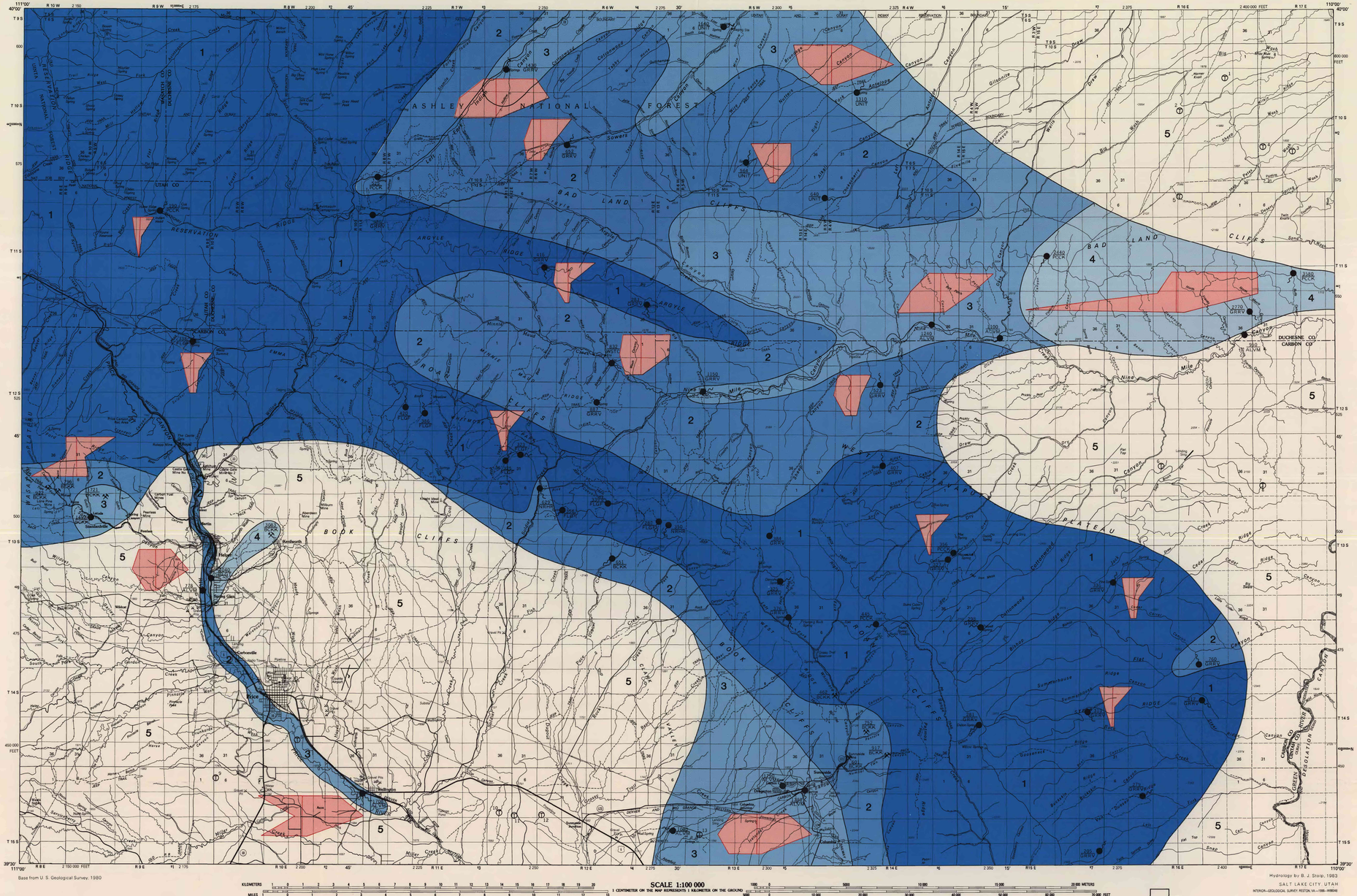
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
U.S. BUREAU OF LAND MANAGEMENT

WATER-RESOURCES INVESTIGATIONS REPORT 84-4227
SHEET 4 of 4



DISSOLVED-SOLIDS CONCENTRATION IN SHALLOW GROUND WATER

HYDROLOGIC MAPS OF THE PRICE 30X60-MINUTE QUADRANGLE, UTAH

BY

H.F. McCormack, K.L. Lindskov, and B.J. Stolp

1984

DISSOLVED SOLIDS IN SHALLOW GROUND WATER

The dissolved-solids concentration in shallow ground water is shown on the accompanying map. The ranges in concentrations shown on the map are based mainly on geologic (Stokes, 1964) and chemical analyses of water from springs, wells, and underground coal mines reported by Price and others (1972), Price and Miller (1973), and Waddell and others (1978, 1981). To supplement the water-quality data from earlier studies, an additional 28 springs and wells were sampled during 1983. Dissolved-solids concentrations could not be defined in areas where no wells or springs were located.

