SELECTED HYDROGEOLOGIC DATA FOR THE BIG MUDDY CREEK VALLEY NEAR PLENTYWOOD, NORTHEASTERN MONTANA

By Gary W. Levings

U.S. GEOLOGICAL SURVEY

Open-File Report 85-406

Prepared in cooperation with the

CITY OF PLENTYWOOD

This report has not been reviewed for conformity
with U.S. Geological Survey stratigraphic nomenclature.

Helena, Montana
July 1985

UNITED STATES DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS

The following factors can be used to convert inch-pound units in this report to the International System (SI) of units:

Multiply inch-pound unit	By	To obtain SI unit
acre	4,047	square meter
foot	0.3048	meter
gallon per minute (gal/min)	0.06309	liter per second
inch	25.40	millimeter
mile	1.609	kilometer

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F = 9/5\ (°C) + 32$$

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ABSTRACT

Selected hydrogeologic data have been compiled for the Big Muddy Creek valley near Plentywood. The data pertain to most of the known municipal, commercial, and domestic wells drilled in the valley. The data include records of 59 wells and 19 test holes, 21 chemical analyses of water samples, and 40 logs describing lithology penetrated during drilling operations.

INTRODUCTION

The purpose of this report is to make available selected ground-water data for an area of the Big Muddy Creek valley near Plentywood. Included are records of wells and test holes, chemical analyses of water, and lithologic logs of wells and test holes. The data pertain to most of the known domestic, commercial, and municipal wells in an area encompassing about 7 square miles. The report, which was prepared in cooperation with the City of Plentywood, can be used in evaluating the hydrogeology in the Plentywood area (fig. 1).

WELL AND TEST-HOLE NUMBERING SYSTEM

In this report, locations are numbered according to geographic position within the rectangular grid system used by the U.S. Bureau of Land Management (fig. 2). The location number consists of as many as 13 characters. The first three characters specify the township and its position north (N) of the Montana Base Line. The next three characters specify the range and its position east (E) of the Montana Principal Meridian. The next two characters are the section number. The next one to four characters designate the quarter section (160-acre tract), quarter-quarter section (40-acre tract), quarter-quarter-quarter section (10-acre tract), and quarter-quarter-quarter-quarter section (2 1/2-acre tract), respectively, in which the well or test hole is located. The subdivisions of the section are designated A, B, C, and D in a counterclockwise direction, beginning in the northeast quadrant. When more than one well or test hole is described within a 2 1/2-acre tract, consecutive digits are added to the number. For example, as shown in figure 2, well 35N55E19ADDB2 is the second well inventoried in the NW1/4 SE1/4 SE1/4 NE1/4 sec. 19, T. 35 N., R. 55 E.

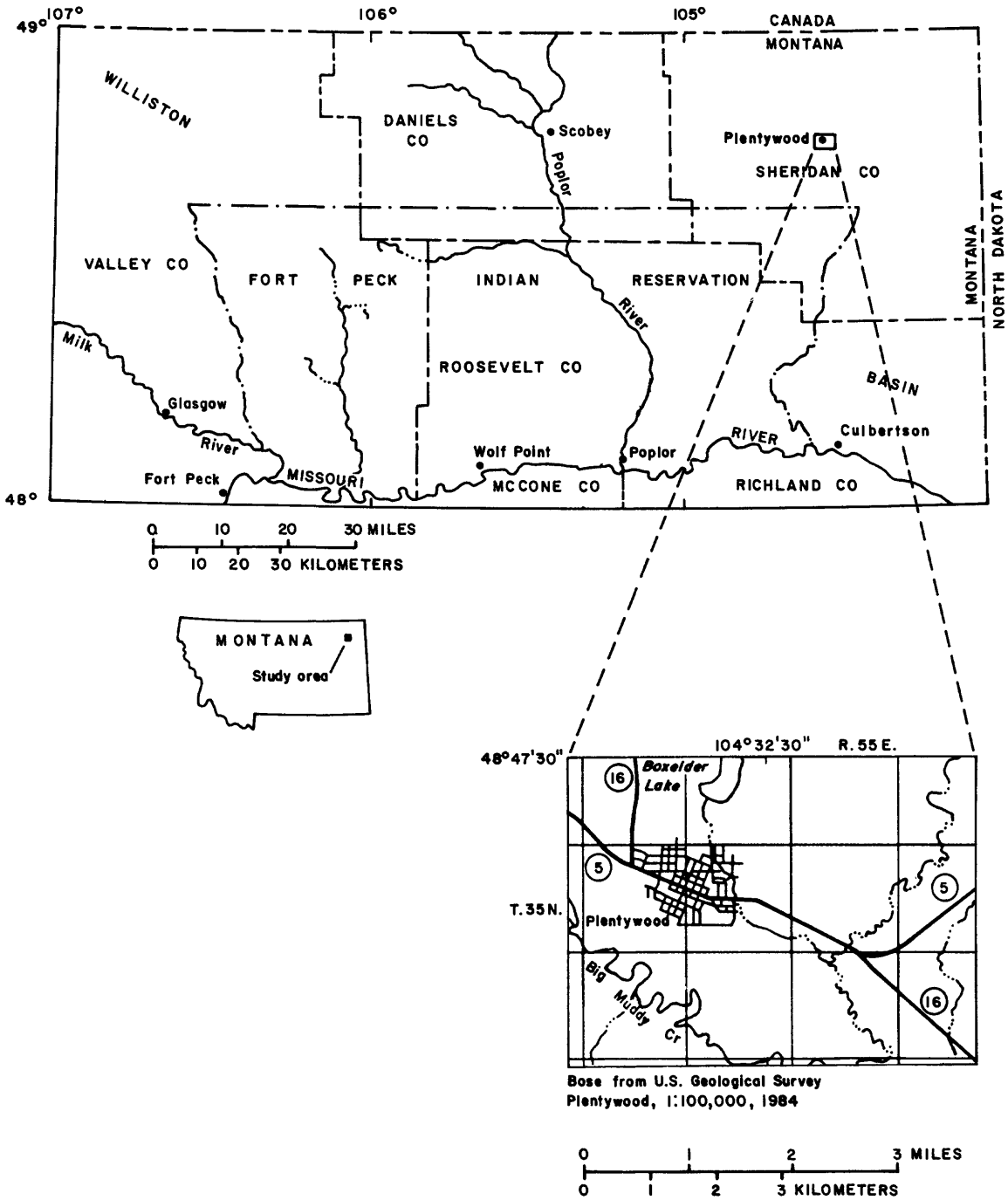

Figure 1.--Location of study area.

