U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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MONTANA BUREAU OF MINES AND GEOLOGY

SCIENTIFIC INVESTIGATIONS MAP 2821
(Sheet 2 of 2)
Tuck, L.K., 2004, Reconnaissance of ground-water resources of northeastern Valley County, Montana

SUMMARY

This report describes the ground-water resources of northeastern Valley County, Montana, near the towns of Larslan, Opheim, and Richland and presents data collected and compiled during this study. Hydrogeologic data were collected for 95 ground-water sites from 1998 through 1999. Water-yielding and water-quality characteristics were evaluated for five hydrogeologic units: Quaternary sand and gravel, Quaternary glacial till, Tertiary sand and gravel, Tertiary Fort Union Formation, and the Upper Cretaceous Fox Hills Sandstone-Hell Creek Formation.

The Quaternary sand and gravel generally includes alluvium of Holocene age along modern flood plains and larger Pleistocene meltwater channels, and locally includes terrace, lake and pond, landslide, eolian, and colluvial deposits of Holocene and Pleistocene age. These deposits consist of gravel, sand, silt, and clay and range in thickness from about 10 to 30 ft.

Quaternary glacial till primarily consists of gravel, sand, silt, and clay that is unstratified, unsorted, and unconsolidated; the till covers much of the south-central part of the study area. Thickness of the till varies but averages 16 ft and can be as much as 65 ft. Although used as a source of water in the study area, till generally has low permeability and yields poor quality of water. The major-ion composition of water in the till was dominated by calcium, sodium, and magnesium cations and the sulfate anion. The dissolved-solids concentrations ranged from 760 to 1,720 mg/L and nitrate concentrations ranged from 8.7 to 30 mg/L.

The Tertiary sand and gravel is primarily composed of discontinuous beds and lenses of gravel, sand, silt, clay, and in the upper part, occasionally volcanic ash and massive beds of caliche. The unit also locally contains interbeds of sandy gravel. The thickness of these deposits varies but typically ranges from about 40 to 120 ft. The gravel consists of well-rounded quartzite and chert pebbles and cobbles and can be as large as 1 ft in diameter. Transmissivity estimates ranged from 940 to 20,000 ft^2/d with a median of about 4,400 ft^2/d and an average of about 6,000 ft^2/d. Hydraulic conductivity estimates ranged from 25 to 270 ft/d with a median of about 75 ft/d and an average of about 100 ft/d.

Available water-use information for about one-half of the irrigation wells indicates that the average amount of water withdrawn from each of these wells is about 140 acre-ft/yr. Thus, the average amount of water withdrawn from the Tertiary sand and gravel for irrigation is estimated to be about 3,640 acre-ft/yr.

Water levels in seven irrigation wells or nearby monitoring wells completed in the Tertiary sand and gravel were periodically measured from the fall 1991 to spring 1994 and a slight increasing water-level trend is indicated for water levels in most wells during this period. Most water-levels measured in 1998 were lower than the 1991-94 periodic water-level measurements. Water levels appear to respond to temporal precipitation patterns in the study area.

The major-ion composition of water in the Tertiary sand and gravel was dominated by the calcium, sodium, and magnesium cations and bicarbonate anion. The dissolved-solids concentrations ranged from 206 to 787 mg/L with a median of 296 mg/L and nitrate concentrations ranged from 1.8 to 26 mg/L with a median concentration of about 13 mg/L. High nitrate concentrations in ground water determined in this study might result from soil organic nitrogen that leaches to the water table.

The Tertiary Fort Union Formation consists of interbedded sand and sandstone, siltstone, clay, and coal and can be as much as 600 ft thick. Fine-grained sandstone, shaley sandstone, and coal beds are the water-yielding units in the Fort Union. However, some of these units can be discontinuous or poorly connected which commonly results in variable well depths, yields, and water quality. Coal within the Fort Union Formation is a source of water to some springs in the study area. The major-ion composition of water in the Fort Union Formation was a mixed type with calcium, magnesium, and sodium as the dominant cations and bicarbonate as the dominant anion. The dissolved-solids concentrations were 265 and 794 mg/L and nitrate concentrations were 0.93 and 1.2 mg/L.

The Upper Cretaceous Fox Hills Sandstone-Hell Creek Formation is composed of brown, gray, and purple claystone, shale, siltstone, and silty to medium-grained sandstone with bentonite beds and lignite. Thickness generally ranges from about 200 to 400 ft. The major-ion composition of water from most wells completed in the Fox Hills Sandstone-Hell Creek Formation was dominated by the sodium cation and from the remaining wells, water also was a mixture of sodium, calcium, and magnesium cations; water from all wells was dominated by the bicarbonate anion. The dissolved-solids concentrations ranged from 258 to 1,030 mg/L with a median of 458 mg/L and nitrate concentrations ranged from <0.05 to 26 mg/L with a median concentration of 0.26 mg/L.

