Seepage Investigation and Selected Hydrologic Data for the Escalante River Drainage Basin, Garfield and Kane Counties, Utah, 1909-2002

By Dale E. Wilberg and Bernard J. Stolp

U.S. GEOLOGICAL SURVEY

Scientific Investigations Report 2004-5233

Prepared in cooperation with the

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT,
GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT

Salt Lake City, Utah
2005

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CONVERSION FACTORS, DATUMS, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
	448.8	gallon per minute
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.59	square kilometer

Water temperature is reported in degrees Celsius (°C) and degrees Fahrenheit (°F) and may be converted by using the following equations:

$$^{o}F = 1.8\ (^{o}C) + 32$$
$$^{o}C = (^{o}F - 32) / 1.8.$$

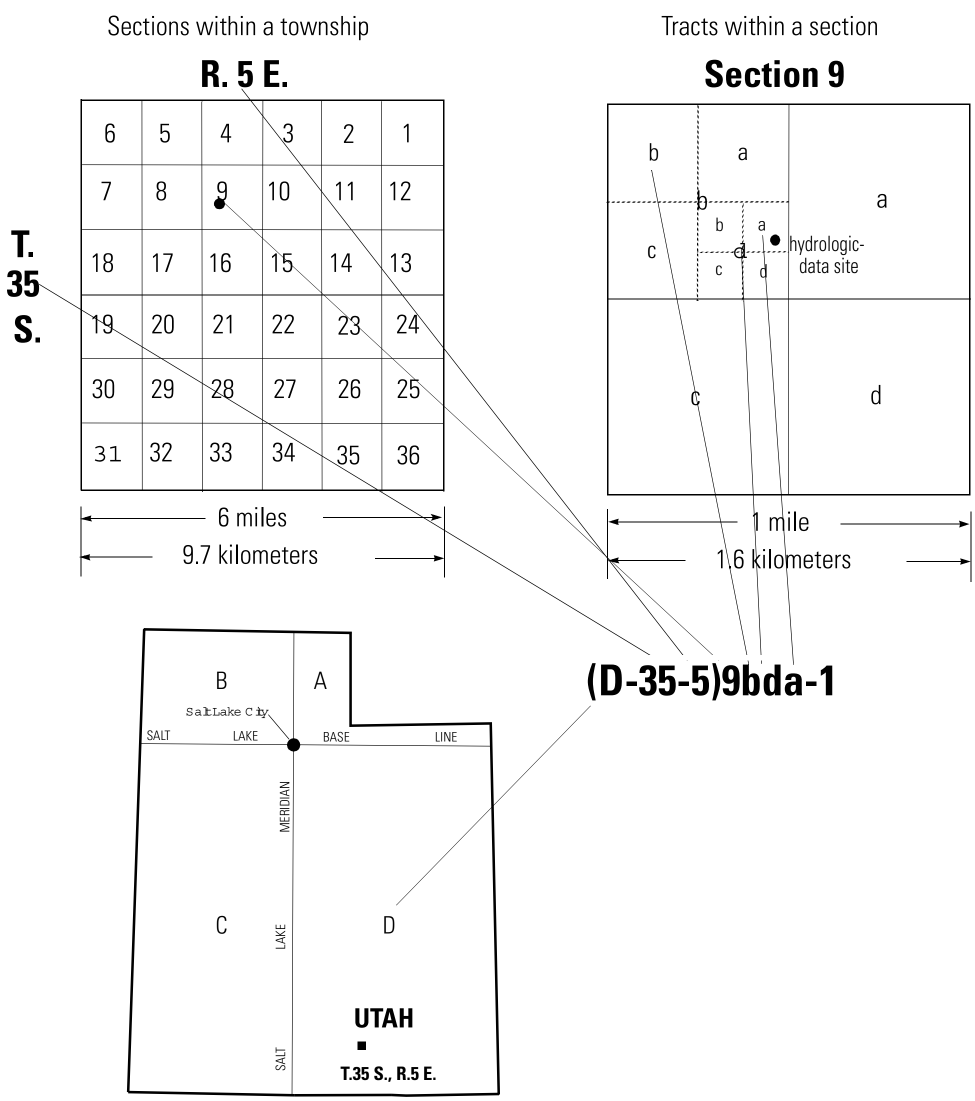
Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27).

Concentrations of chemical constituents in water are reported either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter and micrograms per liter are units expressing the concentration of chemical constituents in solution as mass (grams) of solute per unit volume (liter) of water. A liter of water is assumed to weigh 1 kilogram, except for brines or water at high temperatures because of significant changes in the density of the water. For concentrations less than 7,000 mg/L or 7,000,000 µg/L, the numerical value is the same as for concentrations in parts per million or parts per billion, respectively.

Specific conductance is reported in microsiemens per centimeter (µS/cm) at 25 degrees Celsius. Tritium concentration in water is reported as tritium units (TU). The ratio of 1 atom of tritium to 10^{18} atoms of hydrogen is equal to 1 TU. Chlorofluorocarbons (CFCs) are measured in picomoles per kilogram (pmoles/kg), which is equivalent to parts per quadrillion.

NUMBERING SYSTEM USED FOR HYDROLOGIC-DATA SITES IN UTAH

The system of numbering hydrologic-data sites in Utah is based on the cadastral land-survey system of the U.S. Government. The number describes its position in the land net. The land-survey system divides the State into four quadrants separated by the Salt Lake Base Line and the Salt Lake Meridian. These quadrants are designated by the uppercase letters A, B, C, and D, indicating the northeast, northwest, southwest, and southeast quadrants, respectively. Numbers designating the township and range, in that order, follow the quadrant letter, and all three are enclosed in parentheses. The number after the parentheses indicates the section and is followed by three lowercase letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section—generally 10 acres for a regular section[1]. The lowercase letters a, b, c, and d indicate, respectively, the northeast, northwest, southwest, and southeast quarters of each subdivision. The number after the letters is the serial number of the well or spring within the 10-acre tract. When the serial number is not preceded by a letter, the number designates a well. When the serial number is preceded by an “S,” the number designates a spring. Thus, (D-35-5)9bda-1 designates the first hydrologic-data site visited in the northeast 1/4 of the southeast 1/4 of the northwest 1/4 of section 9, T. 35 S., R. 5 E.



[1]Although the basic land unit, the section, is theoretically 1 square mile, many sections are irregular in size and shape. Such sections are subdivided into 10-acre tracts, generally beginning at the southeast corner, and the surplus or shortage is taken up in the tracts along the north and west sides of the section.

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ABSTRACT

This report contains the results of an October 2001 seepage investigation conducted along a reach of the Escalante River in Utah extending from the U.S. Geological Survey streamflow-gaging station near Escalante to the mouth of Stevens Canyon. Discharge was measured at 16 individual sites along 15 consecutive reaches. Total reach length was about 86 miles. A reconnaissance-level sampling of water for tritium and chlorofluorcarbons was also done. In addition, hydrologic and water-quality data previously collected and published by the U.S. Geological Survey for the 2,020-square-mile Escalante River drainage basin was compiled and is presented in 12 tables. These data were collected from 64 surface-water sites and 28 springs from 1909 to 2002.

None of the 15 consecutive reaches along the Escalante River had a measured loss or gain that exceeded the measurement error. All discharge measurements taken during the seepage investigation were assigned a qualitative rating of accuracy that ranged from 5 percent to greater than 8 percent of the actual flow. Summing the potential error for each measurement and dividing by the maximum of either the upstream discharge and any tributary inflow, or the downstream discharge, determined the normalized error for a reach. This was compared to the computed loss or gain that also was normalized to the maximum discharge. A loss or gain for a specified reach is considered significant when the loss or gain (normalized percentage difference) is greater than the measurement error (normalized percentage error). The percentage difference and percentage error were normalized to allow comparison between reaches with different amounts of discharge.

INTRODUCTION

Grand Staircase-Escalante National Monument was established in 1996 for the protection, preservation, and scientific study of the natural and cultural resources. In keeping with those goals, the U.S. Geological Survey (USGS) is working cooperatively with the U.S. Bureau of Land Management (BLM) to identify and understand the hydrologic system within the monument. Specifically, this includes studying (1) baseline characteristics and variability, (2) regional and subregional surface- and ground-water systems, and (3) site-specific processes and interaction.

Much of the land in the Escalante River drainage basin is managed by the Grand Staircase-Escalante National Monument (pl. 1). The Escalante River is the largest perennial stream in the monument and creates important aquatic and riparian habitat. A seepage investigation of the river was conducted to better understand the hydrologic connection to the surrounding ground-water system. The seepage investigation was designed to determine (1) if large amounts of surface water in the Escalante River are lost or gained, (2) where those losses or gains occurred, (3) the amount of losses or gains and if they are significant, and (4) which rock units are involved. If specific reaches of the river have significantly large losses or gains, then those reaches could be the focus of future, detailed seepage investigations. Similarly, if specific rock units are large sources or sinks of surface water, then those units could be the focus of future detailed seepage investigations.

This report contains the results of the October 2001 seepage investigation along the Escalante River and comparison with an October 1981 seepage investigation. It also includes a compilation of all hydrologic and water-quality data collected by the USGS within the Escalante River drainage basin from 1909 to 2002.

Discharge measurements, seepage loses and gains, results of environmental tracer analyses, and the historical data for 64 surface-water sites and 28 springs (pl. 1) are presented in a series of tables located at the end of the report. All sites presented in this report are organized in downstream order in table 1. For each site, any additional tables that contain data for the site and the original source of the data are listed in table 1. The site identification (site ID) is a unique number that is needed for the data to be accessed electronically within the USGS National Water Information System (NWIS) and is based on the latitude-longitude of a site or, in the case of a streamflow gage, the station number.

Physical Setting and Hydrogeology

The area of the Escalante River drainage basin is approximately 2,020 mi^2 as measured from the point where the Escalante River formerly joined the Colorado River, now covered by Lake Powell. The drainage basin is located within the High Plateau section and the Canyon Lands section of the Colorado Plateau physiographic province (Hunt, 1974). The high-altitude, lava-capped Aquarius Plateau, which is bounded by the Paunsagunt Fault on the west, is in the High Plateau section. The eroded sandstone canyons of the Escalante River and its tributaries are in the Canyon Lands section. Altitude ranges from about 11,200 ft near the headwaters of East Fork Boulder Creek on Boulder Mountain to 3,700 ft at lake level when Lake Powell is full. Altitude of data-collection sites ranges from 9,315 ft at the East Fork Boulder Creek gage (USGS stream gage 09338000) to 3,380 ft at the former site of the Escalante River at mouth gage (USGS stream gage 09339500). Average basin altitude is 6,400 ft. In addition to the canyons of the Escalante River and its tributaries, major geographic features are the (1) Aquarius Plateau and Boulder Mountain on the north where perennial tributaries such as Birch, North, Pine, Mamie, Death Hollow, Sand, Calf, Boulder, and Deer Creeks originate; (2) Escalante Mountains on the west that include Griffin Top and Barney Top, where drainage divides separate the Paria, East Fork of Sevier, Fremont, and the Escalante Rivers; (3) Kaiparowits Plateau and Fiftymile Mountain to the southwest, south, and southeast; and (4) Waterpocket Fold and Circle Cliffs to the east and northeast (pl. 1).

Two geohydrologic units crop out in the canyon of the Escalante River along the channel reach where the October 2001 seepage investigation was done, the Navajo aquifer of Jurassic age and the underlying Chinle-Moenkopi confining unit of Triassic age (Freethey and Cordy, 1991, p. C12-C21). The Navajo aquifer primarily is composed of massive, very fine- to medium-grained, well sorted, crossbedded sandstones of the Wingate Sandstone, Navajo Sandstone, and Page Sandstone, and interbedded fluvial sandstone, siltstone, and mudstone of the Kayenta Formation (Freethey and Cordy, 1991, p. C17). The Page Sandstone does not crop out at river level. The Chinle-Moenkopi confining unit is composed of fluvial and lacustrine sandstone, siltstone, shale, and bentonitic mudstone of the undifferentiated Chinle Formation (Hackman and Wyant, 1973, sheet 1). The Moenkopi Formation does not crop out in the area of seepage investigation.

Massive cliffs and deeply incised canyons are cut into the Navajo and Wingate Sandstones and the stepped slopes of Kayenta Formation from Pine Creek at Mile 0 to below Twentyfive Mile Wash near Mile 55. The Chinle Formation first crops out at Mile 55 along the outside bends on the north side of the river and crops out continuously from about Mile 59 (1 mi above Moody Creek) to about Mile 84 (2 mi above Stevens Canyon). Maximum incision into the soft Chinle Formation by the Escalante River occurs between Mile 68 and Mile 77. Removal of the easily erodable Chinle Formation undercuts the support of the overlying Wingate Sandstone cliffs, which causes them to collapse and the canyon to widen. Large talus and rockslide deposits, primarily composed of boulders from the Wingate Sandstone, and rotational slump block deposits, composed of Chinle Formation, are well developed in this reach of the river.

Previous Studies

Records of surface-water discharge data for the following USGS stream gages (station number in parentheses) in the Escalante River drainage basin are published in the following USGS Water-Supply Papers (WSP): WSP 1313 (U.S. Geological Survey, 1954) for the period before 1950 for Escalante River (09337500, called Escalante Creek before 1913); WSP 1733 (U.S. Geological Survey, 1964) for 1950-60 for North Creek

(09335500), Birch Creek near Escalante (09336000), Birch Creek at mouth (09336500), Pine Creek (09337000), Escalante River (09337500), East Fork Boulder Creek (09338000), East Fork Deer Creek (09338500), Boulder Creek (09339000), and Escalante River at mouth (09339500); and WSP 1925 (U.S. Geological Survey, 1970) for 1961-65 and WSP 2125 (U.S. Geological Survey, 1973) for 1966-70 for Pine Creek (09337000) and East Fork Boulder Creek (09338000). Annual maximum discharges are published in WSP 1313 (U.S. Geological Survey, 1954), WSP 1925 (U.S. Geological Survey, 1970), and WSP 2125 (U.S. Geological Survey, 1973) for crest-stage partial-record stations at Birch Creek near Escalante (09336000), Upper Valley Creek near Escalante (09336400), East Fork Deer Creek near Boulder (09338500), Deer Creek near Boulder (09338900), and Twentymile Wash near Escalante (09339200). Surface-water records of active gages in the Escalante River drainage basin have been published annually since 1962 in USGS publications referred to as Surface Water Records of Utah (U.S. Geological Survey, 1962-65) and Water Resources Data for Utah (U.S. Geological Survey, 1966-82; ReMillard and others, 1983-96; Herbert and others, 1997-2002; Wilberg and others, 2003).

Cloudburst floods in Utah were described by Woolley (1946) for 1850-1938 and by Butler and Marsel (1972) for 1939-69. Both reports contain descriptions of floods in the Escalante River drainage basin. A summary of maximum discharges in streams in Utah was authored by Whitaker (1969) and includes data collected at partial-record stations described above. Equations for estimating streamflow characteristics including average discharge and annual maximum 1-, 7-, and 15-day mean discharges for recurrence intervals of 10, 50, and 100 years were determined at or near the gages in the Escalante River drainage basin by Christiansen and others (1986). Equations for estimating the magnitude and flood frequency of 2-, 5-, 10-, 25-, 50-, and 100-year peak discharges at ungaged sites for areas of Utah and the southwestern United States, including areas in the Escalante River drainage basin, were developed by Thomas and Lindskov (1983), and Thomas and others (1997).