HYDROGEOLOGIC DATA

This report includes records of 59 wells and 19 test holes. The inventory data are for wells and test holes drilled primarily from 1982 through 1984; however, several were drilled earlier, one as early as 1915.

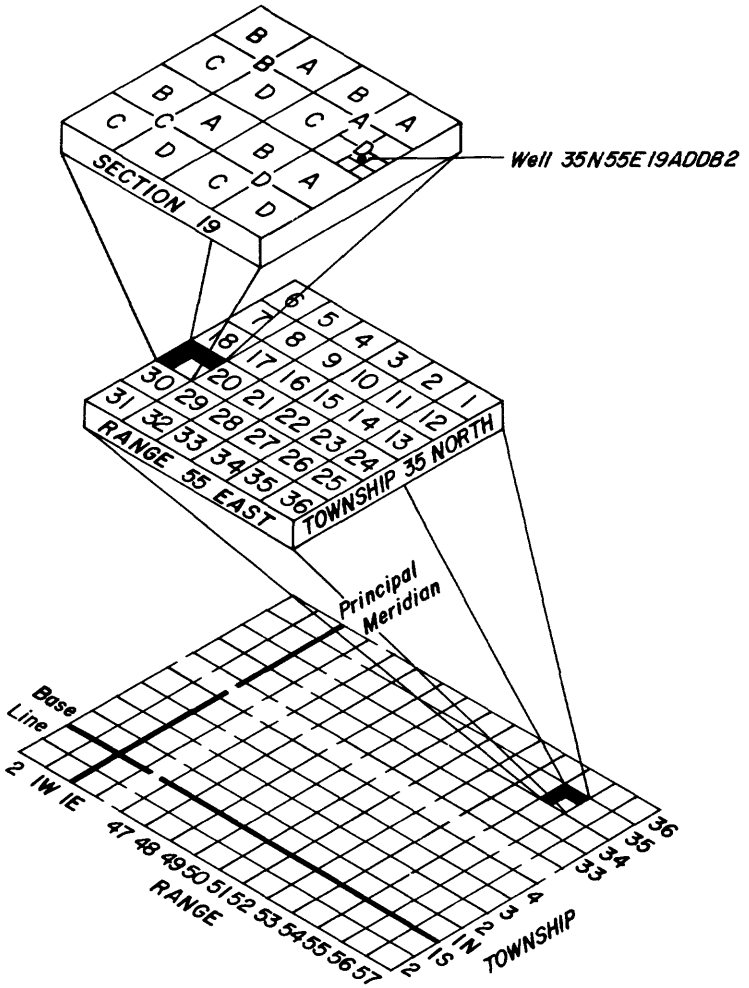

Figure 2.--Numbering system for wells and test holes.

The geologic units penetrated by the wells and test holes range in age from Paleocene to Holocene (table 1). These units produce most of the ground water used for stock, domestic, commercial, and municipal purposes.

Wells and test holes are listed in table 2. Thirteen wells and two test holes were inventoried and accurate locations determined. These sites are shown on figure 3. The locations for the rest of the wells and test holes were from drillers' reports or owners and are only approximate. Well yields were measured under operating conditions at the time of measurement, and do not necessarily indicate the maximum yield of the well. Discharge of a well can vary with changes in pump and well efficiency, pump speed, discharge pressure, and depth to water.

From the wells and test holes, 21 water samples have been collected and analyzed for major cations and anions. The results of these analyses are in table 3. Five water samples were also analyzed for miscellaneous trace-element concentrations (table 4). Data in the tables are as reported by the agency analyzing the samples. The data are reported as dissolved. The dissolved concentration is determined for a water sample after it is passed through a filter having a pore-diameter size of 0.45 micrometer (micron).

Table 1.--*Stratigraphy of shallow formations in the Plentywood area*

System	Series	Formation	Thickness (feet)	General character
Quaternary	Holocene	Alluvium and colluvium	0-125±	Fine- to coarse-grained flood-plain deposits of Big Muddy valley and major tributaries; consist mostly of clay, silt, and sand with possible gravel lenses. Also include colluvium deposits on hillsides and in valleys consisting chiefly of locally derived silt, sand, and gravel.
	Pleistocene	Glacial deposits	0-70±	Unconsolidated glacial outwash and glacial till ranging from poorly to well-sorted clay, silt, sand, and gravel. Also include stream deposits which may be, in part, buried by till.
Tertiary	Paleocene	Fort Union Formation	450-800±	Well-sorted and well-stratified gray clay, bentonitic gray clay, brown carbonaceous clay, lignite, buff silt, gray silty limestone concretions, olive-gray sand, and buff calcareous sandstone. Marked lateral variation in lithology.