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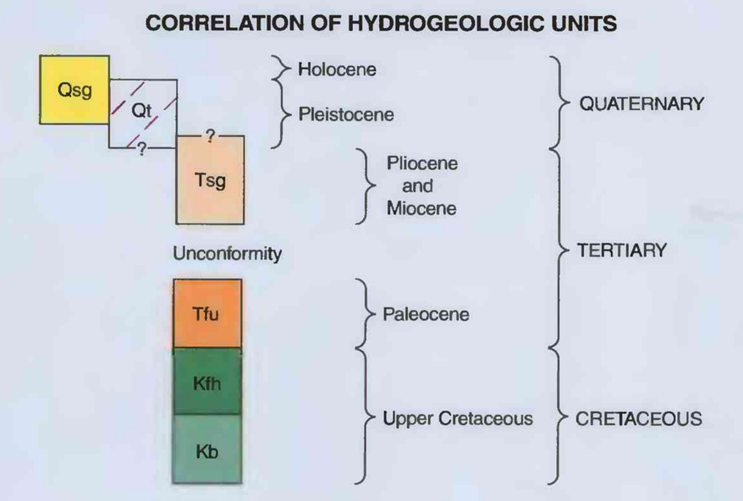
EXPLANATION

CORRELATION OF HYDROGEOLOGIC UNITS

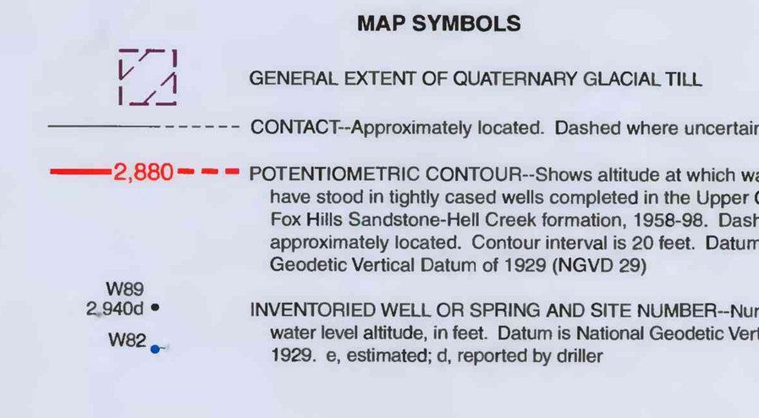


DESCRIPTION OF HYDROGEOLOGIC UNITS[1]

