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Physical and Chemical Characteristics of Knowles, Forgotten, and Moqui Canyons, and Effects of Recreational Use on Water Quality, Lake Powell, Arizona and Utah

Scientific Investigations Report 2004–5120

Prepared in cooperation with GLEN CANYON NATIONAL RECREATION AREA

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By R.J. Hart, H.E. Taylor, R.C. Antweiler, G.G. Fisk, G.M. Anderson, D.A. Roth, M.E. Flynn, D.B. Peart, Margot Truini, *and* L.B. Barber

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TABLE_11.PDF (37 KB)	TABLE_14.PDF (29 KB)

Conversion Factors and Datum

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
	Area	
square hectometer (hm^2)	2.471	acre
	Volume	
cubic meter (m^3)	0.0008107	acre-foot
liter (L)	0.2642	gallon
	Flow rate	
meter per second (m/s)	3.281	foot per second
	Mass	
gram (g)	0.03527	ounce, avoirdupois
kilogram (kg)	2.205	pound avoirdupois

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C = (°F-32)/1.8

ABBREVIATED WATER-QUALITY UNITS

Chemical concentration and water temperature are given only in metric units. Chemical concentration in water is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the solute mass (milligrams) per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million. Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C). Chemical concentration in bottom sediment is given in grams per kilogram (g/kg), micrograms per gram (µg/g), milligrams per kilogram (mg/kg), or micrograms per kilogram (µg/kg). Grams per kilogram is equal to parts per thousands (ppt). Milligrams per kilogram and micrograms per gram are equal to parts per million (ppm). Micrograms per kilogram are equal to parts per billion (ppb).

DATUMS

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929; horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27). Elevation, as used in this report, refers to distance above or below NGVD 29.

Acronyms and Symbols

ADCP	acoustic Doppler current profiler
BTEX	benzene, toluene, ethylbenzene, and xylene
DEET	N,N-diethyl-meta-toluamide
EDTA	ethylenediaminetetraacetic acid
GC/MS	gas chromatography/mass spectrometry
GLCA	Glen Canyon National Recreation Area
GPS	Global Positioning System
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
LDL	laboratory detection limit
MCL	maximum contaminant level
MOM	metalimnetic oxygen minima
MPN	most probable number
MTBE	methyl-tertiary-butyl ether
NIST	National Institute of Standards and Technology
NPEC	nonylphenolpolyethoxycarboxylate
NPS	National Park Service
NTA	nitrilotriacetic acid
NWQL	U.S. Geological Survey National Water Quality Laboratory
PTFE	polytetrafluoroethane
PWC	personal watercraft
REE	rare earth element
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbon
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compound

Al	aluminum	Mo	molybdenum
As	arsenic	Na	sodium
B	boron	NH_4	ammonium
Ca	calcium	Ni	nickel
Cd	cadmium	NO_2	nitrite
Cl	chloride	NO_3	nitrate
Co	cobalt	P	phosphorus
Cu	copper	Pb	lead
Fe	iron	PO_4	phosphate
HCl	hydrochloric acid	S	sulfur
Hg	mercury	Se	selenium
HNO_3	nitric acid	SiO_2	silica
K	potassium	SO_4	sulfate
K_2CrO_7	potassium dichromate	Sr	strontium
Mg	magnesium	U	uranium
Mn	manganese	V	vanadium

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Abstract

Side canyons of Lake Powell are the most popular recreation areas of the Glen Canyon National Recreation Area in Arizona and Utah. There are more than 90 side canyons that are tributaries to the main lake body of Lake Powell. Near Bullfrog and Halls Crossing marinas in Utah, visitors frequent Knowles, Forgotten, and Moqui Canyons to fish, boat, camp, and hike the sandstone formations for which Lake Powell is famous. Areas of recreational activity are greatest near beaches in side canyons. Emissions from houseboats, personal watercraft, speedboats, and from some nonboating recreational activities introduce contaminants to the lake and to beach areas.

The U.S. Geological Survey documented concentrations of trace elements, volatile organic compounds, organic wastewater contaminants, and other byproducts of fuel-based contaminants in water and bed material in Knowles, Forgotten, and Moqui Canyons during the summers of 2001 and 2002. Field work was conducted during four trips when recreational use was at a minimum (before Memorial Day in May) and when it was at a maximum (near Labor Day in September). Knowles Canyon was treated as a control; therefore, public access by motorcraft was not permitted during the study. Electric-powered or oar-powered research boats were used to collect samples and measure properties in Knowles Canyon. Record-low reservoir elevations during 2000–2002 limited the availability of camping and day-use beaches in Forgotten and Moqui Canyons. Although more beach areas were exposed during this period, the steep slopes of the beaches made it difficult to use the beaches for camping purposes.

Side canyon waters of Knowles, Forgotten, and Moqui Canyons were similarly stratified (physically and chemically) during the study from natural advective and convective reservoir processes. Metalimnetic oxygen minimas were observed in September 2001 and 2002 in the side canyons and the main body of Lake Powell. Chemical concentrations of several organic constituents were elevated in Forgotten and Moqui Canyons during the high-use period in September of 2001 and 2002 compared with concentrations during the low-use period in May of 2001 and 2002. Concentrations of some constituents decreased from the mouth of each canyon to the canyon's headwaters, indicating that there could be a mechanism for constituent removal or that the main body of Lake Powell is not in equilibrium with the headwaters of the side canyons. Concentrations of volatile organic compounds, such as benzene, toluene, ethylbenzene, and xylene (BTEX compounds), were highest in the upper reaches of Forgotten and Moqui Canyons where visitor use was greatest. Trace amounts of some organic wastewater compounds, including cholesterol, N,N-diethyl-meta-toluamide (DEET), and ethylenediaminetetraacetic acid (EDTA), were measured in Forgotten and Moqui

Canyons. Except for minor concentrations of some volatile organic compounds and cholesterol, contamination from visitor use in Knowles Canyon was not detected, most likely because the canyon was closed to access.

Concentrations of some organic compounds in bed material sampled in the side canyons near popular beach areas, including polyaromatic hydrocarbons, were above the laboratory detection limits. Several other constituents were present in trace amounts. Benzyl n-butylphthalate and bis (2 ethyl)-phthalate were detected at concentrations above laboratory detection limits. Numerous trace elements were detected above laboratory detection limits in Knowles, Forgotten, and Moqui Canyons.

All water samples from the side canyon transects had low colony counts of *Escherichia coli* (*E. coli*); the highest count was less than one-fourth of the U.S. Environmental Protection Agency recommended limit for recreational water. Four water samples collected near beaches in Moqui Canyon had *E. coli* colony counts that exceeded the U.S. Environmental Protection Agency recommended limit.

INTRODUCTION

Between 2 and 3 million people visit Glen Canyon National Recreation Area (GLCA) each year. Recreational boating and sport fishing in the lake contribute about 350 million dollars to the local and regional economies. Use of the recreation area is high because there are few alternative opportunities for aquatic recreation in the arid Southwest. During 1992, there were 500,000 boat days and about 19 million liters of fuel consumed (Lewis Boobar, aquatic ecologist, Glen Canyon National Recreation Area, written commun., 1998). During 2001, more than 2.3 million people visited the lake, and the average visit lasted 4 days (Grass, 2002). The lake is one of the largest reservoirs in the world (65,800 square hectometers or 163,000 acres) and is one of the most voluminous (33.3 billion cubic meters or 27 million acre-feet), but it is the side canyons that create the opportunity for seclusion in Lake Powell.

During 2000, the U.S. Geological Survey (USGS) and the GLCA began a 2-year sampling program to study the effects of visitor use in three high-use canyons: Knowles, Forgotten, and Moqui (**fig. 1**). The study was funded by the USGS Office of Water Quality's Water-Quality Assessment and Monitoring program and the GLCA.

Purpose and Scope

This report describes the results of a 2-year sampling program of Knowles, Forgotten, and Moqui Canyons of Lake Powell. Four sampling trips—May 15–17, 2001; September 5–7, 2001; May 20–22, 2002; and September 9–12, 2002—were used to document conditions before and after the high-use seasons. Water samples were collected at selected locations in each side canyon and analyzed for major ions, nutrients, dissolved organic and inorganic carbon, trace elements (including rare earth elements; REEs), total petroleum hydrocarbons (TPHs), oil and grease, volatile organic compounds (VOCs), organic wastewater compounds, and bacteria. Bed-material samples from selected beach areas in Knowles, Forgotten, and Moqui Canyons were collected and analyzed for semivolatile organic compounds (SVOCs), trace elements, and REEs. Measurements were made of water temperature, specific conductance, and dissolved oxygen using a depth-profiling instrument. Water velocity was measured using an acoustic Doppler current profiler (ADCP). Discrete measurements of water temperature, specific conductance, and water transparency also were made. The report includes descriptions of the physical and chemical characteristics of each side canyon and an evaluation of the effects of recreational use on side canyon waters. All chemical and bacterial analyses are available in tabular form on the compact disc (CD) provided at the back of the report (tables 10–14).

Water-Quality Issues for Lake Powell

The GLCA has identified more than 90 side canyon tributaries to Lake Powell that receive high visitor use. Water in these side canyons could receive chemical and biological contamination directly or indirectly from human activities in the watershed.

The National Park Service (NPS) has become increasingly concerned about the use of personal watercraft (PWC) on the lakes and reservoirs within the park and the contamination that PWC potentially introduce into the water. Nearly all PWC utilize two-stroke engines, which can discharge about 30 percent of their fuel unburned into the water. During 2001, a Federal judge ordered a ban of the use of PWC on Lake Powell and 19 other Federal areas (Grass, 2002).

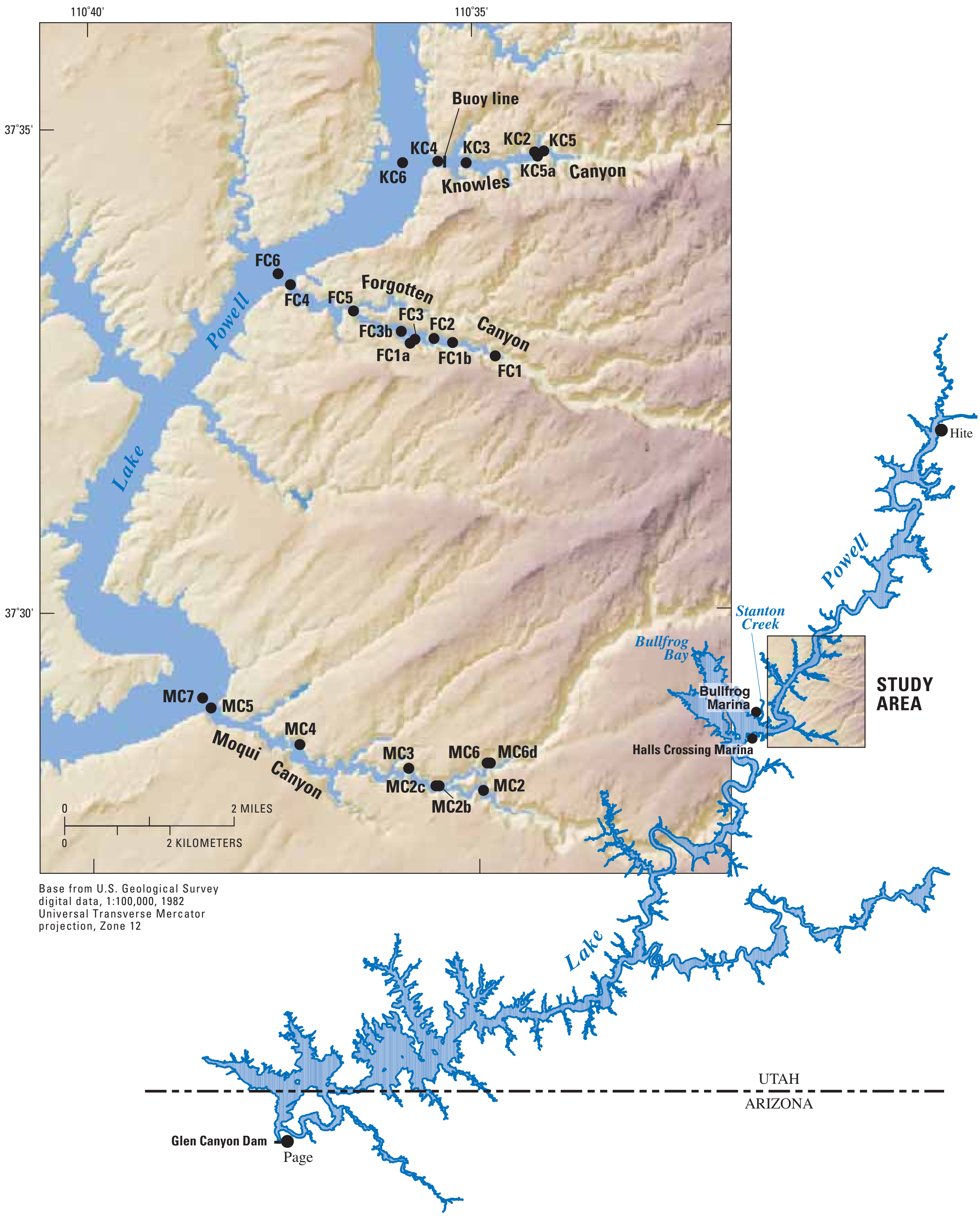


Figure 1. Locations of study area and sampling sites. See table 2 for list of sample sites.

Toluene, benzene, ethylbenzene, xylene, and methyl-tertiary-butyl ether (MTBE) are some constituents of gasoline that can be discharged to the waters from motorcraft (Mark VanMouwerik, hydrologist, National Park Service, written commun., 1999). Other VOCs, TPHs, and oil and grease can also be released into Lake Powell by general motorboat use.

Houseboat use and poor camping practices along the lakeshore can also discharge contaminants to the lake and beach areas. Organic wastewater compounds can derive from domestic products that include detergents, disinfectants, human drugs, food byproducts, insecticides, and pesticides. The GLCA has human-waste disposal facilities throughout the park, but contamination still occurs from accidental spills or visitors purposefully discharging waste into the lake or along its beaches.