The ranges of dissolved-solids concentrations delineated on the map are representative of concentrations in about the upper 200 feet of the ground-water system. Concentrations in deeper water-bearing units may be significantly different than those delineated on the map. Water-quality information from petroleum-test holes indicate that ground water at depths greater than 2,000 feet commonly is moderately saline to briny (see table 4) in the northeast and southwest parts of the area.

The chemical character of shallow ground water varies markedly as indicated by the water-quality diagrams on the map. Calcium and bicarbonate usually are the predominate cation and anion in water containing less than 500 milligrams per liter dissolved solids, which is typical of high-altitude areas. In more saline water, which is typical of lowland areas, the increase in dissolved-solids concentration can be due to increased concentrations of any of the major cations and anions, but it is most commonly due to increased concentrations of sodium, magnesium, and sulfate.

Most of the shallow ground water along Reservation and Argyle Ridges and in the Roan Cliffs contains less than 500 milligrams per liter dissolved solids—the U.S. Environmental Protection Agency's (1977) recommended limit for human drinking water. The reader is referred to table 3 (sheet 3) for a general guide to the use of water for livestock and poultry.

Table 4.--Selected data from petroleum-test holes

Water-yielding geologic unit: Geologic unit found at sample depth. GRRV, Green River Formation; PCCK, Parachute Creek Member of the Green River Formation; WSTC, Wasatch Formation; FRRN, Farron Sandstone Member of Mancos Shale; MVRD, Mesaverde Group; MVJL, Navajo Sandstone; DSRT, Desert Limestone; MSSP, Mississippian System; RDLL, Redwall Limestone.
Sample interval: Depth below land surface where sample was taken.
Dissolved solids: Sum of constituents.
Remarks: Type of water reported in well log in files of Utah Division of Oil, Gas, and Mining. Hem (1970) defines these terms numerically as: slightly saline, 1,000-3,000; moderately saline, 3,000-10,000; very saline, 10,000-35,000; briny, more than 35,000.

Map No.	Water-yielding geologic unit	Sample interval (feet) Depth to Top	Depth to Bottom	Dissolved solids (milligrams per liter)	Remarks
1	GRRV	4,289	4,321	30,300	--
	GRRV	4,498	4,518	5,670	--
2	GRRV	3,616	3,646	8,070	--
3	GRRV	1,820	2,820	--	Reported as very saline
	GRRV	2,820	4,100	--	Reported as briny
	GRRV	4,510	4,545	--	Reported as briny
	MVRD	10,535	12,130	36,000	--
4	PCCK	3,777	3,789	13,500	--
	PCCK	4,014	4,116	35,500	--
5	PCCK	4,119	4,170	6,520	--
	PCCK	4,197	4,218	2,820	--
6	WSTC	1,500	2,500	--	Reported as slightly saline
7	WSTC	2,895	3,004	--	Reported as briny
	WSTC	3,035	3,040	--	Reported as briny
8	FRRN	748	958	--	Reported as moderately saline
9	FRRN	1,851	--	--	Reported as slightly saline
10	MVJO	3,095	3,114	3,759	--
11	MSSP	7,433	7,986	35,800	--
12	RDLL	8,323	9,174	67,800	--
13	DSRT	7,990	8,080	84,600	--

EXPLANATION

DISSOLVED-SOLIDS CONCENTRATION, IN MILLIGRAMS PER LITER

1	Less than 500
2	500 - 1000
3	1000 - 2000
4	2000 - 5000
5	Data insufficient for estimate

SAMPLING SITES

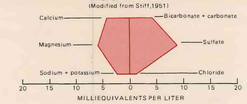
- Spring
- Well
- Underground coal mine
- Petroleum-test hole and number(table 4)

