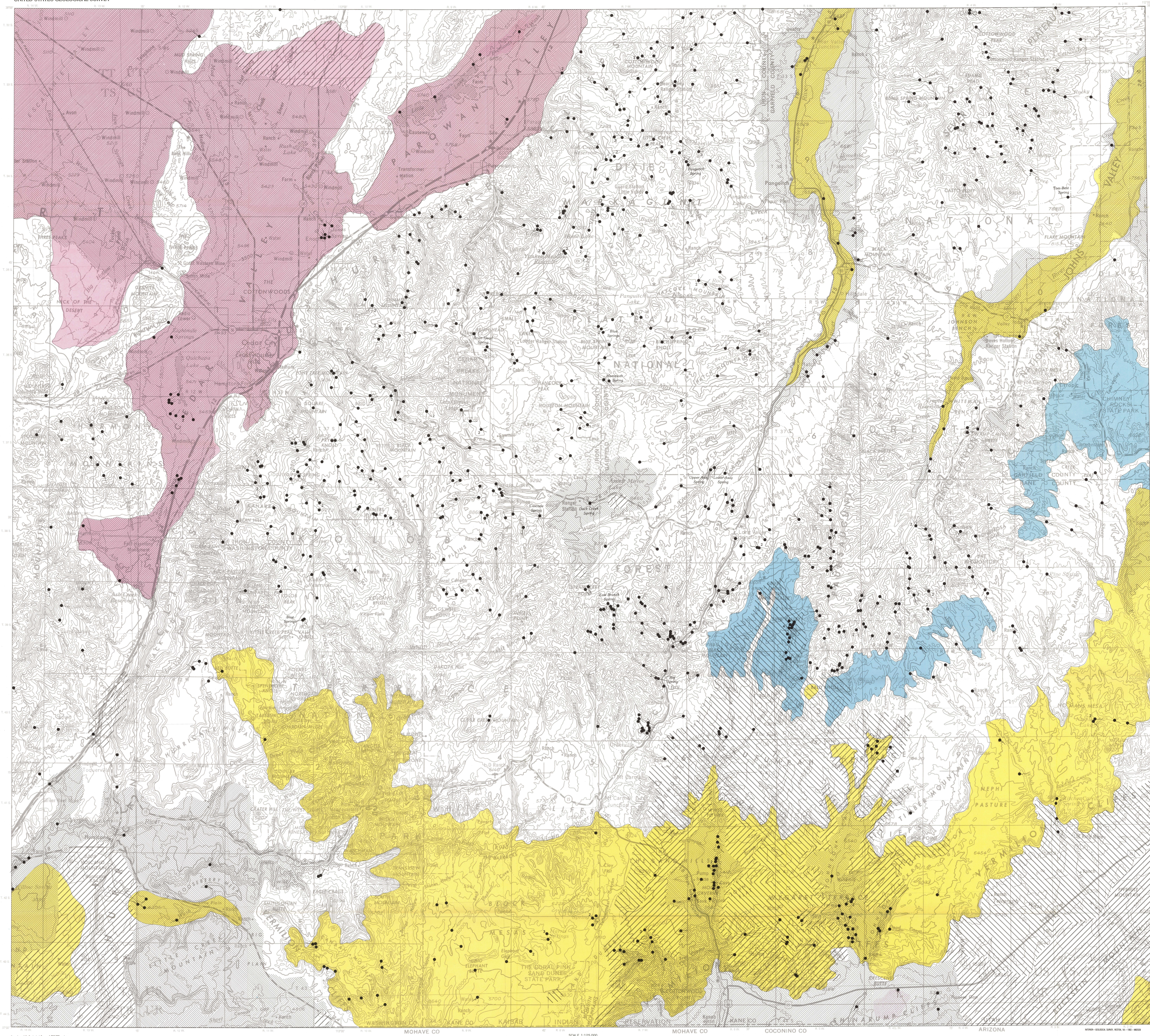
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1235–C



Base from U.S. Geological Survey 1:250,000 series:
Cedar City, Utah, 1953 (1971 revision)

SCALE 1:125 000

2 0 2 4 6 8 MILES

2 0 2 4 6 8 KILOMETERS

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1982 MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM 14°30′ EASTERLY FOR THE CENTER OF THE WEST EDGE TO 14°00′ EASTERLY FOR THE CENTER OF THE EAST EDGE. MEAN ANNUAL CHANGE IS 0°5.5′ WESTERLY

EXPLANATION

Yields of properly constructed wells and water levels in those wells are expected to be within the ranges shown. More detailed information about potential yields of wells and depths of ground water is available from the U.S. Geological Survey, Salt Lake City, Utah