A variety of wastewater-derived contaminants, including metal-complexing agents, surfactant degradation products, antioxidants, caffeine, antimicrobials, steroids, and hormones, were evaluated in this study because of their presence in domestic wastewater and the potentially adverse human-health and ecological effects. Detailed descriptions of these so-called "emerging contaminants" are given in Halling-Sorensen and others (1998), Daughton and Ternes (1999), and Kolpin and others (2002). The rationale for selection of wastewater contaminants evaluated in this study was based on a hierarchical analytical approach that includes a range of compounds covering a spectrum of uses and effects (Barber, 1992). For example, ethylenediaminetetraacetic acid (EDTA) is a low-toxicity, high production-volume chemical used in domestic, commercial, and industrial applications to form stable, water-soluble complexes with trace elements. Because of its uses and chemical characteristics, EDTA occurs at relatively high concentrations in wastewater and can persist in the aquatic environment (Barber and others, 1996; Barber and others, 2000; Leenheer and others, 2001). In contrast, prescription drugs produced in small quantities, such as 17-ethynyl-esterdiol, although prescribed to a large number of people (Arcand-Hoy and others, 1998), occur in the environment at very low concentrations (Huang and Sedlak, 2001) but can have potent effects on biological systems (Desbrow and others, 1998; Johnson and Sumpter, 2001). Additional compounds, such as caffeine and triclosan, were included in this study because their ubiquitous nature makes them general indicators of potential wastewater contamination, and they are biologically active.

Bacteria counts have been monitored in Lake Powell since 1988 at more than 50 beach areas to assess potential effects from recreational use. High fecal coliform counts that exceed Utah primary-contact recreation (swimming) standards (greater than 200 colony-forming units per 100 mL) have resulted in beach closures. These violations generally occur when recently used campsites are inundated by rising lake levels. Beach areas in Forgotten and Moqui Canyons have been closed to swimming from time to time because of bacterial contamination (Long and Smith, 1995). There also is concern about periodic unexplained illnesses that may be due to recreational exposure to lake water (Kevin Berghoff, hydrologist, Glen Canyon National Recreation Area, written commun., 1997).

Because of the increasing use of Lake Powell, the GLCA requires a monitoring program that will provide an indicator of water-quality deterioration caused by visitor use. Side canyon issues related to visitor use extend beyond the aquatic environment to the terrestrial environment.

Physical Setting of Lake Powell

Lake Powell, in northeastern Arizona and southeastern Utah, was created by the construction of Glen Canyon Dam on the Colorado River in 1963 (**fig. 1**). The reservoir reached full-conservation-pool level of 1,128 m (3,700 ft) above NGVD 29 in 1980. The depth of the lake can reach 183 m (600 ft) in the forebay area of the dam, and the lake covers more than 3,058 km (1,900 mi) of shoreline. At full pool, the reservoir stores 33.3 billion cubic meters (27 million acre-feet) of water that is used for conservation storage, recreation, and electrical production.

Glen Canyon Dam is the only major dam on the main stem of the Colorado River above Lees Ferry and controls almost all the flow leaving the upper Colorado River Basin. Lake Powell is the youngest of four reservoirs (including Lakes Mead, Mohave, and Havasu) on the Colorado River. The GLCA encompasses Lake Powell, which extends more than 290 km (180 mi) from the dam near Page, Arizona, into Cataract Canyon, Utah. The farthest upstream marina at Hite, Utah, is about 225 km (140 mi) from Glen Canyon Dam. Near Hite, the reservoir begins to change from a lentic system (lake-like) to a lotic system (flowing or riverine).

In general, Lake Powell is considered to be a meromictic reservoir, meaning that water in the reservoir does not completely mix. This is particularly true in the deepest part of the lake near the forebay of Glen Canyon Dam. Historic records show that meromictic conditions can be reduced when there are high inflows to the reservoir or sustained high releases from the dam (William R. Vernieu, hydrologist, U.S. Geological Survey, written commun., 1997). Eutrophic conditions (high concentrations of nutrients), which form algal blooms, can often be observed at certain locations in the lake and in side canyon waters. Side canyon waters of the lake may have different chemical and physical characteristics from the main lake body owing to differences in size, orientation, inflow contributions (springs and tributary flows), advective and convective processes, and visitor activities.

Design of the Study

Lake Powell contains more than 90 major side canyons that have unique morphology and orientation. The GLCA developed a side-canyon selection model by using a geographic information system (GIS) to help identify and characterize these side canyons (Boobar and others, 1999). Using results from the model, the USGS, in cooperation with the GLCA, conducted a reconnaissance field trip during the summer of 1999 that included water measurements and sample collection at six sites:

- Knowles Canyon
- Forgotten Canyon
- Moqui Canyon
- Stanton Creek
- Bullfrog Marina
- Bullfrog Bay

Depth-profile measurements of water temperature, specific conductance, and dissolved oxygen were made at all sites, and water samples were collected from some sites and analyzed for major ions, trace elements, nutrients, and dissolved organic carbon. An ADCP was tested during the reconnaissance to determine if this technology could detect very slow current velocity that is characteristic of lake or reservoir systems. Water movement in the reservoir is a mechanism for transport of potential contaminants to and from the side canyons. General observations from the reconnaissance trip were:

- Each side canyon studied was chemically and physically stratified similar to that of the main lake body.
- A well-defined thermocline was developed in each side canyon.
- A salinity gradient was present in each side canyon.
- Concentrations of dissolved oxygen were very low (1 to 2 mg/L) in the headwater of each side canyon.
- Dissolved oxygen increased in concentration with distance from the headwater to the mouth of the canyons. A dissolved-oxygen minimum in the thermocline occurred in each side canyon at a depth of 20 m.
- The euphotic depth ranged from about 1 m in the headwaters to more than 9 m at the mouths of the side canyons.

As a result of the reconnaissance, Knowles, Forgotten, and Moqui Canyons were selected for in-depth study. As shown in table 1, Moqui Canyon is the longest and largest of these canyons. Knowles Canyon, the smallest, was selected as a control canyon and was closed to public access upstream from site KC4 (see buoy line, figure 1) for the duration of the study. Only electric trolling motors or oar-powered watercraft were used in Knowles Canyon during the duration of the study to collect and gather information. Field work was conducted during four trips when recreational use was at a minimum (before Memorial Day in May) and when it was at a maximum (near Labor Day in September).

Table 1. Physical characteristics of Knowles, Forgotten, and Moqui Canyons, Lake Powell

[Data source: National Park Service, Glen Canyon National Recreation Area]

Side canyon name	Length, curvature of canyon (kilometers)	Length, straight line from head to mouth (kilometers)	Length, minimum boat ride distance at full-conservation pool (kilometers)	Orientation from head to mouth (degrees)	Area (square meters)	Perimeter, including side channels or secondary canyons (meters)	Width to length ratio	Average area illuminated by the sun daily (square meters)	Average illumination ratio
Knowles	3.4	3.0	3.1	267	764,947	12,235	0.287	461,358	0.602
Forgotten	6.5	4.3	4.4	285	1,074,464	17,576	.184	789,165	.730
Moqui	11.5	6.8	7.0	285	1,798,212	33,267	.219	1,359,792	.760

Sampling sites in each side canyon were distributed from the headwater of the canyon to its mouth with the main lake body (**fig. 1**). A depth-profile survey of temperature, specific conductance, and dissolved oxygen was made at several locations within each canyon (table 2). The profile data were used to help determine the sampling locations and sample depths. Other factors were used in locating sampling sites including known camping areas and the general side canyon morphology. The Global Positioning System (GPS) was used to mark the measurement and sampling locations. Measurement and sample sites were revisited during each data-gathering field trip as lake conditions permitted. During the study, the reservoir elevation declined from about 1,121 m in October 2000 to 1,105 m in September 2002, a difference of 16 m (48 ft). Since September 2002, the reservoir has continued to decline to record lows. The extremely low reservoir elevations exposed lake-bed material that was not present at the beginning of this study.

Table 2. Sample-collection sites in Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

[DOC, dissolved organic carbon; DIC, dissolved inorganic carbon; VOCs, volatile organic compounds; TPH, total petroleum hydrocarbons; SVOCs, semivolatile organic compounds; KC, Knowles Canyon; FC, Forgotten Canyon; MC, Moqui Canyon]

					Water samples					Bed-sediment samples	
Site name, in downstream order (fig. 1)	Depth profile measurement	Water velocity measurement	Discrete measurements of water temperature, specific conductance, pH	Secchi disk measurements	Major ions, nutrients, DOC, DIC, alkalinity, and trace elements	VOCs	TPH and oil and grease	Wastewater, propyl esters, hormones and steroids, surrogates	Bacteria	SVOCs	Trace and rare-earth elements
KC2	X		X	X	X	X	X	X	X		
KC3	X		X	X	X	X	X	X	X		
KC4		X	X	X		X[1]					
KC5	X		X	X	X	X	X	X	X	X	X
KC5a					X	X				X	X
KC6	X										
FC1	X		X	X	X	X	X	X	X	X	X
FC1a	X				X	X			X	X	X
FC1b	X			X					X		
FC2	X		X	X	X	X	X	X	X		
FC3	X	X							X		
FC3b											
FC4	X	X	X	X	X	X	X	X	X		
FC5	X		X	X	X	X	X	X	X		
FC6	X										
MC2			X	X	X	X	X	X	X	X	X
MC2b	X		X		X	X				X	X
MC2c			X		X	X					
MC3	X	X	X	X	X	X	X	X	X		
MC4	X		X	X	X	X	X	X	X		
MC5	X	X	X	X	X	X	X	X	X		
MC6	X		X	X	X	X	X	X	X	X	X
MC6d			X		X	X	X	X			
MC7	X										

[1]Quality-assurance sample only; sampled one time.

Acknowledgments

The authors thank Kitty Roberts, Superintendent of the GLCA, for her support, and for use of the National Park Service research vessel, *Silver Bullet* (NPS 321). Also, without the interest and desire from Lewis Boobar (aquatic ecologist, Glen Canyon National Recreation Area), this program would not have been submitted for national competition. Gratitude is expressed to USGS scientists Allen Meier, Terry Plowman, and Greg Brown for their contributions to field and laboratory work, to USGS hydrologic technician Tom J. Porter for data presentation, and to Northern Arizona University graduate student Natasha Kramer for her field assistance.

METHODS

Measurements of Water Temperature, Specific Conductance, Dissolved-Oxygen Concentration, Water Velocity, and Water Transparency

A Sea-Bird Electronics, Seacat SBE-19-03 was used to make profile measurements. The temperature, specific conductance, dissolved oxygen, and pressure sensors were calibrated annually by the manufacturer. Calibration coefficients were updated in the Sea-Bird software following calibration. Sensors were checked for accuracy by using standard buffers and standards in the laboratory prior to each field trip. The calibration coefficient of the pressure sensor was revised in the field to reference the lake surface elevation.

The Sea-Bird datalogger was programmed to scan the sensors at 0.5-second intervals. The data were logged as raw voltages from the sensors in hexadecimal format. At this sampling interval, the profilers scanned each sensor two or three times per meter and profiles were accomplished in less than 10 minutes, depending on the depth. The profiler was downcast at a descent rate of about 0.5 to 1 m/s. Start time of the downcast and other information pertinent to the measurement site were entered into the Sea-Bird software for site identification purposes. Profile graphs of the data presented in this report are based on derived, converted, and bin-averaged values from the raw hexadecimal data files. Raw data are available, but the Sea-Bird processing software is needed for data conversion. Discrete measurements of water temperature, specific conductance, and pH of shallow water were made at most sampling locations following the methods described by Wilde and Radtke (1998).

An RD Instruments Workhorse Monitor acoustic Doppler current profiler [ADCP; 300 kilohertz (kHz) frequency] was used to measure current velocities in Knowles, Forgotten, and Moqui Canyons. ADCPs measure the velocity at many points (depth cells or bins) over the entire depth range several times per second. Each depth cell is comparable to a single conventional current meter; therefore, an ADCP velocity profile is like a string of current meters uniformly spaced on a mooring (RD Instruments, 1996). Unlike current meters, the ADCP measures average velocity over the depth range of each depth cell. The ADCP measures velocity in the north-south, east-west, and vertical directions, and velocities are computed for each of the individual depth cells (RD Instruments, 1996). Four transducers are mounted at 20-degree angles from vertical on the ADCP. This configuration compensates for the pitch and roll of the boat but limits the distance velocities can be measured near solid boundaries owing to interference from boundary reflection (Gonzalez and others, 1996). The near vertical walls of the side canyons and rapid changes in depth in the channel cross sections made it difficult to measure velocity and resulted in inaccurate data. A velocity profile, therefore, was measured at a fixed point along the cross section. Data were collected for a minimum of 10 minutes at each of the measurement points.

A 20-cm diameter Secchi disk was used to measure the transparency of side canyon waters and also to indicate increases in turbidity caused by recreational use in the side canyon. Secchi-disk measurements were made from the shaded side of the boat usually between the hours of 10 a.m. and 1 p.m. when other data were being collected. The disk was lowered through the water column until it was no longer visible, and the depth of the disk was recorded. This process was repeated three times, and the average value recorded. Secchi-disk transparency depends on several factors including the observer's eyesight, the contrast between the disk and the surrounding water, the reflectance of the disk, and the disk's diameter (Cole, 1975). The surface condition of the lake and turbidity also can affect the readings.

Sample Collection

Water

Water samples were collected using a specially designed depth-sampling device: a laboratory precleaned 2-L polytetrafluoroethane (PTFE) bottle housed in an aluminum canister (to protect the bottle from damage due to handling in the boat and impact with rocks). This canister was suspended by a calibrated line to determine sampling depth and was weighted on the bottom by a 5-kg epoxy-coated weight. The bottle was sealed with a precleaned silicone-rubber stopper attached to a Spiderwire braided (not stretchable) fishing line.