3380 / PCCK — DISSOLVED-SOLIDS CONCENTRATION, IN MILLIGRAMS PER LITER / WATER-YIELDING GEOLOGIC UNIT

WATER-YIELDING GEOLOGIC UNITS

ALVM	alluvium
BCKK	Blackhawk Formation
BLGT	Bluegate Member of the Mancos Shale
FLGF	Flagstaff Limestone
GRRV	Green River Formation
NRHR	North Horn Formation
PCCK	Parachute Creek Member of the Green River Formation
UNIT	Uinta Formation
WSTC	Wasatch Formation

WATER-QUALITY DIAGRAM
(Modified from Stiff,1951)



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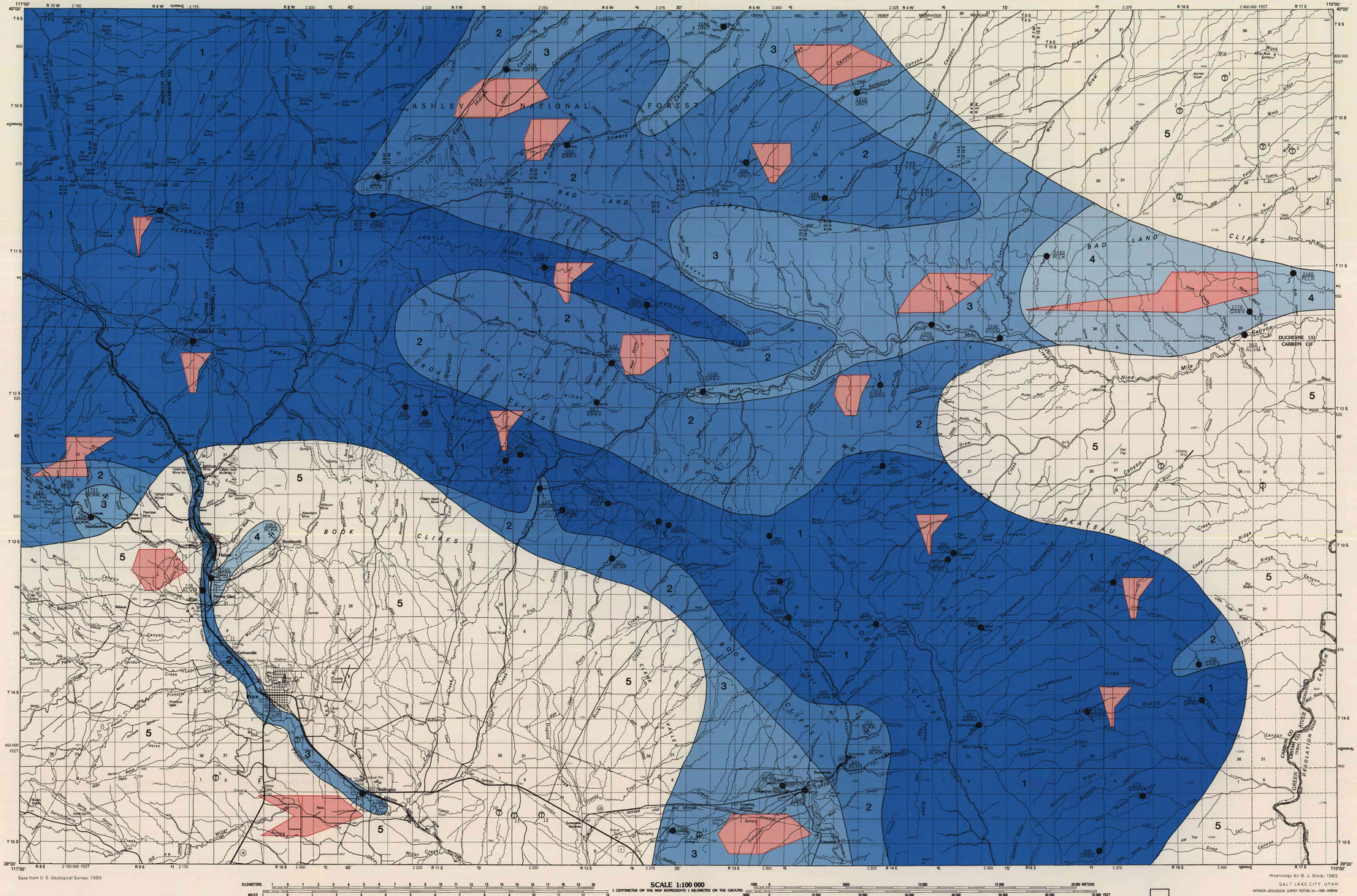

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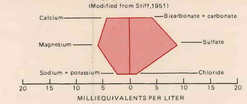

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SHEET 2 of 4

AVERAGE ANNUAL SEDIMENT YIELD

Average annual sediment yield in the area ranges from about 0.1 to 3 acre-feet per square mile as shown on the accompanying map (U.S. Department of Agriculture, 1973). Sediment yields were estimated using slope of land surface, vegetation, land use, soils, and precipitation. The sediment-yield map is presented as a general guide, and larger variations of sediment yield than those indicated may occur in each of the delineated areas. The map needs to be used with discretion to determine sediment yield at specific sites, particularly if there are changes in land use.