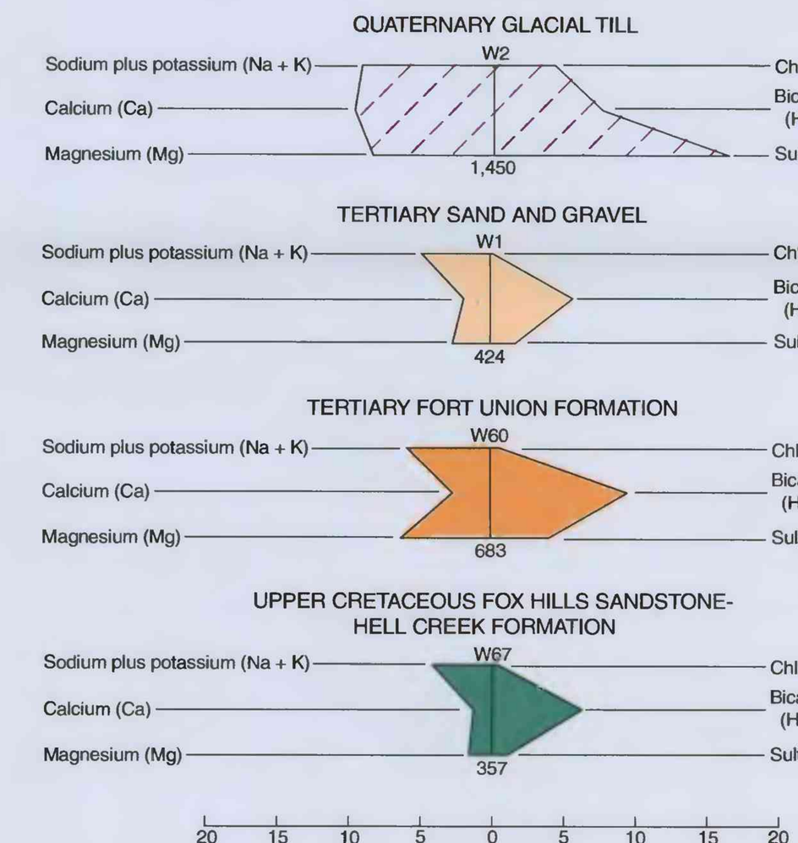
Lithology	Extent and thickness	Water-yielding and water-quality characteristics
Qsg — SAND AND GRAVEL (Holocene and Pleistocene)--Unconsolidated gravel, sand, silt, and clay in alluvium along modern flood plains and along some of the larger Pleistocene meltwater channels. Locally includes terrace, lake and pond, landslide, eolian, and colluvial deposits	Extensive deposits crop out along West Fork Poplar River, Roanwood Creek, Snow Coulee and its tributaries. Thickness ranges from about 10 to 30 ft	Well depth at one well was 36 ft. Specific conductance was 1,440 µS/cm and pH was 7.6
Qt — GLACIAL TILL (Pleistocene)--Unconsolidated to moderately consolidated, yellowish-brown to blue-gray gravel, sand, silt, and clay that generally is unstratified, and unsorted. Boulders are as much as about 6.5 ft in diameter. Includes Pleistocene ice-contact deposits	Extensive deposits crop out in the south-central part of the study area. Thickness averages 16 ft but can be as much as 65 ft	Well depths ranged from 23 to 65 ft. Well yields were not reported. Specific conductance ranged from 1,260 to 2,460 µS/cm and pH ranged from 7.3 to 8.0. Dissolved-solids concentrations in water ranged from 760 to 1,720 mg/L
Tsg — SAND AND GRAVEL (primarily lower Pliocene and Miocene)--Unconsolidated to moderately consolidated, gravel, sand, silt, reddish-brown clay, and volcanic ash. Locally contains interbeds of sandy gravel, sandstone and conglomerate. Average diameter of pebbles and cobbles is about 1 in., but boulders can be as large as 1 ft. Locally includes several interbeds of sand, silt, and caliche as much as about 30 ft thick. Locally includes sand and gravel deposits of possible early Pleistocene (Wiota Gravel) and Pleistocene outwash but primarily is sand and gravel of the Tertiary Flaxville Formation	Extensive deposits crop out from near Opheim to the southeastern part of the study area. Erosional remnants also are scattered throughout the study area. In many areas, Tsg subcrops under Qt. Thickness varies greatly because it has been removed or thinned by erosion. Thickness ranges from 40 to 120 ft	Well depths ranged from 30 to 127 ft with a median of 72 ft. Yields ranged from 5 to 1,500 gal/min with a median of 550 gal/min. Estimates of transmissivity (table 4) ranged from 940 to 20,000 ft^2/d and hydraulic conductivity ranged from 25 to 270 ft/d. Specific conductance ranged from 364 to 2,730 µS/cm with a median of 612 µS/cm and pH ranged from 6.8 to 8.3 with a median of 7.8. Dissolved-solids concentrations in water ranged from 206 to 787 mg/L with a median of 296 mg/L
Tfu — FORT UNION FORMATION (Paleocene)--Interbedded yellowish-brown to gray clay, carbonaceous clay, silt and siltstone, sand and sandstone, and coal. In the study area, the Tullock and Lebo Shale Members of the Fort Union Formation are present. The Tongue River Member might be present as isolated erosional remnants. These two members have three coal beds that are laterally extensive as well as other local coal beds	The formation crops out from the northwestern part of the study area to near Richland along West Fork Poplar River and Roanwood Creek. The Formation subcrops under Qt and Tsg throughout much of the central to southeastern part of the study area. Thickness varies greatly along the Opheim Hills area where it has been removed or thinned by erosion. Thickness can be as much as 600 ft	Well depths ranged from 60 to 96 ft. Well yields in two wells ranged from 6 to 12 gal/min. Specific conductance ranged from 479 to 1,340 µS/cm and pH ranged from 7.2 to 7.8. Dissolved-solids concentrations in water from two wells ranged from 265 to 794 mg/L
Kfh — FOX HILLS SANDSTONE-HELL CREEK FORMATION (Upper Cretaceous)--Brown, gray, and purple claystone, shale, siltstone, and silty to medium-grained sandstone with bentonite beds and coal. The lower 50 to 100 ft of the Hell Creek Formation is predominantly sand or sandstone with a basal conglomerate. The upper part of the Fox Hills Sandstone consists of 35 to 60 ft of sandstone	In the northwestern part of the study area, the formation crops out along the Opheim Hills. In the southeastern part of the study area, the formation crops out along East Fork Little Porcupine Creek. The formation subcrops under Qt and Tsg in the central part of the study area. Thickness varies greatly along the Opheim Hills area where it has been removed or thinned by erosion. Thickness generally ranges from about 200 to 400 ft	Well depths ranged from 92 to 350 ft with a median of 160 ft. Well yields ranged from 4 to 600 gal/min with a median of about 22 gal/min. Specific conductance ranged from 431 to 1,740 µS/cm with a median of 690 µS/cm and pH ranged from 7.0 to 8.2 with a median of 7.7. Dissolved-solids concentrations in water ranged from 258 to 1,030 mg/L with a median of 458 mg/L
Kb — BEARPAW SHALE (Upper Cretaceous)--Fossiliferous semiconsolidated, olive-gray marine shale containing bentonite beds and concretionary zones	Extends along the western and southern study area boundaries. Thickness generally ranges from about 1,000 to 1,200 ft	Characteristics unknown; shale is nearly impermeable and generally is an underlying barrier to flow. Water probably is too mineralized for domestic, stock, or irrigation purposes

[1] Lithology and thickness information modified from Bergantino (2002), Colton and others (1989), Gruber (1980a,b), Whitaker (1980), and Colton (1964).