The empty bottle was loaded into the canister and sealed with the stopper using clean-handling techniques (Wilde and others, 1999). After the boat was positioned at the specified sampling site, one person lowered the apparatus to the desired sampling depth and verified that the suspension line was vertical (to insure an accurate depth reading); a second person pulled the stopper from the bottle using the second line. When the bottle was completely filled (determined by observation of air bubbles reaching the lake surface), the sampler was retrieved. After the sampling apparatus was secured in the boat, the bottle was capped and removed from the canister. The water from the sampler bottle was transferred, in total, to a custom-made, 8-L, PTFE-coated, stainless-steel churn splitter (Leenheer and others, 1989), which was thoroughly rinsed with lake water from the site being sampled.

In this study, all sampling of cross sections (transects) was performed by width integrating across the designated sampling locations at the specified sampling depth. The sampling transect was perpendicular to the thalweg of the channel. Three sampling locations were sampled at each cross section. These sampling locations were always near the left edge of water, near the right edge of water, and midchannel.

Water from each of the three locations in the transect was decanted into the churn. Shallow and deep samples were composited separately. After adding the appropriate sample from each location, the composite in the churn was mixed carefully to avoid aeration of the sample. Triplicate 40-mL samples were removed for VOC analysis using guidelines described in Barber and others (1995). Subsamples for the determination of the various water-chemistry constituents (except VOCs) were collected from the churn into special holding bottles by draining from the churn's spigot in the order listed in table 3. All samples were chilled, immediately placed in the dark, and transported to a field laboratory at Bullfrog Marina where they were processed and (or) preserved.

Table 3. Sample bottles for water-quality determinations listed in order of filling bottle from compositing churn splitter

[mL, milliliters; PTFE, polytetrafluoroethane]

Volume, bottle type	Determination
3 x 40-mL glass vials	Volatile organic compounds
1-L PTFE	Major cations, trace metals, anions, nutrients, dissolved inorganic and organic carbon
1-L amber glass	Wastewater compounds
1-L amber glass	Ethylenediaminetetraacetic acid (EDTA)
1-L amber glass	Total petroleum hydrocarbons
1-L amber glass	Oil and grease
100-mL polyethylene	Field measurements

Sample water from the 1-L PTFE holding bottle was processed as follows:

- Subsamples were filtered through a deionized-water rinsed, 0.45-µm pore-size, polysulfone filter into a 30-mL dark polyethylene bottle for nutrient determinations, a preburned 60-mL glass bottle for dissolved organic and inorganic carbon determination, and a 60-mL polyethylene bottle for anion determinations. These samples were transported unpreserved and chilled to the laboratory for analysis.
- An aliquot of sample from the holding bottle for dissolved cations and trace element determinations was filtered through a 0.40-µm pore-size Nuclepore polycarbonate-membrane filter, using a vacuum filter apparatus made from PTFE (Kelly and Taylor, 1996). The following steps were used to minimize artifactual contamination: (1) the filter apparatus was thoroughly cleaned and rinsed with deionized water; (2) a new 0.40-µm pore size, 47-mm-diameter, polycarbonate-membrane filter was placed on the filter support and precleaned by drawing approximately 50 mL of 0.1 percent (volume/volume) ultrapure nitric acid (HNO_3) rinse solution through the filter into a waste bottle; (3) about 25 mL of a subsample of the composite was then filtered to prerinse the sample receiving bottle and discarded (this step also effectively preloaded the filter with particulates); (4) the balance of the subsample was filtered into a 125-mL polyethylene sample bottle; and (5) the filtered sample was preserved

with the addition of 1 mL of concentrated ultrapure HNO_3, to a pH less than 2 using a PTFE dispensing bottle (Brinton and others, 1996). Only one filter membrane was used for the entire filtration process per sample.

- A second aliquot from the same filtration process was used for the preparation of a sample for total dissolved mercury (Hg) determination. The filtrate for this sample was collected in an acid-rinsed borosilicate glass bottle. A 5-mL mixture of high purity potassium dichromate (K_2CrO_7) and ultrapure HNO_3 was added to 125 mL of the sample, resulting in a final concentration of 0.04 percent (weight/volume) K_2CrO_7 and 4 percent (volume/volume) HNO_3.

Raw water samples were collected in 1-L amber glass bottles baked at 450ºC for the organic wastewater compound analysis. Raw water samples collected for EDTA, nitrilotriacetic acid (NTA), and nonylphenol-polyethoxy-carboxylate (NPEC) were preserved with 2 percent (volume/volume) formalin. Raw water samples for VOC determinations were collected in 40-mL glass vials in triplicate and preserved by the addition of two drops of concentrated hydrochloric acid (HCl) to each vial. The vials were then immediately sealed without headspace. Samples for TPH and oil and grease determinations were preserved by the addition of 10 mL of concentrated sulfuric acid to each 1-L amber glass bottle (baked at 450ºC). All samples for organic determinations were chilled to 4°C for transport to the laboratory for analysis.

Water samples were collected for bacterial analysis at the same sites used for collection of bed-material samples (fig. 1). The samples were collected from approximately 10 cm below the water surface. Laboratory procedures for bacterial analysis followed the Colilert Method provided by IDEXX Laboratories, Inc., to produce data related to *Escherichia coli* (*E. coli*) concentration, as described in “Standard Methods for the Examination of Water and Wastewater” (American Public Health Association, 1998). A few composite water samples from sites in Moqui Canyon (MC2, MC3, and MC4) during the September 2002 trip also were analyzed for bacteria. Detailed methodology and quality-control checks also are described in the 2001 Lake Powell Beach Monitoring Quality Manual (Anderson, 2001).

The sample bottles used for the collection of bacterial samples were supplied with a “certificate of performance” that certified that the bottles met requirements for sterility and full-line accuracy. The sterility and volumetric markings on each batch of sample bottles were checked before the bottles were used. Records of these checks are stored in the GLCA’s Quality Control Logbook at the GLCA laboratories.

Bacteriological samples were immediately stored in an ice chest and cooled to less than 10ºC. Samples were then transported to and logged into the field laboratory at Bullfrog Marina within the holding time of 6 hours where they were sometimes stored in a refrigerator at 1.0 to 4.4°C for as long as an additional 2 hours.

Bed Material

Bed-material samples for chemical analysis were collected at selected beach areas (**fig. 1** and **table 1**) in each of the three canyons during each sampling period. Sites were selected to represent camping or other recreational activity use. To minimize possible oxidation of contaminants associated with the sediments, all samples were collected below the water line (typically below about 0.5 m of water). Water levels dropped considerably during the study as a result of drought conditions, and the high-activity sites selected in May 2001 were unsuitable for sampling during later sampling trips because they were no longer underwater and thus unaffected by recreational boating activities. In subsequent sampling trips nearby sites were selected for sampling, or in some cases, it was not possible to collect samples.

Samples for the determination of inorganic constituents, including trace elements, were collected using the following protocol:

- The beach area selected for bed-material sampling was divided into three equally spaced regions.

- A sample from each region was collected by inserting an HNO_3-cleaned 3-cm diameter by 30-cm long polystyrene tube into the sediment below a minimum water depth of 0.5 m.

The tube was sealed, labeled, and transported chilled (less than 5°C) to the laboratory for processing and analysis.

The sampling protocol resulted in three equally spaced samples near the beach-face of the selected beaches. The average concentration from the three analyses provided a mean value for inorganic constituents in the sediment. In addition, concentrations from the three samples provided spatial variance.

Samples for organic-contaminant determinations also were collected at the sites used for collection of inorganic samples. Approximately 300 g of wet sediment was collected from each region in precleaned, glass, wide-mouth, screw-capped jars using methods described by Radtke (1997). These samples were composited into a single 1-kg sample, which was transported chilled (less than 5°C) to the laboratory for analysis.

Laboratory Analysis

Water samples collected for analysis of dissolved constituents were analyzed directly from sample bottles (preserved after sample processing) with no further pretreatment. Bed-material samples collected for inorganic analysis were totally decomposed prior to analysis using a mixed-acid digestion in a closed PTFE vessel heated in a microwave oven (Alpers and others, 2000).

Major Ions, Nutrients, and Organic Carbon

Major cations present at intermediate to high concentrations were calcium (Ca), magnesium (Mg), sodium (Na), and silica (SiO_2), and were determined by inductively coupled plasma-atomic emission spectrometry (ICP-AES) utilizing a Perkin Elmer Optima 3300, dual view emission spectrometer operating in the axial-view mode (Garbarino and Taylor, 1979; Mitko and Bebek, 1999, 2000). Iron (Fe), phosphorus (P), and sulfur (S) also were determined by using this technique. Potassium (K) was determined by an ICP-AES technique using the same instrumentation operating in the radial-view mode. All samples were determined in triplicate to provide a measure of analytical variability.

Anions, including chloride (Cl), nitrate (NO_3), and sulfate (SO_4), were determined by ion chromatography (Brinton and others, 1996). Other nutrients, including ammonium (NH_4), nitrite (NO_2), and phosphate (PO_4), were determined by an automated spectrophotometric absorption method described by Antweiler and others (1996).

Total alkalinity was determined on unpreserved filtered samples by an automated Gran titrimetric procedure using sulfuric acid as the titrant (Skougstad and others, 1979). Dissolved inorganic carbon was determined by acidification of the sample with phosphoric acid and purgation of the resultant carbon dioxide, which was measured using an infrared absorption spectrophotometric technique. Dissolved organic carbon subsequently was determined by persulfate oxidation of the organic carbon in the sample to carbon dioxide, which was then measured using the same technique (Wershaw and others, 1987).

Trace Elements

Trace element determinations, excluding Hg, were made by inductively coupled plasma-mass spectrometry (ICP-MS) using a Perkin Elmer Elan Model 6000 spectrometer. Aerosols of aqueous samples acidified with HNO_3 were introduced into the spectrometer with a pneumatic nebulizer. Multiple internal standards (indium, iridium, and rhodium) covering the entire element mass range were used to normalize the system for drift. Details of the specific analysis techniques, procedures, and instrumental settings are described in Garbarino and Taylor (1996) and Taylor (2001).

Trace concentrations of dissolved Hg were measured using an automated cold-vapor atomic fluorescence spectrometric (PS Analytical) technique. Details of the method are described in Roth (1994) and Roth and others (2001). Elemental Hg vapor from the samples was produced by chemically reducing Hg in the samples with excess stannous chloride. The resulting vapor was transported to the atomic fluorescence detector with a stream of argon gas for quantitative measurement.

Volatile Organic Compounds, Total Petroleum Hydrocarbons, and Oil and Grease

Samples collected for VOC determinations were analyzed by the National Water Quality Laboratory (NWQL) using purge-and-trap gas chromatography/mass spectrometry methods described in Connor and others (1998). Concentrations of TPHs also were determined by the NWQL using the same extraction procedure followed by a silica gel separation. Concentrations of oil and grease were determined by the NWQL using U.S. Environmental Protection Agency (USEPA) Method 1664 (U.S. Environmental Protection Agency, 1999), which is a gravimetric determination of n-hexane extractable material.

Organic Wastewater and Semivolatile Organic Compounds

Analytical methods used to determine concentrations of organic wastewater compounds are described in Barber and others (2003). Concentrations of EDTA, NTA, and nonylphenolmonoethoxycarboxylate to nonylphenolpenta-ethoxycarboxylate acid (NP1EC-NP5EC) were determined using a modification of the method of Schaffner and Giger (1984). Constituents in the samples were concentrated by evaporation and derivatized, forming the propyl esters, which were extracted into chloroform. The chloroform extracts were evaporated to dryness and redissolved in toluene for analysis by gas chromatography/mass spectrometry (GC/MS) as described in the following paragraphs.

Concentrations of organic wastewater compounds were analyzed by the NWQL using continuous liquid-liquid extraction with methylene chloride at pH 2 (Barber and others, 2000; Kolpin and others, 2002). After extraction, the solvent was analyzed by GC/MS for a suite of compounds. After analysis for wastewater compounds, the methylene chloride extract was evaporated to dryness and the residue was derivatized to form the trimethylsilyl ethers of the hydroxy groups and the methoximine ethers of the keto groups on the steroid and hormone compounds, making them amenable to GC/MS analysis. The derivatized extracts were analyzed by GC/MS for a suite of steroid and hormone compounds.

The propyl-ester, wastewater-compound, and steroid/hormone-compound extracts were analyzed by electron impact GC/MS in both the full-scan and selected ion monitoring modes using a Hewlett Packard (HP) 6890 gas chromatograph and an HP Model 5973 selective mass detector.

Bed-material samples were analyzed by the NWQL for SVOCs. Samples were chilled to 4°C and shipped to the NWQL for analysis as described by Furlong and others (1996). This method involves preconcentration of the SVOCs by solvent extraction, separation by gel chromatography, and measurement by GC/MS.

Bacteria

Water samples were processed in the GLCA Bullfrog Water Laboratory following all quality-assurance/quality-control procedures set by the National Environmental Laboratory Accreditation Program including Demonstrations of Capability and Proficiency Testing (U.S. Environmental Protection Agency, 2002).

A Colilert reagent, which has nutrient indicators specific to *E. coli* and coliform bacteria, was dissolved in 100 mL of sample and poured into a Quanti-Tray and sealed. The samples were incubated for 24 to 28 hours in a 35.0 ± 0.5°C dry incubator. The large and small wells that were both yellow under visible light and fluoresced when exposed to a long-wavelength (365 to 366 nm) ultraviolet lamp were marked as containing *E. coli*. The Most Probable Number (MPN) of *E. coli* per 100 ml was obtained by cross-referencing the number of small and large wells marked on the Colilert MPN Table. A Colilert Comparator, a test tray that shows the minimum amount of yellow color and flourescence, was used during the analysis to assist in determining whether an individual sample cell contained *E. coli*. Wells must appear as both colored yellow and fluorescent on the Colilert Comparator to be marked as containing *E. coli*.

The applicable matrix for the Colilert method was aqueous for recreational water in the GLCA. The laboratory detection limit (LDL) when running the Colilert method is 1 *E. coli* MPN/100 mL. The maximum method detection limit is approximately 2,400 MPN/100 mL.

Quality-Control and Quality-Assurance Procedures

Water Chemistry

All inorganic laboratory sample determinations for major ions, trace elements, and nutrients were randomly performed in triplicate throughout each analysis session. After statistical evaluation, outliers were rejected or samples were rerun until quality-control objectives were satisfactorily met. Error terms representing the precision (1 standard deviation) of the analytical measurements are reported with each measurement.