The smallest sediment yields generally are from high-altitude areas in the Wasatch Plateau, along Reservation and Argyle Ridges, and in the Roan Cliffs. Precipitation at higher altitudes produces a good cover of grass, brush, and conifers—all of which tend to decrease erosion. Lowland areas near Price and Wellington also yield relatively small amounts of sediment because the land surface is nearly level and soils are moderately well to well drained (Swenson and others, 1970, p. 3).

The largest sediment yields generally are from sparsely vegetated lowland areas underlain by easily erodible and poorly drained soils developed on shale. These lowland areas are most susceptible to erosion during intense thunderstorms that are common during summer and fall.

EXPLANATION

AVERAGE ANNUAL SEDIMENT YIELD, IN ACRE-FEET PER SQUARE MILE

Yield	
A	1.0 - 3
B	0.5 - 1
C	0.2 - 0.5
D	0.1 - 0.2

Base from U.S. Geological Survey, 1980

Sediment yields by U.S. Department of Agriculture, 1973

SALT LAKE CITY, UTAH

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1986—W86048

SCALE 1:100 000

1 CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND

UTAH

QUADRANGLE LOCATION

AVERAGE ANNUAL SEDIMENT YIELD

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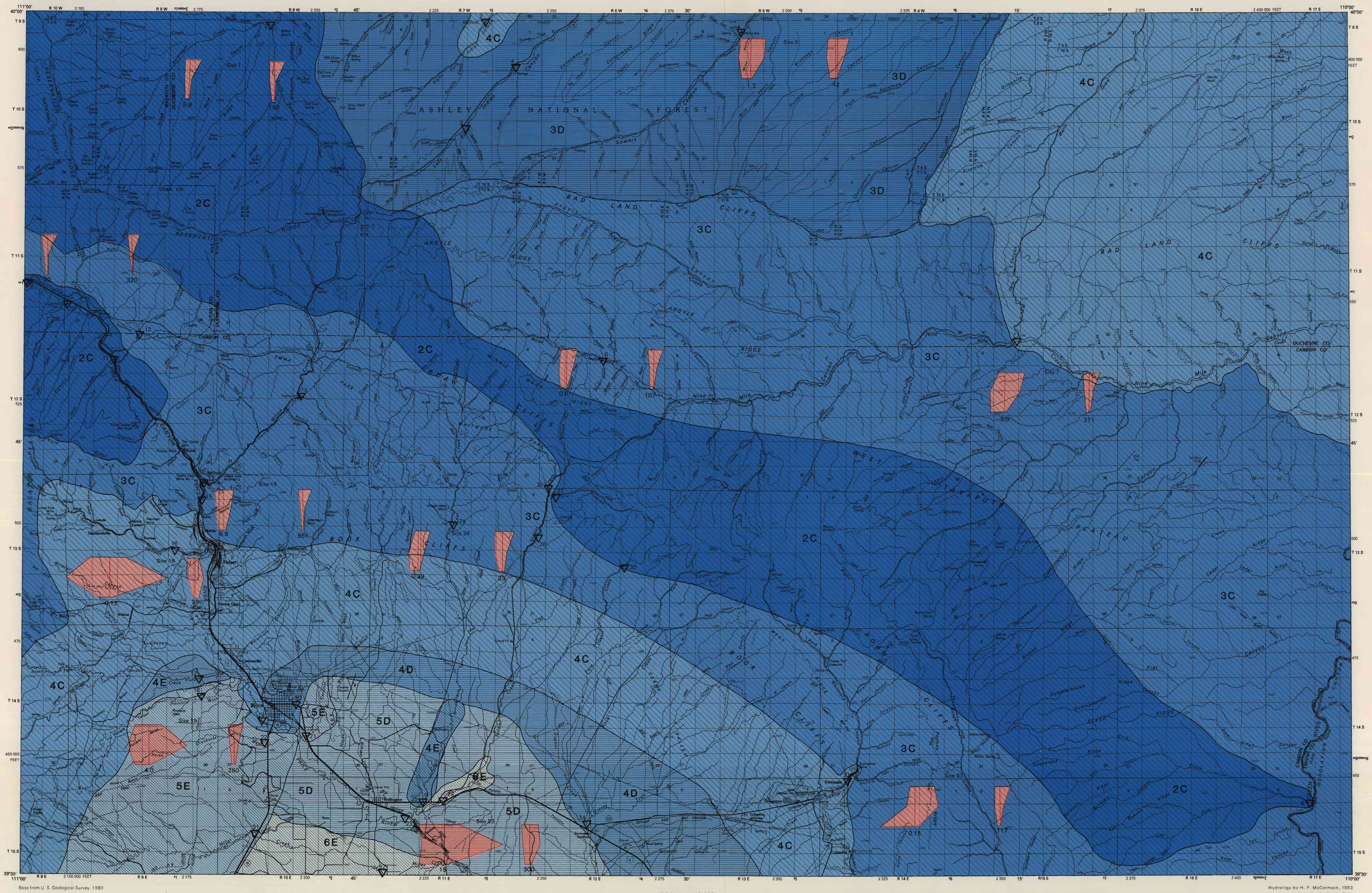

