.17	<.11	[3]E.05
	MSE	ELAB	06-01-00	--	4.4	--	--	<.50	<.50	<.50	--	--	--	--	<.50
28N51E22CBCB02 FPB93-3A	USGS	USGS	04-21-99	--	1.6	--	<.098	29	[3]E.05	[3]E.09	--	<.054	<.17	<.11	E.08
28N51E22CDCC01 M-28	MSE	ELAB	06-01-00	--	14	--	--	<.50	<.50	<.50	--	--	--	--	2.8

Table 5. Concentrations of selected fuel ethers and petroleum compounds in water samples collected from privately owned wells and monitoring wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, 1999-2000 (Continued)

Site number and well name	Collecting agency	Analyzing laboratory	Date sample collected	1,4-Dichlorobenzene	Benzene	Chloroform	Diisopropyl ether	Ethylbenzene	m- and p-Xylene	o-Xylene	Naphthalene	tert-Butyl ethyl ether	tert-Butyl methyl ether	tert-Pentyl methyl ether	Toluene
28N51E27ABAA01	FPOEP	ELAB	03-11-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-30	FPOEP	ELAB	06-30-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	[4]11-09-99	<.50	<.50	E.40	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	[4]11-09-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	11-22-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	MSE	ELAB	06-01-00	--	<.50	--	--	<.50	<.50	<.50	--	--	--	--	<.50
	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	09-29-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E27BBBB01	FPOEP	ELAB	[2]01-27-99	<.50	58	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-31	FPOEP	ELAB	[2]01-27-99	<.50	78	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	MSE	ELAB	06-01-00	--	41	--	--	<.50	<.50	<.50	--	--	--	--	.88
28N51E29AACC01	FPOEP	ELAB	03-11-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-60	FPOEP	ELAB	06-30-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	11-09-99	<.50	<.50	E.28	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	USEPA	01-03-00	.67	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	MSE	ELAB	05-31-00	--	<.50	--	--	<.50	<.50	<.50	--	--	--	--	<.50
	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E29BACA01 M-32	FPOEP	ELAB	11-09-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E29CACB02	FPOEP	ELAB	11-09-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-61	FPOEP	ELAB	01-03-00	.72	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-21-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50

Table 5. Concentrations of selected fuel ethers and petroleum compounds in water samples collected from privately owned wells and monitoring wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, 1999-2000 (Continued)

Site number and well name	Collecting agency	Analyzing laboratory	Date sample collected	1,4-Dichlorobenzene	Benzene	Chloroform	Diisopropyl ether	Ethylbenzene	m- and p-Xylene	o-Xylene	Naphthalene	tert-Butyl ethyl ether	tert-Butyl methyl ether	tert-Pentyl methyl ether	Toluene
28N51E32CCCB01	FPOEP	ELAB	11-10-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-34	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E33BBBB01	FPOEP	ELAB	11-09-99	<.50	<.50	E.41	--	<.50	<.50	<.50	<.50	--	<.50	--	.67
M-36	FPOEP	ELAB	09-29-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
28N51E33BBBC02	FPOEP	ELAB	11-09-99	<.50	<.50	.57	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-38	FPOEP	ELAB	11-17-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
	FPOEP	ELAB	09-29-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
29N51E15CACA01	FPOEP	ELAB	11-02-99	--	<.50	--	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-52	FPOEP	USEPA	01-04-00	.61	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
29N51E16CCAA01	FPOEP	ELAB	11-09-99	<.50	<.50	.51	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
W-3	FPOEP	ELAB	09-20-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
29N51E16DACA01	FPOEP	ELAB	11-10-99	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
M-54	FPOEP	USEPA	01-04-00	.59	<1	<1	--	<1	<1	<1	<1	--	--	--	<1
	FPOEP	ELAB	09-28-00	<.50	<.50	<.50	--	<.50	<.50	<.50	<.50	--	<.50	--	<.50
29N51E32BBBA03 FPB92-1	USGS	USGS	04-21-99	--	.51	--	<.098	[3].25	[3]E.02	[3]<.06	--	<.054	<.17	<.11	[3]E.04
29N51E32BBBB01 W-15	USGS	USGS	04-21-99	--	.11	--	<.098	[3].14	[3]E.05	[3]E.04	--	<.054	<.17	<.11	[3]<.05

[1]U.S. Environmental Protection Agency (2002).
[2]Replicate analyses.
[3]Value of constituent in rinsate sample (table 8) greater than value of constituent for this sample.
[4]Samples collected on same date, but from different residences that share same well.