EXPECTED SUSTAINED YIELDS OF INDIVIDUAL WELLS, IN GALLONS (LITERS) PER MINUTE	EXPECTED DEPTH TO GROUND WATER, IN FEET (METERS) BELOW LAND SURFACE
1-5 (4-19)	Less than 100 (30) Dot pattern indicates some wells will flow under artesian pressure
5-50 (19-190)	100-200 (30-61)
50-500 (190-1900) Locally 500-2000 (1900-7600)	200-500 (61-152)
500-1000 (1900-3800) Locally 1000-3000 (3800-11,400)	500-1000 (152-305) Locally more than 1000 (305)
	Less than 100 (30) to more than 500 (152) Less than 100 (30) along deeply incised streams; more than 500 (150) on higher plateaus, benches, and terraces

2 Spring
Figure indicates number of springs at same site

INTRODUCTION

This is one in a series of maps that describes the geology and related natural resources of the Alton-Kolob coal-fields area, Utah. Shown on this map is the general availability of ground water as indicated by potential yields of individual wells and expected depth to water in wells. Most data used to compile this map were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources Division of Water Rights. Other sources of data included U.S. Geological Survey 7½- and 15-minute topographic quadrangle maps, unpublished reports of field evaluations of potential shock-watering sites by U.S. Geological Survey personnel, and the geologic map of Utah (Stokes, 1964).

This map is very generalized and is intended chiefly for planning purposes. It should be used with discretion. For more detailed information about the availability of ground water in various parts of the map area the reader is referred to the following reports: Thomas and Taylor (1946); Marine (1963); Sandberg (1963, 1966); Carpenter, Robinson, and Bjorklund (1964, 1967); Feltis (1966); Goode (1964, 1966); Cordova, Sandberg, and McConkie (1972); Cordova (1978, 1981); and Bjorklund, Sumsion, and Sandberg (1977, 1978). For a general description of the chemical quality of ground water in the Alton-Kolob coal-fields area the reader is referred to Price (1981).

GENERAL HYDROLOGIC PROPERTIES OF THE ROCKS

Rocks ranging in age from Permian to Holocene are exposed in the Alton-Kolob coal-fields area (Stokes, 1964). They consist chiefly of sedimentary rocks including interbedded strata of sandstone, siltstone, limestone, shale, and conglomerate; but they are capped locally by extrusive igneous rocks. Unconsolidated and partly consolidated deposits of gravel, sand, silt, and clay partly fill Cedar, Parowan, and Escalante Valleys, and the valleys of the larger streams; they also mantle the older sedimentary and igneous rocks locally throughout the area.

Water occurs at varying depths in most of the rocks that underlie the Alton-Kolob coal-fields area. The rocks, where saturated, yield water at varying rates depending primarily on their permeability and the hydraulic head under which the water flows. The most permeable rocks—those that transmit water most readily—are the unconsolidated valley-fill deposits. These deposits yield several hundred to locally more than 2000 gallons per minute of water to individual large-diameter wells in parts of Cedar, Parowan, and Escalante Valleys and the larger stream valleys of the map area. It is estimated that there are more than 40 million acre-feet of water in saturated fill in Cedar and Parowan Valleys alone (Bjorklund and others, 1978, p. 21).

Sandstone strata, particularly where faulted and fractured, also yield water readily to wells in some parts of the Alton-Kolob coal-fields area. This is especially true of the Navajo Sandstone of Late Triassic(?) and Jurassic age. The Navajo is widely exposed in the south-central part of the map area (mostly within the area in which potential well yields range from 50 to 500 gal/min); and it extends beneath younger rocks in the upper reaches of the Virgin River and Kanab Creek. In the Virgin River and Kanab Creek basins, the Navajo yields more than 100 gallons per minute of water to several wells. A large-diameter test well that penetrates younger rocks and taps the Navajo at a depth of more than 1200 feet in the Bald Knoll area reportedly produced more than 1000 gallons per minute. The well was drilled to determine if the Navajo could provide enough water to slurry coal from the Alton coal field to powerplants of the proposed Allen-Warner Valley energy system. (U.S. Department of the Interior, 1980.) Results of the testing are inconclusive at this date (1981).

The Navajo Sandstone in the south-central part of the map area is estimated to contain more than 200 million acre-free of recoverable water (Cordova, 1981, table 15). As indicated above, however, the water occurs at considerable depth in some places.

Extrusive igneous rocks of Tertiary and Quaternary age underlie parts of the highest plateaus in the map area. Those rocks commonly contain permeable scoreaceous, vesicular, and fractured zones through which water is rapidly transmitted to springs. Likewise, fractures (in same places enlarged by solution) in limestone of the Wasatch Formation of Tertiary age also transmit water readily to springs. As a whole, however, the Wasatch, which underlies most of the high central part of the map area, generally is less permeable than the Navajo and extrusive igneous rocks.

Rocks generally having the least permeability in the Alton-Kolob coal-fields area are the siltstone and shale strata commonly found in the Tropic Shale and Dakota Sandstone of Cretaceous age and the Chinle and Moenkopi Formations of Triassic age. Those rocks, however, are not widely exposed in the area and in most places are either overlain or underlain by more permeable water-bearing strata. For more information about the general hydrologic properties of rocks that underlie the Alton-Kolob coal-fields area the reader is referred to Carpenter, Robinson, and Bjorklund (1967, table 1); Cordova, Sandberg, and McConkie (1972, table 7); Bjorklund, Sumsion, and Sandberg (1978, table 3); and Cordova (1981, table 2).