Water-quality analyses and seepage investigation data were collected by the USGS in support of various ground-water and surface-water studies. These studies were cooperatively funded by the USGS and either the State of Utah, Department of Natural Resources; or the U.S. Department of the Interior, Bureau of Land Management. Some data republished in this report originally were interpreted or published in Price (1978 and 1979), Plantz (1983 and 1985), Blanchard (1986), and Wilberg (1995).

Descriptions of geology are contained in Doelling and others (2000). A historic perspective of the geography and geology of the area is contained in Gregory and Moore (1931).

Methods

Most of the Escalante River corridor is remote and difficult to access. To make the necessary streamflow measurements for the seepage investigation, approach to the river was by foot or helicopter. The river between the Escalante gage and Horse Canyon, informally referred to as the upper canyon, was accessed by hiking, either overland to the rim and then descending into the canyon or by hiking along the river corridor. Access below Horse Canyon was by helicopter, which was authorized by Glen Canyon National Recreation Area.

In May 2001 an unfunded float trip of the Escalante River along the 79-mi reach between Calf Creek and Cow Canyon on Lake Powell (which was at an altitude of 3,668 ft on May 24, 2001) was organized to collect water samples, to assess general logistics that would be required for the seepage investigation, and to explore a relatively remote river canyon. The float trip was facilitated by runoff from an above-average snowpack in the headwaters of the Escalante River drainage basin. Twenty-six water samples were measured in the field for temperature and specific conductance, 5 samples were collected for laboratory analysis of common constituents, 10 samples were collected for tritium analysis, and 5 samples were collected for analysis of chlorofluorcarbons (CFCs). During the October 2001 seepage investigation, eight additional water samples were collected from selected sites along the Escalante River and one from Twentyfive Mile Wash for analysis of CFCs.

By using the streamflow data gathered during the seepage investigation, losses (-) or gains for each of the 15 reaches between the Escalante gage and Stevens Canyon (table 2) were determined according to the following equation:

$$\text{Computation of loss (-) or gain} = Q_{ds} - (Q_{us} + Q_{in} - Q_{diversion}) \qquad (1)$$

where:

Q_{ds} = discharge measured at a downstream site;
Q_{us} = discharge measured at an upstream site;
Q_{in} = discharge measured at a tributary inflow (if a tributary is not mentioned in table 3, then it had no flow); and
$Q_{diversion}$ = discharge of a diversion (there were no diversions along any reaches measured during this seepage investigation).

A technique developed by Wilberg and others (2001) was used to determine if the difference between discharge measured at upstream and downstream sites in a specified reach exceeds the error associated with the measurement of discharge at those sites. A significant loss or gain is determined when the loss or gain exceeds the error associated with measurement of discharge. Measurements of discharge made during this seepage investigation generally were rated as good or fair, which means in the opinion of the hydrographer, the amount of water measured was within 5 percent of the actual discharge for a measurement rated good or within 8 percent for a measurement rated fair. These ratings are based on subjective evaluation of objective factors that could affect the accuracy of the measurement. The factors include number and distribution of vertical sections where velocity is measured, average velocity, uniformity of flow, regularity and firmness of channel bottom, steadiness of stage and discharge during the measurement, and presence or absence of ice, wind, or debris in the flow that could affect the ability of the current meter to accurately measure the current velocity (C.W. Boning, U.S. Geological Survey, written commun., 1993). When measuring discharges of less than about 1 or 2 ft^3/s, shallow water depths can place the velocity meter too close to the channel bottom, which can cause the velocity to be underestimated (Rantz and others, 1982, p. 132, 135, and 144). Standard USGS practice is for hydrographers to assign qualitative ratings of accuracy to individual discharge measurements—excellent, good, fair, and poor.

Each specified reach, which is defined as the portion of channel between two discharge measurement sites, is normalized to the maximum discharge of either the upstream measurement site plus any inflow, or the discharge at the downstream site plus any diversions. This is computed by using the following equations:

$$(N_d\%) = \frac{Q_{ds} - (Q_{us} + Q_{in} - Q_{diversion})}{MaxQ_{(us + inflow,\ ds + diversions)}} \bullet 100 \qquad (2)$$

where:

$N_d\%$ = normalized percentage difference;
Q_{ds} = discharge measured at a downstream site;
Q_{us} = discharge measured at an upstream site;
Q_{in} = discharge measured at a tributary inflow (if a tributary is not mentioned in table 3, then it had no flow);
$Q_{diversion}$ = discharge of a diversion (there were no diversions along any reaches measured during this seepage investigation);
$MaxQ$ = maximum discharge measured at consecutive upstream or downstream sites. Tributary inflows are added to the upstream discharge;
100 = conversion to percentage; and
the normalized percentage error is:

$$(N_e\%) = \pm\frac{(aQ_{ds} + aQ_{us} + aQ_{in} + aQ_{diversion})}{(MaxQ_{(us + inflow,\ ds + diversion)})} \bullet 100 \qquad (3)$$

where:

$N_e\%$ = normalized percentage error; and
a = accuracy of a discharge measurement as determined by the hydrographer, a determination of how close the measured discharge is to the actual discharge: 2 percent for excellent, 5 percent for good, 8 percent for fair, and greater than 8 percent for poor.

If Q_{ds} is greater than Q_{us} plus Q_{in}, that is, if more water was measured at the downstream section of the reach than was measured at the upstream section plus any inflow to that reach (equation 1), then the algebraic sign in equations 1, 2, and 3 is plus (+), which signifies a gain. Conversely, if Q_{ds} is less than Q_{us} plus Q_{in}, then the sign is minus (-), which signifies a loss for that specific reach. A computed loss or gain for a specific reach is considered significant if the normalized percentage difference ($N_d\%$) is greater than the normalized percentage error ($N_e\%$). The percentage difference and percentage error were normalized to allow comparison between reaches with different amounts of discharge.

Acknowledgments

D. Kip Solomon of the Dissolved Gas Laboratory at the University of Utah donated his services and laboratory facility for the analyses of CFCs. Norman R. Henderson at Glen Canyon National Recreation Area generously provided pickup and delivery of samples, instruments, equipment, and personnel by boat to Bullfrog Marina following the Escalante River reconnaissance trip in May 2001. J. Douglas Powell, Grand Staircase-Escalante National Monument geologist, participated in water sample collection and reconnaissance during the May 2001 Escalante River float trip. Joni Vanderbilt, former Grand Staircase-Escalante National Monument hydrologist, participated in the 2001 seepage investigation and made the Escalante River discharge measurement at Horse Canyon.

SEEPAGE INVESTIGATION OF THE ESCALANTE RIVER DRAINAGE BASIN

Discharge was measured on October 23 and 24, 2001, during base-flow conditions from the USGS gage on the Escalante River near Escalante to the mouth of Stevens Canyon about 86 mi downstream near the maximum pool level of Lake Powell. Discharge was measured in the Escalante River at 16 individual sites along 15 consecutive reaches. Discharge also was measured or estimated at the mouths of 14 tributaries to the Escalante River. There were no diversions. The seepage investigation was terminated at Stevens Canyon because it represented the end of natural channel conditions not influenced by fluctuating lake levels, which can affect both sedimentation and channel characteristics.

The reach from the Escalante gage to the mouth of The Gulch, a distance of about 28 miles, was investigated on the first day. Discharge was measured at eight cross sections along the Escalante River (seven reaches) and at the mouths of five tributaries (table 3). Discharge was measured at 10 cross sections along the Escalante River (9 reaches) between The Gulch and Stevens Canyon, a distance of about 55 miles, on the second day. Discharge was measured, or estimated if the flows were too small to measure with a current meter, at the mouths of nine tributaries.

Two stage recorders were operated during the seepage investigation to monitor the fluctuations of the Escalante River. The stage recorded at the permanent gage near Escalante (09337500) increased 0.04 ft during the 2-day investigation and the daily mean discharge increased from 4.3 ft^3/s to 4.7 ft^3/s. The stage increased 0.08 ft on the day preceding the start of the seepage investigation and the daily mean discharge was 3.2 ft^3/s. The significance of this 0.08 ft rise on October 22, 2001, and its potential impact on the seepage investigation is moderated by attenuation downstream, increasing flow in the river as result of tributary inflows, the relatively small amount of discharge associated with the rise, and the fact that the increase ended 12 hours or more before the seepage investigation measurements began, a sufficient amount of time for the increase to transit the reach. A temporary stage recorder was installed on the Escalante River below the mouth of Calf Creek and operated for 65 hours and 45 minutes from October 22, 2001, at 1530 hours to October 25, 2001, at 0915 hours. River stage was recorded at 15-minute intervals. The stage fluctuated 0.04 ft during the operation of the temporary gage and 0.03 ft during the 2-day seepage investigation. The small amount of stage variation and the lack of rising or falling trends indicate that the stage was quite stable. Two discharge measurements on October 23 and 24, 2001, at the temporary gage were 28.1 and 26.5 ft^3/s, respectively, and corroborate the relatively stable base-flow conditions.

None of the 15 reaches along the Escalante River between the Escalante gage and Stevens Canyon that were measured during the seepage investigation of October 23 and 24, 2001, had computed losses or gains that exceeded the normalized error ($N_e\%$) (see Methods section and table 2). This finding does not indicate that losses or gains do not occur, but rather that the losses or gains were of a smaller magnitude than the errors associated with measurements of discharge. The first two reaches from the gage near Escalante (09337500, site 10) to Escalante River above Sand Creek (site 13) had normalized measurement errors that exceeded the normalized percentage difference by less than 2.1 percent (table 2). A loss or gain might have been determined in these reaches if the discharge measurements were rated as good or fair. This was not possible because shallow stream depths created less than ideal measurement conditions.

Several springs that discharge from the Navajo aquifer in Coyote Gulch and along the lake-affected channel in the reach below the mouth of Coyote Gulch were not investigated during the October 2001 seepage investigation. These springs are located near the contact of the Kayenta Formation and the overlying Navajo Sandstone (table 4, S25-S28) and could hold important indicators about the source and recharge areas, flow paths, time of travel, and quantity of discharge for water-budget estimates. Although there were no significant losses or gains along the Escalante River in October 2001, streamflow increases downstream, primarily from tributary inflow. Discharge and specific-conductance measurements made during the October 2001 seepage investigation are shown in figure 1.

Two speculative reasons that no significant seepage losses or gains were measured and implications regarding the ground- and surface-water systems and their interactions are:

(1) Accretion of flow in the Escalante River between Pine Creek and Boulder Creek is accounted for as inflow from tributaries. This reach includes perennial tributaries that have headwaters in the Aquarius Plateau and is where the Navajo aquifer is in direct contact with the potential recharge area in higher altitudes of the Aquarius Plateau.

(2) Ground-water discharge from the Navajo aquifer does not occur along the channel of the Escalante River but rather along the tributary channels, especially in the canyon upstream of Boulder Creek; therefore, gaining reaches were not determined during seepage investigations along the Escalante River.

Although tributaries to the Escalante River in the canyon upstream of Boulder Creek are assumed to gain water from the Navajo aquifer, primarily from springflow and fractures, the validity of this assumption could be tested by conducting a seepage investigation along a tributary channel. Identification of gaining reaches along any tributary channels could be used to define areas that could be critical to water-resource management. Mamie, Sand, Calf, and Boulder Creeks all have suitable conditions (perennial flow, outcrops of fractured Navajo Sandstone) conducive for seepage investigations. A seepage investigation at three or four sections along Boulder Creek from the town of Boulder to the mouth would be both logistically and hydrologically feasible. Logistically because there is more than one place to access the different reaches of Boulder Creek, 8and hydrologically because of the relatively large (larger than Calf, Sand, or Mamie Creeks) volume of water to measure. Discharge of the Escalante River can sometimes double with the inflow of Boulder Creek, which contributes considerably more discharge than what generally is observed at the town of Boulder.

Environmental Tracer Sampling

During the May 2001 float trip, water samples were collected from the Escalante River, tributary streams, and springs for analysis of tritium (^3H) and CFCs. In addition, water samples were collected at nine sites for CFC analysis during the seepage investigation in October 2001. These environmental tracers are used to age-date ground water that has recharged the hydrologic system since the early 1950s. The 2001 sampling was done at a reconnaissance level to evaluate the utility of these tools to better explain surface- and ground-water interaction. Tritium (^3H) is a radioactive isotope of hydrogen that occurs naturally in very small quantities. Concentrations several orders of magnitude larger than background were introduced into the hydrologic cycle during atmospheric (open air) nuclear testing. Atmospheric testing at the Nevada test sites began with the Able test on January 27, 1951, and ended with the Little Feller I test on July 17, 1962 (Dept. of Energy, 2000, p. 24 and 46). As a result, tritium concentrations are useful for determining whether ground water recharged prior to or after 1950. Tritium units (TU) of less than 0.5 generally are considered indicative of water that recharged the ground-water system prior to open-air nuclear testing, thus, prior to 1951. One TU represents one molecule of $^3H^1HO$ in 10^{18} molecules of ^1H_2O.

Samples of surface water collected in Scorpion Gulch, Fools Canyon, and Stevens Canyon (sites 50, 57, and 61), respectively, are all younger than 50 years (table 5). These samples represent ground-water discharge to the streams and did not contain any obvious components of surface runoff. Surface water represents a mixture of all ground-water sources feeding the stream, and thus can give an indication of average ground-water age for a drainage. On the basis of limited sampling in 2001, the surface water appears to have a component of younger (less than 50 years) ground water. Because the sampled water has been exposed to the atmosphere as it moves from ground-water source to sampling point, there is a potential that

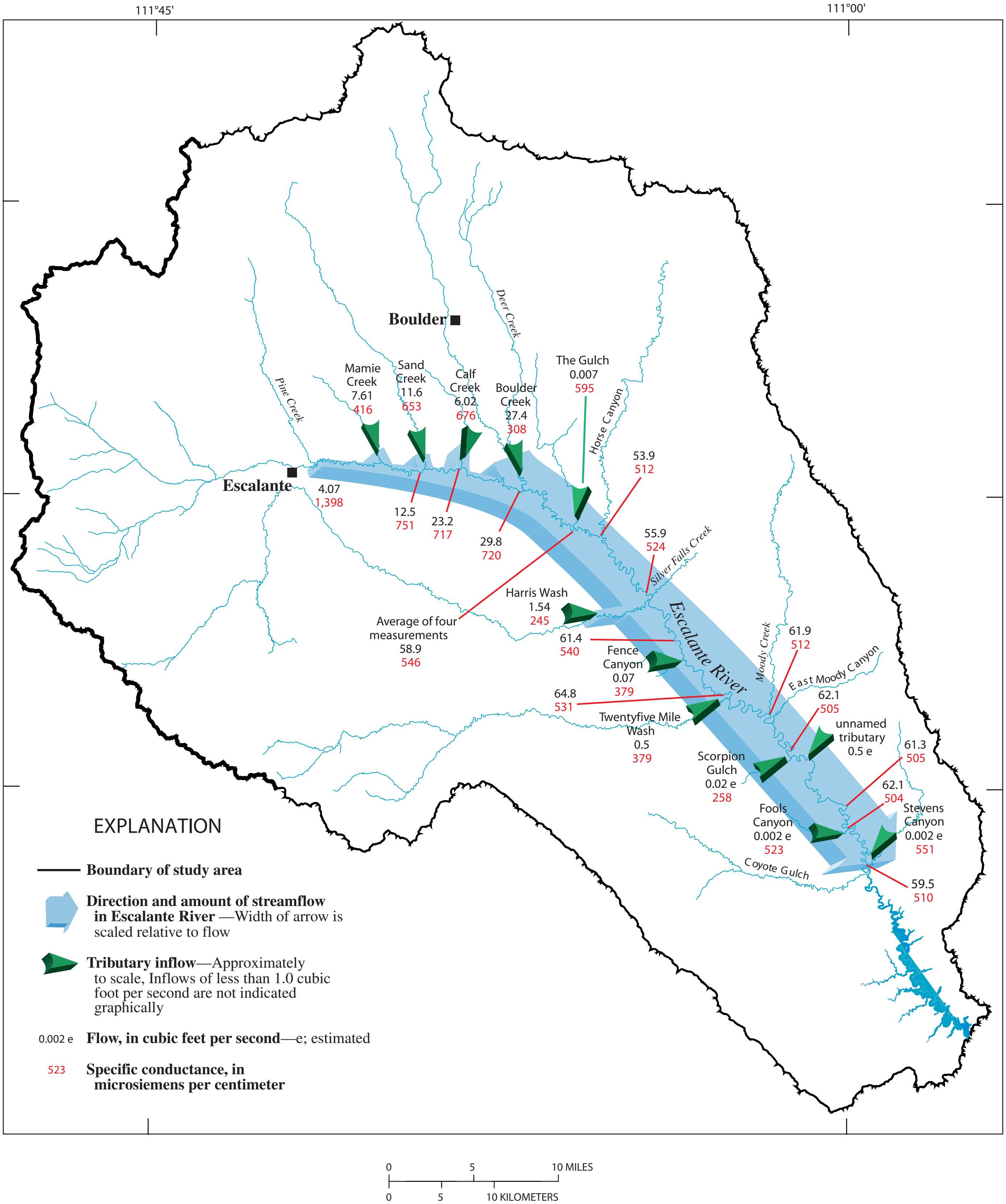

Figure 1. Instantaneous discharge and specific-conductance measurements made on October 23 and 24, 2001, along the Escalante River, Garfield and Kane Counties.

the tritium in the surface water came from exchange of water molecules in the atmosphere. Current background atmospheric concentrations are about 9 TU. With enough time, exchange will cause all surface water to have a concentration of 9 TU. The exchange, however, is slow and the estimated time that sampled waters were exposed to the atmosphere is on the order of several hours, which potentially could increase the TU concentration by a few tenths (0.1 to 0.3).