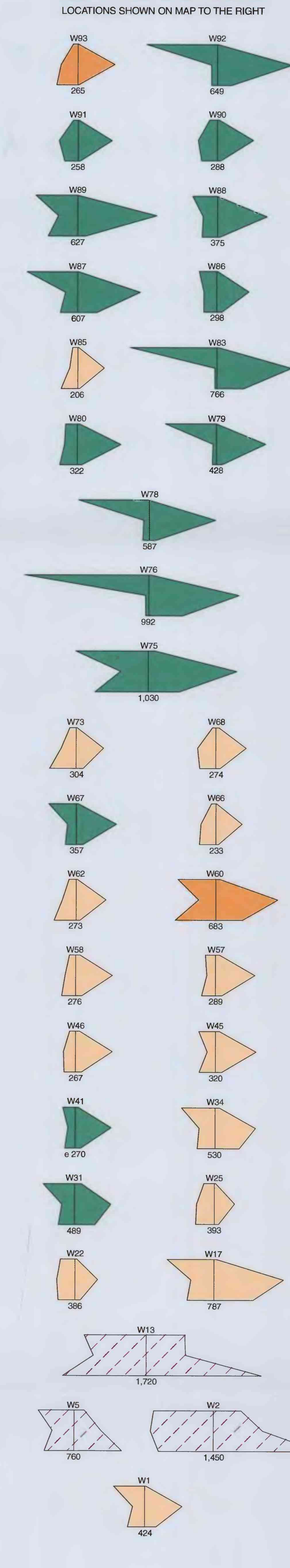
MAP SYMBOLS

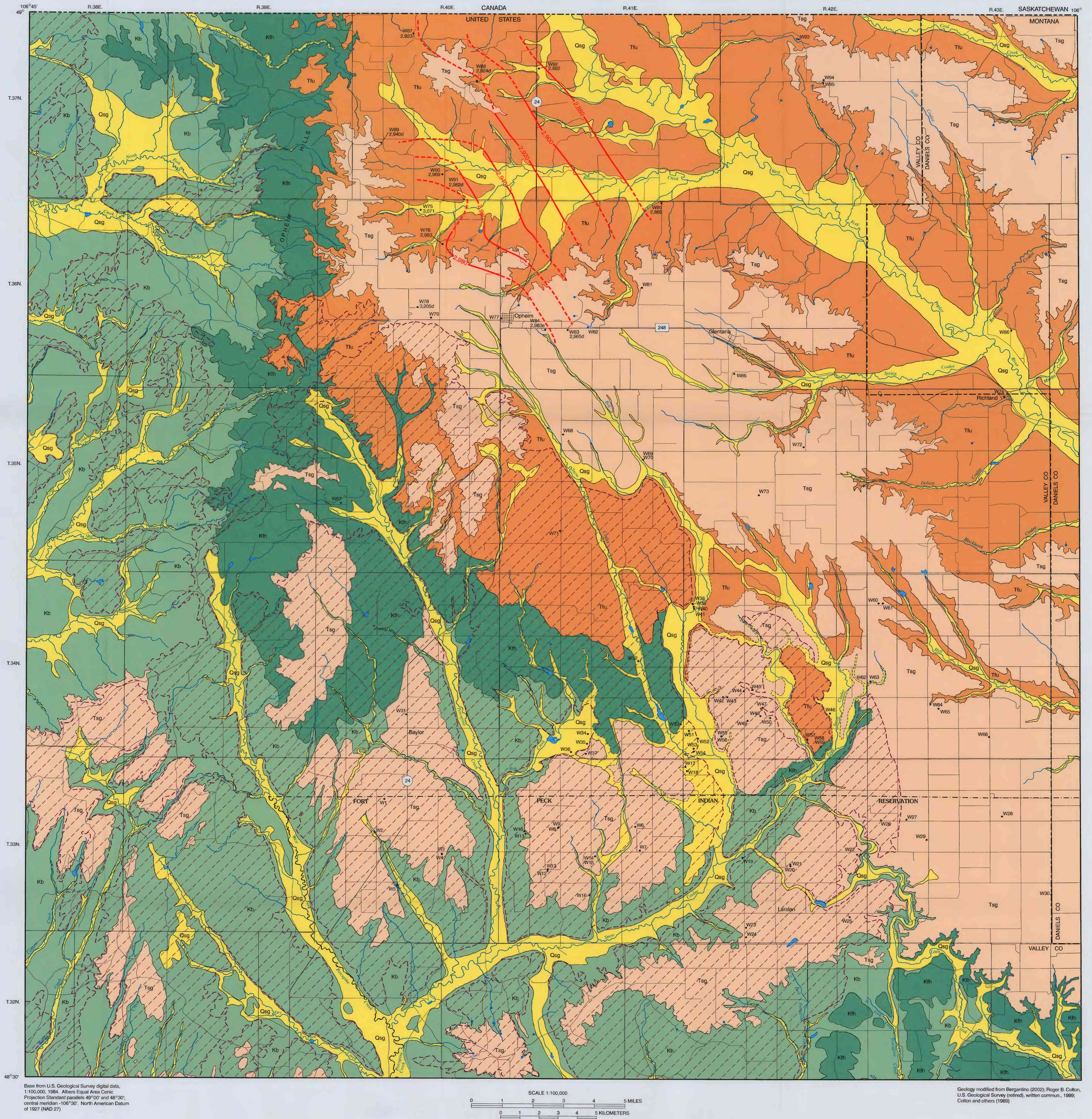


WATER-QUALITY DIAGRAMS SHOWING CHEMICAL COMPOSITION OF WATER FROM WELLS



SELECTED WATER-QUALITY DIAGRAMS
LOCATIONS SHOWN ON MAP TO THE RIGHT





Base from U.S. Geological Survey digital data, 1:100,000, 1984. Albers Equal-Area Conic Projection Standard parallels 49°00' and 46°30', central meridian -106°30'. North American Datum of 1927 (NAD 27)

SCALE 1:100,000
0 1 2 3 MILES