EXPECTED YIELDS OF WELLS

The yield of a well depends on the hydrologic properties of the rocks tapped by the well; but it also depends on the depth and diameter of the well, the methods by which it was drilled and completed, and on the size, depth, and type of its pump. The minimum expected yields of individual wells shown on this map are based on the assumption that they are at least 6 inches in diameter; fully penetrate the aquifer; either have no casing through the aquifer or have perforated casing or well screens opposite the aquifer; and are equippped with efficient pumps. The yields shown are those that could be sustained for several years. In many parts of the Alton-Kolob coal-fields area, individual wells may obtain yields larger than those shown. These larger yields, however, probably would not be sustained from year to year because of limitations of either storage capacity in the aquifer or the rate of natural recharge to the aquifer. For example, some canyons contain saturated permeable alluvial deposits that could yield up to 100 gallons per minute of water to a well for short periods of pumping, but recharge (from less permeable bedrock) to the alluvium is too slow to sustain such withdrawal rates, and well yields will decrease with time.

EXPECTED DEPTH TO GROUND WATER

The ranges of expected depth to ground water shown on this map are based on measured and reported depths to water in wells. For areas where such water-level data are not available, the expected depths to water are inferred from the general geology, topography, and information in unpublished reports of field investigations of prospective stock-water well sites. The depths shown, in most cases, represent the depth to the top of the main zone of saturation (the regional water table). In areas such as the Parowan Valley and the area east of Kanab, where water levels (the potentiometric surfaces) are higher than the land surface, the main water-yielding zone may be more than 100 feet below land surface. Also, in the high plateau areas, ground-water bodies are perched at varying levels above the main zone of saturation. These perched ground-water bodies support the flow of many springs. Although wells tapping such shallow perched aquifers could produce enough water for domestic and stock supply, they probably could not produce large sustained supplies.

SPRINGS

Most of the springs shown on this map were originally identified on U.S. Geological Survey 7½- and 15-minute topographic quadrangle maps. The springs shown probably represent less than 75 percent of the actual number of springs in the area. Of those shown, records of geologic source, occurrence, discharge rate, and chemical quality of the water are available for about 25 percent. Those records are available in Wilson and Thomas (1964); Carpenter, Robinson, and Bjorklund (1964, table 2); Goode (1964, table 3, and 1966, table 2); Mundorff, (1971); Bjorklund, Sumsion and Sandberg (1977, table 2); and Cordova (1981, table 21).

Most of the springs for which records are available discharge less than 1 to about 50 gallons per minute; but some discharge more than 100 gallons per minute and a few have maximum discharges of more than 10 cubic feet per second (more than 4500 gallons per minute). Most of the springs in the area discharge from the Wasatch Formation or the extrusive igneous rocks in the headwater areas of the Virgin and Sevier Rivers and Coal and Kanab Creeks. Most of the low-altitude springs discharge from sandstone strata of Cretaceous age and the Navajo Sandstone where those rocks have been incised by streams.

Mundorff (1971, p. 26) lists 10 major springs in the Alton-Kolob coal-fields area as follows:

Name	General location	Discharge (ft^3/s)
Blue Springs	T. 36 S., R. 7 W.	10
Mammoth Spring	T. 36 S., R. 7 W.	1.8–314
Brian Head Spring	T. 36 S., R. 9 W.	2
Upper Asay Spring	T. 37 S., R. 6 W.	8
Lower Asay Spring	T. 37 S., R. 6 W.	28–35
Duck Creek Spring	T. 38 S., R. 8 W.	9.5–25
Cascade Spring	T. 38 S., R. 8 W.	0–30
East Branch Spring	T. 39 S., R. 7 W.	1
Blue Springs	T. 39 S., R. 11 W.	2
Big Spring	T. 40 S., R. 7 W.	0.9–1.1

Cascade and Duck Creek Springs are fed in part by seepage from Navajo Lake, and Lower Asay Spring is fed in part by return seepage of the flow from Duck Creek Spring. (See Wilson and Thomas, 1964, p. C12–C14). Other major springs in the area are Panguitch Spring (T. 34 S., R. 6 W.), with an estimated discharge of 900 gallons per minute, and Tom Best Spring (T. 34 S., R. 3 W.), with an estimated discharge of 500 gallons per minute (Feltis, 1966, table 4, p. 72).

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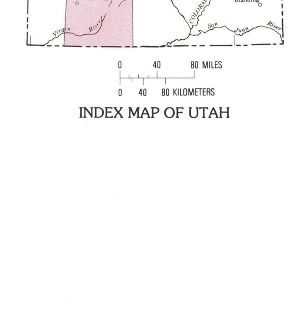

INDEX MAP OF UTAH

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1982—W82028

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MAP SHOWING GENERAL AVAILABILITY OF GROUND WATER IN THE ALTON-KOLOB COAL-FIELDS AREA, UTAH

By
Don Price

1982