Water collected from springs that discharge directly from consolidated rock have 0.53 or less TU and indicate an apparent age of greater than 50 years (table 5). With the exception of the spring sampled in Coyote Gulch (S24), these consolidated-rock springs are all located along the Escalante River. These springs have small discharges and a minimal affect on total streamflow. When comparing the age of the springs to those of the tributaries, it seems plausible that flow paths might be deflected toward the incised tributary side canyons. Flow paths toward tributaries appear shorter (younger) and might be a path of least resistance for ground-water discharge. Water from the spring in tuning fork canyon (S23), which discharges from a veneer of talus of Quaternary age, appears less than 50 years old. Given the spring location and the similarity in tritium concentration of the stream in tuning fork canyon (site 52), it is likely that the spring represents stream water that is moving in and out of the adjacent colluvium.

CFCs are synthetic, nontoxic, stable chemical compounds that contain carbon, chlorine, fluorine, and sometimes hydrogen. CFCs were developed in the early 1930s and are used for a variety of domestic and industrial purposes. In the 1970s it was discovered that CFCs deplete stratospheric ozone and considerable effort has been expended to quantify atmospheric concentrations since they were first produced. The solubility of CFCs in water is well known and that makes it possible to use these compounds to determine the apparent age of ground water (apparent because a number of simplifications are used to determine age). Sampling for CFC concentrations in the Escalante River was done to explore the potential of using surface waters to determine an average ground-water age for the drainage basin (table 6). Whereas tritium values indicate a before- or after-1950 recharge time, CFCs provide a discrete age (for example 22-year-old water, plus or minus some uncertainty). Average ground-water age is a fundamental characteristic of a ground-water system. Recharge rates and the amount of water stored in the ground-water reservoir are both reflected in the average ground-water age; increased recharge rates will decrease age, increased storage will increase age (Cook and Böhlke, 2000, p. 9). If ground-water age were preserved in the perennial streamflow, then surface-water samples might be useful to estimate flow-weighted mean transit times. Unlike tritium, CFCs are dissolved gases that exchange rapidly with the atmosphere. To interpret CFC ages, the gas-exchange rate of the Escalante River must be known. That is beyond the scope of this report; therefore, only CFC concentrations are presented in table 6. Further research is needed to determine the utility of CFCs to quantify average ground-water travel times in the Escalante River drainage basin.

Comparison of 1981 and 2001 Seepage Investigations

Seepage along the Escalante River also was measured during October 1981; the data are listed in table 3 and described by Blanchard (1986, p.19). The 1981 and 2001 measurements for each individual reach of the Escalante River from the USGS gage (site 10) to Boulder Creek (site 29) are graphed in figure 2. Flows were greater in 1981 for all reaches because 1981 was hydrologically and climatically wetter than 2001.

The average October streamflow at the Escalante gage (09337500, site 10) for 47 years of record (1943-55, 1973-2002) is 7.70 ft^3/s. In October 1981, the average streamflow was 14.2 ft^3/s and represents the seventh highest for the period of record. By contrast, the average streamflow in October 2001 was 3.15 ft^3/s and represents the eleventh lowest. Tributary flows at Mamie Creek (site 12), Sand Creek (site 14), and Calf Creek (site 18) were of similar magnitudes for both time periods. Flow in Boulder Creek was about 50 percent greater in October 1981 than in October 2001.

To compare measurements in 1981 and 2001, climatic conditions preceding the two periods were examined using long-term precipitation records for the town of Escalante. Precipitation has been recorded at Escalante since 1901 (Western Regional Climate Center, 2004). The cumulative departure of total precipitation from normal for July to October 1981 was +3.61 inches. Departure for the same period in 2001 was -1.68 inches. Cumulative departure for the 5 years prior to October 1981 and October 2001 were, respectively, +5.71 inches and -1.41 inches (Western

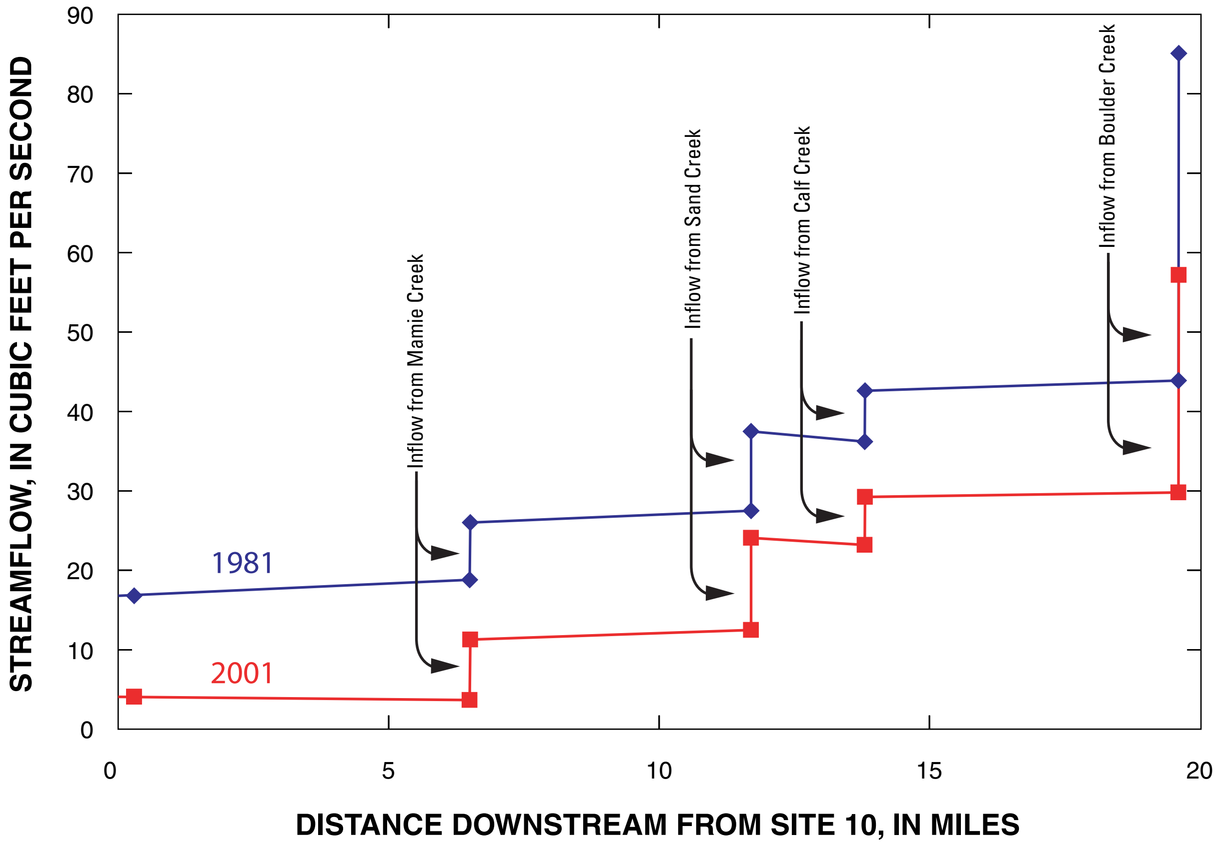

Figure 2. Streamflow on October 21, 1981, and October 23, 2001, along the Escalante River, Garfield and Kane Counties, Utah.

Regional Climate Center, 2004). These comparisons indicate that conditions preceding the 1981 seepage investigation were wetter than conditions preceding 2001. Cumulative departure is the sum of difference between each month or year's measured precipitation and the long-term average, and describes the collective affects of climatic trends. The table below summarizes the departures.

Departure from long-term average precipitation at Escalante, Utah

Time period	Amount above (+) or below (-) average
Cumulative departure for July-October, 1981	+3.61 inches
Cumulative departure for 1977-81 (previous 5 years)	+5.71 inches
Cumulative departure for July-October, 2001	-1.68 inches
Cumulative departure for 1997-2001 (previous 5 years)	-1.41 inches

Perennial or base flow in Mamie, Sand, and Calf Creeks appears only slightly affected by changes in precipitation prior to October 1981 and October 2001. However, flow in Boulder Creek seems to have been affected by the less-than-normal precipitation prior to October 2001. Perennial or base flow in Mamie, Sand, and Calf Creeks originates mainly as ground-water discharge from the Navajo aquifer. A component of perennial flow in Boulder Creek is also derived from the Navajo aquifer. A partial explanation for the variation in perennial flow measured at the mouth of Boulder Creek is that the additional flow measured in 1981, is derived from shallow circulating ground water. This might include ground water stored in soils, and adjacent stream-channel and alluvial deposits.

Streamflow derived from ground water will show a significant change only if recharge to, and water levels in, the underlying aquifer/aquifers change. By inference, it appears that any decrease in recharge to the Navajo aquifer (which underlies Mamie, Sand, and Calf Creeks) caused by the drier period had little effect on water levels. Probably the amount of water stored in the Navajo aquifer is significantly larger than any potential 5-year variations in recharge. Alternatively, there does appear to be a ground-water component in the Boulder Creek drainage that is affected by 5-year changes in climate and recharge.

HYDROLOGIC AND WATER-QUALITY DATA

As a resource to future hydrologic investigations of the Escalante River drainage basin, a compilation of all hydrologic and water-quality data collected by the USGS for the area is published as a series of tables located at the end of this report. The sources of these data are listed in table 1 and discussed in the "Previous Studies" section of this report. The compilation consists of data for 64 surface-water sites and 28 springs (pl. 1). Data published here were collected by the USGS in the Escalante River drainage basin from September 1909 for the Escalante River near Escalante gage (09337500) to December 2002 for a specific-conductance measurement of surface water at Boulder Creek near Boulder Creek gaging station (09339000) when it was reactivated.

Discharge data were collected for different periods of time at 12 gaging stations operated and maintained by the USGS in the Escalante River drainage basin beginning in 1909 at the Escalante River near Escalante gage (09337500), which was called Escalante Creek until 1913. Selected data for gaging stations in the Escalante River drainage basin are presented in table 7 and include period of record, drainage area, annual mean discharge for complete water years, extreme maximum and minimum discharge quantities, and dates.

Field measurements of specific conductance and temperature taken during routine site visits to the gages at Pine Creek near Escalante (gaging station 09337000) during 1969-91, and Escalante River near Escalante (gaging station 09337500) during 1971-91, are listed in tables 8 and 9, respectively. These data are presented to show near-monthly and seasonal variation.

Physical properties and results of chemical analyses for water collected at the gaging station at Escalante River near Escalante (09337500) are listed in table 10. The data were collected during 1969-72 and are presented here as background water-quality information.

Physical properties and results of chemical analyses for water collected at the gaging station at Escalante River at mouth (09339500) during 1951-53 are listed in table 11 and are presented for historical purposes only. The gage was discontinued in September 1953 and the site was covered by the rising waters of Lake Powell in June of 1963. This gage was established to determine streamflow, sediment loads, and chemical constituents and required a USGS employee to live at the site. Access to the gage was so obscure over the stretches of slickrock that paint markings were applied on the rock to keep travelers to the gage on course. Later, in an article about the Escalante area, W.R. Moore (1955, p. 414) quoted a local horse packer who stated "The Government built the cheapest highway in history. Seven miles with a gallon of paint."

Water-quality analyses for common constituents in water from selected sites in the Escalante River drainage basin are presented in table 12. Samples were collected from 14 surface-water sites and 18 spring sites from April 1981 to August 2002.

SUMMARY

This report contains the results of the October 2001 seepage investigation along the Escalante River and includes a compilation of hydrologic and water-quality data collected by the USGS within the Escalante River drainage basin from 1909 to 2002 for 64 surface-water sites and 28 springs (pl. 1). This report was written as part of a larger cooperative study by the USGS and BLM done to identify and understand the hydrologic system within Grand Staircase-Escalante National Monument. The purpose of the seepage investigation was to determine if large amounts of surface water in the Escalante River were lost or gained, to determine where those losses or gains occurred, to quantify the losses or gains and determine if they were significant, and to identify which rock formations were involved.

None of the 15 reaches along the Escalante River between the Escalante gage and Stevens Canyon where discharge was measured during the seepage investigation of October 23 and 24, 2001, had computed losses or gains that exceeded the normalized percentage error. Losses or gains were computed for each reach by subtracting the sum of the discharge measured at an upstream site and any tributary inflow in that reach from the discharge measured at a downstream site. For ease of comparison among reaches, the computed losses or gains were normalized. A computed loss or gain is considered significant when the normalized difference is greater than the normalized error.

Individual reaches along tributaries in the upper canyons could be the focus of future seepage investigations. Specifically, tributaries such as Boulder Creek, Mamie Creek, Sand Creek, Deer Creek, and Calf Creek offer the most potential to find reaches of significant gains in surface-water discharge.