Table 6. Concentrations of selected petroleum compounds in brine water from brine-injection wells in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, September 2000

[Concentrations reported in micrograms per liter. Abbreviations: ELAB, Energy Laboratories, Inc.; FPOEP, Fort Peck Tribes Office of Environmental Protection. Symbol: E, estimated value containing less certainty than values without "E"]

Site number and well name	Collecting agency	Analyzing laboratory	Date of sample	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Benzene	Ethylbenzene	Isopropyl benzene	m- and p-Xylene	o-Xylene	n-Propylbenzene	Naphthalene	Toluene
28N51E10ACCA01	FPOEP	ELAB	[2]09-29-00	70	22	1,760	150	E8.4	306	159	15	34	1,830
Huber 5-D[1]	FPOEP	ELAB	[2]09-29-00	87	28	1,750	181	11	360	186	19	36	1,860
29N51E30DDDD01	FPOEP	ELAB	[2]09-29-00	56	19	1,710	115	E6.6	268	128	12	23	1,530
Murphy 1-D	FPOEP	ELAB	[2]09-29-00	<10	19	1,670	122	E7.1	272	138	13	23	1,530

[1]Reported as Murphy 5-D in Thamke and Craigg (1997).
[2]Replicate analyses.

Table 7. Radium-226 and radium-228 concentrations in water from well W-15 in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, April 1999

[Constituents are dissolved. Sample collected by the U.S. Geological Survey and analyzed by Quanterra Analytical Services, Richland Laboratory, Richland, Wash. Units are in picocuries per liter. 2 Sigma is the combined standard uncertainty. Abbreviation: USEPA, U.S Environmental Protection Agency. Symbol: --, no data]

Site number and well name	Date sample collected	Radium-226	Radium-226 (2 Sigma)	Radium-228	Radium-228 (2 Sigma)	Combined Radium-226 and Radium-228
		USEPA Maximum Contaminant Level[1]				
		--	--	--	--	5
29N51E32BBBB01 W-15	04-21-99	0.86	0.17	1.6	0.52	--

[1]U.S. Environmental Protection Agency (2002).

Table 8. Physical properties, major-ion concentrations, and trace-element concentrations in rinsate water after field cleaning of sampling equipment in the East Poplar oil field study area, Fort Peck Indian Reservation, northeastern Montana, 1997-1999

[Tap water was used for equipment cleaning. Site number indicates site where sampling equipment was used prior to collecting rinsate water. Constituents are dissolved, except as indicated. Samples collected and analyzed by the U.S. Geological Survey. Abbreviations: µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter. Symbols: <, less than minimum reporting level; --, no data]

Site number and well name	Date sample collected	Specific conductance, laboratory (µS/cm)	pH, laboratory (standard units)	Calcium (mg/L as Ca)	Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Alkalinity, total (mg/L as $CaCO_3$)	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Bromide (mg/L as Br)	Iodide (mg/L as I)	Dissolved solids, computed (mg/L)	Boron (µg/L as B)	Iron (µg/L as Fe)	Lithium (µg/L as Li)
29N51E31DBDD01 FPB92-8	08-28-97	1,510	7.9	75	30	220	6.6	446	280	64	0.6	--	--	965	290	5	--
28N51E22CBCB02 FPB93-3A	04-21-99	1,620	7.6	85	34	240	<.1	454	290	75	.7	0.128	0.018	1,010	280	<10	100

Table 9. Concentrations of selected fuel ethers and petroleum compounds in rinsate water after field cleaning of sampling equipment in the East Poplar oil field study area and in water from TP-1, 1999

[Samples analyzed by the U.S. Geological Survey. Concentrations reported in micrograms per liter. Abbreviations: FPOEP, Fort Peck Tribes Office of Environmental Protection; USGS, U.S. Geological Survey. Symbols: <, less than minimum reporting level; E, estimated]

Site name	Collecting agency	Date sample collected	Benzene	Diisopropyl ether	Ethylbenzene	m- and p-Xylene	o-Xylene	tert-Butyl ethyl ether	tert-Butyl methyl ether	tert-Pentyl methyl ether	Toluene
FPB93-3A[1]	USGS	04-21-99	E0.04	<0.098	1.8	3.9	1.4	<0.054	<0.17	<0.11	E0.08
TP-1	FPOEP	06-18-99	<.1	<.098	.27	1.0	.36	<.054	<.17	<.11	<.05

[1]Site name indicates where sampling equipment was used prior to collecting rinsate water.