0 1 2 3 4 5 KILOMETERS

Geology modified from Bergantino (2002), Roger B. Colton, U.S. Geological Survey (retired), written commun., 1999; Colton and others (1989)

Figure 4. Generalized hydrogeology, chemical composition of water from selected wells, and potentiometric surface (1958-98) for the Upper Cretaceous Fox Hills Sandstone-Hell Creek Formation, northeastern Valley County, Montana.

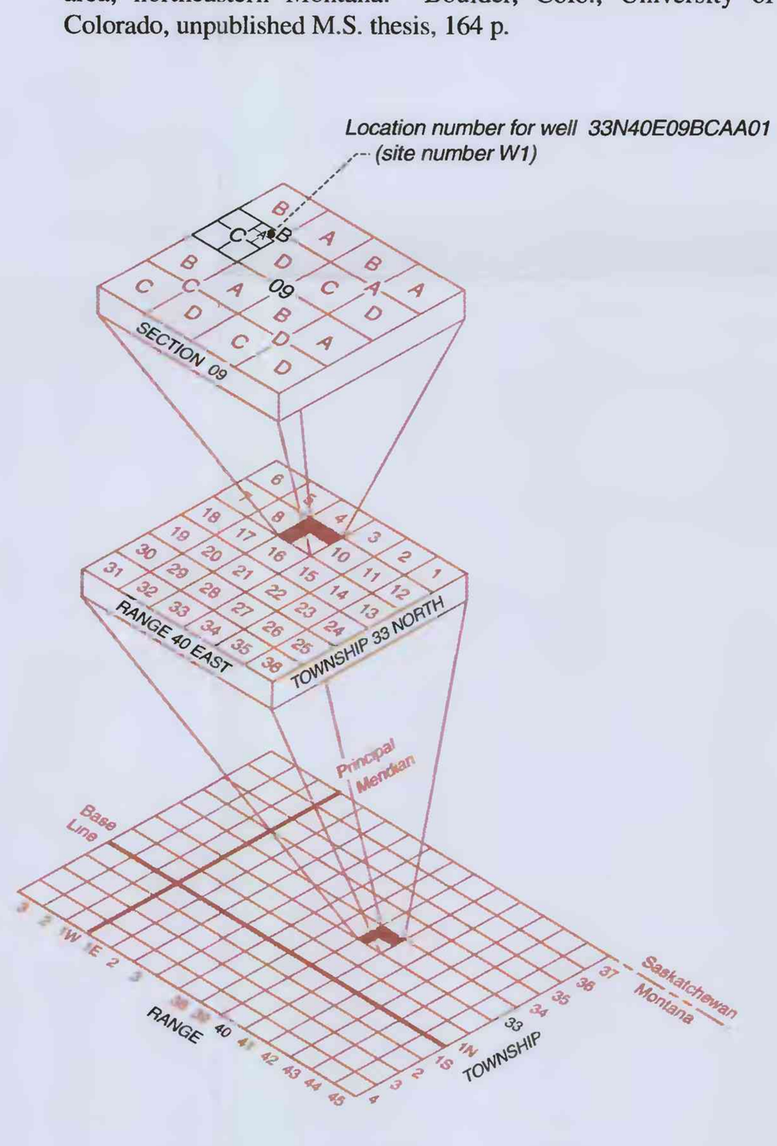


Figure 3. Numbering system for ground-water sites.