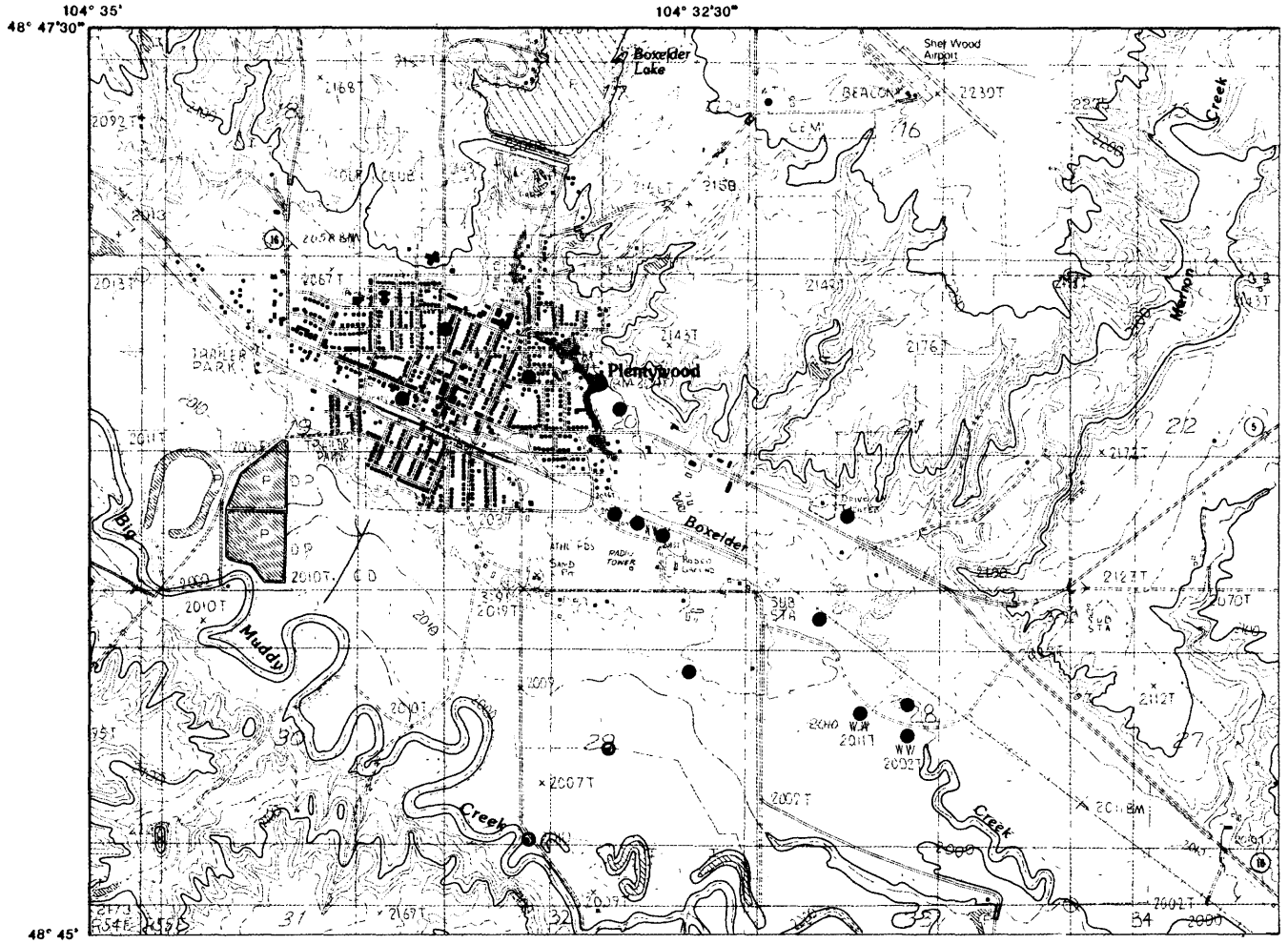

Figure 3.--Location of inventoried wells and test holes.

Logs describing the lithology of stratigraphic units penetrated in drilling a well were obtained mostly from landowners, well drillers, and city and county records. Some logs also were obtained from test holes drilled and cased to assist in monitoring water levels, providing water samples for chemical analysis, and determining aquifer characteristics. The logs for 40 wells and test holes are in table 5. The lithologic descriptions are as reported by well drillers or geologists, except for minor word changes made for consistent presentation.

Table 2.--*Records of wells and test holes*

[Local number--numbering system in text. Site type--T, test hole; W, well. Depth of well or test hole--in feet below land surface. Altitude of land surface--in feet above sea level. Water level--in feet below land surface; R, reported; M, measured. Remarks--C, chemical analysis in table 3 or 4; L, well log in table 5]

Local number	Site type	Owner	Date completed (month-day-year)	Depth of well or test hole (feet)	Casing diameter (inches)	Depth to first opening (feet)	Geologic unit
35N55E18CD	W	Bussinger, James	08-25-57	62	4	52	Fort Union Formation
35N55E18DCC	T	City of Plentywood	07-00-81	200	--	--	Fort Union Formation
35N55E19AAAC	W	Everson, Harold	09-03-84	119	5	101.5	Fort Union Formation
35N55E19AADB	W	Midby, Merl	10-20-82	100	6	92	Fort Union Formation
35N55E19AADD	W	Syme, James	05-17-83	50	6	40	Outwash
35N55E19ABD	W	Holje, Shirley	09-07-83	90	6	80	Fort Union Formation
35N55E19ADB	W	Lord, Bill	12-20-82	55	6	45	Fort Union Formation
35N55E19ADCA	W	Madsen, Leo	04-04-83	60	6	48	Outwash
35N55E19ADD	T	City of Plentywood	00-00-45	60	--	--	Outwash
35N55E19ADDA	T	City of Plentywood	00-00-45	54	--	--	Outwash
35N55E19ADDB1	W	City of Plentywood	00-00-36	226	12	206	Fort Union Formation
35N55E19ADDB2	W	City of Plentywood	00-00-36	410	15.5; 12.5; 8; 6	--	Fort Union Formation
35N55E19ADDB3	W	City of Plentywood	--	55	--	--	Outwash
35N55E19ADDB4	T	City of Plentywood	05-14-53	56	48, 24	46	Outwash
35N55E19BAA	W	Sheridan Ready Mix Inc.	03-29-83	55	6	35	Outwash
35N55E19BD	W	Oxtra, Norl	05-26-71	33	4	29	Fort Union Formation
35N55E19DAB	W	Larsen, Hans	07-19-83	90	5	70	Fort Union Formation
35N55E19DAC1	W	City of Plentywood	10-10-41	138	8, 4.5	110	--
35N55E19DAC2	T	City of Plentywood	00-00-45	135	--	--	Fort Union Formation
35N55E19DAD	W	City of Plentywood	01-01-15	148	--	--	--
35N55E19DBD	W	Medders, Elsie	11-01-82	70	6	65	Fort Union Formation
35N55E20ACCA	W	Nielsen, Elmer	05-03-84	50	5	43.5	Outwash
35N55E20BAB1	W	City of Plentywood	00-00-36	474	--	--	Fort Union Formation
35N55E20BAB2	W	City of Plentywood	00-00-44	47	180	--	Outwash
35N55E20BAB3	W	--	00-00-30	31	72	--	Outwash
35N55E20BB	W	School District #20	06-10-65	50	4	47	Outwash

