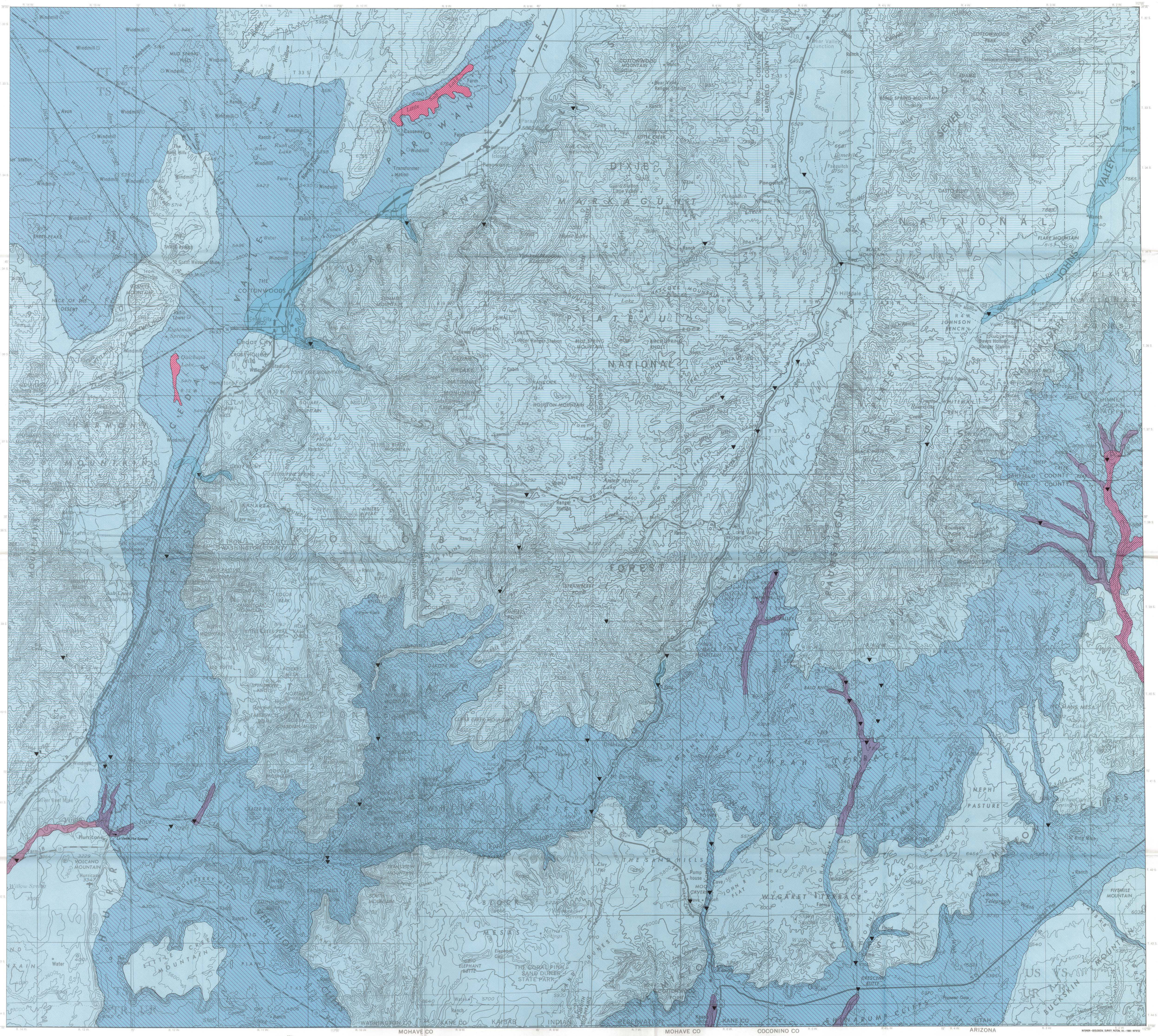
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-1235-A



EXPLANATION

Dissolved-solids concentrations, in milligrams per liter, of surface water are generally in the ranges specified

Minimum range (generally during high-runoff periods)	Maximum range (generally during low-runoff periods)
Less than 250	Less than 250
250–500	250–500
500–1000	500–1000
1000–3000	1000–3000
More than 3000	More than 3000

▼E
Data site used for control

Dissolved-solids determined by laboratory analysis except E, estimated from specific conductance of streamflow as determined by field conductivity meter

INTRODUCTION

This is one of a series of maps that describes the geology and related natural resources of the Alton-Kolob coal-fields area, Utah. The purpose of this map is to show the general chemical quality of surface water in the area by ranges of dissolved-solids concentrations (salinity) known or assumed to occur in the water.