Table 3. Trace-element concentrations in ground water from selected wells, northeastern Valley County, Montana, 1978-98

[Site and location number described in text. Constituents are dissolved. Selected samples were collected in 1998 by the U.S. Geological Survey (USGS) and analyzed by Analytical Division, Montana Bureau of Mines and Geology (MBMG), Butte, Mont. Selected samples were collected in 1995 by the USGS and analyzed by the USGS National Water-Quality Laboratory (NWQL), Denver, Colo. Samples were collected by MBMG prior to 1995 at wells W60 and W78 and analyzed by MBMG. Abbreviations: µg/L, micrograms per liter. Remarks: QA-F, quality-assurance sample (field blank); QA-R, quality-assurance sample (replicate). Symbols: --, no data; <, less than minimum reporting level]

Site number (fig. 4)	Location number	Sample date	Arsenic (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Boron (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)	Selenium (µg/L)	Silver (µg/L)	Strontium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)	Remarks
W1	33N40E09BCAA01	06-16-98	6	78	<2	100	<2	13	<2	2.2	<5	<2	<50	<2	<10	3	6	<1	350	12	12	--
W2	33N40E17ADDB01	06-16-98	4	23	<2	140	<2	15	<2	6.1	<5	<2	<50	<1	<10	20	78	<1	960	7	10	--
		06-16-98	4	24	<2	140	<2	19	<2	6.6	21	<2	<50	<2	<10	22	97	<1	1,020	9	11	QA-R[1]
		06-16-98	--	--	--	170	--	--	--	--	<30	--	--	--	--	--	--	--	--	--	--	QA-R[2]
W5	33N40E28ABAC01	05-19-95	--	--	--	--	--	--	--	--	<3	--	--	<1	--	--	--	--	660	--	--	--
W13	33N41E20DBBD01	05-17-95	--	--	--	--	--	--	--	--	30	--	--	<3	--	--	--	--	1,300	--	--	--
W17	33N42E06BBCD01	06-17-98	<1	40	<2	720	<2	23	<2	<2	2,200	<2	<50	150	<10	12	<1	<1	360	6	23	--
W22	33N42E24ABAC01	05-18-95	--	--	--	--	--	--	--	--	6	--	--	<1	--	--	--	--	--	400	--	--
W25	33N42E36BAAC01	05-17-95	--	--	--	--	--	--	--	--	<3	--	--	<1	--	--	--	--	--	450	--	--
W31	34N40E28DAAB01	06-14-98	7	72	<2	98	<2	9.9	<2	<2	<5	<2	<50	<1	<10	5	10	<1	410	13	10	--
W34	34N41E33AADB01	06-16-98	1	65	<2	150	<2	15	<2	--	8	<2	<50	<1	<10	5	9	<1	400	5	<2	--
		06-16-98	1	65	<2	140	<2	12	<2	<2	25	<2	<50	<2	<10	5	8	<1	430	<5	<2	QA-R[1]
		06-16-98	--	--	--	160	--	--	--	--	<10	--	--	--	--	--	--	--	--	--	--	QA-R[2]
W41	34N42E07BABD01	06-17-98	<1	76	<2	76	<2	12	<2	<2	<5	<2	<50	<1	<10	3	2	<1	350	<5	7	--
		06-17-98	<1	78	<2	76	<2	11	<2	<2	<5	<2	<50	<1	10	3	2	<1	360	<5	4	QA-R[1]
		06-17-98	--	--	--	79	--	--	--	--	<10	--	--	--	--	--	--	--	--	--	--	QA-R[2]
W45	34N42E21CBDD01	06-16-98	<1	88	<2	<80	<2	14	<2	2.3	<5	<2	<50	<1	<10	4	3	<1	530	5	3	--
		06-16-98	1	86	<2	100	<2	9.2	<2	<2	<5	<2	<50	<1	<10	4	3	<1	540	5	3	QA-R[1]
		06-16-98	--	--	--	100	--	--	--	--	<10	--	--	--	--	--	--	--	--	--	--	QA-R[2]
W46	34N42E26DABB01	06-16-98	<1	190	<2	59	<2	11	<2	3.8	6	<2	<50	<1	<10	6	2	<1	340	<5	4	--
W57	34N42E35BCBC01	06-16-98	2	94	<2	85	<2	14	<2	<2	6	<2	<50	<1	<10	4	1	<1	400	5	<2	--