Altitude of land surface (feet)	Water level (feet)	Date water level measured (month-day-year)	Reported discharge (gallons per minute)	Remarks
2,040	30R	8-25-57	6	L
2,060	--	--	--	L, Peterson Test Hole #8.
2,160	30R	09-03-84	9	L
2,055	45R	10-20-82	7	--
2,055	20R	05-17-83	7	--
2,055	45R	09-07-83	5	--
2,050	25R	12-20-82	5	--
2,042	25R	04-04-83	12	C, L
2,040	23R	00-00-45	--	L; On railroad right-of-way SE of Main Street.
2,045	22R	00-00-45	--	L; Back of Gamble Store, Main St. and 1st Ave.
2,045	11R	00-00-36	--	C, L; SW corner Jefferson and 1st Ave.
2,045	--	--	--	C, L; SW corner Jefferson and 1st Ave.
2,045	22R	--	--	C, L; Jefferson St. and 1st Ave.
2,045	--	--	--	L; Jefferson St. and 1st Ave.
2,050	20R	03-29-83	11	--
2,030	22R	05-26-71	10	--
2,045	50R	07-19-83	7	L
2,040	--	--	--	C; South of Lasater's Gardens.
2,040	3R	00-00-45	--	L
2,040	--	--	--	C; South of Lasater's Gardens.
2,010	40R	11-01-82	12	--
2,035	30R	05-03-84	12	C, L
2,055	--	--	--	L; near corner of Marron and Hill Streets.
2,055	--	--	--	C; near corner of Marron and Hill Streets.
2,055	18R	00-00-30	76	C, L
2,050	24R	06-10-65	20	--

Table 2.--*Records of wells and test holes*--Continued

Local number	Site type	Owner	Date completed (month-day-year)	Depth of well or test hole (feet)	Casing diameter (inches)	Depth to first opening (feet)	Geologic unit
35N55E20BBCB	W	City of Plentywood	00-00-46	57	--	--	Outwash
35N55E20BCBC1	T	City of Plentywood	08-15-31	175	8	--	Fort Union Formation
35N55E20BCBC2	T	City of Plentywood	00-00-45	90	--	--	Outwash
35N55E20BCDD	W	Schmidt, Ralph	11-12-84	57	6	47	Outwash
35N55E20BDA	W	Larsen, Andy	08-20-61	37	4	32	Outwash
35N55E20BDBA	W	Abenroth, August	07-21-83	46	4	25	Outwash
35N55E20BDBC1	W	Holge, Earl	08-31-81	40	5	--	Outwash
35N55E20BDBC2	W	Marriage, Lester	09-12-83	55	6	45	Outwash
35N55E20BDBC3	W	Anderson, Chester	11-17-83	60	6	50	Outwash
35N55E20BDCA	W	Lidahl, Tom	09-17-83	55	6	45	Outwash
35N55E20BDCD	W	Arneklev, Duane	09-21-83	60	6	50	Outwash
35N55E20BDD	W	Lord, Jane	--	58	4	48	Outwash
35N55E20CABA1	W	Hanson, Charles	04-02-83	40	6	30	Outwash
35N55E20CABA2	W	Leom, Ken	06-29-83	55	5	35	Outwash
35N55E20CABB	W	Christensen, Art	06-29-83	55	5	35	Outwash
35N55E20CBBD	W	Nielsen, Vern	--	62	5	42	Outwash
35N55E20CCA	W	Johnston, R. L.	09-17-83	54	5	34	Outwash
35N55E20CDBC1	T	City of Plentywood	07-00-81	80	1	--	Outwash
35N55E20CDBC2	T	City of Plentywood	07-13-82	100	--	57	Outwash
35N55E20CDC	T	City of Plentywood	07-25-81	80	--	--	Outwash
35N55E20CDCC	T	City of Plentywood	07-00-81	100	--	--	Outwash
35N55E20DA	W	Sheridan County	05-05-65	40	4	32	Outwash
35N55E20DAB	W	Chandler, William	04-08-83	100	6	90	Fort Union Formation
35N55E20DBBD1	W	Christensen, Ron	07-20-83	60	4	20	Outwash
35N55E20DBBD2	W	Tange, Carl	05-22-84	40	6	32	Outwash
35N55E20DBC	T	City of Plentywood	07-00-81	80	1	--	Outwash
35N55E20DCAD	W	City of Plentywood	09-17-57	61	48,16	50	Outwash
35N55E20DCBA	W	City of Plentywood	08-24-57	60	48,24	50	Outwash
35N55E20DCBB	W	City of Plentywood	06-03-57	65	48,24	55	Outwash
35N55E20DDA	T	City of Plentywood	07-00-81	100	--	--	Outwash
35N55E20DDB	T	City of Plentywood	07-25-81	80	--	--	Outwash
35N55E21C	W	Simonson, Barney	08-30-77	192	4	183	Fort Union Formation
35N55E21CBB	W	Keough, Earl	06-30-78	100	4	92	Fort Union Formation