Base from U.S. Geological Survey, 1980

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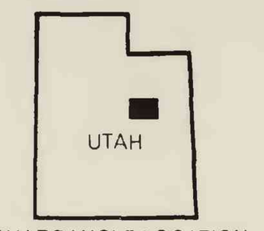

UTAH

QUADRANGLE LOCATION

Hydrology by H. F. McCormack, 1983
SALT LAKE CITY, UTAH
INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1986—W86048

DISSOLVED-SOLIDS CONCENTRATION IN STREAMFLOW

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DISSOLVED SOLIDS IN STREAMFLOW

Dissolved-solids concentrations in streamflow at 34 selected sites are listed in table 2. The data in table 2 are primarily from Hood and others (1976), Mundorff (1972, 1977), Price and Miller (1975), and Waddell and others (1978, 1981). Dissolved-solids concentrations ranged from 163 milligrams per liter at Price River near Heiner (site 15) to 6,220 milligrams per liter at Miller Creek near Wellington (site 32). Where data were available, ranges of dissolved-solids concentrations on the accompanying map were determined using concentrations from table 2. Where data were not available, dissolved-solids concentrations were estimated assuming that areas with similar geology and soil conditions would yield similar dissolved-solids concentrations.

The smallest dissolved-solids concentrations in the Price River basin are in streams draining high-altitude areas where the rocks consist primarily of sandstone and limestone that contain small quantities of readily soluble minerals. The largest dissolved-solids concentrations are in streams draining lowland areas underlain by shale, which contains large quantities of soluble minerals. Generally, dissolved-solids concentrations increase in a downstream direction due to return flow of irrigation water and to evaporation.

A guide to the use of water for livestock and poultry, based on dissolved-solids concentration, is given in table 3. The table should be used only as a general guide because . . . . "animals drink little, if any, highly saline water if water of low salt content is available to them. Unless they have been previously deprived of water, animals can consume moderate amounts of highly saline water for a few days without being harmed. Abrupt changes from water of low salinity to highly saline water cause more problems than a gradual change. Depressed water intake is very likely to be accompanied by depressed feed intake" . . . . (U.S. Environmental Protection Agency, 1972, p. 309).

The recommended limit of dissolved-solids concentrations for human drinking water is 500 milligrams per liter (U.S. Environmental Protection Agency, 1977). In general, most of the streamflow in the study area is not suitable for drinking water without treatment.

Water-quality diagrams (modified from Stiff, 1951) are presented on the map to show variations in the water types between low and high streamflow. In general, water types and dissolved-solids concentrations at sites 1, 5, 6, and 9, are similar during both high and low streamflow, and water types and dissolved solids at these sites are typical of streams draining high-altitude areas. There are significant changes in water type and dissolved-solids concentrations between low and high streamflow at sites 7, 16, 19, 23, and 33. These significant changes are typical of streams draining low-altitude areas underlain by shale, affected by return flow from irrigation, or receiving mine discharge.