W58	34N42E35CAAD01	06-16-98	1	160	<2	60	<2	13	<2	<2	<5	<2	<50	<1	<10	6	2	<1	490	<5	<2	--
W60	34N43E06CDDB01	04-02-82	--	--	--	1,700	--	<2	--	--	--	<40	80	--	<20	<10	<2	--	<1	88	--	--
		06-16-98	2	91	<2	350	<2	22	<2	--	46	<2	<50	<1	12	7	6	<1	830	9	<2	--
W62	34N43W19BCCD01	06-16-98	2	300	<2	52	<2	13	<2	<2	<5	<2	<50	<1	<10	4	3	<1	580	9	<2	--
W66	34N43W34ADAA01	06-18-98	2	380	<2	30	<2	8.0	<2	--	<5	<2	<50	<1	<10	6	2	<1	420	<5	14	--
W67	35N40E19DACC01	06-17-98	<1	20	<2	110	<2	9.6	<2	<2	6	<2	<50	<1	<10	3	4	<1	240	<5	7	--
W68	35N41E09BCCC01	06-17-98	12	360	<2	44	<2	9.0	<2	<2	<5	<2	<50	<1	<10	6	2	<1	440	34	10	--
W73	35N42E21BDDD01	06-15-98	10	270	<2	64	<2	10	<2	--	11	<2	<50	<1	<10	6	6	<1	550	34	2	--
W75	36N40E03BACD01	06-15-98	<1	21	<2	260	<2	16	<2	4.0	<5	<2	73	200	<10	20	7	<1	1,280	<5	230	--
W76	36N40E11BCBA01	06-15-98	<1	11	<2	810	<2	29	<2	5.4	24	<2	<50	13	<10	<2	2	<1	81	8	<2	--
W78	36N40E22BCDD01	08-28-78	--	<100	--	1,140	--	--	--	--	150	--	90	10	--	--	--	--	160	--	--	--
W79	36N40E22DCDA01	06-14-98	<1	12	<2	608	<2	15	<2	<2	360	<2	<50	23	<10	<2	<1	<1	90	<5	5	--
W80	36N41E01BABB01	06-15-98	<1	84	<2	91	<2	13	<2	--	160	<2	<50	43	<10	6	<1	<1	460	<5	12	--
		06-15-98	<1	84	<2	97	<2	14	<2	<2	180	<2	<50	43	<10	6	<1	<1	460	<5	12	QA-R[1]
		06-15-98	--	--	--	94	--	--	--	--	170	--	--	--	--	--	--	--	--	--	--	QA-R[2]
W83	36N41E28BBAD01	06-15-98	<1	5.9	<2	640	<2	22	<2	3.2	120	<2	<50	6	<10	<2	1	<1	81	6	<2	--
W85	36N42E32ACDA01	06-15-98	3	79	<2	63	<2	8.5	<2	--	<5	--	<50	<1	<10	3	2	<1	350	13	11	--
W86	36N43E26ABAD01	06-17-98	1	88	<2	82	<2	8.5	<2	<2	<5	<2	<50	<1	<10	5	3	<1	360	<5	3	--
W87	37N40E05DAAD01	06-15-98	<1	25	<2	360	<2	<2	<2	2.5	76	<2	<50	34	<10	8	<1	<1	360	19	53	--
W88	37N40E14BBBC01	06-15-98	<1	32	<2	490	<2	16	<2	<2	240	<2	<50	55	<10	4	<1	<1	410	<5	16	--
W89	37N40E30AAAD01	06-15-98	<1	42	<2	530	<2	24	<2	<2	1,400	<2	<50	79	<10	7	<1	<1	390	7	21	--
		06-15-98	--	--	--	540	--	--	--	--	1,200	--	--	--	--	--	--	--	--	--	--	QA-R[1]
W90	37N40E33AAAC01	06-15-98	1	100	<2	100	<2	9.6	<2	<2	200	<2	<50	60	<10	7	<1	<1	360	<5	85	--
W91	37N40E34DCDC01	06-15-98	<1	75	<2	56	<2	9.3	<2	<2	<5	<2	<50	<2	<10	6	<1	<1	380	<5	<2	--
W92	37N41E07CBCC01	06-15-98	<1	18	<2	430	<2	18	<2	2.4	160	<2	<50	5	<10	<2	<1	<1	150	<5	<2	--
		06-15-98	--	--	--	430	--	--	--	--	160	--	--	--	--	--	--	--	--	--	--	QA-R[1]
W93	37N42E05DAAD01	06-17-98	<1	97	<2	93	<2	13	<2	4.6	<5	<2	<50	<2	<10	5	3	<1	470	<5	13	--
		06-17-98	<1	99	<2	87	<2	10	<2	4.5	<5	<2	<50	3	<10	5	3	<1	430	<5	13	QA-R[1]
		06-17-98	--	--	--	89	--	--	--	--	<10	--	--	--	--	--	--	--	--	--	--	QA-R[2]
		06-15-98	<1	<2	<2	<30	<2	<2	<2	<2	<10	<2	<50	<1	<10	<2	<1	<1	<1	<5	<2	QA-F[3]
		06-17-98	<1	<2	<2	<30	<2	<2	<2	<2	<10	<2	<50	<1	<10	<2	<1	<1	<1	<5	<2	QA-F[3]

[1] Duplicate sample (analyzed at MBMG).
[2] Triplicate sample (analyzed at NWQL).
[3] Field-blank sample (analyzed at MBMG).