Table 10. Physical properties and nitrate concentrations in water samples from selected wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, 1983-99

[Bold type indicates data collected after 1996 and not reported in Nimick and Thamke (1998). Geologic unit: Qt, Quaternary glacial till; Tf, Tertiary Flaxville Formation; Tfu, Tertiary Fort Union Formation; Khc, Upper Cretaceous Hell Creek Formation; Kfh-Khc, Upper Cretaceous Hell Creek Formation and Fox Hills Sandstone. Abbreviations: µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter. Symbols: --, no data; <, less than minimum reporting level]

Well name (fig. 1)	Location number	Geologic unit	Depth of well (feet)	Date	Specific conduct-ance, field (µS/cm)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)
N-1	29N44E14ADAB01	Khc	65	09-27-94	737	<0.01	4.0
				05-09-95	710	.01	4.0
				11-06-97	**732**	--	**4.7**
				02-04-98	**718**	**<.01**	**4.4**
				04-28-98	**740**	**<.01**	**4.6**
				07-14-98	**763**	**<.01**	**5.0**
				11-04-98	**751**	**<.01**	**5.5**
				01-27-99	**729**	**<.01**	**5.0**
				05-12-99	**759**	**<.01**	**5.0**
				08-25-99	**806**	**<.01**	**6.5**
N-2	29N45E18CCBB01	Khc	110	09-27-94	631	<.01	14
				05-02-95	626	<.01	16
				11-06-97	**707**	--	**22**
				[1]02-04-98	**687**	**<.01**	**19**
				[1]02-04-98	**687**	**<.01**	**19**
				04-28-98	**636**	**<.01**	**16**
				07-14-98	**716**	**<.01**	**21**
				11-04-98	**700**	**<.01**	**21**
				01-27-99	**753**	**.01**	**24**
				05-12-99	**645**	**<.01**	**17**
				08-24-99	**726**	**<.01**	**17**
N-3	29N46E10DAAC01	Tfu	100	05-07-95	697	<.01	12
				11-06-97	**622**	--	**10**
				02-04-98	**592**	**<.01**	**8.8**
				04-27-98	**591**	**<.01**	**9.2**
				07-15-98	**582**	**<.01**	**8.6**
				11-03-98	**592**	**<.01**	**8.5**
				01-27-99	**605**	**.01**	**9.5**
				05-12-99	**598**	**<.01**	**10**
				08-24-99	**609**	**<.01**	**8.8**
N-4	30N42E33DDDD01	Tf	60	05-08-95	1,970	.01	17
				11-05-97	**2,100**	--	**24**
				02-04-98	**2,140**	**<.01**	**24**
				04-28-98	**2,360**	**<.01**	**27**
				07-14-98	**2,430**	**<.01**	**25**

Table 10. Physical properties and nitrate concentrations in water samples from selected wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, 1983-99 (Continued)

Well name (fig. 1)	Location number	Geologic unit	Depth of well (feet)	Date	Specific conduct-ance, field (µS/cm)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)
N-4 (Continued)				**11-04-98**	**2,430**	**<.01**	**29**
				[1]01-26-99	**2,220**	**<.01**	**24**
				[1]01-26-99	**2,220**	**.01**	**25**
				05-13-99	**2,130**	**<.01**	**24**
				08-25-99	**2,240**	**<.01**	**22**
N-5	30N44E20ACBA01	Kfh-Khc	68	10-01-94	1,110	<.01	16
				05-03-95	1,040	<.01	15
				11-05-97	**1,010**	--	**14**
				02-04-98	**1,050**	**<.01**	**16**
				[1]04-28-98	**1,040**	**<.01**	**15**
				[1]04-28-98	**1,040**	**<.01**	**15**
				07-14-98	**1,110**	**<.01**	**16**
				11-04-98	**1,070**	**<.01**	**15**
				01-28-99	**968**	**<.01**	**14**
				05-12-99	**1,070**	**<.01**	**17**
				08-24-99	**1,050**	**<.01**	**13**
N-6	31N43E29BCCB01	Qt	40	08-16-94	1,000	<.01	22
				05-08-95	929	.01	22
				11-05-97	**918**	--	**23**
				02-04-98	**893**	**<.01**	**23**
				04-28-98	**878**	**<.01**	**22**
				07-14-98	**875**	**<.01**	**21**
				11-04-98	**877**	**<.01**	**21**
				05-13-99	**905**	**<.01**	**23**
				08-25-99	**992**	**<.01**	**21**
N-7	31N44E15BADB01	Kfh-Khc	150	09-30-94	514	<.01	1.3
				05-06-95	508	<.01	1.3
				11-06-97	**517**	--	**1.5**
				02-04-98	**514**	**<.01**	**1.5**
				04-28-98	**512**	**.01**	**1.8**
				07-14-98	**517**	**<.01**	**1.4**
				11-04-98	**515**	**<.01**	**1.4**
				05-12-99	**521**	**<.01**	**1.6**
				08-24-99	**525**	**<.01**	**1.4**