Calibration curves for instrumental determinations were established by the use of at least five separate concentration calibration standards prepared gravimetrically from pure metals or metal salts. Laboratory reagent blanks and field process blanks were analyzed when appropriate and used to evaluate the integrity of sample determinations.

The accuracy of the determinations was further assessed by the periodic analysis of standard reference materials within each set of laboratory samples. Natural water matrix reference standards routinely comprised at least 20 percent of each batch of sample analysis. Different standard reference materials were used for each analytical method. Several separate reference materials, having constituent concentrations that bracketed the expected analyte concentrations in the study samples, were routinely analyzed in an identical fashion to the samples. National Institute of Standards and Technology Standard Reference Materials [NIST 1643d, at a 1:10 dilution (30)], and USGS Standard Reference Water Samples [T135 (32) to T157 (14) and Hg7 (12) to Hg26 (12)] were extensively used to evaluate the accuracy of all inorganic analytical determinations (Peart and others, 1998). Numbers in parentheses following the standard identification represents the number of times the reference material was analyzed in this study.

Correlation plots of observed and most probable values for four trace elements (arsenic (As), cadmium (Cd), strontium (Sr), and vanadium (V)) covering a variety of concentration ranges demonstrate the accuracy of determinations performed in this study (**fig. 2***A*).

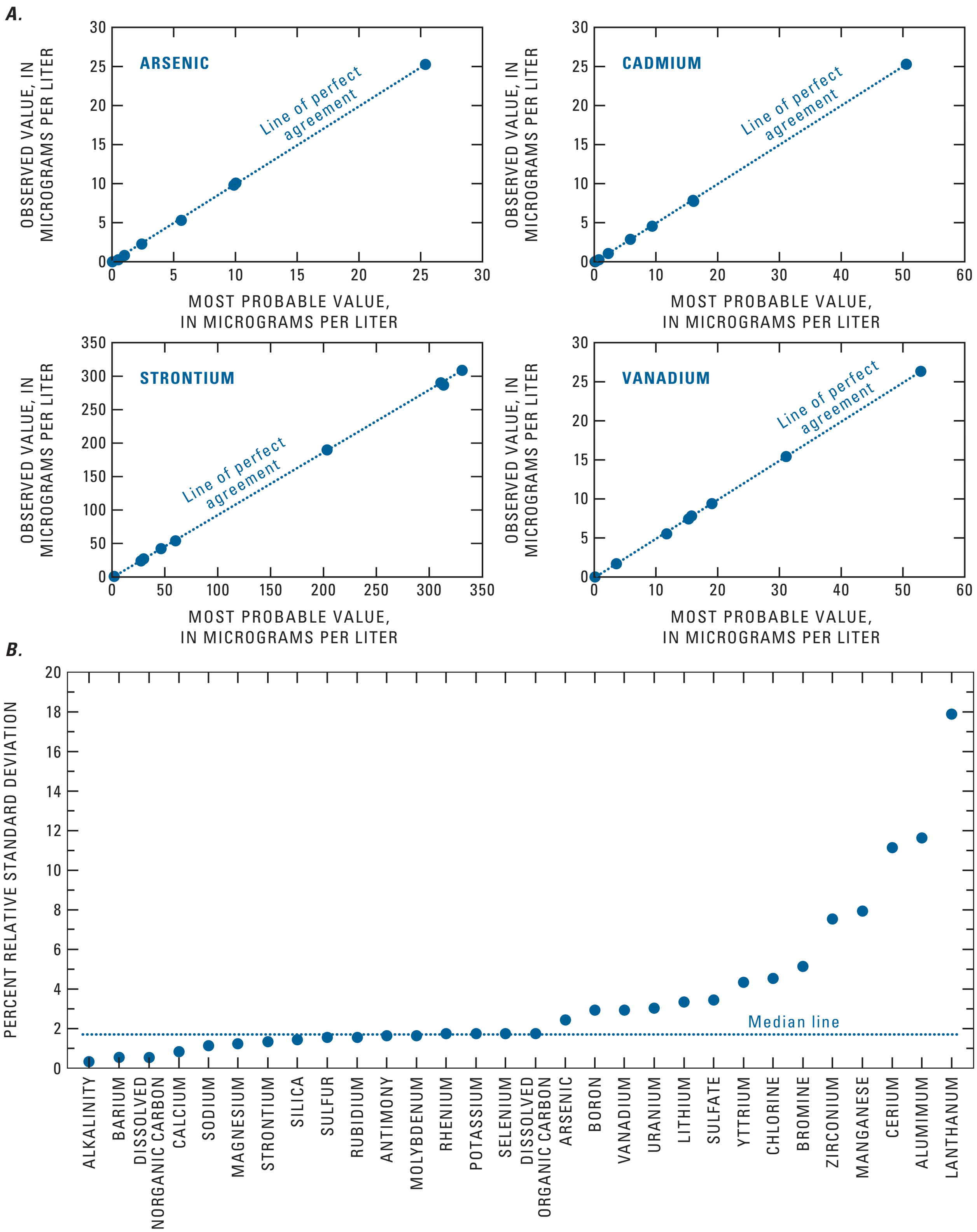


Figure 2. *A*, Correlation of observed versus most-probable values for arsenic, cadmium, strontium, and vanadium in National Institute of Standards and Technology and U.S. Geological Survey-National Reference Water Sample; and *B*, Percent relative standard deviation for differences in concentrations of selected chemical constituents between field duplicates.

Accuracy for these four elements is typical of the accuracy for all elements measured. The “line of perfect agreement” on the plots represents ideal correlation and demonstrates no measurable bias in the accuracy of the data. Table 4 lists elements whose concentrations are at least 10 times the LDL and the median of the absolute values of the differences between the observed and the most probable values, expressed as a percent. The value for only one element, uranium (U), exceeded 5 percent absolute error. Values for all other elements were in the 0.3 to 4 percent range.

Table 4. Median absolute values of the differences between the observed and the most probable values for constituents observed at concentrations greater than 10 times their respective laboratory detection limits in water samples

Chemical constituent	Absolute percent off[1]	Number of standard reference samples[2]	Chemical constituent	Absolute percent off[1]	Number of standard reference samples[2]
Aluminum	1.6	7	Magnesium	0.3	7
Antimony	1.5	7	Manganese	1.3	7
Arsenic	2.6	6	Molybdenum	1.7	7
Barium	.7	7	Nickel	2.9	7
Beryllium	2.0	5	Potassium	1.1	7
Boron	.9	7	Selenium	2.0	6
Cadmium	1.3	7	Silica	.8	7
Calcium	.6	7	Sodium	1.1	7
Chromium	3.8	7	Strontium	.4	7
Cobalt	.7	4	Thallium	1.1	6
Copper	.8	7	Uranium	5.3	5
Lead	.9	7	Vanadium	.6	7
Lithium	2.6	7	Zinc	3.3	7

[1]Median of the absolute values of the differences between the observed values and the “most probable value,” expressed as a percent.

[2]Number of standard reference samples use for statistical calculations.

Measurement precision or variability is evaluated by the analysis of field duplicates. During the study, samples from four sites were collected in duplicate and processed in the field, transported to the laboratory, and analyzed under identical conditions. Table 5 shows the median difference in concentrations and the median relative percent standard deviation for the duplicates for constituents present at concentrations greater than 10 times the LDL. As shown in figure 2*B* and table 5, the greatest median relative standard deviation is about 18 percent for the element lanthanum, which occurs at a median difference in concentration of 0.0009 µg/L. Most other constituents showed median percent relative standard deviations in the 1 to 8 percent range (fig. 2*B*). Table 6 shows the median difference in concentrations and the median relative percent standard deviation for the duplicates for constituents present at concentrations less than 10 times the LDL. The median percent relative standard deviation values range from 2.4 to 55.1. Most of these constituents are present at very low concentrations (sub part-per-billion levels). Only cobalt (Co), copper (Cu), and nickel (Ni) showed median differences that were higher than those typically measured in natural waters (Hem, 1985), which could have been the result of sample or analytical contamination.

Table 5. Median difference and median percent relative standard deviation for constituents observed at concentrations greater than 10 times their respective laboratory detection limits in field replicate water samples

[meq/L, milliequivalents per liter; µg/L, micrograms per liter; mg/L, milligrams per liter;]

Constituent	Median difference	Unit	Median percent relative standard deviation
Alkalinity	0.009	meq/L	0.3
Aluminum	.4	µg/L	11.6
Antimony	.003	µg/L	1.6
Arsenic	.04	µg/L	2.4
Barium	.5	µg/L	.5
Beryllium	1.0	µg/L	5.1
Boron	2	µg/L	2.9
Calcium	.5	mg/L	.8
Cerium	.0007	µg/L	11.1
Chloride	2.4	mg/L	4.5
Dissolved organic carbon	.07	mg/L (as carbon)	1.7
Lanthanum	.0009	µg/L	17.9
Lithium	1.1	µg/L	3.3
Magnesium	.3	mg/L	1.2
Manganese	.06	µg/L	7.9
Molybdenum	.07	µg/L	1.6
Potassium	.06	mg/L	1.7
Rubidium	.02	µg/L	1.5
Rhenium	.0010	µg/L	1.7
Sodium	.7	mg/L	1.1
Sulfate	7	mg/L	3.4
Sulfur	1.0	mg/L	1.5
Selenium	.04	µg/L	1.7
Silica	.09	mg/L	1.4
Strontium	10	µg/L	1.3
Uranium	.11	µg/L	3.0
Vanadium	.06	µg/L	2.9
Yttrium	.0006	µg/L	4.3
Zirconium	.002	µg/L	7.5

Table 6. Median difference and median percent relative standard deviation for constituents observed at concentrations less than 10 times their respective laboratory detection limits in field replicate water samples

[mg/L, milligrams per liter; µg/L, micrograms per liter; ng/L, nanograms per liter]

Constituent	Median difference	Units	Median percent relative standard deviation
Ammonia	0.005	mg/L (as nitrogen)	14.6
Dysprosium	.0002	µg/L	12.9
Erbium	.0004	µg/L	27.4
Gadolinium	.0007	µg/L	31.2
Holmium	.00005	µg/L	10.9
Iron	1.2	µg/L	36.6
Lead	.006	µg/L	32.4
Mercury	.05	ng/L	12.5
Neodymium	.0010	µg/L	10.5
Nitrate	.014	mg/L (as nitrogen)	21.6
Praseodymium	.0002	µg/L	17.4
Samarium	.0005	µg/L	10.3
Tellurium	.005	µg/L	27.2
Terbium	.00013	µg/L	28.6
Thallium	.002	µg/L	28.3
Thorium	.008	µg/L	55.1
Tungsten	.005	µg/L	9.4
Ytterbium	.0002	µg/L	12.8
Zinc	.4	µg/L	28.4

Because of concern about sample contamination from boat engines during the sampling for VOC determinations, a sample was collected in the mouth of Knowles Canyon (site KC4) on September 12, 2002, from the opposite side of the boat from where samples were normally collected, with the boat engines idling. Results of the analysis of this blank showed no measurable concentrations of any of the VOC constituents above the detection limit of 0.2 µg/L. Duplicate samples collected from sites MC2b and MC4 in September 2002 also were analyzed for VOCs.

The NWQL analyzed reagent water blanks and reagent water spikes with each set of organic wastewater-compound analyses to monitor the method performance as part of the laboratory quality control. Duplicate water samples were collected during 2002 to check the replication of results produced by the laboratory.

The NTA/EDTA/NPEC analysis included a reagent water blank and reagent water spike with each set of analyses to monitor method performance. In addition, surrogate standards were added to the sample prior to analysis to evaluate recovery. The steroid/hormone analysis also included surrogate standards added to the sample prior to derivatization to evaluate performance of the method. Duplicate water samples were collected during 2002 to check the replication of results produced by the laboratory.

Bed-Material Chemistry

Accuracy of inorganic determinations in bed-material samples was established by analysis of selected standard reference materials using the same analytical methods used for the water samples (see previous section). The primary sediment reference material used was NIST Standard Reference Material (SRM) 2704 Buffalo River Sediment. This standard was measured at a frequency of 20 percent of the number of bed-material samples analyzed. Results of typical selected elements measured are compared with the SRM certified values in **table 7**. The results are representative of results for the other elements reported in this study. Average values for elements from trace (less than 10 µg/g) to minor (10 to 1,000 µg/g) concentrations are generally close to the error of the NIST certified values. For elements at higher concentrations, such as Ca and Fe, errors are somewhat larger, but not unexpectedly so because the analytical method is not suited for optimal accuracy at percent concentration levels.

Table 7 shows an indication of the analytical precision (individual error terms for each measurement) and subsampling variance (interreplicate agreement). Again, for constituents at trace to minor concentrations, interreplicate agreement is usually 10 percent or better. This observation is confirmed by inspection of the data from duplicate samples collected at the Moqui 2B beach site on September 10, 2002 (**table 8**). These duplicates were specifically collected and analyzed to validate the quality-control precision of the analysis.

In addition, one duplicate bed-material sample also was collected for chemical analysis of trace organic constituents at the Moqui 2B beach site on September 10, 2002. Although most of the reported data are below the LDLs, constituents reported above LDLs show good agreement between the samples.