Most of the water-quality data used to compile this map were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources and by Utah's Five County Association of Governments under the U.S. Environmental Protection Agency 208 Water Quality Studies (Vaughn Hansen Associates, 1975–77, Appendix 7). The ranges of dissolved-solids concentrations were generally based on actual chemical analyses, but at some sites the ranges were estimated from field measurements of specific conductance of the water. In the Alton-Kolob coal-fields area, as determined from the relations of specific conductance to dissolved-solids concentration in available complete chemical analyses, dissolved-solids concentrations range from about 60 to 70 percent of the specific conductance.

In those areas where little or no surface-water-quality data were available, ranges of dissolved-solids concentrations are inferred on the basis of the following: (1) known ground-water quality, which affects the quality of surface water during low-flow periods; (2) geology (Stokes, 1964); (3) water yields (Bagley and others, 1964); (4) topography; and (5) man's activities (such as irrigation and use of salt to deice roads), which affect surface-water quality.

Other sources of information about the chemical quality of surface water in parts of the Alton-Kolob coal-fields area include: Wilson and Thomas (1964), Hahl and Cabell (1965), Hahl and Mundorff (1968), Vaughn Hansen Associates (1975–77), and Sandberg (1979).

SURFACE-WATER QUALITY

Surface water in the Alton-Kolob coal-fields area generally ranges from fresh to moderately saline according to the following classification commonly used by the U.S. Geological Survey:

Class	Dissolved-solids concentration (milligrams per liter)
Fresh	Less than 1,000
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Briny	More than 35,000

The freshest water is in the principal runoff-producing areas of the Paunsaugunt and Markagunt Plateaus and Pine Valley Mountains, where dissolved-solids concentrations of runoff are generally less than 250 mg/L (milligrams per liter) even during low-flow periods. The most highly saline water is runoff in the Paria River downstream from Cannonville and water in Quichapa and Little Salt Lakes, where dissolved-solids concentrations are known or assumed to exceed 3,000 mg/L. The bottoms of usually dry Quichapa and Little Salt Lakes are coated with salt, indicating that any storm runoff that collects in these lakes eventually becomes briny during desiccation. This may also be true of Rush Lake.

Sevier River

Dissolved-solids concentrations of headwater inflow to the Sevier River within the map area are generally less than 250 mg/L during both high- and low-runoff periods. Headwater areas of the Sevier River are underlain largely by rocks which contain relatively small amounts of readily soluble minerals. Because of this, the salinity of the river increases only slightly downstream, and this increase may be due largely to return flows from irrigated pastures. Dissolved-solids concentrations of runoff in the lower reaches of the river in the map area are not known to exceed 500 mg/L even during low-flow periods.

The few complete chemical analyses available indicate that runoff from that part of the map area drained by the Sevier River is mainly of a calcium bicarbonate or calcium magnesium bicarbonate type. (See Hahl and Mundorff, 1968, pl. 2.)

Virgin River

The headwater areas of the Virgin River that are above 7,000-feet in altitude, like those of the Sevier River, are underlain largely by rocks that contain relatively small amounts of readily soluble minerals. Because of this, dissolved-solids concentrations of the inflow to the Virgin River from those areas are low—generally less than 250 mg/L during both high- and low-runoff periods. However, the salinity of the river increases quite rapidly downstream, and in the lowermost reach shown on this map, dissolved-solids concentrations generally exceed 1,000 mg/L during both high- and low-runoff periods. This increased salinity is attributed chiefly to geologic conditions in the lower stream reaches. The North and East Forks of the Virgin River descend through a geologic section comprised largely of shale, siltstone, and other rock units, which, unlike those in the headwater areas, contain large amounts of evaporites and other readily soluble minerals. Those easily erodable rocks contribute significantly to both the salt and sediment loads of the river.