Table 10. Physical properties and nitrate concentrations in water samples from selected wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, 1983-99 (Continued)

Well name (fig. 1)	Location number	Geologic unit	Depth of well (feet)	Date	Specific conduct-ance, field (µS/cm)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)
N-8	31N46E01CBCA01	Tfu	90	08-16-94	634	<.01	17
				11-05-97	**660**	--	**19**
				02-04-98	**656**	**<.01**	**17**
				04-27-98	**646**	**<.01**	**21**
				[1]07-14-98	**663**	**<.01**	**21**
				[1]07-14-98	**663**	**<.01**	**21**
				[1]11-03-98	**691**	**<.01**	**20**
				[1]11-03-98	**691**	**<.01**	**21**
				01-27-99	**675**	**<.01**	**22**
				05-12-99	**702**	**<.01**	**24**
				08-24-99	**708**	**<.01**	**22**
N-9	31N46E08CBCC01	Tfu	55	[2]09-13-83	980	--	28
				10-03-94	862	<.01	23
				08-18-95	913	<.01	27
				11-05-97	**807**	--	**24**
				02-05-98	**844**	**<.01**	**26**
				04-27-98	**868**	**<.01**	**28**
				07-15-98	**752**	**<.01**	**22**
				11-03-98	**727**	**<.01**	**21**
				01-27-99	**819**	**<.01**	**25**
				05-12-99	**796**	**<.01**	**25**
				[1]08-25-99	**728**	**<.01**	**16**
				[1]08-25-99	**728**	**<.01**	**17**
N-10	31N46E11CBBD01	Tf	35	05-20-95	2,020	.01	82
				11-05-97	**2,020**	--	**92**
				02-04-98	**1,830**	**<.01**	**89**
				04-27-98	**2,560**	**.02**	**116**
				07-14-98	**2,670**	**.02**	**116**
				11-03-98	**2,380**	**.01**	**102**
				01-27-99	**2,300**	**.02**	**105**
				05-12-99	**2,880**	**.03**	**132**
				08-25-99	**2,440**	**<.01**	**102**
N-11	31N46E28DDCD01	Khc	150	05-07-95	872	<.01	19
				11-05-97	**964**	--	**22**

Table 10. Physical properties and nitrate concentrations in water samples from selected wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, 1983-99 (Continued)

Well name (fig. 1)	Location number	Geologic unit	Depth of well (feet)	Date	Specific conduct-ance, field (µS/cm)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)
N-11 (Continued)				**02-04-98**	**957**	**<.01**	**20**
				04-28-98	**945**	**<.01**	**19**
				07-15-98	**948**	**<.01**	**19**
				11-05-98	**940**	**.01**	**18**
				01-27-99	**928**	**.01**	**18**
				05-12-99	**940**	**<.01**	**20**
				08-24-99	**934**	**<.01**	**18**
N-12	31N47E16BCAA01	Tfu	100	09-27-94	645	<.01	3.3
				05-21-95	637	<.01	3.0
				11-05-97	**646**	--	**2.7**
				02-05-98	**649**	**<.01**	**2.6**
				04-27-98	**642**	**<.01**	**2.4**
				07-15-98	**655**	**<.01**	**2.5**
				11-03-98	**644**	**<.01**	**2.8**
				01-27-99	**610**	**.01**	**2.3**
				05-12-99	**651**	**<.01**	**2.4**
				08-24-99	**612**	**<.01**	**2.6**
N-13	31N48E17ABAA01	Tf	40	09-29-94	547	<.01	5.2
				02-05-98	**544**	**<.01**	**5.5**
				04-27-98	**544**	**<.01**	**6.0**
				07-15-98	**512**	**.01**	**5.4**
				11-03-98	**514**	**<.01**	**5.8**
				01-27-99	**548**	**<.01**	**5.5**
				[1]05-12-99	--	**<.01**	**7.5**
				[1]05-12-99	--	**<.01**	**8.1**
				08-25-99	**586**	**<.01**	**7.5**
N-14	32N44E03BDCA01	Khc	70	[3]06-21-85	1,320	--	99
				09-28-94	1,490	<.01	90
				05-18-95	1,410	<.01	83
				11-06-97	**1,340**	--	**84**
				02-03-98	**1,370**	**<.01**	**86**
				07-14-98	**1,430**	**<.01**	**86**
				11-03-98	**1,300**	**<.01**	**85**
				01-28-99	**1,480**	**<.01**	**96**
				05-12-99	**1,530**	**<.01**	**110**
				08-24-99	**1,590**	**<.01**	**89**