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Table 1. Records of selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah

[**Site number:** See plate 1 for site location. **Local number**: See numbering system used for hydrologic-data sites in Utah, unsurveyed indicates that individual section boundaries were not available for the location and the local number was based on extrapolation from nearby sections; **Description of site**: Number in parentheses is gaging station number; **Site ID**: A unique number in the USGS database that is used to identify a site and is based on the latitude (first 6 digits) and longitude (last 7 digits) of the site; **Source of data:** USGS, U.S. Geological Survey; WSP, USGS Water-Supply Paper; OFR, USGS Open-File Report; TP, Technical Publication of the Utah Department of Natural Resources; WDR, USGS Water-Data Report; Do., ditto; BLM, Bureau of Land Management; ft, feet; mi, mile]

Site number	Local number	Description of site	Site ID	Table containing additional data	Source of data
		SURFACE-WATER SITES			
1	(D-35-2)16aca-1	North Creek near Escalante (09335500) 0.1 mi above mouth	3746001114059	7	WSP 1733, p. 363
2	(D-34-1)31aba-1	Birch Creek about 10.5 mi above confluence with North Creek	3748501114942	12	Site 21 in OFR 83-871
3	(D-35-1)13dba-1	Birch Creek near Escalante (09336000)	3745441114415	7	
4	(D-36-1)9cbc-1	Upper Valley Creek near Liston Flat	3741171114804	12	Site 25 in OFR 83-871
5	(D-35-2)29bba-1	Upper Valley Creek near Escalante (09336400)	3744301114235	7	TP 21, p. 33
6	(D-35-2)16cbb-1	Birch Creek 0.8 mi above confluence with North Creek	3745481114139	12	Site 23 in OFR 83-871
7	(D-35-2)16aca-1	Birch Creek at mouth (09336500)	3745541114102	7	WSP 1733, p. 364
8	(D-35-2)16adb-1	Escalante River 400 ft below confluence of North and Birch Creeks	3745561114051	12	Site 22 in OFR 83-871
9	(D-34-2)12cac-1	Pine Creek near Escalante (09337000)	3751451113807	7, 8	WDR UT-01-1
10	(D-35-3)9dba-1	Escalante River near Escalante at USGS gage (09337500)	3746411113426	2,3,4,7,9,10	Do.
11	(D-35-4)7bdd-1	Escalante River above Mamie Creek	3746501113019	2,3,4,12	TP 81
12	(D-35-4)7bda-1	Mamie Creek at mouth	3746561113020	2, 3, 4	
13	(D-35-4)10ccb-1	Escalante River above Sand Creek	3746301112726	2, 3, 4	TP 81
14	(D-35-4)10ccb-2	Sand Creek at mouth	3746301112725	2, 3, 4	Do.
15	(D-35-4)12cac-1	Escalante River above Calf Creek	3746321112504	2, 3, 4	Do.
16	(D-35-4)11abd-1	Calf Creek above BLM campground, near Escalante	3747481112445	4, 8, 12	OFR 95-340
17	(D-35-4)1acc-1	Calf Creek at BLM campground bridge	3747331112452	3, 4	OFR 95-340
18	(D-35-4)12cac-2	Calf Creek at mouth	3746361112506	2, 3, 4	TP 81
19	(D-35-4)12cad-1	Escalante River below Calf Creek at USGS temporary gage	3746351112456	2,3,4,6,12	
20	(D-35-5)22bbb-1	Escalante River above Boulder Creek	3745251112058	2, 3, 4, 8,12	TP 81
21	(D-32-4)10aca-1	East Fork Boulder Creek near Boulder (09338000)	3802301112700	4,7	WSP 1733, p. 367
22	(D-32-5)29 (unsurveyed)	East Fork Deer Creek near Boulder (09338500)	3800051112320	7	WSP 1733, p. 368
23	(D-34-5)16aca-1	Deer Creek near Boulder (09338900)	3751121112116	4,7	TP 21, p. 33
24	(D-35 -5)9bda-1	Boulder Creek near Boulder (09339000)	3746551112134	4,7	
25	(D-35-5)22bbb-2	Boulder Creek at mouth	3745261112058	2,3,4,6,12	
26	(D-35-5)15dcd-1	Unnamed tributary 1.1-mi below Boulder Creek, left bank	3745271112013	4	
27	(D-35-5)35aad-1	Unnamed tributary 1.6 mi above The Gulch and 0.1 mi above mouth	3743331111850	4	
28	(D-35-5)36adc-1	Pool 200 ft up unnamed tributary 0.3 mi above The Gulch	3743211111800	4	
29	(D-35-6)36aad-1	Escalante River above The Gulch	3743311111748	2, 3, 4	
30	(D-35-6)36aad-2	The Gulch at mouth	3743321111748	2, 3, 4	
31	(D-35-6)31bbd-1	Escalante River below The Gulch	3743291111732	3	TP 81
32	(D-35-6)32dbc-1	Escalante River above Horse Canyon	3743071111600	2, 3, 4	
33	(D-35-6)32dbd-1	Horse Canyon 500 ft above mouth	3743091111555	4	
34	(D-36-6)23aac-1	Silver Falls Creek at mouth	3740011111241	3, 4	
35	(D-35-2)36dcd-1	Alvey Wash 500 ft above Coal Bed Canyon	3742521113743	12	Site 24 in OFR 83-871
36	(D-36-6)23dbb-1	Escalante River above Harris Wash	3739461111254	2, 3, 4, 6	
37	(D-36-6)23acc-1	Harris Wash at mouth	3739481111255	2, 3, 4	

Table 1. Records of selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah—Continued

Site number	Local number	Description of site	Site ID	Table containing additional data	Source of data
		SURFACE-WATER SITES—Continued			
38	(D-36-7)31dcc-1	Unnamed left bank tributary 1.2 mi above Fence Canyon	3737381111050	4	
39	(D-37-7)6dcd-1 (unsurveyed)	Escalante River above Fence Canyon	3736461111042	2,3,4,6,12	
40	(D-37-7)7aba-1 (unsurveyed)	Fence Canyon at mouth	3736451111042	2, 3, 4	
41	(D-37-7)8baa-1 (unsurveyed)	Neon Canyon at base of falls 0.6 mi above mouth	3736421110950	4	
42	(D-38-4)10dad-1	Left Hand Collett Canyon	3731081112708	12	
43	(D-37-5)29bca	Twentymile Wash near Escalante (09339200)	3733521112315	7	TP 21, p. 33
44	(D-37-7)22bda-1	Escalante River above Twentyfive Mile Wash	3734461110742	2, 3, 4, 6	
45	(D-37-7)22bda-2	Twentyfive Mile Wash at mouth	3734461110744	2, 3, 4, 6	
46	(D-37-7)25aac-1	Moody Creek	3733581110509	3	
47	(D-37-7)25acc-2	Escalante River below Moody Creek	3733561110509	2, 3, 4, 6	
48	(D-37-7)25dad-1	East Moody Canyon at mouth	3733301110458	4	
49	(D-38-8)5ccb-1	Escalante River above Scorpion Gulch	3731441110344	2, 3, 4, 6	
50	(D-38-8)5ccc-1	Scorpion Gulch near mouth	3731381110345	5, 6, 12	
51	(D-38-8)5ccb-2	Scorpion Gulch at mouth	3731441110343	2, 3, 4	
52	(D-38-8)4bcd-1	Unnamed tributary 2 mi below Scorpion Gulch and 0.4 mi from mouth (informally designated tuning fork canyon)	3732041110232	4, 5, 6	
53	(D-38-8)4cca-1	Mouth of unnamed tributary 2 mi below Scorpion Gulch on left (informally designated tuning fork canyon)	3731451110239	2, 3	
54	(D-38-8)22 (unsurveyed)	Mouth of unnamed canyon 6.5 mi above Fools Canyon on left bank	3729531110201	4	
55	(D-38-8)23 (unsurveyed)	Escalante River 3.7 mi above Fools Canyon	3729111110007	2, 3, 4	
56	(D-38-8)35 (unsurveyed)	Escalante River above Fools Canyon	3728021110004	2, 3, 4, 6	
57	(D-38-8)35 (unsurveyed)	Fools Canyon 1 mi above mouth	3727571110046	4, 5	
58	(D-38-8)35 (unsurveyed)	Fools Canyon at mouth	3728021110005	2, 3, 4	
59	(D-39-8)1adb-1 (unsurveyed)	Unnamed canyon 3 mi above Stevens Canyon on left bank	3727071105854	4	
60	(D-39-8)12add-1 (unsurveyed)	Escalante River above Stevens Canyon	3726101105852	2, 3, 4, 6	
61	(D-39-9)7bcd-1	Stevens Canyon near mouth	3726081105838	5, 12	
62	(D-39-8)12add-2 (unsurveyed)	Stevens Canyon at mouth	3726081105852	3, 4	
63	(D-39-8)12ddd-1	Escalante River at Coyote Gulch	3725411105847	4	
64	(D-40-9)23cb (unsurveyed)	Escalante River at mouth near Escalante, 2.2 mi below Davis Gulch and 5.1 mi above confluence with Colorado River left bank (09339500)	3718591105411	4, 7, 11	WSP 1733, p. 369
		SPRINGS			
S1	(C-34-1)24ccc-S1	Spring in headwaters of Birch Creek about 2.5 mi south of Griffin Top	3749441115125	12	OFR 83-871
S2	(C-35-1)12ada-S1	Spring area in Corn Creek about 2 mi northeast of Barney Top	3746511115023	12	Do.
S3	(C-35-1)24dbc-S1	Spring near Yankee Meadow about 1 mi east of Table Cliff Plateau	3744451115055	12	Do.
S4	(C-36-1)1dad-S1	Garden Spring near Upper Valley guard station	3742081115029	12	Do.
S5	(D-35-1)33dda-S1	Spring in Upper Valley above Allen Creek	3742581114704	12	Do.
S6	(D-35-2)16acd-S1	Spring in Upper Valley Creek above confluence with North Creek	3745541114057	12	Do.
S7	(D-35-4)7bda-S1	Spring in Mamie Creek 400 ft above mouth	3746571113021	3, 4	see Goode (1969) for data from other springs in Death Hollow

Table 1. Records of selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah—Continued

Site number	Local number	Description of site	Site ID	Table containing additional data	Source of data
		SPRINGS—Continued			
S8	(D-35-4)10ccb-S1	Spring in Sand Creek 200 ft above mouth	3746311112726	3, 4	
S9	(D-35-5)1abd-S1	Calf Creek Spring	3747481112444	4, 12	OFR 95-340
S10	(D-35-5)23cba-S1	Seepage from fracture in Navajo Sandstone, right bank about 2 mi below Boulder Creek	3745001111931	4	
S11	(D-35-6)31bcc-S1	wall spring (informal designation)	3743211111738	3, 4, 6, 12	
S12	(D-35-6)31dba-S1	Spring in fern glen alcove 400 ft above mouth	3743101111700	4	
S13	(D-37-1)10acd-S1	Horse Spring near Canaan Peak	3736231114621	12	OFR 83-871
S14	(D-37-3)6aaa-S1	Rock Spring	3737351113619	12	Do.
S15	(D-36-2)13aad-S1	Oak Spring above Dave Canyon in Alvey Wash	3740581113729	12	Do.
S16	(D-37-2)36cbc-S1	Camp Spring in Right Hand Collet Canyon, Kaiparowits Plateau	3732381113824	12	Do.
S17	(D-38-3)17bda-S1	Relishen Seep, Long Canyon, Kaiparowits Plateau	3730351113629	12	Do.
S18	(D-38-3)14cbc-S1	Hardhead Water Spring, Long Canyon, Kaiparowits Plateau	3730171113334	12	Do.
S19	(D-38-3)11aad-S1	Spring near Willard Canyon, Left Hand Collet Canyon, Kaiparowits Plateau	3731341113233	12	Do.
S20	(D-38-8)5bab-S1	Spring from fracture in Wingate Sandstone, 300 ft above Scorpion Gulch	3731441110350	4, 5	
S21	(D-38-8)8ada-S1	Spring 1 mi below Scorpion Gulch, right bank, at Wingate-Chinle Formation contact	3731321110318	5, 6, 12	
S22	(D-38-8)8ada-S2	Spring 200 ft downstream (east) of (D-38-8)8ada-S1 at Wingate-Chinle Formation contact	3731321110316	4	
S23	(D-38-8)4dbc-S1	Spring in tuning fork canyon, 2 mi below Scorpion Gulch and 0.4 mi from mouth	3732041110231	5, 6, 12	
S24	(D-39-8)13bab-S1	Spring in Coyote Gulch about 1 mi above mouth, left bank at Navajo-Kayenta contact	3725371105936	5, 12	
S25	(D-39-9)19dba-S1	Spring 3.3 mi below Coyote Gulch, right bank, discharges from rocks above Lake Powell	3724151105800	4	Do. See Cooley (1965) for data from other springs along Escalante River below Coyote Gulch
S26	(D-39-9)19dcc-S1	Spring about 4 mi below Coyote Gulch, right bank, large volume spring discharges from rocks above Lake Powell	3724001105809	4, 5	Do.
S27	(D-39-9)20cad-S1	Spring 4.7 mi below Coyote Gulch, left bank	3724111105717	4	Do.
S28	(D-39-9)29aac-S1	Spring 5.7 mi below Coyote Gulch, left bank, discharges from rocks above Lake Powell	3723451105651	4, 5	Do.

Table 2. Error analysis for data collected during seepage investigation along 15 reaches of the Escalante River between gaging station 09337500 and Stevens Canyon, Garfield and Kane Counties, Utah, October 2001

[**Site number**: See table 1 and plate 1 for location of sites and reaches; **Description of reach**: Tributary inflows with measured or estimated discharge are described and numbered; **Q_{us},** discharge measured at upstream site; **Q_{ds}**, discharge measured at downstream site; **Q_{in}**, discharge measured at tributary inflow. If tributary is not mentioned, then it had zero discharge; ft^3/s, cubic feet per second; e, estimated; G, in the opinion of the hydrographer, the measured discharge is within 5 percent of actual discharge; F, within 8 percent; P, greater than 8 percent; **Computation of loss (-) or gain** = Q_{ds} - (Q_{us} +Q_{in} - $Q_{diversion}$); **N_d%,** Normalized percentage difference, used to determine the difference between discharge measured at upstream and downstream cross sections of a given channel reach. See text for equations and definitions of terms; **N_e%,** Normalized percentage error, used to determine if a computed loss or gain significantly exceeds errors associated with discharge measurement. See text for equations and definitions of terms; **N_d%**, greater than **(>) Ne%: Y**, Yes; **N**, No. If Y, then computed loss (-) or gain is considered significant. **Formation:** Jn, Jurassic Navajo Sandstone; Jk, Jurassic Kayenta Formation; Jw, Jurassic Wingate Sandstone; Trc, Triassic Chinle Formation; —, no data available]