Table 7. Accuracy and precision of inorganic sediment determinations by comparison of typical elements measured in four separate analyses of National Institute of Standards and Technology Standard Reference Material 2704 Buffalo River Sediment with reported certified values

[µg/g, micrograms per gram; Wt %, weight percent]

Element	Units	Analyses				Certified values
		Run 1	Run 2	Run 3	Run 4	
Antimony	µg/g	3.7 ± 0.1	4.1 ± 0.0	3.6 ± 0.0	3.7 ± 0.2	3.8 ± 0.2
Cadmium	µg/g	3.38 ± .03	3.59 ± .17	3.26 ± .07	3.46 ± .03	3.45 ± .22
Calcium	Wt %	2.00 ± .01	2.59 ± .35	1.85 ± .13	2.44 ± .03	2.60 ± .03
Chromium	µg/g	129 ± 2	134 ± 13	122 ± 8	124 ± 1	135 ± 5
Cobalt	µg/g	13 ± 0	14 ± 2	13 ± 0	14 ± 0	14 ± 1
Copper	µg/g	96 ± 0	99 ± 12	95 ± 7	95 ± 0	99 ± 5
Iron	Wt %	4.02 ± .06	4.10 ± .02	4.02 ± .20	4.02 ± .02	4.11 ± .10
Lead	µg/g	159 ± 3	156 ± 16	148 ± 0	163 ± 1	161 ± 17
Lithium	µg/g	41 ± 2	52 ± 1	35 ± 2	42 ± 0	48 ± 4
Manganese	µg/g	534 ± 13.	639 ± 79	579 ± 33	606 ± 5	555 ± 19
Nickel	µg/g	42 ± 1	43 ± 5	42 ± 2	42 ± 0	44 ± 3
Phosphorus	µg/g	958 ± 15	1,130 ± 80	978 ± 65	980 ± 10	998 ± 28
Selenium	µg/g	1.6 ± .5	1.5 ± .8	1.6 ± .5	1.6 ± .4	1.1 ± .1
Thallium	µg/g	.96 ± .03	1.10 ± .36	.96 ± .09	.96 ± .02	1.06 ± .07
Uranium	µg/g	3.0 ± .1	3.1 ± .4	2.8 ± .0	3.0 ± .1	3.1 ± .1
Vanadium	µg/g	92 ± 1	105 ± 4	91 ± 5	88 ± 0	95 ± 4
Zinc	µg/g	413 ± 6	411 ± 49	408 ± 8	422 ± 3	438 ± 12

Bacteria

With each batch of samples, a positive and negative control was run with at least 10 percent field blanks. Controls for the Colilert method were created using sterile deionized water. The reagent water was tested for chlorine, pH, and specific conductance every day it was created. Standard plate counts were conducted on reagent water monthly. The reagent water also was tested annually by the Utah Department of Health for heavy metals, total organic carbon, and ammonia/total nitrogen. Field blank controls were samples of sterile deionized water processed to detect possible contamination during field sampling and handling. Positive and negative controls were produced from inoculations of *E. coli* and *Enterobacter aerogenes* stocks, respectively. These control samples ensure media and incubation temperatures are conducive and selective for *E. coli* growth.

Table 8. Concentrations of selected elements in duplicate bed-material samples from MC2b, September 10, 2002

[Wt %, weight percent; µg/g, micrograms per gram]

Element	Units	Duplicate 1			Duplicate 2		
Aluminum	Wt %	1.2	±	0.2	1.2	±	0.2
Arsenic	µg/g	1.1	±	.1	1.0	±	.4
Barium	µg/g	247	±	27	248	±	49
Beryllium	µg/g	.25	±	.06	.26	±	.04
Bismuth	µg/g	.01	±	.01	.02	±	.04
Calcium	Wt %	1.6	±	.6	1.3	±	.9
Cadmium	µg/g	.06	±	.02	.08	±	.02
Cerium	µg/g	10	±	2	10	±	2
Cobalt	µg/g	1.5	±	.1	1.3	±	.4
Chromium	µg/g	4.1	±	.7	3.6	±	.8
Copper	µg/g	4.1	±	.5	4.0	±	.6
Dysprosium	µg/g	.64	±	.12	.71	±	.13
Erbium	µg/g	.36	±	.05	.44	±	.09
Europium	µg/g	.21	±	.03	.24	±	.05
Iron	Wt %	.28	±	.04	.28	±	.03
Gallium	µg/g	2.6	±	.5	2.4	±	.3
Gadolinium	µg/g	.70	±	.15	.78	±	.23
Germanium	µg/g	.95	±	.09	.92	±	.03
Hafnium	µg/g	.79	±	.05	.97	±	.51
Holmium	µg/g	.14	±	.03	.14	±	.03
Potassium	Wt %	1.2	±	.2	1.2	±	.2
Lanthanum	µg/g	5.5	±	1.3	4.8	±	.8
Lithium	µg/g	8.6	±	.7	7.9	±	.9
Lutetium	µg/g	.06	±	.0	.07	±	.0
Magnesium	Wt %	.58	±	.2	.51	±	.2
Manganese	µg/g	191	±	71	182	±	83
Sodium	Wt %	.13	±	.01	.13	±	.01
Neodymium	µg/g	4.6	±	1.1	4.5	±	1.3
Nickel	µg/g	2.5	±	.4	2.9	±	1.5
Lead	µg/g	5.3	±	.8	5.5	±	1.0
Praseodymium	µg/g	1.2	±	.3	1.1	±	.3
Rubidium	µg/g	35	±	8	36	±	8
Antimony	µg/g	.19	±	.03	.35	±	.18
Scandium	µg/g	2.0	±	.5	2.2	±	.3
Samarium	µg/g	.9	±	.2	.9	±	.3
Strontium	µg/g	57	±	14	61	±	23
Tantalum	µg/g	.26	±	.06	.24	±	.04
Terbium	µg/g	.11	±	.02	.12	±	.03
Thorium	µg/g	1.2	±	.4	1.2	±	.1
Titanium	Wt %	.04	±	.01	.04	±	.01

Table 8. Concentrations of selected elements in duplicate bed-material samples from Moqui 2B, September 10, 2002—Continued

Element	Units	Replicate 1			Replicate 2		
Thallium	µg/g	0.18	±	0.03	0.19	±	0.07
Thulium	µg/g	.06	±	.01	.06	±	.01
Uranium	µg/g	.43	±	.03	.51	±	.08
Vanadium	µg/g	8.2	±	3.8	6.5	±	1.2
Wolfram	µg/g	.16	±	.08	.13	±	.00
Yttrium	µg/g	3.6	±	.7	3.9	±	.8
Ytterbium	µg/g	.40	±	.09	.43	±	.05
Zinc	µg/g	7	±	3	18	±	12

PHYSICAL AND CHEMICAL CHARACTERISTICS OF KNOWLES, FORGOTTEN, AND MOQUI CANYONS

The physical and chemical characteristics of Knowles, Forgotten, and Moqui Canyons were probably directly affected by record-low lake elevations during the study (**fig. 3**). Declines in elevation exposed previously submerged lakebed sediments, and after the first year of the study, some water-sample collection sites no longer existed. More beaches were exposed in Knowles, Forgotten, and Moqui as a result of the lower reservoir elevations during the study, but in many cases the slopes of the beaches were too steep for camping or other recreational activities.

For the purpose of this report, the discussion of physical characteristics of side canyon waters includes temperature, specific conductance, dissolved-oxygen concentration, velocity, and transparency. The discussion of chemical characteristics includes all water properties determined by laboratory analytical procedures for concentrations of inorganic and organic constituents.

Physical Characteristics of Side Canyon Waters

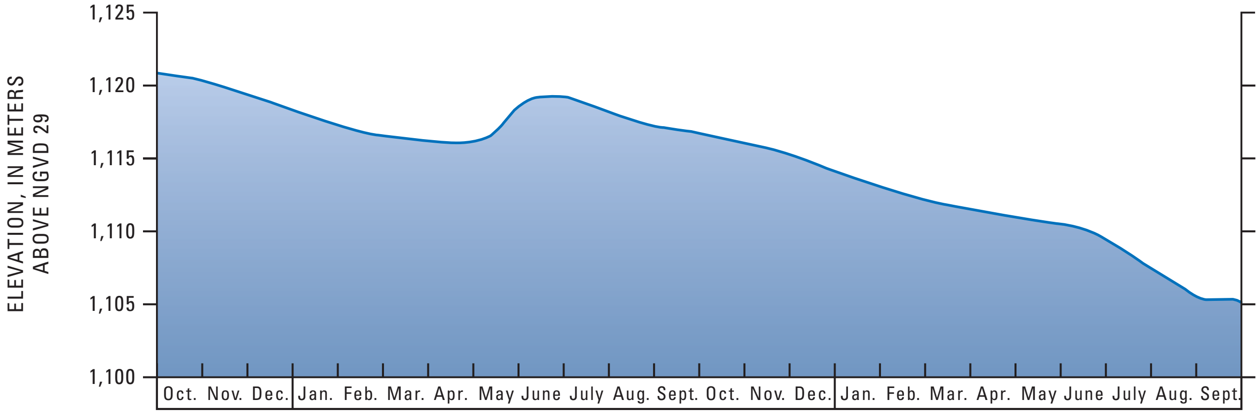
Water Temperature, Specific Conductance, and Dissolved-Oxygen Concentration

Advective processes within Lake Powell occur by inflows from the Colorado River, the San Juan River, other tributaries, and by wind action. Once inflows reach Lake Powell, they move through the lake as density currents because they have a different density from that of the lake. The main factors that drive the differences in density are temperature, dissolved solids, and suspended material. Vertical or convective transport mechanisms in the water column can result from density instabilities. For example, when surface water in Lake Powell cools, the resulting denser water sinks, generating convective motions (Thornton and others, 1990). Density, along with other factors, including vertical mixing caused by wind motion, solar radiation, energy transfer at the air-water interface, and reservoir morphology, influence the formation and strength of the water-column stratification. Density currents in side canyon waters of Lake Powell control the spatial distribution of dissolved solids and suspended material.

Several investigators have measured and documented density currents in Lake Powell (Johnson and Merritt, 1979; Hart and Sherman, 1996; Marzolf and others, 1998; Susan Hueftle, hydrologist, U.S. Geological Survey, written commun., 2002). A specific study of the physical transport mechanisms in Knowles, Forgotten, and Moqui Canyons had not been documented prior to this study.

Water in the side canyons was strongly stratified throughout this study (**figs. 4**–6). As with stratification in the main lake body, stratification in the canyons was most pronounced during the late summer when inflows to the lake were warm and least turbid, and dissolved-solids concentrations were high. The water temperature and specific conductance (an indicator of the dissolved-solids concentration or salinity in the water) indicated an interflow density current several meters below the water surface in each canyon during September 2001 and 2002; a less pronounced and shallower overflow-density current was observed during the late spring sampling trips. The depth of density currents in the main lake body (as indicated by specific conductance and water temperature) below the water surface along a longitudinal transect from Knowles to Moqui Canyons corresponded with the depths of density currents near the mouths of each side canyon (**fig. 7**).

A. **Reservoir elevation**



B. **Knowles Canyon.** Note white ladder in background of photo (arrow), which rests at former water-surface level and is about 11.3 meters above water surface in September 2002.

C. **Forgotten Canyon.** Note white "bathtub ring," which extends about 11.3 meters above water surface in September 2002.

Figure 3. *A*, Reservoir elevation during October 2000 to September 2002; *B*, Effects of reservoir decline in Knowles Canyon, September 2002; and *C*, Effects of reservoir decline in Forgotten Canyon, September 2002.

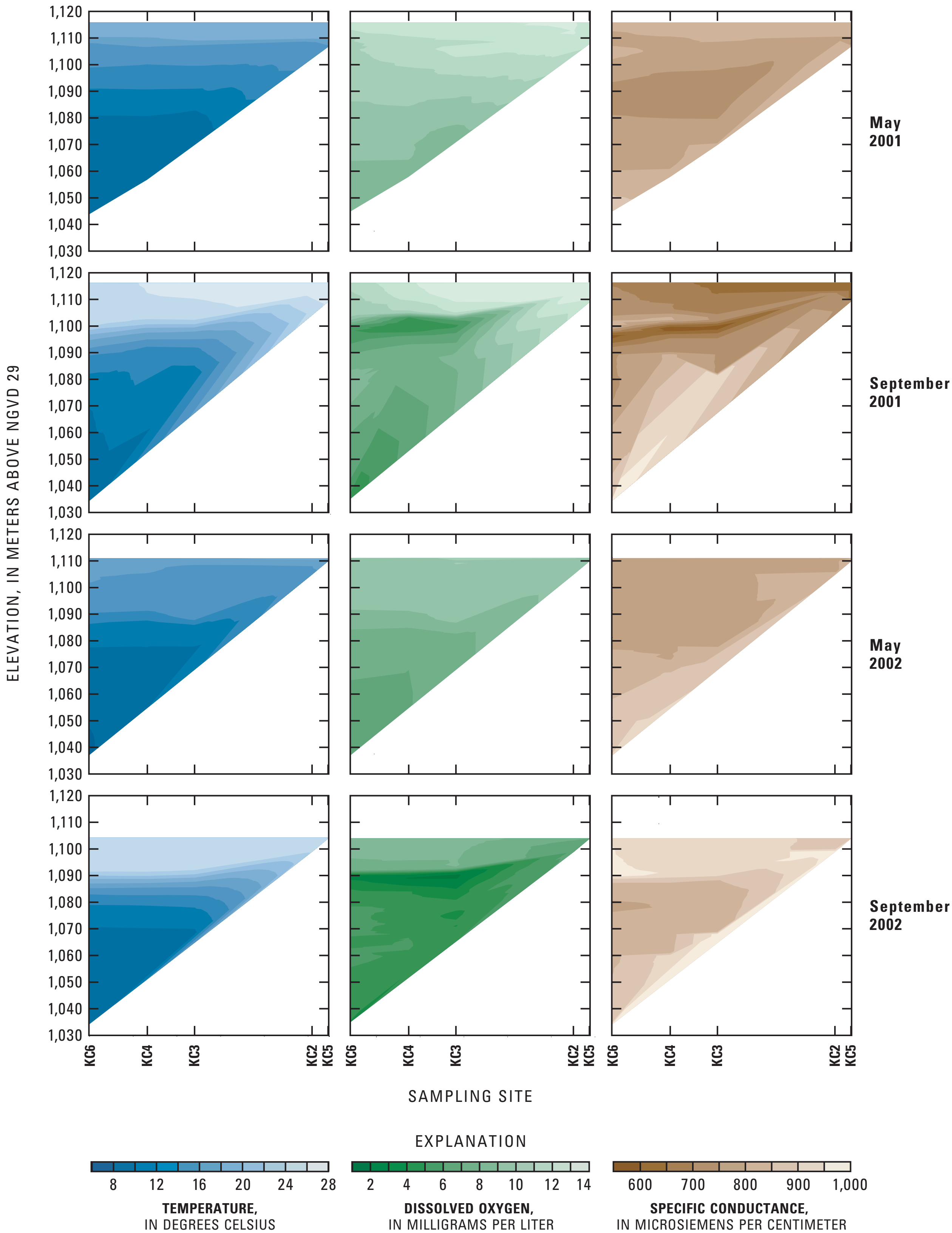


Figure 4. Longitudinal depth profiles of water temperature, specific conductance, and dissolved oxygen in Knowles Canyon for May 2001, September 2001, May 2002, and September 2002.