Table 10. Physical properties and nitrate concentrations in water samples from selected wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, 1983-99 (Continued)

Well name (fig. 1)	Location number	Geologic unit	Depth of well (feet)	Date	Specific conductance, field (µS/cm)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)
N-15	33N40E28ABAC01	Tf or Qt	23	05-19-95	1,160	<.01	8.7
				11-06-97	**1,420**	--	**11**
				02-03-98	**1,320**	**<.01**	**10**
				04-28-98	**1,270**	**.01**	**9.9**
				07-15-98	**1,260**	**<.01**	**10**
				11-05-98	**1,290**	**<.01**	**9.6**
				01-26-99	**1,250**	**.01**	**9.2**
				05-13-99	**1,230**	**<.01**	**10**
				08-24-99	**1,340**	**<.01**	**8.9**
N-16	33N49E24CCDC01	Tfu	96	[2]09-15-83	1,040	--	8.7
				09-21-94	698	.01	5.7
				05-05-95	536	.02	1.7
				04-18-96	535	.02	1.8
				11-05-97	**739**	--	**8.4**
				02-05-98	**558**	**.02**	**2.7**
				04-27-98	**522**	**.02**	**1.6**
				[1]07-15-98	**696**	**.02**	**6.0**
				[1]07-15-98	**696**	**.02**	**6.1**

[1] Replicate analysis.

[2] Data from Donovan and Bergantino (1987).

[3] Data retrieved from the Montana Bureau of Mines and Geology Ground Water Information Center database files.

Table 11. Pesticides analyzed in water samples from selected wells completed in the Flaxville and underlying aquifers study area, Fort Peck Indian Reservation, northeastern Montana, August 1999

[Concentrations of all selected pesticides in water samples from all six wells were less than minimum reporting level. Wells sampled: N-1, N-4, N-6, N-9, N-10, N-13 (table 10, fig. 1). Samples collected and analyzed by Montana Department of Agriculture, Bozeman, Mont. Abbreviation: µg/L, micrograms per liter]

Type	Name	Minimum reporting level (µg/L)	Type	Name	Minimum reporting level (µg/L)
Nitrogen- and phosphorus-containing pesticides	Acetochlor	0.50	Sulfonylurea herbicides	Chlorsulfuron	0.10
	Alachlor	.38		Nicosulfuron	.10
	Atrazine	.13		Metsulfuron methyl	.10
	Bromacil	2.5		Prosulfuron	.10
	Butylate	.15		Triasulfuron	.10
	Carboxin	.60		Triflusulfuron methyl	.10
	Cyanazine	.40			
	Cycloate	.25	Chlorinated acids	2,4-D	.28
	EPTC	.25		2,4-DB	.72
	Hexazinone	.76		Dichlorprop (2,4-DP)	.30
	Imazalil	5.0		Bentazon	.63
	Metolachlor	.75		Clopyralid	1.0
	Metribuzin	.15		Dicamba	.28
	Prometon	.30		5-OH-Dicamba	.25
	Prometryn	.19		Diclofop methyl	.60
	Pronamide (Propyzamide)	.76		Dinoseb	.28
	Propachlor	.50		MCPA	2.6
	Propazine	.13		MCPP (Mecoprop)	2.6
	Simazine	.30		PCP (Pentachlorophenol)	.16
	Tebuthiuron	1.3		Picloram	.35
	Terbacil	2.2		Triclopyr	.25
	Terbutryn	.25			
	Triallate	.50			

☆ U.S. GOVERNMENT PRINTING OFFICE: 2003 — 673-100 / 66009 Region No. 8