Site number	Description of reach	Q_{us} (ft^3/s)	Q_{ds} (ft^3/s)	Q_{in} (ft^3/s)	Computation of loss (-) or gain	Normalized percentage difference (N_d%)	Normalized percentage error (N_e%)	N_d% > N_e% (Y or N)	Formation
	October 23, 2001								
10 to 11	Escalante River at USGS gage (09337500) to Escalante River above Mamie Creek	4.07G	3.66P	0	-0.41	-10.1	-12.2	N	Jn
11 to 13	Escalante River above Mamie Creek to Escalante River above Sand Creek, includes Mamie Creek inflow (Site 12)	3.66P	12.5G	7.61G	1.23	9.8	10.4	N	Jn
13 to 15	Escalante River above Sand Creek to Escalante River above Calf Creek, includes Sand Creek inflow (site 14)	12.5G	23.2F	11.6G	-.9	-3.7	-12.7	N	Jn/Jk
15 to 19	Escalante River above Calf Creek to Escalante River below Calf Creek, includes Calf Creek inflow (site 18)	23.2F	28.1G	6.02F	-1.12	-3.8	-12.8	N	Jk
19 to 20	Escalante River below Calf Creek (at temporary USGS gage) to Escalante River above Boulder Creek	28.1G	29.8F	0	1.7	5.7	12.7	N	Jk/Jn
20 to 29	Escalante River above Boulder Creek to Escalante River above The Gulch (first measurement), includes Boulder Creek inflow (site 25)	29.8F	59.8F	27.4G	2.6	4.3	14.3	N	Jn
20 to 29	Escalante River above Boulder Creek to Escalante River above The Gulch (second measurement), includes Boulder Creek inflow (site 25)	29.8F	60.0G	27.4G	2.8	4.7	11.3	N	Jn
	October 24, 2001								
29 to 32	Escalante River above The Gulch (first measurement) to Escalante River above Horse Canyon, includes The Gulch inflow (site 30)	58.0G	53.9G	e .01P	-4.1	-7.1	-9.6	N	Jn
29 to 32	Escalante River above The Gulch (second measurement) to Escalante River above Horse Canyon, includes The Gulch inflow (site 30)	57.6G	53.9G	e .01P	-3.7	-6.4	-9.7	N	Jn
32 to 36	Escalante River above Horse Canyon to Escalante River above Harris Wash	53.9G	55.9G	0	2.0	3.6	9.8	N	Jn/Jk
36 to 39	Escalante River above Harris Wash to Escalante River above Fence Canyon, includes Harris Wash inflow (site 37)	55.9G	61.4G	1.54P	3.96	6.4	9.8	N	Jk/Jw
39 to 44	Escalante River above Fence Canyon to Escalante River above Twentyfive Mile Wash, includes Fence Canyon inflow (site 40)	61.4 G	64.8 F	.07P	3.33	5.1	12.7	N	Jw

Table 2. Error analysis for data collected during seepage investigation along 15 reaches of the Escalante River between gaging station 09337500 and Stevens Canyon, Garfield and Kane Counties, Utah, October 2001—Continued

Site number	Description of reach	Q_{us} (ft^3/s)	Q_{ds} (ft^3/s)	Q_{in} (ft^3/s)	Computation of loss (-) or gain	Normalized percentage difference (N_d%)	Normalized percentage error (N_e%)	N_d% > N_e% (Y or N)	Formation
	October 24, 2001—Continued								
44 to 47	Escalante River above Twentyfive Mile Wash to Escalante River below Moody Creek, includes Twentyfive Mile Wash inflow (site 45)	64.8 F	61.9 F	.5P	-3.4	-5.2	-15.6	N	JwTrc
47 to 49	Escalante River below Moody Creek to Escalante River above Scorpion Gulch	61.9 F	62.1 G	0	.2	.3	13.0	N	Trc
49 to 55	Escalante River above Scorpion Gulch to Escalante River 3.7 mi above Fools Canyon, includes Scorpion Gulch inflow (site 51) and estimate of tuning fork inflow (site 53) (didn't land helicopter to measure tuning fork inflow to avoid disturbing campers near mouth as per special use permit stipulations)	62.1 G	61.3 G	.02P e .5P	-1.32	-2.1	-9.9	N	Trc
55 to 56	Escalante River 3.7 mi above Fools Canyon to Escalante River above Fools Canyon	61.3 G	62.1 G	0	.8	1.3	9.9	N	Trc
56 to 60	Escalante River above Fools Canyon to Escalante River above Stevens Canyon, includes Fools Canyon inflow (site 58)	62.1 G	59.5 G	e .002	-2.6	-4.2	-9.8	N	Trc/Jw

Table 3. Discharge, specific conductance, and temperature of water measured during seepage investigations along the Escalante River and tributaries, Garfield and Kane Counties, Utah, October 1981 and October 2001

[**Site number**: See plate 1 for location of sites. **Description of site**: USGS, U.S. Geological Survey; (09337500), station number of streamflow-gaging station operated by the USGS; **Discharge**: ft^3/s, cubic feet per second; e, estimated; **Specific Conductance**: µS/cm, microsiemens per centimeter at 25 degrees Celsius; **Water Temperature**: °C, degrees Celsius; **Formation:** Jn, Jurassic Navajo Sandstone; Jk, Jurassic Kayenta Formation; Jw, Jurassic Wingate Sandstone; Trc, Triassic Chinle Formation; —, no data available; <, less than; ft, feet; mi, mile]

Site number	Description of site	Discharge (ft^3/s)	Specific conductance (µS/cm)	Water temperature (°C)	Formation
	October 21, 1981				
10	Escalante River near Escalante at USGS gage (09337500)	16.8	—	—	Jn
11	Escalante River above Mamie Creek	18.8	850	—	Jn
12	Mamie Creek at mouth	7.2	420	—	Jn
13	Escalante River above Sand Creek	27.5	680	—	Jn
14	Sand Creek at mouth	10.0	800	—	Jn
15	Escalante River above Calf Creek	36.2	730	—	Jk
18	Calf Creek at mouth	6.4	680	—	Jk
20	Escalante River above Boulder Creek	43.9	680	—	Jn
25	Boulder Creek at mouth	41.2	280	—	Jn
29	Escalante River above The Gulch	88.8	500	—	Jn
30	The Gulch at mouth	1.0	520	—	Jn
	October 22, 1981				
31	Escalante River below The Gulch	78.9	—	—	Jn
36	Escalante River above Harris Wash	73.3	500	—	Jk
37	Harris Wash at mouth	5.9	700	—	Jk
39	Escalante River above Fence Canyon	78.9	510	—	Jw
	October 23, 2001				
10	Escalante River near Escalante at USGS gage (09337500)	4.07	1,398	7.0	Jn
11	Escalante River above Maime Creek	3.66	1,337	10.0	Jn
12	Mamie Creek at mouth	7.61	416	12.0	Jn
S7	Spring in Death Hollow, 400 ft above mouth, right side	<.004e	98	—	Jn
13	Escalante River above Sand Creek	12.5	751	9.5	Jn
14	Sand Creek at mouth	11.6	653	9.0	Jn
S8	Spring in Sand Creek 200 ft above mouth, right side	.01e	900	15.5	Jn
15	Escalante River above Calf Creek	23.2	717	12.0	Jk
17	Calf Creek at bridge to BLM Calf Creek Campground	5.89	—	13.5	Jk
18	Calf Creek at mouth	6.02	676	13.0	Jk
19	Escalante River below Calf Creek at USGS temporary gage	28.1	705	12.0	Jk
20	Escalante River above Boulder Creek	29.8	720	11.5	Jn
25	Boulder Creek at mouth	27.4	308	9.5	Jn
29	Escalante River above The Gulch (first measurement)	59.8	551	10.5	Jn
29	Escalante River above The Gulch (second measurement)	60.0	551	—	Jn
30	The Gulch at mouth	.007	595	—	Jn
	October 24, 2001				
17	Calf Creek at BLM campground bridge	6.36	—	11.5	Jk
18	Calf Creek at mouth	5.28	680	—	Jk
19	Escalante River below Calf Creek at USGS temporary gage	26.5	700	7.0	Jk
29	Escalante River above The Gulch (first measurement)	58.0	540	10.0	Jn
29	Escalante River above The Gulch (second measurement)	57.6	540	10.0	Jn
S11	(D-35-6)31bcc-S1 (wall spring)	.021	144	15.0	Jn

Table 3. Discharge, specific conductance, and temperature of water measured during seepage investigations along the Escalante River and tributaries, Garfield and Kane Counties, Utah, October 1981 and October 2001—Continued

Site number	Description of site	Discharge (ft^3/s)	Specific conductance (μS/cm)	Water temperature (°C)	Formation
	October 24, 2001—Continued				
32	Escalante River above Horse Canyon	53.9	512	12.0	Jk
34	Silver Falls Creek at mouth	dry	—	—	Jk
36	Escalante River above Harris Wash	55.9	524	8.0	Jk
37	Harris Wash at mouth	1.54	245	7.5	Jk
39	Escalante River above Fence Canyon	61.4	540	8.5	Jw
40	Fence Canyon at mouth	.07	379	8.0	Jw
44	Escalante River above Twentyfive Mile Wash	64.8	531	9.5	Jw
45	Twentyfive Mile Wash at mouth	.50	379	8.0	Jw
46	Moody Creek at mouth	dry	—	—	Trc
47	Escalante River below Moody Creek	61.9	512	9.5	Trc
49	Escalante River above Scorpion Gulch	62.1	505	10.5	Jw
51	Scorpion Gulch at mouth	.02 e	258	11.0	Jw
53	Mouth of unnamed tributary 2 mi below Scorpion Gulch (tuning fork canyon)	.5 e	—	—	Trc
55	Escalante River 3.7 mi above Fools Canyon (near slumps blocks in Chinle Formation)	61.3	504	11.5	Trc
56	Escalante River above Fools Canyon	62.1	505	12.0	Trc
58	Fools Canyon at mouth	.002e	523	14.5	Trc
60	Escalante River above Stevens Canyon	59.5	510	11.0	Jw
62	Stevens Canyon at mouth	.002e	551	8.0	Jw

Table 4. Field measurements of specific conductance and water temperature from selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah, 1951-2002

[**Site number:** See plate 1 for location of sites; **Description of site:** See numbering system used for hydrologic-data sites in Utah for location of springs; **Date:** In year, month, day format; **Specific conductance:** µS/cm, microsiemens per centimeter at 25^{o} Celsius; **Water temperature:** ^{o}C, degrees Celsius; — , no data; USGS, U.S. Geological Survey; BLM, Bureau of Land Management; mi, mile; ft, feet]

Site number	Description of site	Date	Specific conductance (µS/cm)	Water temperature (^{o}C)
	SURFACE-WATER SITES			
10	Escalante River near Escalante at USGS gage (09337500)	20011023	1,398	7.0
11	Escalante River above Mamie Creek	[1]19811021	850	—
		[1]20011023	1,340	10.0
12	Mamie Creek at mouth	[1]19811021	420	—
		[1]20011023	416	12.0
13	Escalante River above Sand Creek	[1]19811021	680	—
		20011023	751	9.5
14	Sand Creek at mouth	[1]19811021	800	—
		[1]20011023	653	9.0
15	Escalante River above Calf Creek	[1]19811021	730	—
		[1]20011023	717	12.0
16	Calf Creek above BLM campground and outflow from Calf Creek spring	19940601	660	21.5
17	Calf Creek at BLM campground bridge	19940518	670	14.4
		[1]20011023	—	13.5
18	Calf Creek at mouth	[1]19811021	680	—
		[1]20011023	676	13.0
		[1]20011024	680	9.5
19	Escalante River below Calf Creek at USGS temporary gage	[1]20011023	705	12.0
		[1]20011024	700	7.0
20	Escalante River above Boulder Creek	[1]19811021	680	—
		[1]20011023	720	11.5
21	East Fork Boulder Creek near Boulder (09338000)	19710820	80	7.0
		19710915	90	9.5
		19711020	90	4.0
		19720111	—	1.0
		19720419	110	.0
		19720606	70	5.5
		19720711	80	8.0
		19720814	105	11.0
		19720913	105	9.0
23	Deer Creek near Boulder (09338900)	20000616	440	18.0
24	Boulder Creek near Boulder (09339000)	20020409	360	—
		20021210	266	1.5
25	Boulder Creek at mouth	[1]19811021	280	—
		20010517	320	20.0
		[1]20011023	308	9.5
26	Unnamed tributary 1.1 mi below Boulder Creek, left bank	20010518	193	—
27	Unnamed tributary 1.6 mi above The Gulch and 0.1 mi from mouth	20010518	194	17.0
28	Pool 200 feet up unnamed tributary and 0.3 mi above The Gulch	20010518	162	—
29	Escalante River above The Gulch	[1]19811021	500	—
		[1]20011023	551	10.5
		[1]20011024	540	10.0

Table 4. Field measurements of specific conductance and water temperature from selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah, 1951-2002—Continued

Site number	Description of site	Date	Specific conductance (μS/cm)	Water temperature (°C)
	SURFACE-WATER SITES—Continued			
30	The Gulch at mouth	[1]19811021	520	—
		20010518	555	—
		[1]20011023	595	—
32	Escalante River above Horse Canyon	[1]20011024	512	12.0
33	Horse Canyon 500 ft above mouth	20010519	820	21.5
34	Silver Falls Creek at mouth	20010520	1,110	28.0
36	Escalante River above Harris Wash	[1]19811022	500	—
		[1]20011024	524	8.0
37	Harris Wash at mouth	[1]19811022	700	—
		20010520	785	18.5
		[1]20011024	245	7.5
38	Unnamed tributary 1.2 mi above Fence Canyon, left bank	20010520	295	25.0
39	Escalante River above Fence Canyon	[1]19811022	510	—
		[1]20011024	540	8.5
40	Fence Canyon at mouth	20010520	390	20.0
		[1]20011024	379	8.0
41	Neon Canyon at base of falls 0.6 mi above mouth	20010520	123	13.5
44	Escalante River above Twentyfive Mile Wash	[1]20011024	531	9.5
45	Twentyfive Mile Wash at mouth	20010520	1,300	—
		[1]20011024	379	8.0
47	Escalante River below Moody Creek	[1]20011024	512	9.5
48	East Moody Canyon at mouth	20010521	626	28.5
49	Escalante River above Scorpion Gulch	[1]20011024	505	10.5
51	Scorpion Gulch at mouth	[1]20011024	258	11.0
52	Unnamed tributary 2 mi below Scorpion Gulch and 0.4 mi from mouth	20010522	502	21.5
54	Mouth of unnamed canyon 6.5 mi above Fools Canyon on left bank	20010522	1,420	20.5
55	Escalante River 3.7 mi above Fools Canyon	[1]20011024	504	11.5
56	Escalante River above Fools Canyon	[1]20011024	505	12.0
57	Fools Canyon 1 mi above mouth	20010523	524	25.0
58	Fools Canyon at mouth	[1]20011024	523	14.5
59	Unnamed canyon 3 mi above Stevens Canyon on left bank	20010523	465	17.0
60	Escalante River above Stevens Canyon	[1]20011024	510	11.0
62	Stevens Canyon at mouth	[1]20011024	551	8.0
63	Escalante River at Coyote Gulch	20010524	286	—
64	Escalante River at mouth at USGS gage (09339500)	19510524	717	—
	SPRINGS			
S7	(D-35- 4) 7bda-S1	[1]20011023	98	14.0
S8	(D-35- 4)10ccb-S1	[1]20011023	900	15.5
S9	(D-35- 5) 1abd-S1	19940518	650	14.4
—		19940601	650	14.5
S10	(D-35- 5)23cba-S1	20010518	344	—
S11	(D-35- 6)31bcc-S1	[2]20010518	146	15.0
		[1]20011024	144	15.0
S12	(D-35- 6)31dba-S1	20010519	157	—
S20	(D-38- 8) 5bab-S1	20010522	198	17.5
S22	(D-38- 8) 8ada-S2	20010522	142	16.5
S25	(D-39- 9)19dba-S1	20010524	148	—

Table 4. Field measurements of specific conductance and water temperature from selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah, 1951-2002—Continued

Site number	Description of site	Date	Specific conductance (μS/cm)	Water temperature (ºC)
	SPRINGS—Continued			
S26	(D-39- 9)19dcc-S1	20010524	160	—
S27	(D-39- 9)20cad-S1	20010524	159	—
S28	(D-39- 9)29aac-S1	20010524	169	—

[1]Sample duplicated in table 3.

[2]Chemical analysis in table 12.