Table 4. Estimates of aquifer hydraulic characteristics for large-yielding wells completed in Tertiary sand and gravel, northeastern Valley County, Montana

[Site number described in text. Type of opening: P, perforated; S, screened. Type of discharge: P, pumped; A, compressed air. Abbreviations: ft, foot; ft/d, foot per day; ft^2/d, foot squared per day; gal/min, gallon per minute; (gal/min)/ft, gallon per minute per foot; in., inches. Symbol: --, no data]

Site number (fig. 4)	Type of opening	Diameter of opening (in.)	Well yield (gal/min)	Specific capacity [(gal/min)/ft]	Drawdown (ft)	Length of test (hours)	Type of discharge	Saturated thickness (ft)	Estimated transmissivity[1] (ft^2/d)	Estimated hydraulic conductivity[2] (ft/d)
W1	S	16	300	14	21	12	P	34	2,100	62
W14	S	16	690	26	27	24	P	44	4,400	100
W33	S	16	700	16	44	19	P	60	11,000	180
W34	S	16	250	7.1	35.3	12	P	35.8	940	26
W35	S	16	550	16	34	20	P	41	11,000	270
W36	S	16	650	93	7	--	P	22.5	--	--
W37	S	12	950	20	47	5	P	49	3,500	71
W42	S	16	900	19	48.6	40	P	63.5	2,700	42
W43	S	16	548	11	50	31	P	64	1,600	25
W44	P	16	1,400	39	36	38	P	60	5,300	88
W45	S	16	1,400	31	45	22	P	71	5,300	75
W46	P	16	1,500	50	30	10	P	75	8,700	120
W47	S	16	300	86	3.5	4	P	72	15,000	210
W48	S	16	600	400	1.5	2	P	73.5	20,000	270
W50	S	16	300	27	11	1.5	P	77	3,900	51
W51	S	12.2	850	53	16	2	P	57	6,700	120
W53	S	12	550	18	30.3	12	P	58	3,500	60
W54	S	12	425	14	31	12	P	53	2,700	47
W58	P	16	1,500	37	41	5	A	66	6,400	97
W62	S	16	1,400	47	30	12	P	82	8,000	98
W69	S	16	400	21	19	10	P	30	2,100	70
W73	S	16	140	7	20	18	P	26	940	36

[1] Transmissivity estimated from specific-capacity data using methods from Walton (1962), which assumes a specific yield of 0.2 for unconfined conditions, the well diameter is 12 in., and the pumping period is either 1, 8, or 24 hours. As noted by Walton (1962), large increases in the radius (or diameter) of the well result in relatively small changes in the specific capacity but long pumping periods might result in a decrease in specific capacity because drawdown continually increases with time.
[2] Hydraulic conductivity estimated by dividing estimated transmissivity by saturated thickness (as reported on drillers' log).

CONVERSION FACTORS, DATUM, ABBREVIATED UNITS, AND ACRONYMS

Multiply	By	To obtain
acre	4,047	square meter (m^2)
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m^3/yr)
foot (ft)	0.3048	meter (m)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot squared per day (ft^2/d)	0.09290	meter squared per day (m^2/d)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
gallon per day per foot [(gal/d)/ft]	0.01242	cubic meter per day per meter [(m^3/d)/m]
gallon per minute (gal/min)	0.06309	liter per second (L/s)
gallon per minute per foot [(gal/min)/ft]	0.2070	liter per second per meter [(L/s)/m]
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.59	square kilometer (km^2)

Degree Celsius (°C) may be converted to degree Fahrenheit (°F) by using the following equation:

$$°F = 9/5(°C)+32$$

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), unless otherwise noted.

Abbreviated units used in this report:

µS/cm	microseimens per centimeter at 25 degrees Celsius
µg/L	micrograms per liter
mg/L	milligrams per liter

Acronyms used in this report:

EPA	U.S. Environmental Protection Agency
MBMG	Montana Bureau of Mines and Geology
MCL	Maximum Contaminant Level, established by the U.S. Environmental Protection Agency
NWIS	National Water Information System
NWQL	U.S. Geological Survey National Water Quality Laboratory, Denver, Colo.
RPD	relative percent difference
SDWR	Secondary Drinking Water Regulations, established by the U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

U.S. Geological Survey, Reston, Virginia: 2004
For sale by U.S. Geological Survey, Information Services
Box 25286, Denver Federal Center
Denver, CO 80225-0286

For additional information write to:
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RECONNAISSANCE OF GROUND-WATER RESOURCES OF NORTHEASTERN VALLEY COUNTY, MONTANA

By
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2004