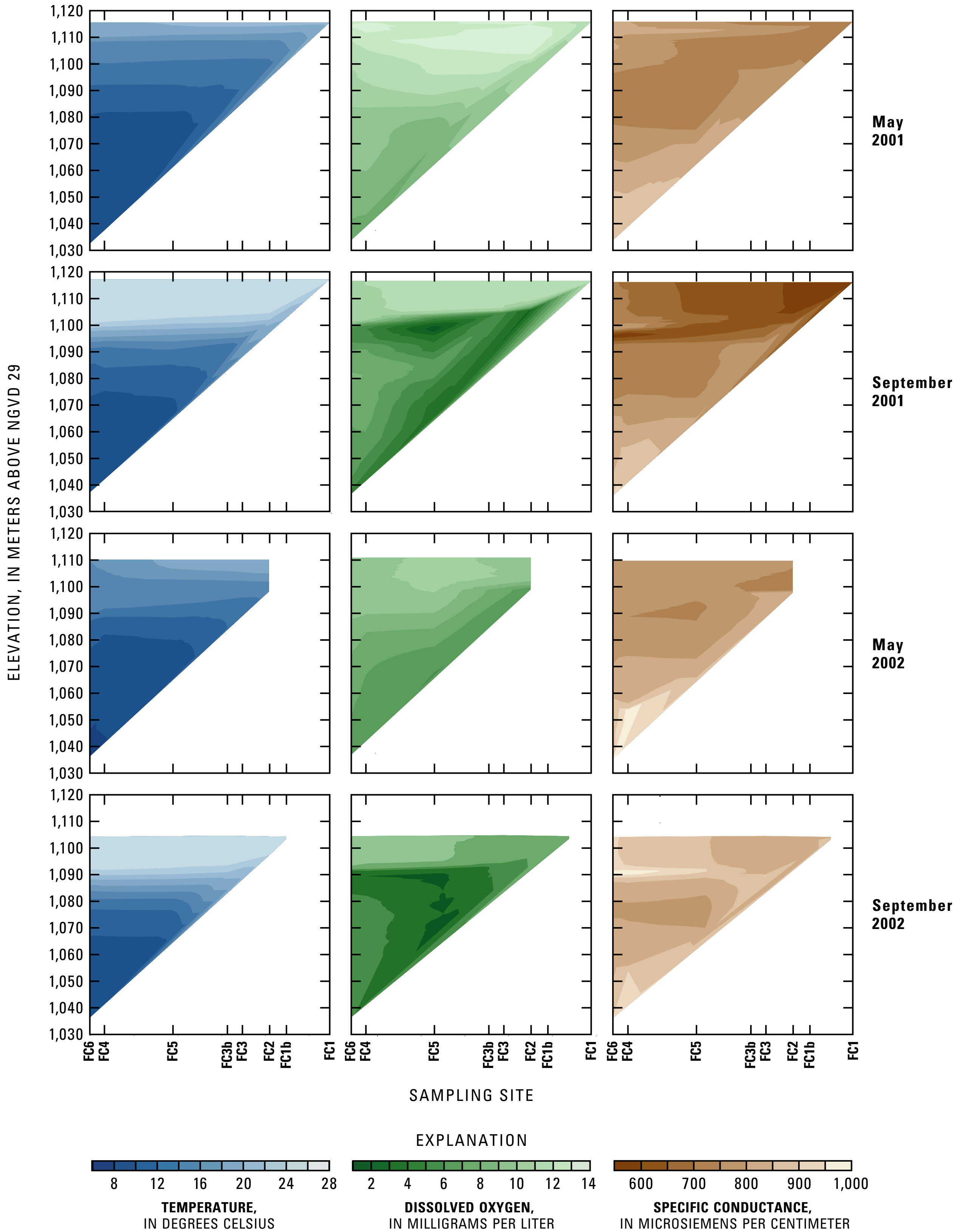


Figure 5. Longitudinal depth profiles of water temperature, specific conductance, and dissolved oxygen in Forgotten Canyon for May 2001, September 2001, May 2002, and September 2002.

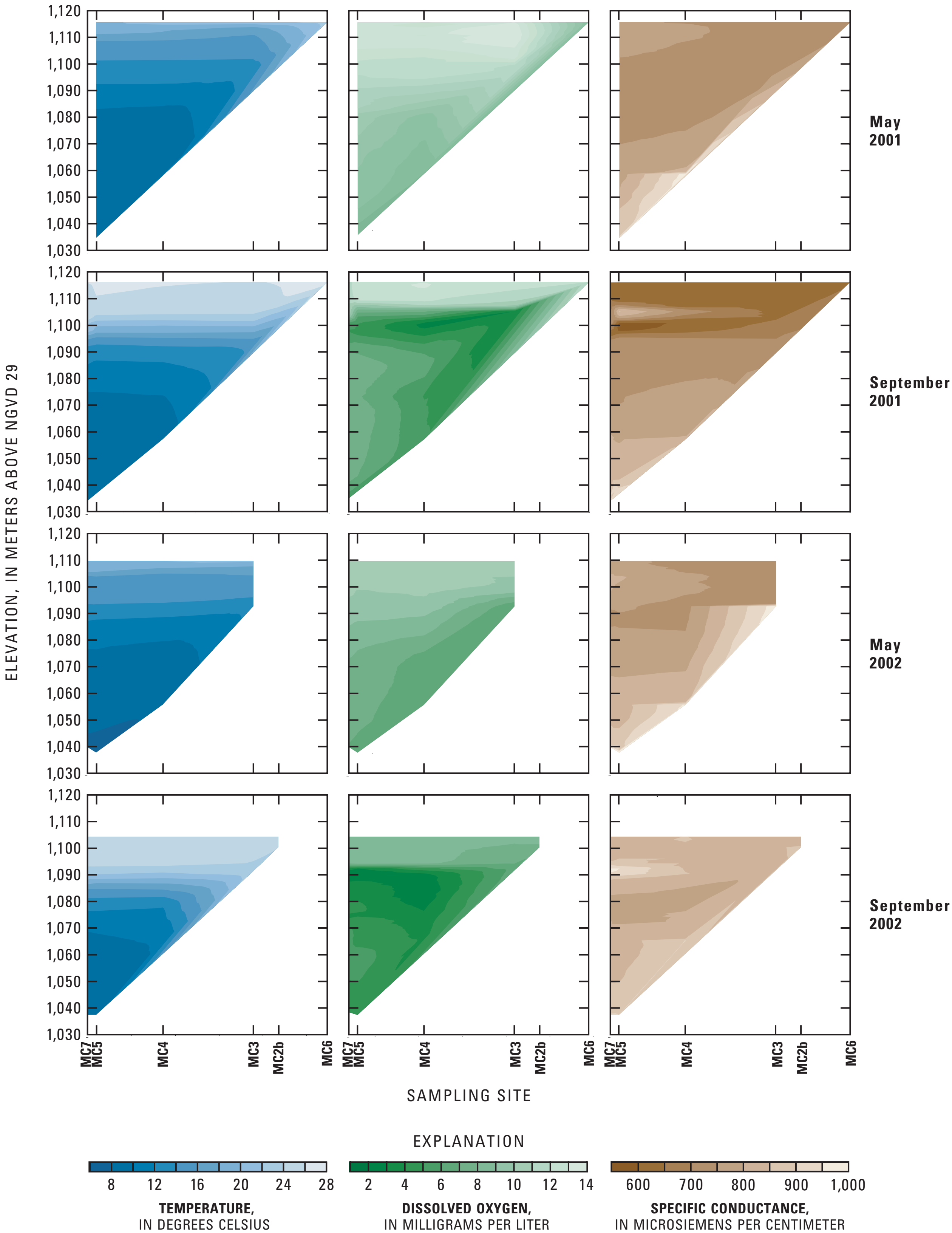


Figure 6. Longitudinal depth profiles of water temperature, specific conductance, and dissolved oxygen in Moqui Canyon for May 2001, September 2001, May 2002, and September 2002.

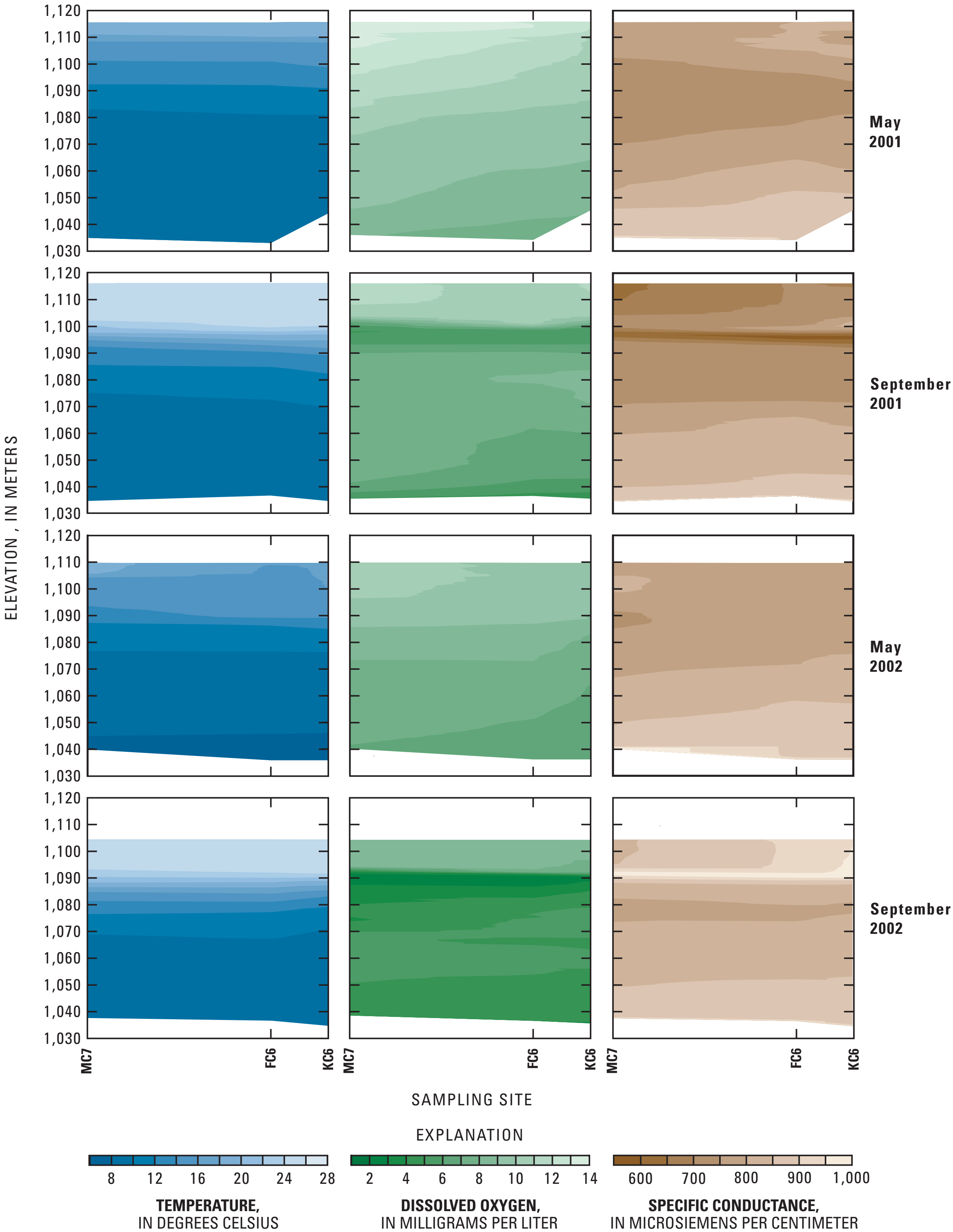


Figure 7. Longitudinal depth profiles of water temperature, specific conductance, and dissolved oxygen in the main channel of Lake Powell near the mouths of Knowles, Forgotten, and Moqui Canyons for May 2001, September 2001, May 2002, and September 2002.

A thermocline and chemocline (an area of rapid change in temperature and an area of rapid change of specific conductance with depth, respectively) were evident in each side canyon and were more pronounced with depth near the mouth of each side canyon (**figs. 4**–6). Water temperatures ranged from 8 to 28°C, specific conductance ranged from 600 to 1,000 µS/cm, and dissolved-oxygen concentrations ranged from about 2 to about 14 mg/L during the study period. Dissolved-oxygen concentrations typically decreased with depth at all sample locations. Metalimnetic oxygen minima (MOM) occurred in all side canyons during September 2001 and 2002 (figs. 4–6). The MOM also occurred in the main stem of Lake Powell during these periods (**fig. 7**). Numerous mechanisms can cause MOMs, including (1) decomposition of organic matter in the upper water layers due to warm temperatures, (2) severe reduction in oxygen due to large concentrations of zooplankton, and (3) high bacterial utilization of oxygen where suspended sediment coincides with the dense metalimnetic layer along gentle basin slopes (Wetzel, 1975). At the side-canyon headwaters where water depths were shallow, temperature, specific conductance, and dissolved-oxygen concentration were constant with depth.

Water Velocity

An ADCP was tested by the USGS in the forebay of Glen Canyon Dam in 1996 using a 600-kHz system. The goal of that test was to determine if the technology was capable of detecting velocity currents generated by the penstocks of Glen Canyon Dam. That test was partly successful. At extreme depths the ADCP could not produce a response. The higher frequency (600 kHz) used for measurements in the forebay may not have been low enough to sense suspended materials, which are needed for the velocity determinations, at the extreme depths near the dam. Before this study, ADCP technology had not been tested in areas of Lake Powell where water velocity is extremely slow.