Table 5. Tritium concentration in water from selected surface-water sites and springs along the Escalante River and tributaries, Garfield and Kane Counties, Utah, 2001

[Analyses by Dissolved Gas Lab, University of Utah, Salt Lake City, Utah. Site number: See plate 1 for location of sites; **Description of site:** See numbering system used for hydrologic-data sites in Utah; **Site ID:** A unique number in the U.S. Geological Survey database that is used to identify a site and is based on the latitude (first 6 digits) and longitude (last 7 digits) of the site. 1927 North American Datum (NAD 1927); **Date and time sampled:** month, day, year and 24-hour time that sample was collected; **Formation:** Qt, Quaternary rockfall talus; Jn, Jurassic Navajo Sandstone; Jk, Jurassic Kayenta Formation; Jw, Jurassic Wingate Formation; Trc, Triassic Chinle Formation; **Tritium units:** represents one molecule of $^{3}H^{1}HO$ in 10^{18} molecules of H_2O; ft, feet; mi, mile]

Site number	Description of site	Site ID	Date and time sampled	Formation	Tritium units	Uncertainty of analysisin Tritium Units	
						Plus	Minus
S20	Spring in fracture 300 ft above Scorpion Gulch, right bank (D-38-8)5bab-S1	373144 1110350	05-22-01 at 0940 hrs	Jw	0.53	0.03	0.06
50	Stream in Scorpion Gulch near mouth	373138 1110345	05-21-01 at 2000 hrs	Jw	1.20	.06	.10
S21	Spring 1 mi below Scorpion Gulch, right bank (D-38-8)8ada-S1	373132 1110318	05-22-01 at 1130 hrs	Jw/Trc	.05	.01	.02
52	Stream in tuning fork canyon	373204 1110232	05-22-01 at 1530 hrs	Jw	3.81	.19	.19
S23	Spring in tuning fork canyon (D-38-8)4dbc-S1	373204 1110231	05-22-01 at 1630 hrs	Jw/Qt	4.17	.21	.21
57	Stream in Fools Canyon 1 mi above mouth	372757 1110046	05-23-01 at 1500 hrs	Jw	2.72	.23	.47
61	Stream in Stevens Canyon near mouth	372608 1105838	05-24-01 at 1105 hrs	Jw	5.48	.27	.27
S24	Spring in Coyote Gulch, left bank (D-39-8)13bab-S1	372537 1105936	05-24-01 at 1400 hrs	Jn/Jk	.30	.07	.13
S26	Spring about 4 mi below Coyote Gulch, right bank (D-39-9)19dcc-S1	372400 1105809	05-24-01 at 1755 hrs	Jn/Jk	.39	.02	.02
S28	Spring 5.7 mi below Coyote Gulch, left bank (D-39-9)29aac-S1	372345 1105651	05-24-01 at 1830 hrs	Jn/Jk	.04	.00	.01

Table 6. Chlorofluorocarbon concentration in water from selected surface-water sites and springs along the Escalante River and tributaries, Garfield and Kane Counties, Utah, 2001

[Analysis by Dissolved Gas Lab, University of Utah, Salt Lake City, Utah; **Site number:** See plate 1 for location of sites. Sample was divided into three equal volumes, a, b, and c, for individual laboratory analysis; **Description of site:** See numbering system used for hydrologic-data sites in Utah; **Site ID:** A unique number in the U.S. Geological Survey database that is used to identify a site and is based on the latitude (first 6 digits) and longitude (last 7 digits) of the site. 1927 North American Datum (NAD 1927); **Date sampled:** in month, day, year format; **Formation:** Qt, Quaternary rockfall talus; Jn, Jurassic Navajo Sandstone; Jk, Jurassic Kayenta Formation; Jw, Jurassic Wingate Sandstone; Trc, Triassic Chinle Formation; **CFC-11 concentration:** Chlorofluorocarbon-11 (CCl2F); **CFC-12 concentration:** Chlorofluorocarbon-12 (CCl2F2); pmoles/kg, picomoles per kilogram; mi, mile]

Site number	Description of site	Site ID	Date sampled	Formation	CFC-11 concentration (pmoles/kg)	CFC-12 concentration (pmoles/kg)
19a	Escalante River below Calf Creek at U.S. Geological Survey temporary gage	3746351112456	10-25-2001	Jk	4.57	2.98
19b					6.35	3.08
19c					5.73	2.97
25a	Boulder Creek at mouth	3745261112058	05-17-2001	Jn	3.56	1.55
25b					2.38	1.27
25c					2.24	1.24
S11a	Wall spring (informal designation) (D-35-6)31bcc-S1	3743321111738	05-18-2001	Jn	.05	.16
S11b					.37	.05
S11c					.19	.07
36a	Escalante River above Harris Wash	3739461111254	10-24-2001	Jk	4.67	2.40
36b					4.59	2.53
36c					6.59	2.62
39a	Escalante River above Fence Canyon	3736461111042	10-24-2001	Jn	5.51	2.42
39b					4.50	2.52
39c					5.49	2.67
44a	Escalante River above Twentyfive Mile Wash	3734461110742	10-24-2001	Jw	4.57	2.51
44b					4.98	2.35
44c					6.04	2.39
45a	Twentyfive Mile Wash at mouth	3734461110744	10-24-2001	Jw	3.73	2.21
45b					3.99	2.30
45c					3.85	2.39
47a	Escalante River below Moody Creek	3733561110509	10-24-2001	Trc	2.91	2.54
47b					3.89	2.62
47c					4.67	4.51
49a	Escalante River above Scorpion Gulch	3731441110344	10-24-2001	Jw	3.29	2.19
49b					4.92	2.34
49c					4.08	2.49
50a	Scorpion Gulch near mouth	3731381110345	05-21-2001	Jw	3.07	1.53
50b					2.78	1.39
50c					3.02	1.69
S21a	Spring 1 mi below Scorpion Gulch, right bank at Wingate-Chinle Formation contact (D-38-8)8ada-S1	3731321110318	05-22-2001	Jw/Trc	2.42	1.58
S21b					2.25	1.58
S21c					2.21	1.37
S23a	Spring in tuning fork canyon, 2 mi below Scorpion Gulch and 0.4 mi from mouth (D-38-8)4dbc-S1	3732041110231	05-22-2001	Qt/Jn	2.96	1.95
S23b					3.06	1.89
S23c					3.71	1.90
56a	Escalante River above Fools Canyon	3728021110004	10-24-2001	Jw	6.84	2.23
56b						
56c					4.33	2.27
60a	Escalante River above Stevens Canyon	3726101105852	10-24-2001	Jw	3.99	2.49
60b					3.93	2.31
60c					4.69	2.55

Table 7. Selected data for gaging stations in the Escalante River drainage basin, Garfield and Kane Counties, 1909-2002

[**Site number**: See plate 1 for location of streamflow-gaging stations; **Description of site**: General description of active or discontinued gaging station; **Source of data:** USGS, U.S. Geological Survey; SWR, Surface Water Records of Utah, USGS-published surface-water data from 1961 to 1969; TP, Technical Publication, reports prepared by the USGS in cooperation with Utah State agencies, typically Department of Natural Resources, Division of Water Rights; WDR, Water Data Report, USGS-published water-data reports since 1975; WRD, Water Resources Data, USGS-published water data reports from 1965-74; WSP, Water-Supply Paper, USGS-published report series; ft^3/s, cubic feet per second; approx., approximately; —, no data; mi, miles; mm-dd-yyyy, month, day, year]

Site number	Gaging station number	Description of site	Period of record	Drainage area (square miles)	Annual mean discharge (ft^3/s)
1	09335500	North Creek near Escalante	Jul 1950-Sep 1955	90	7.64
3	09336000	Birch Creek near Escalante	Jul 1950-Sep 1951, Annual peaks 1959-74	36	.54
5	09336400	Upper Valley Creek near Escalante	Water years 1959-74	53	—
7	09336500	Birch Creek at mouth, near Escalante	Oct 1951-Jul 1955	100	3.26
9	09337000	Pine Creek near Escalante[4]	Jul 1950-Sep 1955, Jul 1957-Sep 2002	78	5.15
10	09337500	Escalante River near Escalante[4]	Aug 1909-Apr 1913 Oct 1942-Sep 1955, Dec 1971-Sep 2002	310	11.0
21	09338000	East Fork Boulder Creek near Boulder	Jul 1951-Sep 1955, Jul 1957-Sep 1972	21.4	23.7
22	09338500	East Fork Deer Creek near Boulder	Jul 1950-Sep 1955	1.9	1.39
23	09338900	Deer Creek near Boulder[4]	Annual peaks 1959-74	63	—
24	09339000	Boulder Creek near Boulder[4]	Jul 1950-Sep 1955[8]	175	23.0
43	09339200	Twentymile Wash near Escalante	Annual peaks 1959-68	140	—
64	09339500	Escalante River at mouth near Escalante (approx 2.2 mi below Davis Gulch and 5.1 mi above confluence with Colorado River left bank, site inundated by Lake Powell June 1963)	Apr 1951-Sep 1955	1,770	85.2

[1]No flow for part of each day August 6, 1951; November 25-27, 1952; December 1, 1953.
[2]No flow at times.
[3]Some flow throughout most years, but dry on occasions.
[4]Active gaging station.
[5]No flow at times some years.
[6]No flow for part of day as result of freeze up.
[7]Gage reactivated in September 2001.
[8]Gage reactivated in December 2002.
[9]Only intermittent or ephemeral flow.
[10]Miscellaneous discharge measurements and water samples were obtained at the mouth of the Escalante River during river reconnaissance trips from Linwood, Utah, to Lee's Ferry, Arizona, by USGS on October 15, 1946; September 24, 1947; and October 5, 1948 (H.W. Chase, District Engineer, written commun., 1948).

Table 7. Selected data for gaging stations in the Escalante River drainage basin, Garfield and Kane Counties, 1909-2002—Continued

Site number	Number of water years used to calculate annual mean	Gaging station number	Extremes				Source of data
			Maximum discharge (ft^3/s)	Date of maximum discharge (mm-dd-yy)	Minimum discharge (ft^3/s)	Date of minimum discharge (mm-dd-yy)	
1	5	09335500	3,610	08-21-52	0	(1)	WSP 1733, TP 21
2	1	09336000	3,400	08-19-63	0	(2)	WSP 1733, SWR 1963
4	—	09336400	5,560	08-02-59	0	(3)	SWR 1962
7	3	09336500	1,010	07-12-54	.1	07-13-55 and 07-14-55	WSP 1733
9	50	09337000	1,010	08-02-67	0	(5)	WRD 1967
10	46	09337500	4,550	08-24-98	0.07	12-24-78	WDR-UT-98-1
21	20	09338000	483	05-20-64	8.2	11-05-51	WSP 1733, SWR 1964
22	5	09338500	224	08-03-61	0	[6]02-10-53	SWR 1962, WSP 1733
23	—	09338900	3,820	08-03-61	0	(3)	[7]SWR 1962
24	5	09339000	4,650	07-25-55	6.1	06-26-53	WSP 1733
43	—	09339200	4,620	08-27-63	0	(9)	SWR 1963
64	5	09339500	14,600	08-04-51	4.4	08-20-50 and 07-11-51	[10]WSP 1733

Table 8. Field measurements of specific conductance and water temperature at gaging station at Pine Creek near Escalante (09337000, site 9), Garfield County, Utah, 1971-91

[**Record number:** A unique number that identifies one water-quality sample in the U.S. Geological Survey data base. See plate 1 for location of gaging station 09337000; **Date:** in year, month, day format; **Specific conductance**: µS/cm, microsiemens per centimeter at 25^{o} Celsius; **Water temperature:** ^{o}C, degrees Celsius; —, no data]

Record number	Date	Specific conductance (µS/cm)	Water temperature (^{o}C)	Record number	Date	Specific conductance (µS/cm)	Water temperature (^{o}C)
97100373	19710819	340	19.0	97601505	19760527	245	10.5
97100374	19710915	400	13.5	97601506	19760701	240	18.0
97200857	19711021	400	1.0	97601507	19760805	260	21.0
97200859	19720217	340	0.0	97701409	19761011	350	8.0
97200860	19720323	360	9.0	97701410	19761109	345	7.0
97200861	19720418	400	11.0	97701411	19770104	325	.5
97200862	19720512	220	4.0	97701412	19770228	400	3.0
97200863	19720605	255	15.0	97801337	19771004	420	22.0
97200864	19720711	250	22.5	97801338	19771109	420	2.0
97200865	19720814	360	17.5	97801339	19780112	420	.0
97200866	19720913	340	14.0	97801340	19780321	350	5.5
97300980	19721018	340	7.5	97801341	19780426	420	11.5
97300981	19721018	340	7.5	97801342	19780602	250	11.0
97300982	19721129	400	.0	97801343	19780710	225	22.0
97300983	19721129	400	.0	97801344	19780809	220	20.0
97300984	19730108	375	.0	97801345	19780911	390	20.0
97300985	19730108	375	.0	97901219	19781004	340	15.5
97300986	19730418	360	4.0	97901220	19781107	350	9.0
97300987	19730509	380	9.5	97901221	19781212	455	1.5
97300988	19730613	280	11.5	97901222	19790418	400	5.0
97300989	19730710	380	19.0	97901223	19790515	400	8.0
97400862	19731002	350	5.0	97901224	19790612	405	15.0
97400863	19731213	300	.5	97901225	19790717	390	20.0
97400864	19740214	320	.5	97901226	19790822	350	16.5
97400865	19740319	350	8.5	97901227	19790920	275	12.0
97400866	19740501	370	13.0	98001344	19791004	350	13.0
97400867	19740606	300	11.0	98001345	19791115	380	7.0
97400868	19740710	220	21.0	98001346	19800408	380	4.0
97400869	19740828	340	13.0	98001347	19800506	350	3.0
97501693	19741009	315	8.0	98001348	19800624	390	18.0
97501694	19741205	380	.5	98001349	19800806	380	18.0
97501695	19750128	320	.0	98101259	19801006	345	14.0
97501696	19750228	340	.0	98101260	19801201	310	.5
97501697	19750508	440	10.0	98101261	19810114	330	.5
97501698	19750702	445	21.0	98101262	19810324	375	8.5
97501699	19750731	295	21.5	98101263	19810421	—	7.0
97501700	19750904	345	20.0	98101264	19810519	375	11.0
97601498	19751010	375	9.5	98101265	19810624	225	14.0
97601499	19751119	360	.5	98101266	19810715	310	15.0
97601500	19751211	380	.5	98101267	19810903	370	16.0
97601501	19760122	365	.0	98200773	19811008	370	6.0
97601502	19760204	370	.0	98200774	19811117	375	3.0
97601503	19760311	355	.5	98200775	19811216	385	.5
97601504	19760421	55	10.0	98200776	19820114	400	.5

Table 8. Field measurements of specific conductance and water temperature at gaging station at Pine Creek near Escalante (09337000, site 9), Garfield County, Utah, 1971-91—Continued