Altitude of land surface (feet)	Water level (feet)	Date water level measured (month-day-year)	Reported discharge (gallons per minute)	Remarks
2,055	--	--	70	C, Plentywood #1
2,050	--	--	--	L
2,050	21R	00-00-45	--	L; Rear of City Hall
2,040	35R	11-12-84	15	--
2,040	22R	08-20-61	10	--
2,040	23R	07-21-83	9	--
2,040	20R	08-31-81	9	C, L
2,040	45R	09-12-83	15	--
2,040	30R	11-17-83	15	--
2,035	45R	09-17-83	--	--
2,035	30R	09-21-83	15	--
2,030	20R	--	8	--
2,035	28R	04-02-83	11	--
2,035	25R	06-29-83	7	--
2,035	25R	06-29-83	6	--
2,040	22R	--	9	--
2,040	18R	09-17-83	12	L
2,035	--	--	--	L, Peterson Test Hole #3.
2,035	27.5R	07-13-82	50	L, LTP #3, Casing pulled after test.
2,030	--	--	--	L, Peterson Test Hole #4.
2,030	--	--	--	L, Peterson Test Hole #1.
2,035	30R	05-05-65	8	--
2,050	50R	04-08-83	7	--
2,035	22R	07-20-83	15	--
2,035	25R	05-22-84	10	--
2,035	--	--	--	L, Peterson Test Hole #7.
2,033	--	--	20	L, Plentywood #5.
2,034	--	--	65	C, L, Plentywood #4.
2,035	--	--	65	C, L, Plentywood #3.
2,025	--	--	--	L, Peterson Test Hole #6.
2,020	--	--	--	L, Peterson Test Hole #5.
--	4R	08-30-77	2.5	L
2,060	41R	06-30-78	8	--

Table 2.--*Records of wells and test holes*--Continued

Local number	Site type	Owner	Date completed (month-day-year)	Depth of well or test hole (feet)	Casing diameter (inches)	Depth to first opening (feet)	Geologic unit
35N55E21CCC	W	Kemmis, Merton	03-22-82	83	5	68	Outwash
35N55E21CDBB01	W	Golden Wheel	04-03-76	195	5	181	Fort Union Formation
35N55E21CDCB	W	Blue Moon Inc.	09-03-77	28	4	23	Outwash
35N55E27BAA	W	Wilson, Elbert	10-04-80	176	4, 3	171	Fort Union Formation
35N55E27CAA	W	Simonson, Barney	05-10-82	50	6	40	Outwash
35N55E28ACB	W	DeTienne, Victor	10-08-80	40	5	35	Outwash
35N55E28BAD	T	City of Plentywood	05-22-81	100	--	--	Outwash
35N55E28BBAD	W	City of Plentywood	07-27-82	52.5	--	--	Outwash
35N55E28BDAD	W	City of Plentywood	07-28-82	83	--	--	Outwash
35N55E28BDB1	T	City of Plentywood	07-13-82	100	--	--	Outwash
35N55E28BDB2	T	City of Plentywood	07-14-82	100	--	--	Outwash
35N55E28BDCA	W	City of Plentywood	10-15-65	62.5	48, 24	53	Outwash
35N55E28BDDD	W	City of Plentywood	07-23-65	60	48, 24	50	Outwash
35N55E28C	W	Simonson, Barney	09-02-77	40	4	34	Alluvium
35N55E29AAAA	W	Anderson, Larry	04-25-80	64	4	56	Outwash
35N55E29ADAA	W	Reed, Dixie	03-13-84	70	6	60	Outwash
35N55E29ADBB	W	Darvis, Rick	09-30-84	90	4	50	Outwash
35N55E29CDBB	T	Darvis, Rick	09-27-84	160	--	--	Fort Union Formation
35N55E29DBBB	T	Darvis, Rick	09-27-84	130	--	--	Fort Union Formation

Altitude of land surface (feet)	Water level (feet)	Date water level measured (month-day-year)	Reported discharge (gallons per minute)	Remarks
2,015	25R	03-22-82	12	--
2,040	8.5	08-04-83	12	--
2,025	19R	09-03-77	20	--
2,080	90R	10-04-80	6	--
2,060	10R	05-10-82	12	--
2,015	20R	10-08-80	22	--
2,010	--	--	--	L, Peterson Test Hole #2.
2,015	10R	07-27-82	75	L, Plentywood #9.
2,005	7.6R	07-28-82	200	L, Plentywood #8.
2,015	--	--	--	L, LTP Test Hole #4.
2,015	--	--	--	L, LTP Test Hole #5.
2,011	--	--	30	L, Plentywood #7.
2,002	--	--	50	C, L, Plentywood #6.
2,000	11R	09-02-77	30	--
2,020	17R	04-25-80	20	--
2,020	25R	03-13-84	13	--
2,013	19.08	09-30-84	--	C, L, U.S. Geological Survey Test Hole #3.
2,010	--	--	--	L, U.S. Geological Survey Test Hole #1.
2,010	--	--	--	L, U.S. Geological Survey Test Hole #2.

Table 3.--*Major chemical constituents and physical properties of water from wells*

[Constituents are dissolved and in milligrams per liter, except as indicated. Abbreviations: Microsiemens, microsiemens per centimeter at 25°C; °C, degrees Celsius. Agency analyzing sample--MBMG, Montana Bureau of Mines and Geology; MSBH, Montana State Board of Health; P, Permutit Co.; W, Western Filter Co.]

Local Number	Date of sample (month-day-year)	Geologic unit	Onsite specific conductance (microsiemens)	Onsite pH (standard units)	Onsite water temperature (°C)	Hardness (Ca, Mg)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)
35N55E19ADCA	10-02-84	Outwash	2,400	7.6	9.0	962	153	141	205
35N55E19ADDB1	01-09-37	Fort Union Formation	--	--	--	50	3.9	9.7	--
	02-01-39	Fort Union Formation	--	--	--	67	20	4.3	--
	10-06-45	Fort Union Formation	--	--	--	44	11	4.0	--
35N55E19ADDB2	06-03-36	Fort Union Formation	--	--	--	36	8	4.0	--
35N55E19ADDB3	04-04-45	Outwash	--	--	--	463	62	74	--
35N55E19DAC1	12-20-41	--	--	--	--	64	23	6.6	--
35N55E19DAD	01-17-30	--	--	--	--	47	4.0	9.0	--
	06-07-37	--	--	--	--	62	17	4.8	--
35N55E20ACCA	10-02-84	Outwash	2,650	7.7	8.0	1,045	168	152	239
35N55E20BAB2	07-08-44	Outwash	--	--	--	--	334	378	--
35N55E20BAB3	02-16-40	Outwash	--	--	--	--	100	119	--
	12- -45	Outwash	--	--	--	--	161	169	--
	03- -47	Outwash	--	--	--	--	315	60	--
35N55E20BBCB	04-06-46	Outwash	--	--	--	--	114	108	--
	10-02-84	Outwash	2,200	7.4	9.5	889	140	131	203
35N55E20BDBC1	10-02-84	Outwash	1,850	7.7	9.0	781	120	117	144
35N55E20DCBA	10-02-84	Outwash	1,760	7.6	8.0	699	122	96	143
35N55E20DCBB	07-23-57	Outwash	--	--	--	630	110	86.6	--
35N55E28BDDD	10-02-84	Outwash	1,610	7.7	8.0	716	117	103	100
35N55E29ADBB	09-30-84	Outwash	1,530	7.9	9.0	635	119	82	113