Table 2.--Dissolved-solids concentrations in surface water at selected stream sites

Site no.	Site name	Period of record used (water years)	Number of samples	Dissolved solids (milligrams per liter)	
				Maximum	Minimum
1	West Fork Avintaquin Creek near Fruitland	1973	3	413	316
2	Right Fork Indian Canyon 9 miles above mouth	1974	1	1,160	--
3	Left Fork Indian Canyon above Spring Hollow	1974	1	598	--
4	Left Fork Indian Canyon below Jones Hollow	1974	2	847	819
5	Sowers Creek near Duchesne	1973	5	879	635
6	Minnie Maud Creek near Myton	1958, 1972	3	511	343
7	Nine Mile Creek at Nutter Ranch, near Myton[1]	1958	2	1,000	296
8	Rock Creek at Desolation Canyon	1947	2	440	354
9	Price River below White River, near Colton	1969-70	7	278	169
10	Beaver Creek near Soldier Summit	1969-70	6	256	177
11	Ford Creek at Highway 6, near Castle Gate	1969-70	3	353	260
12	Horse Creek near Castle Gate	1969-70	2	733	653
13	Willow Creek near Castle Gate	1969-70	3	536	421
14	Willow Creek at Castle Gate	1947, 1951, 1969-70, 1980-81	36	925	274
15	Price River near Heiner	1948-1950, 1956, 1958, 1969-70, 1980-81	69	648	163
16	Spring Canyon below Sowbelly Gulch, at Helper	1969-70, 1979-81	40	2,690	481
17	Gordon Creek near Carbonville	1969-70	5	2,240	1,130
18	Pinnacle Wash near Price[2]	1969-70	4	4,370	4,030
19	Price River at Price	1969-70	9	1,860	380
20	Meads Wash at Highway 6, at Price	1969-70	4	2,400	609
21	Cardinal Wash at Highway 6, at Price	1969-70	3	3,610	1,020
22	Drunkards Wash at Highway 10 at Price	1969-70	5	3,990	2,760
23	Price River near Wellington	1947, 1949, 1957, 1969-70	21	3,000	601
24	Coal Creek near Helper	1976-81	23	798	469
25	Coal Creek at Highway 6, near Wellington	1969-70	5	2,910	2,260
26	Soldier Creek above Pine Canyon	1976, 1979-80	7	551	270
27	Pine Canyon near Wellington	1976, 1979-80	8	333	238
28	Soldier Creek below mine, near Wellington	1969-70, 1979-82	25	696	277
29	Soldier Creek at Highway 6, near Wellington	1947, 1969-70	8	6,050	1,440
30	Dugout Creek near Sunnyside	1980-81	15	485	348
31	Miller Creek at Highway 10, near Wellington	1969-70	4	4,720	1,970
32	Miller Creek near Wellington	1969-70	5	6,220	2,050
33	Grassy Trail Creek at Sunnyside	1975-82	41	1,810	331
34	Grassy Trail Creek below Dugout and Rock Creeks, near Dragerton	1969-70	5	2,510	872

[1] Published as Minnie Maud Creek.
[2] Published as Pinnacle Creek.

Table 3.--Guide to the use of water for livestock and poultry (Adapted from U.S. Environmental Protection Agency, 1972, p. 308.)

Dissolved-solids concentrations (milligrams per liter)	Recommended uses
Less than 1,000	Relatively low level of salinity. Excellent for all classes of livestock and poultry.
1,000-2,999	Very satifactory for all classes of livestock. May cause temporary and mild diarrhea in livestock not accustomed to it, or watery droppings in poultry.
3,000-4,999	Satisfactory for livestock, but may cause temporary diarrhea or be refused at first by animals not accustomed to it. Poor water for poultry, often causing water feces, increased mortality, and decreased growth, especially in turkeys.
5,000-6,999	Can be used with reasonable safety for dairy and beef cattle, sheep, swine, and horses. Avoid use for pregnant or lactating animals. Not acceptable for poultry.

EXPLANATION

RANGE OF DISSOLVED-SOLIDS CONCENTRATION, IN MILLIGRAMS PER LITER

Concentration in low flow

2	Less than 500
3	500 - 1000
4	1000 - 3000
5	3000 - 5000
6	5000 - 7000

Concentration in high flow

C	Less than 500
D	500-1000
E	Greater than 1000

8 ▽ WATER-QUALITY SAMPLING SITE—Number is site number listed in table 2

WATER-QUALITY DIAGRAM
(Modified from Stiff, 1951)