La Verkin (Dixie) Hot Springs are also a major contributor to the salinity of the Virgin River. Those springs rise along a fault at the base of the Hurricane Cliffs and discharge directly into the river (Milligan and others, 1966, p. 42). They have dissolved-solids concentrations of about 10,000 mg/L (Mundorff, 1970, p. 44) and, according to Hagen and others (1971, p. 56), contribute about 104,000 tons of salt to the river annually.

Other sources of salinity in the Virgin River include irrigation-return flows and effluents from communities in the drainage basin. Consumptive use of streamflow by phreatophytes along some water courses also increases the river's salinity by concentrating its salt load into less flow.

The few available complete chemical analyses indicate that runoff from the headwater areas of the Virgin River is generally of a calcium bicarbonate or calcium magnesium bicarbonate type, as in the Sevier River basin. A small amount of available data also suggests that water leaving the map area in the Virgin River is mainly of a calcium chloride type during high-flow periods and a sodium chloride type during low-flow periods.

Paria River

Water that generally contains less than 500 mg/L of dissolved solids is diverted from the Sevier River to the Paria River basin for irrigation in the Tropic-Cannonville area. Soils in the Tropic-Cannonville area are developed largely on shale; and, therefore, they contain considerable amounts of readily soluble minerals. Consequently, irrigation-return flows to the Paria River are saline and increase the river's salinity. Dissolved-solids concentrations of the river between Cannonville and the map boundary generally exceed 3,000 mg/L during low flow. Salt deposits are left on the banks and dry bottoms of the Paria River and some of its tributaries, from dessicated streamflow (and locally effluent ground water) during non-runoff periods. Those salts are readily redissolved in the initial surges of subsequent runoff, adding to and rapidly increasing the salinity of that runoff.

The water diverted to the Paria River from the Sevier River is of a calcium bicarbonate type, but the water that leaves the map area in the Paria River is of a sodium sulfate type.

Kanab Creek and Johnson Wash

In the Skutumpah Terrace area, Kanab Creek and Johnson Wash drain easily erodable shales, siltstone, and associated rocks that contribute large quantities of salt and sediment to the two streams. Consequently, during low-flow periods, dissolved-solids concentrations along the main stems of both streams commonly exceed 500 mg/L and locally exceed 1,000 mg/L. The lower concentrations in the middle reaches (in Tps. 42 and 43 S.) of Johnson Wash are attributed to influent seepage of fresher water from the Navajo Sandstone of Triassic(?) and Jurassic age, which crops out extensively in those reaches (Stokes, 1964).

A small amount of data available indicate that the headwaters of both Kanab Creek and Johnson Wash are chiefly of a calcium bicarbonate or calcium magnesium bicarbonate type, and water in the lower stream reaches is chiefly of a magnesium bicarbonate type.

Tributaries to Cedar and Parowan Valleys

The principal tributaries to Cedar and Parowan Valleys are Coal, Summit, Parowan, Red, and Little Creeks. Runoff in all these streams generally contains less than 500 mg/L of dissolved solids during both high- and low-runoff periods. Coal Creek drains some geologic units that contain relatively large amounts of readily soluble minerals; and, consequently, dissolved-solids concentrations of that stream occasionally range from 500 to 1,000 mg/L during low-flow periods.

Although sulfate is a major anion in the water in the lower reaches of Coal Creek, during low flow most of the runoff in this stream and the other principal tributaries to Cedar and Parowan Valleys is of a calcium magnesium bicarbonate type.

There is no direct information regarding the chemical quality of surface water within Cedar and Parowan Valleys or other low valley areas. Diversions and natural flows from the mountain streams to the valley bottoms are assumed to increase in salinity, due largely to return flow from irrigated lands and urban or suburban runoff. In most valley areas, however, the maximum dissolved-solids concentrations of free-flowing surface water probably does not greatly exceed 500 mg/L.

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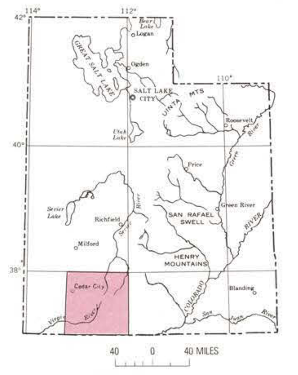

INDEX MAP OF UTAH

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

SCALE 1:125 000

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP SHOWING GENERAL CHEMICAL QUALITY OF SURFACE WATER IN THE ALTON-KOLOB COAL-FIELDS AREA, UTAH

By
Don Price
1980

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