Record number	Date	Specific conductance (μS/cm)	Water temperature (°C)
98200777	19820222	390	1.0
98200778	19820331	440	6.0
98200779	19820429	195	5.5
98200780	19820520	180	9.0
98200781	19820623	400	10.5
98200782	19820722	310	18.0
98200783	19820817	345	18.0
98301022	19821007	365	3.0
98301023	19821115	445	.5
98301024	19821228	270	.5
98301025	19830126	400	6.0
98301026	19830307	395	.5
98301027	19830415	435	2.0
98301028	19830518	470	3.0
98301029	19830620	330	12.0
98301030	19830809	370	17.0
98301031	19830920	335	7.0
98401607	19831018	370	8.0
98401608	19831207	385	.5
98401609	19840112	410	.5
98401610	19840209	390	.5
98401611	19840312	400	3.0
98401612	19840412	435	7.0
98401613	19840510	160	9.5
98401614	19840613	400	10.5
98401615	19840718	320	23.0
98401616	19840822	285	15.5
98601853	19851016	385	8.0
98601854	19851129	370	.5
98601855	19860117	390	1.0
98601856	19860311	415	5.0
98601857	19860424	310	6.5
98601858	19860602	320	15.0
98601859	19860701	275	—
98601860	19860818	235	20.0
98802136	19871008	390	8.5
98802137	19871201	—	1.0
98802138	19880210	425	1.0
98802139	19880406	—	6.0
98802140	19880505	335	—
98802141	19880610	—	14.5
98802142	19880713	—	17.0
98802143	19880826	260	17.0
98900833	19881103	380	5.0
98900834	19881207	390	4.0
98900835	19890214	—	1.0
98902431	19890404	—	12.5
98900837	19890503	370	11.0
98902449	19890607	320	17.0
98902450	19890713	405	23.0
98902451	19890811	385	20.0
98902452	19890912	390	13.5
99000224	19891005	395	10.5
99000631	19891101	440	10.0
99000632	19891207	430	10.0
99000633	19900118	—	1.0
99000634	19900301	445	.0
99000986	19900304	425	7.0
99000987	19900426	490	10.0
99001690	19900601	440	9.0
99001691	19900720	430	19.0
99002015	19900821	450	16.0
99101372	19901018	425	7.5
99101373	19901129	550	.5
99101374	19910123	—	.2
99101375	19910220	450	.0
99101376	19910328	475	2.0
99101377	19910424	450	3.5
99101378	19910515	235	9.5
99101379	19910618	285	16.0
99101380	19910716	225	20.5
99101831	19910820	410	14.0

Table 9. Field measurements of specific conductance and water temperature at gaging station at Escalante River near Escalante (09337500, site 10), Garfield County, Utah, 1969-2001

[**Record number:** A unique number that identifies one water-quality sample in the U.S. Geological Survey data base. See plate 1 for location of gaging station 09337500; **Date:** In year, month, date format; **Specific conductance**: μS/cm, microsiemens per centimeter at 25^{o} Celsius; **Water temperature:** ^{o}C, degrees Celsius; —, no data]

Record number	Date	Specific conductance (μS/cm)	Water temperature (^{o}C)
96900543	19690806	700	22.0
96900544	19690806	700	22.0
97000373	19691211	280	.0
97000376	19700820	800	17.0
97100375	19701112	800	7.0
97100376	19701112	845	7.0
97100378	19710406	758	—
97200867	19711203	825	1.5
97200869	19720606	610	26.0
97300990	19721018	1,400	11.5
97300991	19721129	1,540	3.5
97300992	19730322	1,350	8.0
97300993	19730418	950	6.0
97300994	19730509	480	19.0
97300995	19730613	470	15.0
97300996	19730809	1,200	28.0
97400870	19731002	940	11.5
97400871	19731101	1,380	12.0
97400872	19731213	925	2.0
97400873	19740214	750	.5
97400874	19740319	850	11.0
97400875	19740502	1,900	7.0
97400876	19740605	1,800	20.0
97400877	19740828	2,200	20.0
97501701	19741009	1,600	14.0
97501702	19741205	2,000	6.0
97501703	19750402	2,100	.0
97501704	19750508	2,000	19.0
97501705	19750702	2,300	26.5
97501706	19750801	2,000	12.0
97501707	19750905	2,150	10.0
97601508	19751008	2,000	2.5
97601509	19751119	1,600	7.0
97601510	19751211	1,100	5.5
97601511	19760123	1,280	.0
97601512	19760204	850	.5
97601513	19760311	1,100	1.0
97601514	19760422	1,850	6.0
97601515	19760527	1,550	12.0
97601516	19760701	2,000	20.5
97601517	19760806	2,300	15.0
97601518	19760831	2,050	24.5
97701413	19761011	1,320	10.0
97701414	19761109	1,300	13.0
97701415	19770228	1,400	8.0
97701416	19770523	2,000	19.0
97701417	19770705	1,900	24.0
97701418	19770809	1,850	28.0
97801346	19771004	1,700	8.0
97801347	19771109	1,550	5.5
97801348	19780111	1,550	—
97801349	19780112	1,720	.0
97801350	19780222	1,250	.5
97801351	19780602	1,500	15.5
97801352	19780710	3,000	25.0
97801353	19780810	1,400	15.0
97801354	19780911	1,500	23.0
97901228	19781004	1,450	—
97901229	19781107	1,050	13.5
97901230	19781212	1,340	.5
97901231	19790306	1,110	5.0
97901232	19790418	720	7.5
97901233	19790515	760	9.0
97901234	19790611	450	20.0
97901235	19790717	2,480	24.0
97901236	19790822	1,120	24.5
97901237	19790921	1,380	9.0
98001350	19791004	1,410	15.5
98001351	19791115	1,740	5.0
98001352	19800205	1,470	1.0
98001353	19800408	960	7.0
98001354	19800506	1,070	10.0
98001355	19800624	720	24.0
98101268	19801006	1,100	20.0
98101269	19801201	980	—
98101270	19810114	870	1.5
98101271	19810324	1,120	11.0
98101272	19810421	—	11.0
98101273	19810519	1,560	12.0
98101274	19810624	1,630	16.0
98101275	19810715	890	23.0
98101276	19810903	1,120	14.5
98200784	19811008	1,070	8.0
98200785	19811117	920	4.5
98200786	19811216	860	1.0
98200787	19820114	960	.5
98200788	19820222	670	6.0
98200789	19820331	850	6.0
98200790	19820429	300	7.5
98200791	19820520	290	11.0

Table 9. Field measurements of specific conductance and water temperature at gaging station at Escalante River near Escalante (09337500, site 10), Garfield County, Utah, 1969-2001—Continued

Record number	Date	Specific conductance (μS/cm)	Water temperature (ºC)
98200792	19820623	1,020	15.0
98200793	19820722	1,580	17.0
98200794	19820817	920	19.0
98301032	19821007	1,210	6.0
98301033	19821115	1,550	1.0
98301034	19821228	630	.5
98301035	19830126	850	3.0
98301036	19830307	—	7.0
98301037	19830415	970	4.0
98301038	19830518	810	5.0
98301039	19830620	420	—
98301040	19830809	650	26.0
98401617	19831018	870	9.0
98401618	19831207	760	.5
98401619	19840112	1,030	1.0
98401620	19840209	810	.5
98401621	19840312	910	9.0
98401622	19840412	1,270	6.0
98401623	19840510	315	10.0
98401624	19840613	710	12.0
98401625	19840719	1,560	15.0
98401626	19840822	600	17.0
98601861	19851016	1,040	12.0
98601862	19851129	1,080	—
98601863	19860117	940	3.0
98601864	19860311	930	9.0
98601865	19860424	1,220	16.0
98601866	19860602	1,040	15.0
98601867	19860701	2,810	18.0
98601868	19860818	1,810	27.0
98700894	19870911	2,050	16.0
98802107	19871008	2,070	7.0
98802108	19871201	—	4.5
98802109	19880210	1,260	4.0
98802110	19880406	—	6.0
98802111	19880505	1,060	—
98802112	19880826	690	19.0
98900145	19881004	1,940	15.5
98900795	19881103	850	9.0
98900796	19881207	1,140	8.0
98902764	19890118	1,500	—
98900797	19890129	1,120	—
98900798	19890302	790	4.5
98900799	19890404	1,100	19.0
98900800	19890503	1,950	23.0
98902453	19890607	2,270	26.0
98902454	19890713	2,650	30.0
98902455	19890811	2,300	25.0
98902456	19890912	2,600	18.0
99000225	19891005	2,680	18.0
99000963	19891101	1,280	10.0
99000964	19891207	2,300	2.0
99002092	19900118	1,500	—
99000966	19900223	—	10.0
99000967	19900404	2,690	18.0
99000968	19900426	2,440	14.0
99001512	19900601	—	16.0
99001513	19900717	—	23.0
99002009	19900821	340	26.0
99101217	19901129	2,500	7.0
99101218	19910123	2,420	6.5
99101219	19910220	2,410	10.0
99101220	19910328	2,990	16.0
99101221	19910424	2,890	12.0
99101222	19910515	2,890	20.5
99101223	19910618	4,350	23.0
99101827	19910820	3,390	21.5
00200308	20011023	1,400	7.0

Table 10. Physical properties and results of chemical analyses for water from the gaging station at Escalante River near Escalante (09337500, site 10), Garfield County, Utah, 1969-72

[**Record number:** A unique number that identifies one water-quality sample in the U.S. Geological Survey data base; See plate 1 for location of gaging station 09337500. **Date**: In year, month, day format; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25º Celsius; ºC, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; —, no data]

Record number	Date	Discharge (ft^3/s)	pH, water, whole, field, (standard units)	Specific conductance (µS/cm)	Temperature, water (ºC)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)
96900542	19690805	30.2	7.6	3,260	26.0	1,900	587	101
96900545	19690806	143	7.9	931	22.0	290	29.0	52.0
97000374	19691211	18	7.9	831	0.0	330	75.0	35.0
97000375	19700415	24.4	8.3	731	14.0	260	63.0	24.0
97100376	19701112	15	8.0	845	7.0	300	75.0	27.0
97100377	19710406	18	8.5	700	16.0	—	—	—
97200868	19711203	20	8.1	915	1.5	320	79.0	31.0
97200870	19720606	10	7.4	625	26.0	230	57.0	22.0

Record number	Sodium, dissolved (mg/L as Na)	Alkalinity, water, unfiltered, field (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L as SO_4)	Solids, residue at 180ºC, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Boron, dissolved (µg/L as B)
96900542	205	153	90.0	—	14.0	2,030	3,240	3,140	—
96900545	114	354	17.0	—	11.0	176	619	615	—
97000374	53.0	203	64.0	—	—	160	552	511	—
97000375	54.0	164	64.0	—	—	130	456	437	—
97100376	56.0	171	50.0	—	20.0	164	561	498	—
97100377	—	—	—	—	—	—	—	—	—
97200868	65.0	168	73.0	—	—	180	—	533	—
97200870	38.0	123	49.0	.4	12.0	120	—	377	60

Table 11. Physical properties and results of chemical analyses for water from the gaging station at Escalante River at mouth (09339500, site 64), Kane County, Utah, 1951-53

[**Record number:** A unique number that identifies one water-quality sample in the U.S. Geological Survey data base. See plate 1 for location of station 09339500; **Date**: In year, month, day format**;** ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; —, no data]

Record number	Date	Discharge, daily mean (ft^3/s)	Specific conductance (µS/cm)	pH, water, whole (standard units)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)
95100392	19510301	83	490	7.7	200	50.0	19.0	4.00
95100393	19510311	67	491	7.6	200	50.0	19.0	3.80
95100394	19510321	60	506	7.3	210	50.0	20.0	4.30
95100395	19510401	85	528	7.4	220	52.0	22.0	5.10
95100396	19510411	32	552	7.8	230	52.0	24.0	7.00
95100397	19510421	49	546	7.8	220	52.0	23.0	5.30
95100398	19510501	59	558	7.8	230	52.0	24.0	5.60
95100399	19510511	35	548	7.5	230	56.0	21.0	4.00
95100400	19510521	45	460	7.7	200	50.0	17.0	5.10
95100402	19510601	81	498	7.7	200	50.0	19.0	4.80
95100403	19510611	27	633	7.7	250	56.0	26.0	6.10
95100404	19510621	17	643	7.6	250	54.0	28.0	5.90
95100405	19510701	15	651	7.8	240	48.0	30.0	5.60
95100406	19510711	7.2	624	7.8	240	48.0	28.0	6.40
95100407	19510721	14	703	7.8	250	57.0	27.0	7.50
95100408	19510801	33	713	7.7	300	82.0	23.0	11.0
95100409	19510811	38	690	7.8	290	72.0	26.0	8.80
95100410	19510821	50	635	7.7	280	77.0	22.0	8.80
95100411	19510901	100	619	7.8	240	60.0	22.0	7.20
95100412	19510911	34	629	7.9	260	64.0	24.0	5.80
95100413	19510921	34	597	7.9	240	61.0	22.0	4.80
95200449	19511001	51	572	7.9	230	60.0	20.0	6.20
95200450	19511011	38	586	8.0	240	60.0	23.0	4.30
95200451	19511101	88	514	7.8	230	56.0	21.0	3.80
95200452	19511111	55	542	7.8	230	54.0	23.0	2.20
95200453	19511121	69	457	7.9	200	50.0	19.0	2.00
95200454	19511201	100	493	7.9	220	52.0	22.0	2.20
95200455	19511211	19	524	7.5	240	58.0	24.0	3.40
95200456	19520101	168	546	8.0	240	58.0	24.0	4.40
95200457	19520111	40	546	—	230	55.0	23.0	3.60
95200458	19520127	207	472	—	180	46.0	17.0	4.00
95200459	19520201	119	480	7.8	200	48.0	19.0	3.60
95200460	19520219	107	487	7.9	210	48.0	21.0	3.00

Table 11. Physical properties and results of chemical analyses for water from the gaging station at Escalante River at mouth (09339500, site 64), Kane County, Utah, 1951-53—Continued

Sodium, dissolved (mg/L as Na)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L as SO_4)	Solids, residue at 180 °C, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Boron, dissolved (μg/L as B)
23.0	26.0	0.3	22.0	72.0	301	301	—
24.0	28.0	.3	21.0	75.0	308	306	—
25.0	28.0	.1	20.0	80.0	330	314	—
27.0	31.0	.2	18.0	88.0	339	331	—
28.0	33.0	.2	17.0	95.0	349	345	—
28.0	33.0	.2	16.0	91.0	344	337	—
30.0	35.0	.2	14.0	97.0	356	345	—
28.0	28.0	.2	18.0	89.0	344	337	—
21.0	21.0	.3	18.0	59.0	284	283	—
27.0	29.0	.3	18.0	77.0	308	310	—
35.0	41.0	.3	19.0	117	398	388	—
36.0	44.0	.4	16.0	124	401	395	—
37.0	46.0	.4	15.0	132	410	393	—
36.0	45.0	.4	19.0	126	394	385	—
43.0	42.0	.4	21.0	136	453	430	—
34.0	22.0	.3	16.0	174	495	471	—
35.0	36.0	.3	19.0	150	470	446	—
27.0	22.0	.3	14.0	146	431	415	—
33.0	22.0	.3	14.0	136	410	387	—
32.0	34.0	.2	20.0	130	411	403	—
31.0	32.0	.2	17.0	123	385	379	—
30.0	29.0	.2	15.0	115	370	362	—
29.0	33.0	.2	16.0	117	377	371	90
23.0	26.0	.2	15.0	92.0	326	322	—
26.0	31.0	.1	18.0	98.0	344	339	140
21.0	25.0	.3	16.0	80.0	288	290	—
24.0	26.0	.4	18.0	82.0	308	315	—
24.0	30.0	.2	20.0	87.0	336	339	160
29.0	26.0	.2	19.0	94.0	351	358	—
28.0	29.0	—	22.0	90.0	370	344	—
29.0	22.0	.3	17.0	78.0	309	295	—
26.0	22.0	.3	18.0	76.0	316	300	50
24.0	24.0	.3	19.0	81.0	324	305	—