Sodium adsorption ratio	Sodium plus potassium, (Na + K)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate, (SO_4)	Chloride, (Cl)	Fluoride, (F)	Silica, (SiO_2)	Solids, sum of constituents	Nitrate, as N	Agency analyzing sample
2.88	--	6.7	702	0	754	41.3	0.6	19	2,037	14.1	MBMG
--	602	--	1,040	--	328	112	--	68	1,610	--	MSBH
--	755	--	1,131	--	222	385	--	56	1,940	--	MSBH
--	699	--	970	--	263	298	--	42	1,870	--	MSBH
--	632	--	975	--	439	92	--	45	1,670	--	MSBH
--	305	--	325	--	594	66	--	12	1,300	--	MSBH
--	624	--	942	--	590	25	--	66	1,850	--	MSBH
--	637	--	997	--	544	23	--	--	1,780	--	MSBH
--	646	--	939	--	411	150	--	57	1,770	--	MSBH
3.22	--	8.5	500	0	1,020	92.7	.4	15	1,950	7.6	MBMG
--	--	--	--	--	415	17	--	--	--	--	P
--	116	--	246	--	538	15	.4	18	992	--	W
--	100	--	--	--	787	21	--	15	1,810	--	W
--	140	--	--	--	831	22	--	15	1,339	--	W
--	256	--	620	--	689	34	--	5.0	1,540	--	MSBH
2.96	--	6.5	610	0	749	33	.5	19.5	1,897	4.03	MBMG
2.24	--	6.8	560	0	590	21.9	.3	18	1,581	2.88	MBMG
2.35	--	6.3	517	0	475	67	.3	19.4	1,449	3.63	MBMG
--	101	--	412	--	470	12	.1	--	1,031	13.2	MSBH
1.63	--	4.3	452	0	568	7.9	.3	17.7	1,372	1.27	MBMG
1.95	--	4.9	463	0	496	24.6	.3	20.5	1,325	.02	MBMG

Table 4.--*Trace-element concentrations of water from wells*

[Constituents are dissolved and in micrograms per liter. Analyses by Montana Bureau of Mines and Geology. <, less than]

Local Number	Date (month-day-year)	Geologic unit	Aluminum (Al)	Boron (B)	Bromide (Br)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Iron (Fe)
35N55E19ADCA	10-02-84	Outwash	<30	400	<0.1	3	<2	18	23
35N55E20ACCA	10-02-84	Outwash	<30	260	<.1	<2	4	19	65
35N55E20BBCB	10-02-84	Outwash	<30	450	.1	<2	4	14	22
35N55E28BDDD	10-02-84	Outwash	<30	220	.1	<2	<2	12	25
35N55E29ADBB	09-30-84	Outwash	<30	270	<.1	2	<2	9	770

Lithium (Li)	Manganese (Mn)	Molybdenum (Mo)	Nickel (Ni)	Silver (Ag)	Strontium (Sr)	Titanium (Ti)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
91	120	30	<10	<2	1,570	16	<1	18	<4
82	3	<30	<10	<2	1,470	19	3	21	<4
88	11	<20	<10	<2	1,480	18	1	7	<4
56	990	30	20	<2	1,020	16	<1	5	<4
52	700	20	<10	<2	960	12	<1	<3	<4

Table 5.--*Logs of wells and test holes*

[Well numbering system described in text. Thickness is in feet. Depth is in feet below land surface]

35N55E18CD	Thickness	Depth
Topsoil	2	2
Gravel	8	10
Brown clay	22	32
Gravel	1	33
Blue clay	25	58
Coal and water	4	62
35N55E18DCC		
Till, oxidized	16	16
Gravel	2	18
Till, oxidized	14	32
Till	23	55
Lignite, soft	2	57
Sandstone	3	60
Till	58	118
Till, layers of lignite	26	144
Sandstone, water	7	151
Till, lignite	49	200
35N55E19AAAC		
Brown clay	4	4
Gravel	6	10
Blue clay	20	30
Coal	1	31
Clay, mixed colors	7.5	38.5
Coal, bailed 1½ gal/min	5.5	44
Mostly blue clay	27	71
Coal and clay seams	6	77
Blue clay	5	82
Sand (1½ gal/min water)	3	85
Sandy clay	8	93
Coal	1	94
Clay and sandy clay seams	12	106
Fine sandy clay	4	110
Fine sand	9	119

35N55E19ADCA	Thickness	Depth
Sandy clay	20	20
Sand and clay	20	40
Gravel and sand	20	60
35N55E19ADD		
Gravel and sand	23	23
Clay, yellow	10	33
Gravel	1	34
Clay, yellow	12	46
Clay, blue	4	50
Gravel, coarse	3	53
Clay, blue	7	60
35N55E19ADDA		
Clay and gravel	4	4
Gravel, dry	24	28
Sand, very coarse; and gravel	13	41
Clay, yellow	1	42
Sand	1	43
Clay, yellow	5	48
Sand, coarse; gravel and boulders	6	54
35N55E19ADDB1		
Gumbo	8	8
Gravel and boulders	22	30
Gumbo	12	42
Sand and gravel	13	55
Gumbo	29	84
Rock	1	85
Gumbo	12	97
Sand	9	106
Gumbo	18	124
Rock	3	127
Gumbo	63	190
Coal	2	192
Black gumbo	19	211
Sand	18	229
Black gumbo	2	231