The ADCP testing for this study was successful, and the results showed the complexity of water movement in the side canyon waters. The ADCP 300 was used to measure velocity profiles at the mouth of each canyon (sites KC4, FC4, and MC5, **fig. 1**) and at selected sites upstream from the mouths of Forgotten and Moqui Canyons (sites FC3 and MC3, fig. 1). Eighty-seven percent of the total depth cells (or bins) were measured at each site. For a typical riverine application of an ADCP, measurements involving 75 percent of the total depth cells are considered good measurements of discharge (± 5 percent; Kevin Oberg, hydrologist, U.S. Geological Survey, oral commun., 2003).

Water generally moved slowly (0 to 0.9 m/s) at the mouths of the side canyons (**fig. 8***A*–*C*). At the mouth of Moqui Canyon (site MC5, fig. 1), pockets of higher velocity (0.5 to 0.8 m/s) occurred at depths of 50 to 70 m (fig. 8*C*). Similar velocity patterns were evident at the upstream sites in Forgotten and Moqui Canyons (figs. 1 and 8*D*–*E*). Average and discrete velocity values were near zero at the headwater sites and had only small variances. The velocity at FC3 and MC3 was expected to be lower, owing to the shallower depths, the morphology in the headwaters section of the canyons, and the lack of inflow to the canyons during the measurements.

Vertical velocity at the mouth of each side canyon ranged from -0.3 to 0.3 m/s (fig. 8*A*–*C*). The overall direction of vertical water movement at the mouth of each side canyon (sites KC4, FC4, and MC5, fig. 1) was downward from the surface to the lakebed. In some areas, water also moved upward. At sites FC3 and MC3, in the upper headwaters of Forgotten and Moqui Canyons, vertical velocity was slower than at the mouth, and movement also was downward (fig. 8*D*–*E*).

Water Transparency

During the study, the transparency of water generally decreased from May to September of 2001 and 2002 in the side canyons. Secchi-disk depths ranged from about 12 m in May 2001 near the mouth of Forgotten Canyon to about 4 m in the same location in September 2001 (**fig. 9**). This decrease in light penetration could have been due to the effects of motorboat traffic causing turbid conditions, wind action, influx of suspended material due to surface-water runoff, or increase in productivity. In the upper ends of the side canyons, motorboat traffic, activities associated with houseboat camping, and natural inflow from streams probably caused an increase in suspended material and therefore reduced light penetration. Water transparency in Knowles Canyon, the control canyon, ranged from about 1 to 6 m during the 2-year study. During 2002, water transparency in Knowles Canyon did not vary substantially between seasons, but transparency characteristics from the mouth to upstream areas were similar to those within Forgotten and Moqui Canyons (fig. 9).

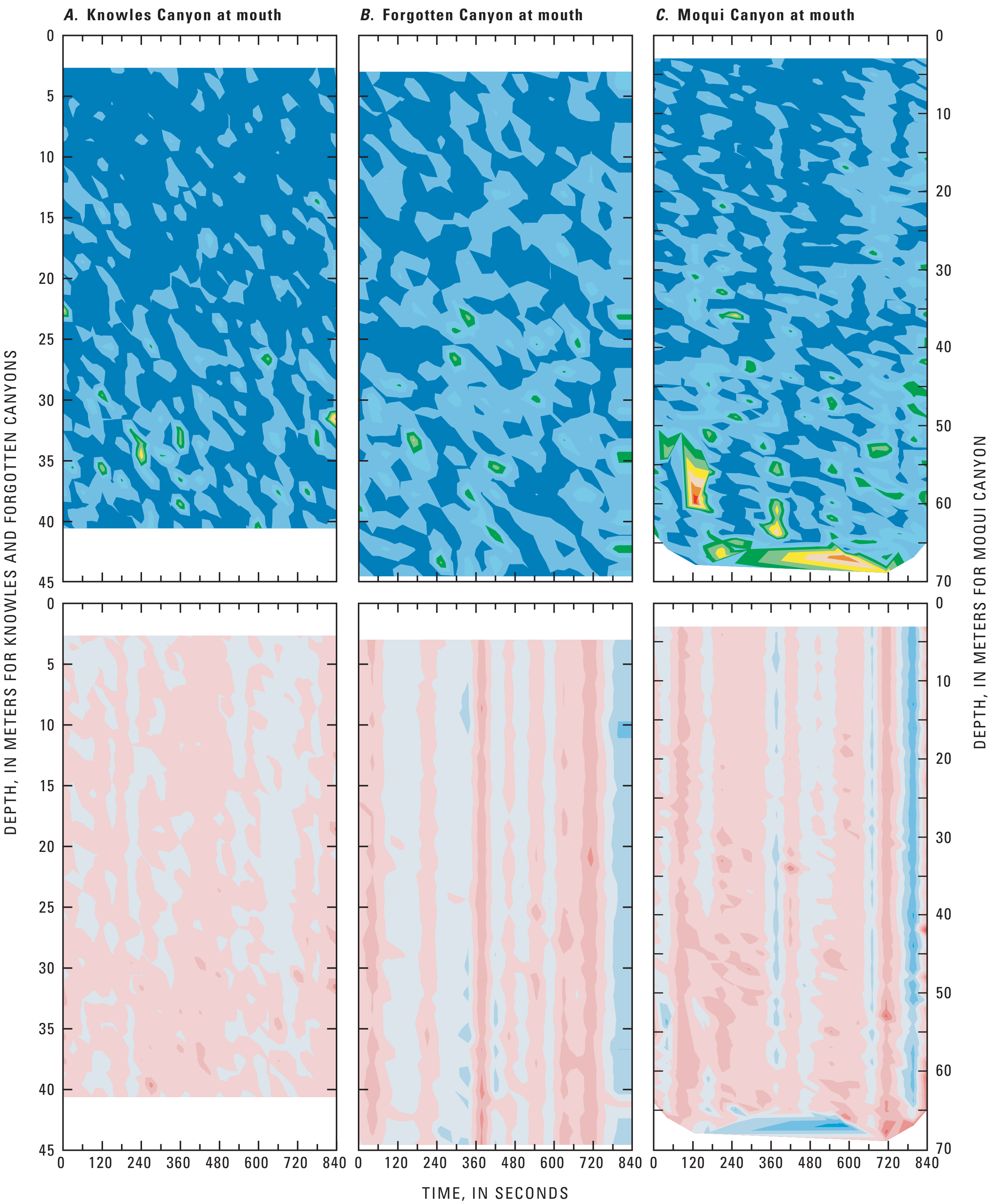


Figure 8. Contours of horizontal velocity and average vertical velocity. *A*, Mouth of Knowles Canyon, September 11, 2002; *B*, Mouth of Forgotten Canyon, September 10, 2002; *C*, Mouth of Moqui Canyon, September 12, 2002; *D*, Site FC3, September 10, 2002; and *E*, MC3, September 12, 2002.

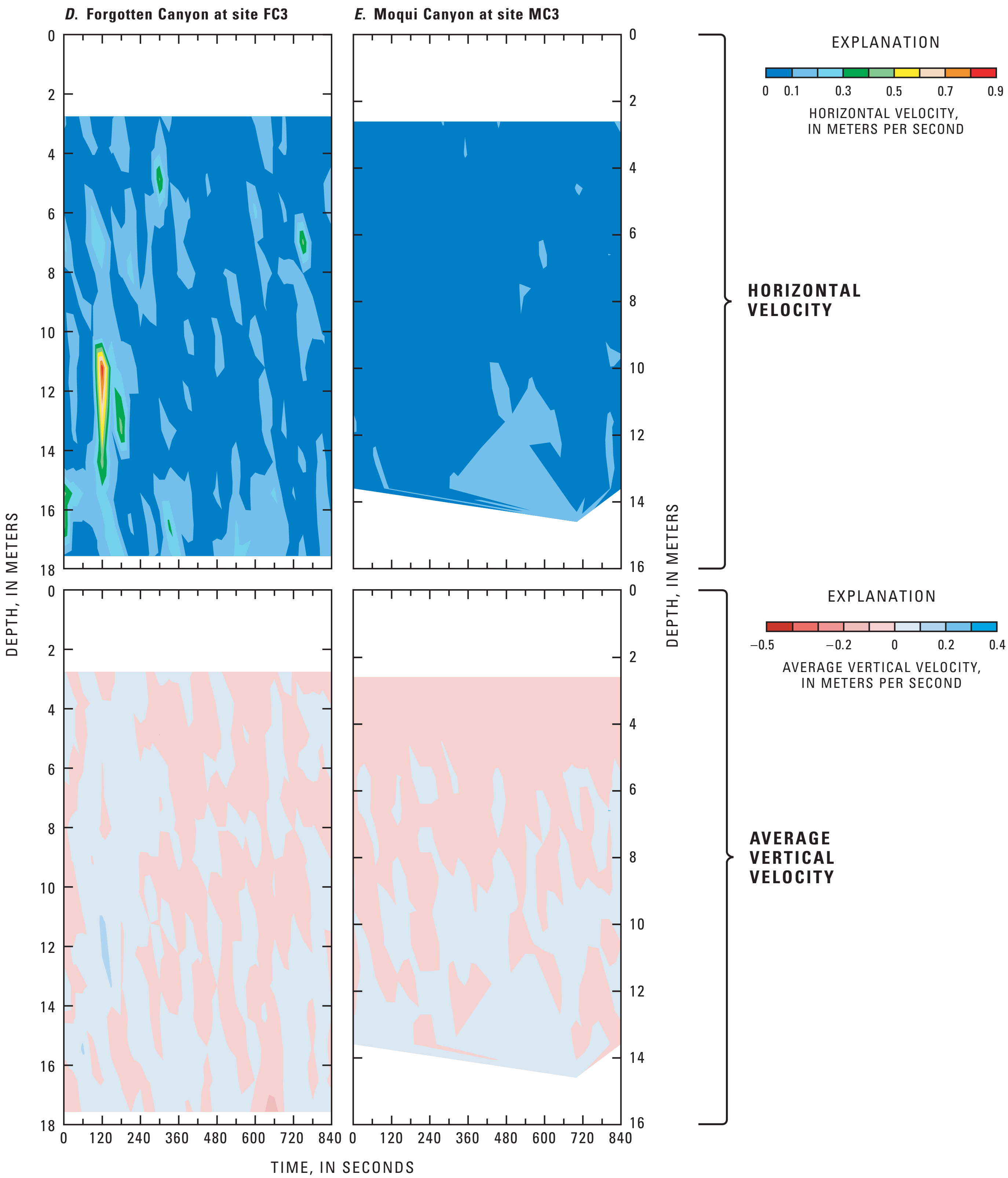


Figure 8. Continued.

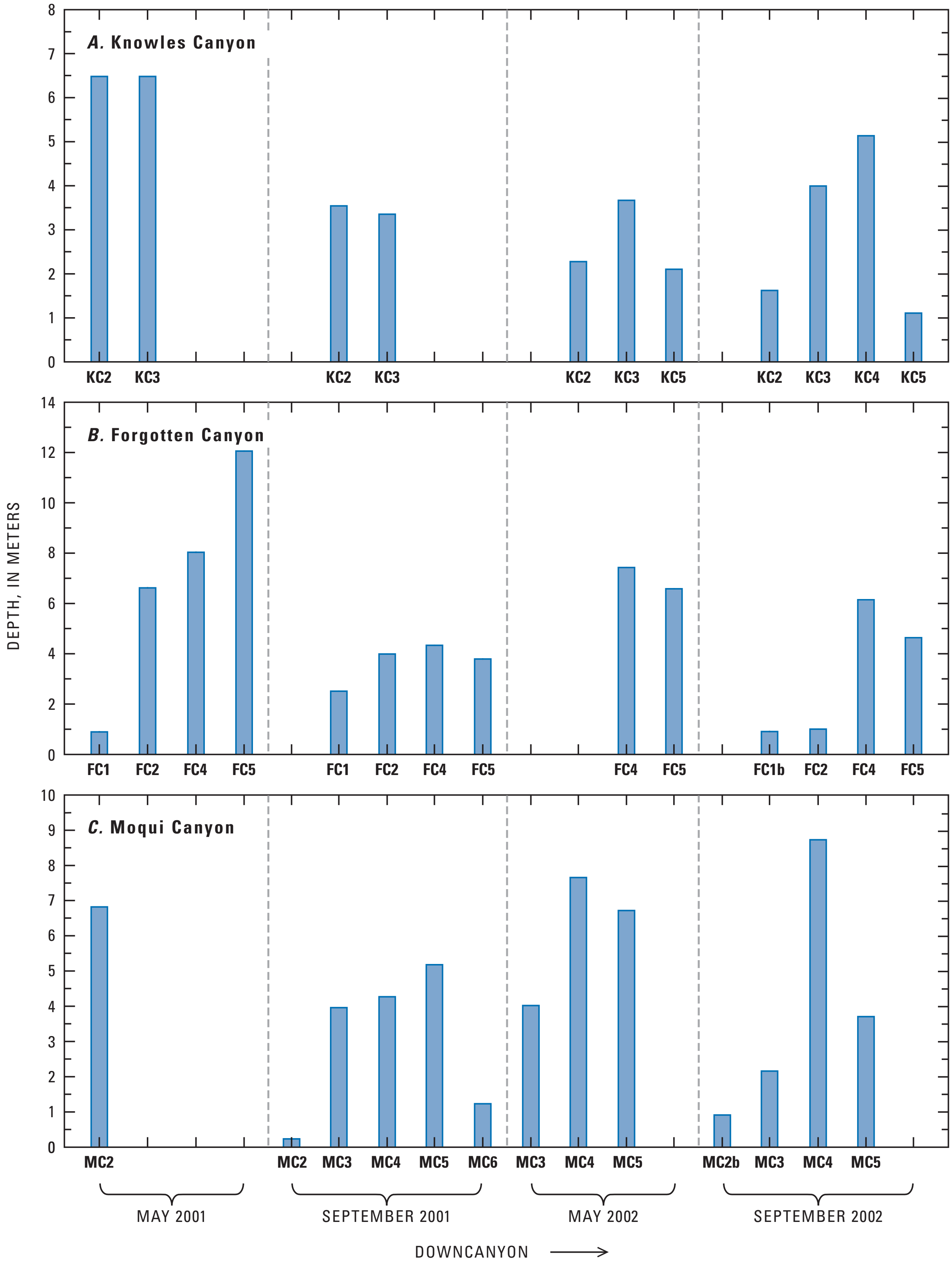


Figure 9. Secchi-disk depth, May 2001 to September 2002. *A*, Knowles Canyon; *B*, Forgotten Canyon; and *C*, Moqui Canyon.