Table 11. Physical properties and results of chemical analyses for water from the gaging station at Escalante River at mouth (09339500, site 64), Kane County, Utah, 1951-53—Continued

Record number	Date	Discharge, daily mean (ft^3/s)	Specific conductance (μS/cm)	pH, water, whole (standard units)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)
95200461	19520301	162	474	7.9	190	45.0	18.0	4.50
95200462	19520311	132	476	8.0	200	46.0	20.0	3.50
95200463	19520321	98	486	7.6	200	48.0	20.0	3.80
95200464	19520401	207	481	7.8	190	45.0	19.0	3.80
95200465	19520411	98	486	7.9	200	46.0	20.0	3.60
95200466	19520421	132	418	7.9	170	40.0	18.0	4.00
95200467	19520501	110	412	7.7	180	44.0	17.0	4.20
95200468	19520511	179	332	7.8	150	41.0	12.0	3.00
95200469	19520521	83	429	7.8	180	44.0	17.0	3.30
95200470	19520604	505	367	7.9	150	38.0	13.0	5.00
95200471	19520611	81	493	7.9	200	49.0	20.0	4.00
95200472	19520621	26	617	7.9	250	56.0	26.0	4.90
95200473	19520701	31	635	7.8	250	56.0	26.0	5.80
95200475	19520714	32	694	7.8	280	68.0	26.0	6.60
95200476	19520721	25	705	7.6	290	72.0	27.0	5.80
95200477	19520801	72	751	7.6	300	76.0	26.0	6.50
95200478	19520811	30	772	7.6	320	88.0	25.0	6.50
95200479	19520821	107	810	7.5	370	98.0	30.0	7.80
95200481	19520904	45	753	7.9	320	82.0	27.0	5.90
95200482	19520912	49	663	8.1	280	75.0	22.0	5.70
95200483	19520923	379	564	8.0	260	63.0	24.0	4.80
95300298	19521011	49	622	8.1	260	68.0	21.0	—
95300300	19521021	71	549	7.6	240	59.0	22.0	5.20
95300302	19521114	74	593	7.4	260	75.0	17.0	—
95300303	19521220	122	474	7.3	200	52.0	16.0	—
95300304	19530107	95	474	7.3	190	49.0	16.0	—
95300305	19530219	88	442	7.4	180	49.0	15.0	—
95300308	19530411	48	547	7.7	220	64.0	13.0	—
95300311	19530511	49	574	8.0	220	55.0	21.0	—
95300314	19530611	40	591	7.8	230	52.0	23.0	—
95300316	19530701	26	594	7.9	220	50.0	24.0	—
95300317	19530720	50	787	—	—	—	—	—
95300318	19530801	662	778	—	—	—	—	—
95300319	19530821	27	1160	—	—	—	—	—
95300321	19530911	53	881	8.0	420	117	30.0	—

Table 11. Physical properties and results of chemical analyses for water from the gaging station at Escalante River at mouth (09339500, site 64), Kane County, Utah, 1951-53—Continued

Sodium, dissolved (mg/L as Na)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L as SO_4)	Solids, residue at 180 °C, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Boron, dissolved (μg/L as B)
30.0	21.0	0.3	16.0	76.0	309	296	—
26.0	24.0	.3	19.0	76.0	318	298	50
27.0	27.0	.1	16.0	82.0	310	307	—
30.0	22.0	.1	16.0	76.0	304	302	—
27.0	26.0	.2	18.0	74.0	313	303	70
21.0	19.0	.2	17.0	60.0	268	259	—
17.0	18.0	.3	22.0	52.0	263	257	—
12.0	13.0	.3	17.0	38.0	208	207	60
21.0	24.0	.3	21.0	65.0	273	273	—
20.0	14.0	.4	20.0	42.0	236	228	—
26.0	30.0	.4	21.0	75.0	310	308	—
33.0	42.0	.2	18.0	117	396	384	—
36.0	42.0	.3	18.0	132	412	400	—
36.0	40.0	.3	25.0	142	446	443	150
38.0	39.0	.3	22.0	138	464	448	—
45.0	35.0	.4	19.0	162	500	484	—
41.0	35.0	.4	17.0	173	511	499	20
35.0	24.0	.4	18.0	193	560	536	—
37.0	40.0	.2	19.0	160	492	481	—
29.0	34.0	.2	16.0	128	426	413	70
26.0	26.0	.2	16.0	114	362	365	—
29.0	35.0	—	21.0	121	404	—	110
24.0	24.0	.3	15.0	101	344	340	—
24.0	26.0	—	14.0	101	370	—	—
22.0	—	—	28.0	—	302	—	—
21.0	22.0	—	28.0	74.0	285	—	—
20.0	—	—	—	—	267	—	—
26.0	32.0	—	18.0	83.0	335	—	—
30.0	34.0	—	16.0	91.0	354	—	—
33.0	39.0	—	17.0	110	366	—	
33.0	40.0	—	18.0	114	372	—	120
—	—	—	—	—	532	—	—
—	—	—	—	—	540	—	—
—	—	—	—	—	900	—	—
35.0	31.0	—	20.0	255	641	—	—

Table 12. Physical properties and results of chemical analyses for water from selected surface-water sites and springs in the Escalante River drainage basin, Garfield and Kane Counties, Utah, 1981-2002

[**Site number:** See plate 1 for location of site where chemical analyses data have been collected; **Site description or local name:** See numbering system used for hydrologic-data sites in Utah, see table 1 for complete description of site; **Record number:** A unique number that identifies one water-quality sample in the U.S. Geological Survey database; **Date:** In month, day, year format; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25° Celsius, °C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; BLM, Bureau of Land Management; —, no data; <, less than; E, estimated; mi, mile]

Site number	Site description or local name	Record number	Date	Discharge, instantaneous (ft^3/s)	Specific conductance, lab (µS/cm)	pH, water, whole, field (standard units)	pH, water, whole, lab (standard units)	Specific conductance (µS/cm)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)
	SURFACE-WATER SITES										
2	Birch Creek 10.5 mi above confluence with North Creek	98102979	04-20-81	1.4	332	8.5	8.2	—	10.0	160	36.0
		98102980	08-25-81	1.1	327	8.7	8.7	280	18.0	160	29.0
		98202219	05-05-82	2.6	221	7.9	8.4	205	13.5	100	24.0
4	Upper Valley Creek near Liston Flat	98102958	04-21-81	0.73	1,340	8.5	8.2	1,400	9.5	360	63.0
		98102959	08-25-81	.36	1,090	8.6	8.4	1,140	27.5	280	34.0
		98202199	03-03-82	1.6	1,260	8.5	8.7	980	9.5	390	62.0
6	Birch Creek 0.8 mi above confluence with North Creek	98102969	04-20-81	2.6	459	8.6	8.3	465	20.5	240	47.0
		98102970	08-25-81	1.8	426	8.5	8.3	435	24.5	220	39.0
		98202213	05-05-82	5.6	391	8.1	8.4	375	18.0	190	41.0
8	Escalante River below confluence of North and Birch Creek	98102972	04-21-81	21.3	669	8.4	8.3	680	6.5	250	50.0
		98102973	08-25-81	14	447	8.4	8.4	470	19.5	190	40.0
11	Escalante River above Mamie Creek	98202216	10-21-81	18.7	829	8.4	8.1	1,730	5.5	300	64.0
16	Calf Creek above BLM campground	99400306	06-01-94	5.25	652	8.2	8.2	660	21.5	280	64.0
19	Escalante River below Calf Creek	00200645	08-21-02	—	—	8.3	—	450	19.5	190	47.8
20	Escalante River above Boulder Creek	98202211	10-21-81	43.9	721	8.5	8.2	680	12.5	280	64.0
25	Boulder Creek at mouth	98202212	10-21-81	41.2	266	8.6	8.1	280	10.0	130	35.0
35	Alvey Wash above Coal Bed Canyon	98202203	11-15-81	.1	1,220	8.2	7.9	1,230	3.5	690	139
		98202204	03-03-82	.12	1,220	8.4	8.6	1,070	14.0	620	125
39	Escalante River above Fence Canyon	98202183	10-22-81	78.9	512	8.5	8.2	510	13.5	220	53.0
42	Left Hand Collett Canyon	98202156	03-03-82	.27	3,300	8.1	8.2	3,490	11.0	2,300	300
50	Scorpion Gulch near mouth	00100638	05-22-01	—	306	—	8.0	299	13.5	160	39.0
61	Stevens Canyon near mouth	00100640	05-24-01	—	401	—	7.8	401	15.5	170	35.6
	SPRINGS										
S1	(C-34-1)24ccc-S1	98202222	11-13-81	—	560	7.3	7.6	580	8.0	320	69.0
S2	(C-35-1)12ada-S1	98202217	11-13-81	—	535	7.3	8.1	540	8.0	310	62.0
S3	(C-35-1)24dbc-S1	98202208	11-13-81	.02	459	7.5	8.0	485	8.0	270	50.0
S4	(C-36-1) 1dad-S1	98202201	10-21-81	.04	565	7.4	7.8	590	8.5	300	60.0
S5	(D-35-1)33dda-S1	98102966	09-23-81	—	658	6.9	7.5	590	9.0	220	26.0
S6	(D-35-2)16acd-S1	98202214	10-16-81	.11	769	7.3	8.0	820	10.5	320	60.0
S9	(D-35-5) 1abd-S1	99400305	06-01-94	.14	640	8.0	7.7	650	14.5	250	38.0
S11	(D-35-6)31bcc-S1	00100637	05-18-01	—	147	—	8.1	146	15.0	65	13.6
S13	(D-37-1)10acd-S1	98202177	10-25-81	.02	934	7.2	7.6	1,010	8.5	550	128
S14	(D-37-3) 6aaa-S1	98202186	10-19-81	<.01	1,470	8.1	8.1	1,540	11.5	880	140
S15	(D-36-2)13aad-S1	98202197	10-20-81	<.01	606	7.4	7.8	670	7.0	350	82.0
S16	(D-37-2)36cbc-S1	98202162	10-19-81	<.01	3,670	7.0	8.0	4,070	12.5	2,100	330
S17	(D-38-3)17bda-S1	98202155	11-14-81	<.01	630	8.0	8.3	680	8.5	360	69.0
S18	(D-38-3)14cbc-S1	98202154	10-19-81	<.01	1,680	7.8	8.1	1,620	12.5	790	120
S19	(D-38-3)11aad-S1	98202158	11-14-81	<.01	974	8.1	8.3	980	11.0	480	48.0
S21	(D-38-8) 8ada-S1	00101634	05-22-01	—	145	—	7.7	142	16.5	67	15.5
S23	(D-38-8) 4dbc-S1	00100639	05-22-01	—	524	—	7.8	508	13.5	260	53.9
S24	(D-39-8)13bab-S1	00100641	05-24-01	—	163	—	8.2	168	20.5	79	17.1

[1]Filtered lab alkalinity.

Table 12. Physical properties and results of chemical analyses for water from selected surface-water and spring sites in the Escalante River drainage basin, Garfield and Kane Counties, Utah, 1981-2002—Continued

Date	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)	Sodium, dissolved (mg/L as Na)	Alkalinity, unfiltered, lab (mg/L as $CaCO_3$)	Alkalinity, unfiltered, field (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L as SO_4)	Solids, residue at 180° C, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Boron, dissolved (µg/L as B)
						SURFACE-WATER SITES						
04-20-81	18.0	1.70	6.6	170	—	3.7	.2	18.0	2.7	200	189	30
08-25-81	21.0	1.90	6.4	160	—	3.7	.2	18.0	<1.0	186	—	30
05-05-82	10.0	1.40	4.7	110	120	2.5	.1	18.0	6.0	136	133	20
04-21-81	48.0	3.70	190	380	—	23.0	0.4	11.0	280	867	847	170
08-25-81	47.0	2.90	160	400	—	27.0	.3	14.0	170	636	696	190
03-03-82	57.0	3.30	160	320	—	13.0	.6	9.0	290	823	787	150
04-20-81	29.0	2.00	11.0	160	—	3.8	.3	13.0	31.0	272	233	50
08-25-81	30.0	1.90	11.0	180	—	18.0	.2	15.0	28.0	238	251	50
05-05-82	22.0	1.90	6.9	190	260	3.0	.4	13.0	5.0	217	208	60
04-21-81	31.0	2.10	50.0	260	—	8.1	.3	14.0	95.0	439	407	70
08-25-81	21.0	2.20	25.0	170	—	4.2	.2	17.0	49.0	259	261	50
10-21-81	34.0	3.10	59.0	220	—	48.0	.3	20.0	120	—	484	—
06-01-94	28.0	2.90	28.0	140	—	52.0	—	18.0	130	—	407	—
08-21-02	17.3	3.72	24.2	[1]115	—	34.9	—	13.4	75.7	—	287	—
10-21-81	28.0	3.20	42.0	170	—	45.0	.3	20.0	130	—	436	—
10-21-81	11.0	1.90	6.1	120	—	4.4	.1	26.0	15.0	—	172	—
11-15-81	84.0	4.60	14.0	240	—	10.0	.3	11.0	430	830	838	170
03-03-82	74.0	4.30	12.0	93	—	12.0	.5	8.8	370	797	663	130
10-22-81	20.0	2.80	24.0	150	—	22.0	.2	21.0	84.0	—	318	—
03-03-82	370	13.0	120	110	—	70.0	.5	8.2	2,200	—	3,150	350
05-22-01	15.2	1.22	3.0	—	—	2.1	.1E	10.4	2.8	—	170	—
05-24-01	20.7	3.32	16.0	—	—	6.6	.2E	<.5	11.5	—	211	—
						SPRINGS						
11-13-81	36.0	1.80	5.3	310	—	3.5	.3	15.0	<5.0	—	338	40
11-13-81	37.0	1.30	3.0	290	—	2.2	.2	9.0	<5.0	—	285	30
11-13-81	35.0	3.00	2.2	260	—	1.8	.3	6.6	<5.0	—	260	50
10-21-81	36.0	1.10	7.4	270	—	13.0	.3	8.7	11.0	—	300	30
09-23-81	37.0	1.50	23.0	240	—	4.9	.2	9.2	12.0	—	259	40
10-16-81	42.0	2.80	57.0	300	—	9.4	.5	12.0	110	—	474	120
06-01-94	38.0	9.30	31.0	163	—	23.0	—	9.9	140	—	390	—
05-18-01	7.64	1.14	2.4	63	—	3.5	<.2	9.2	4.6	—	107	—
10-25-81	56.0	2.00	18.0	350	—	6.9	.2	18.0	170	—	610	60
10-19-81	130	3.10	17.0	420	—	26.0	.3	11.0	440	—	1,020	40
10-20-81	36.0	1.90	6.9	240	—	10.0	.2	9.7	98.0	—	390	10
10-19-81	320	12.0	280	410	—	31.0	.1	9.2	2,300	—	3,530	630
11-14-81	45.0	1.60	8.2	240	—	12.0	.3	8.9	100	—	389	20
10-19-81	120	2.10	51.0	270	—	120	.5	12.0	480	—	1,080	100
11-14-81	88.0	2.20	.1	340	—	52.0	.4	12.0	120	—	566	50
05-22-01	6.81	.98	1.8	68	—	1.6	<.2	10.0	2.6	—	80	—
05-22-01	30.1	2.66	12.1	281	—	4.1	.1E	10.6	11.5	—	294	—
05-24-01	8.91	.39	1.9	80	—	1.4	.1E	10.5	2.9	—	91	—