Table 5.--*Logs of wells and test holes*--Continued

35N55E19ADDB2	Thickness	Depth
Gumbo	240	240
Coal	14	254
Sand	13	267
Coal	5	272
Black gumbo	25	297
Sand	3	300
Coal	2	302
Gray gumbo	4	306
Coal	1	307
Gray gumbo	37	344
Hard rock	3	347
Brown sandy gumbo	31	378
Sandy shale	14	392
Sand	10	402
Hard shell	--	--
Gray gumbo	8	410

35N55E19ADDB3		
Clay	5	5
Very coarse sand and gravel (dry)	17	22
Gravel, water-bearing	11	33
Clay, brown	12	45
Sand, very coarse; gravel and boulders	10	55

35N55E19ADDB4		
Topsoil	3	3
Gravel	2	5
Fine sand and gravel	5	10
Yellow sandy clay	5	15
Sandy clay	5	20
Very fine sand	5	25
Fine sand	5	30
Fine sand and gravel	5	35
Coarse sand and gravel	5	40
Fine sand and coal	5	45
Fine sand and gravel	5	50
Sand and boulders	6	56
Clay	3	59

35N55E19DAB	Thickness	Depth
Topsoil	2	2
Clay	10	12
Fine sand and gravel	43	55
Clay	15	70
Sandstone	20	90

35N55E19DAC2		
Gravel and boulders	10	10
Clay, blue	35	45
Sand, dirty gray	10	55
Sand, gray and boulders; hard water	8	63
Shale	36	99
Coal	1	100
Shale, very hard	6	106
Rock	2	108
Sandstone, fine-grained, gray; soft water (35-50 gal/min)	25	133
Clay, blue	2	135

35N55E20ACCA		
Yellow sandy and small gravel seams	27	27
Gravel	2	29
Coarse sand	2	31
Sand and gravel, dry	9	40
Coarse sand	3	43
Gravel (water well here)	6	49
Clay	1	50

35N55E20BAB1		
Gumbo	24	24
Gravel	6	30
Clay	6	36
Gravel	12	48
Gumbo	42	90

Table 5.--*Logs of wells and test holes*--Continued

35N55E20BAB1 (Continued)	Thickness	Depth
Coal	1	91
Gumbo	7	98
Coal	1	99
Gumbo	4	103
Sand	2	105
Gumbo	14	119
Sand	5	124
Gumbo	11	135
Sand	25	160
Gumbo	21	181
Coal	1	182
Gumbo	2	184
Sand	8	192
Coal	8	200
Gumbo	3	203
Coal	12	215
Gumbo	9	224
Coal	2	226
Gumbo	5	231
Coal	4	235
Gumbo	9	244
Sand	4	248
Coal	4	252
Black gumbo	28	280
Hard sand	17	297
Black gumbo	34	331
Hard rock	1	332
Gray gumbo	23	355
Hard rock	2	357
Black gumbo	14	371
Gray gumbo	27	398
Coal	2	400
Sandy clay	8	408
Sand	10	418
Clay	29	447
Sandy clay	10	457
Clay	17	474

35N55E20BAB3		
Sandy loam	12	12
Sand	4	16
Clay, glacial	4	20
Sand	5	25
Gravel	4	29
Conglomerate	2	31

35N55E20BCBC1 (log starts at 28 feet)	Thickness	Depth
Gravel	21	49
Clay	24	73
Water sand; hard water	32	105
Clay	33	138
Water sand; hard water	3	141
Clay	10	151
Water sand; soft water	6	157
Clay	18	175

35N55E20BCBC2		
Topsoil	3	3
Gravel (dry)	18	21
Sand, coarse; gravel and boulders; water	30	51
Clay, blue	39	90

35N55E20BDBC1		
Sandy till	24	24
Gravel, coarse	16	40

35N55E20CCA		
Sand	12	12
Sandy clay	20	32
Sand, clay, and gravel	22	54

35N55E20CDBC1		
Till, gravelly	2	2
Gravel	7	9
Till, lignite	13	22
Sand-till mixture	14	36
Till, oxidized	8	44
Till, sandy	10	54
Gravel	3	57
Gravel, clean	15	72
Till	8	80

Table 5.--*Logs of wells and test holes*--Continued

35N55E20CDBC2	Thickness	Depth
Topsoil, black	1	1
Sand (dirty with light gravel), brown	6	7
Gravel, brown	15	22
Sand and light gravel with coal, colored	6	28
Rock and coal, black	1	29
Clay (sandy), brown	14	43
Sandy clay, gray	13	56
Sand and gravel, colored	13	69
Sandy clay, blue	31	100
35N55E20CDC		
Gravel	8	8
Lignite	3	11
Sand, coarse gravel	5	16
Till, oxidized	23	39
Layer of lignite	--	39
Gravel	14	53
Till	4	57
Gravel	1	58
Till and gravel layers	14	72
Till	8	80
35N55E20CDCC		
Topsoil	9	9
Till	23	32
Till and gravel, cobbles	6	38
Till, sandy	22	60
Till	14	74
Hard pan	1	75
Gravel, clean, coarse	15	90
Till, some gravelly	10	100
35N55E20DBC		
Till, oxidized	12	12
Gravel, coarse	4	16
Till, oxidized	15	31

35N55E20DBC (Continued)	Thickness	Depth
Gravel and sand	11	42
Till and gravel	4	46
Gravel layered with till	6	52
Gravel and lignite layered with till	20	72
Till	8	80
35N55E20DCAD		
Topsoil and clay	3	3
Sand and gravel	17	20
Yellow clay	9	29
Sand and gravel	12	41
Very hard sand and gravel	2	43
Hard fine sand	3	46
Fine sand and gravel, tight	4	50
Hard sand and gravel	6	56
Coarse gravel and sand	5	61
Clay	--	61
35N55E20DCBA		
Hard soil	3	3
Hard yellow clay	10	13
Stones, gravel, sand	9	22
Coarse gravel	7	29
Yellow clay	13	42
Sandy clay	3	45
Hard sand	6	51
Hard sand, gravel	5	56
Tight sand and gravel	4	60
Clay	--	60
35N55E20DCBB		
Hard topsoil	5	5
Hard clay, sand, and gravel	5	10
Sand	2	12

Table 5.--*Logs of wells and test holes*--Continued

35N55E20DCBB (Continued)	Thickness	Depth
Fine tight sand	11	23
Rocks, yellow clay	1	24
Yellow clay	8.5	32.5
Blue clay	16.5	49
Claystone, fine sand	10	59
Coarse gravel	3	62
Blue clay	1	63
Coarse gravel	2	65
Clay	--	65
35N55E20DDA		
Loam	3	3
Till, oxidized	9	12
Till	6	18
Soft till	34	52
Gravel	4	56
Till	40	96
Shale	4	100
35N55E20DDB		
Topsoil	4	4
Till, oxidized	28	32
Lignite	2	34
Till	8	42
Gravel	3	45
Till and gravel layers	18	63
Gravel layers turning to till	17	80
35N55E21C		
Sandy clay	12	12
Gravel	3	15
Clay	5	20
Mostly sand, trace of gravel	5	25
Gray clay	20	45
Clay	22.5	67.5
Rock	.5	68
Clay	40	108

35N55E21C (Continued)	Thickness	Depth
Coal	1	109
Clay	5	114
Rock	3	117
Clay	5	122
Clay and coal streaks	4	126
Clay	12	138
Rock	.5	138.5
Clay	13	151.5
Coal	.5	152
Clay	31	183
Coal	.5	183.5
Clay	2.5	186
Sand	3	189
Harder clay	3	192
35N55E28BAD		
Topsoil	6	6
Till	16	22
Till, gravelly	11	33
Till, sandy	11	44
Gravel, coarse	11	55
Till, gravelly	6	61
Till, some lignite	39	100
35N55E28BBAD		
Topsoil (sandy), black	3	3
Sand and gravel, brown	12	15
Clay, blue	15	30
Sandy clay with light dirty gravel lenses	7	37
Sand (drilled fair), colored	3	40
Gravel	12.5	52.5
Sandy clay, blue	47.5	100
35N55E28BDAD		
Topsoil, brown	3	3
Sandy clay, brown	4	7
Sandy clay, blue	19	26
Soft clay with small lenses of gravel, blue	9	35

Table 5.--*Logs of wells and test holes*--Continued

35N55E28BDAD (Continued)	Thickness	Depth
Gravel, colored	2	37
Soft clay, blue	5	42
Dirty sand and light gravel with lenses of clay	14	56
Sandy clay, blue	7	63
Dirty sand with clay, blue	12	75
Gravel (took water)	8.5	83.5
Clay, blue	16.5	100
35N55E28BDB1		
Topsoil, black	1	1
Sandy clay, brown	8	9
Clay, blue	9	18
Sand and gravel with lenses of clay, blue	5	23
Lenses of dirty sand and clay, blue	29	52
Sand and gravel, colored	6	58
Dirty sand and light gravel, blue	3	61
Sandy blue clay with small lenses of light gravel	17	78
Sandy clay, blue	22	100
35N55E28BDB2		
Topsoil	3	3
Sandy clay	7	10
Sandy clay with lenses of fine sand	10	20
Fine dirty sand with lenses of coal and light gravel	18	38
Lenses of dirty sand sand and clay	12	50
Dirty sand	8	58

35N55E28BDB2 (Continued)	Thickness	Depth
Sandy clay with lenses of dirty sand and gravel	42	100
35N55E28BDCA		
Topsoil, rock, sand and gravel	19.5	19.5
Clay	24.5	44
Fine silty sand, dirty	5	49
Gravel, rock, sand, streaks of clay	12.5	61.5
Clay, sand, gravel streaks, dirty	1	62.5
35N55E28BDDD		
Clay topsoil	3	3
Fine silty sand	9	12
Hard clay, dirty sand	3	15
Rock, clay, coal, and sand	23	38
Clay, rock, gravel, and sand	6	44
Rock, clay, coal, fine sand	3	47
Gravel, sand, rock, coal	11.5	58.5
Fine, silty, dirty sand	1.5	60
35N55E29ADBB		
Gravel with coarse sand; thin layers of carbonaceous material, carbonate rock prevalent	28	28
Clay, tan with some sand and gravel	6	34
Sand, coarse	6	40
Clay, tan and gray	7	47

Table 5.--*Logs of wells and test holes*--Continued

35N55E29ADBB (Continued)	Thickness	Depth
Gravel, some carbonates but quartzite and granite predominate with depth	24	71
Sand, clay bound, blue gray with some streaks of light gray	14	85
Coal seam	1	86
Clay, greenish-gray	4	90

35N55E29CDBB	Thickness	Depth
Clay, sandy; brown to tan	20	20
Sand, quartzite with coal flakes and pea size gravel	6	26
Clay, soft, tan with thin laminations of coal	16	42
Clay, soft, tan, sandier with depth and contains thin layers of gravel, coal slack, and carbonaceous material	8	50
Sand with soft clay	13	63
Gravel and sand	1	64
Clay, soft, tan	2	66
Clay, sandy, yellow	11	77

35N55E29CDBB (Continued)	Thickness	Depth
Sand, with soft clay layers	6	83
Carbonaceous layer	1	84
Clay, soft, gray	9	93
Coal slack	1	94
Clay sandy	16	110
Clay, soft, brown, very sticky	15	125
Clay, sticky, blue	15	140
Clay, sticky, brown	6	146
Coal	4	160

35N55E29DBBB	Thickness	Depth
Sand, dark-brown, silty	8	8
Clay, light-brown, silty with detrital wood and coal slack	2	10
Sand, very fine with some coal slack	17	27
Clay, tan	5	32
Clay, gray with some dark-gray zones	54	86
Gravel, limestone and dolomite predominate	2	88
Clay, greenish-gray, silty	31	119
Clay, gray, sticky	10	129
Clay, brown	1	130