Chemical Characteristics of Side Canyon Waters

The relative major-ion composition of side canyon waters is a result of naturally occurring reservoir processes. Overall, compositions in the three canyons are similar (**fig. 10**); however, constituent concentrations are less variable in Knowles Canyon (**fig. 11**).

Concentrations of inorganic constituents differ from the mouths to the heads of Forgotten and Moqui Canyons, but vary little among the three canyons. In contrast, there are discernible differences in concentrations of VOCs among the canyons. Benzene was present in Forgotten and Moqui Canyons at concentrations above the LDL (**fig. 12**).

The only sample from Knowles Canyon that contained a detectable concentration of benzene was collected near the mouth of the canyon, which easily can be affected by the main body of the lake. Other fuel-derived VOCs, including toluene, ethylbenzene, xylene, and MTBE, also were present in the lower canyons and absent in Knowles Canyon. These findings were not unexpected because the only reasonable sources of VOCs in Lake Powell are associated with human activities, and Knowles Canyon was the only one of the three canyons that was closed to motorized traffic for the duration of the study.

As stated previously, there were no consistent increases or decreases in concentrations of inorganic constituents from the mouth of Knowles Canyon to the head of the canyon. In contrast, data for both Forgotten and Moqui Canyons do show trends in concentrations for many constituents along the longitudinal axes of the canyons. Two major but opposite patterns were observed. The first (and dominant) trend is a decrease in concentration from the mouth to the head of the canyon (**fig. 13**). This trend is present for 12 chemical constituents, including Ca, Mg, Na, SO_4, NO_3, As, selenium (Se), and U.

Because the main body of Lake Powell has higher elemental concentrations than the headwaters of the side canyons, there must either be a removal mechanism in the side canyons or a lack of equilibrium between the side canyons and the main lake body. It is unlikely that there are any reasonable mechanisms to remove, for example, Na, or that any removal mechanism in Forgotten and Moqui Canyons would not also occur in Knowles Canyon. The most likely explanation, therefore, is a lack of equilibrium, indicated by chemical gradients, between the main lake body and the headwaters of the side canyons. The origin of the gradients is most likely the Colorado River as it enters Lake Powell. One of the factors affecting the magnitude of the gradients is distance. Concentrations of measurable inorganic constituents decreased by only 2 percent (a value that lies at our ability to detect a difference) in the 4-km reach from the mouth of Knowles Canyon to the mouth of Forgotten Canyon. Consequently, in the evaluation of the effects that distance has on constituent concentrations, differences in concentrations are likely to be undetectable in the 3-km reach of Knowles Canyon, between its head and mouth (**table 1**). Forgotten and Moqui Canyons, however, are longer at 6 and 11.5 km, respectively. A second factor, which most likely has an even greater effect upon the magnitude of the gradient than distance, is the tortuosity of the canyon. The greater the deviation between the longitudinal axis of the canyon and a straight line, the less flow patterns can mix the water to ameliorate the gradient. Thus, mixing likely precludes formation of a gradient in Knowles Canyon, which is the straightest of the three, whereas far stronger disequilibria can occur in Forgotten, and especially Moqui, which are much more sinuous.

Less common, but far more significant in terms of water-quality issues, is an opposite trend, in which concentrations increase from the mouth of a canyon to its head (**fig. 14**). The list of constituents for which this trend is observed includes many elements associated with sediments [aluminum (Al), manganese (Mn), and the REEs, lead (Pb), vanadium (V), and VOCs]. As noted previously, this pattern was not detected in Knowles Canyon. Although fewer constituents have this trend, the existence of such a trend is significant and indicates a source of these constituents in the upper parts of the drainage areas in Forgotten and Moqui Canyons. As stated before, the only reasonable sources for VOCs in the canyons are those associated with human activities. For Al and the REEs, the explanation is more subtle. If the most reasonable source of these elements were sediments in storm runoff, then concentrations also would be higher in the headwaters of Knowles Canyon. A more plausible reason is that the greater recreational use of Forgotten and Moqui Canyons, especially in the headwaters, causes far more turbulence of the water and, therefore, far more resuspension of sediments than in Knowles Canyon. This explanation, however, does not adequately explain the data trends for V, Pb, and Mn. As with the VOCs, increases in concentrations of these constituents in the headwaters of Forgotten and Moqui Canyons most likely result from human activities. Fuel compounds associated with the various watercraft or other recreational activities are possible constituent sources.

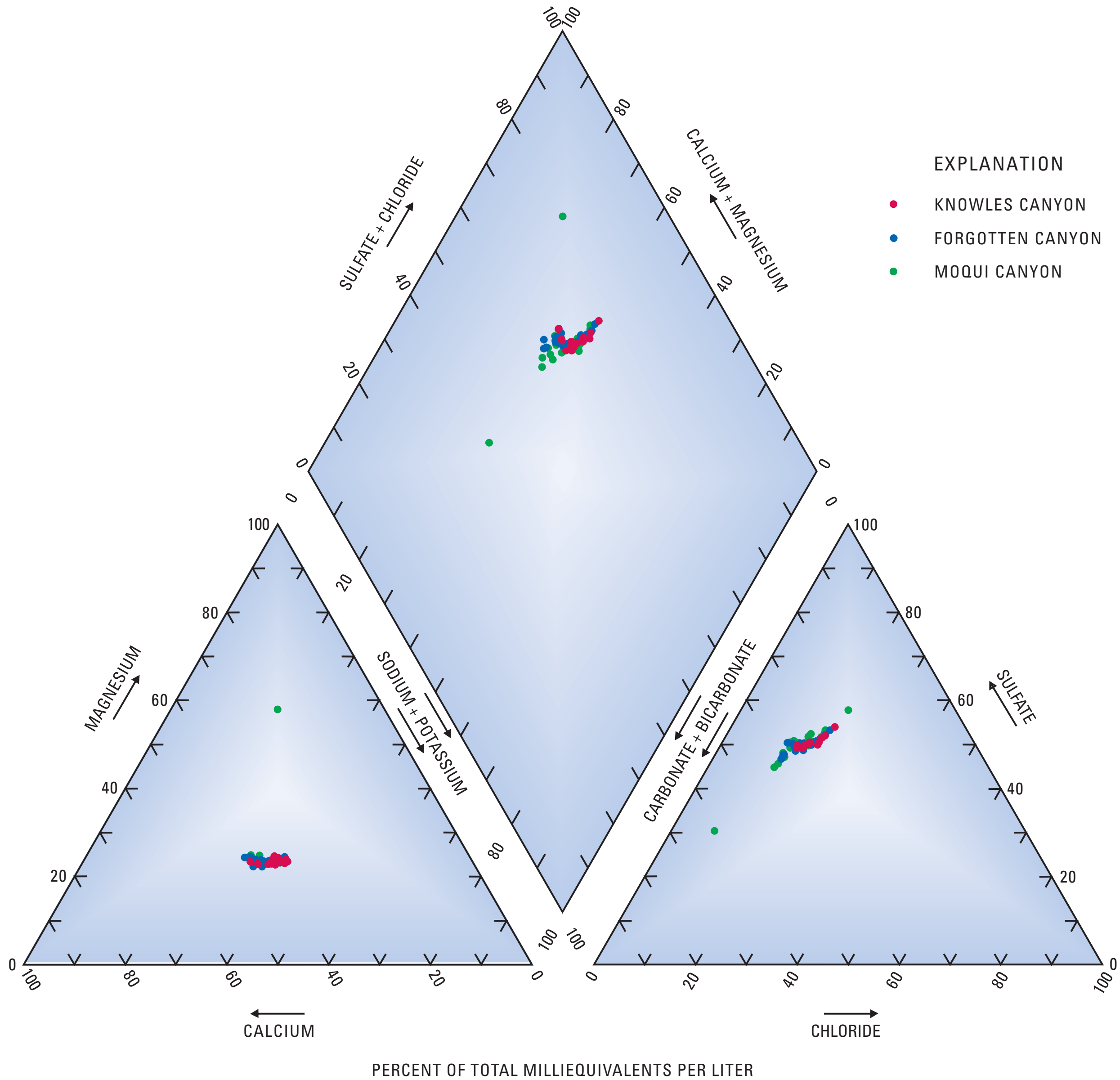


Figure 10. Relative compositions of water in Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002.

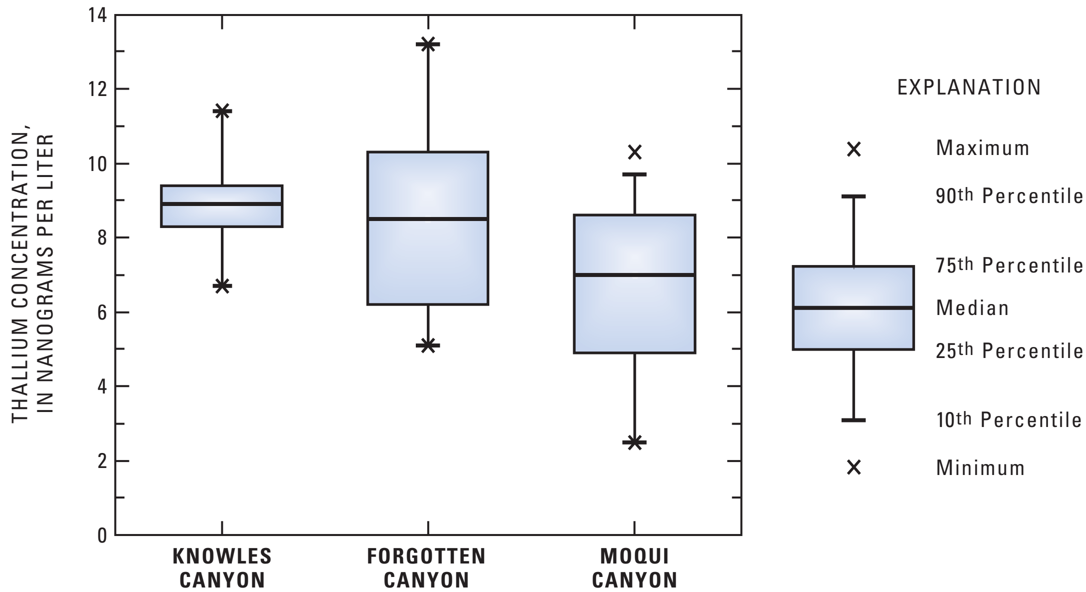


Figure 11. Variability in concentrations of thallium in surface water, Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002.

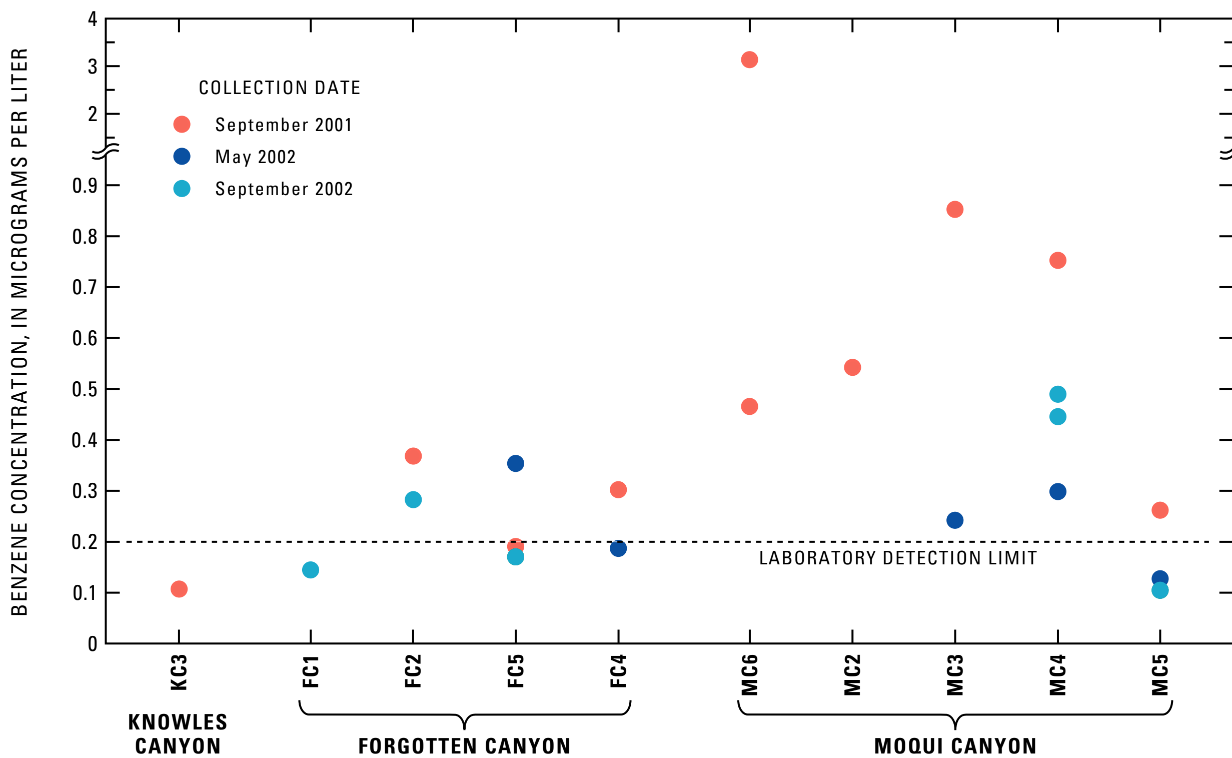


Figure 12. Concentrations of benzene in surface water, Knowles, Forgotten, and Moqui Canyons, September 2001, and May and September 2002. Values below the dashed lines are highly uncertain and do not necessarily represent the concentrations displayed. Only samples which showed "measurable" benzene are displayed.

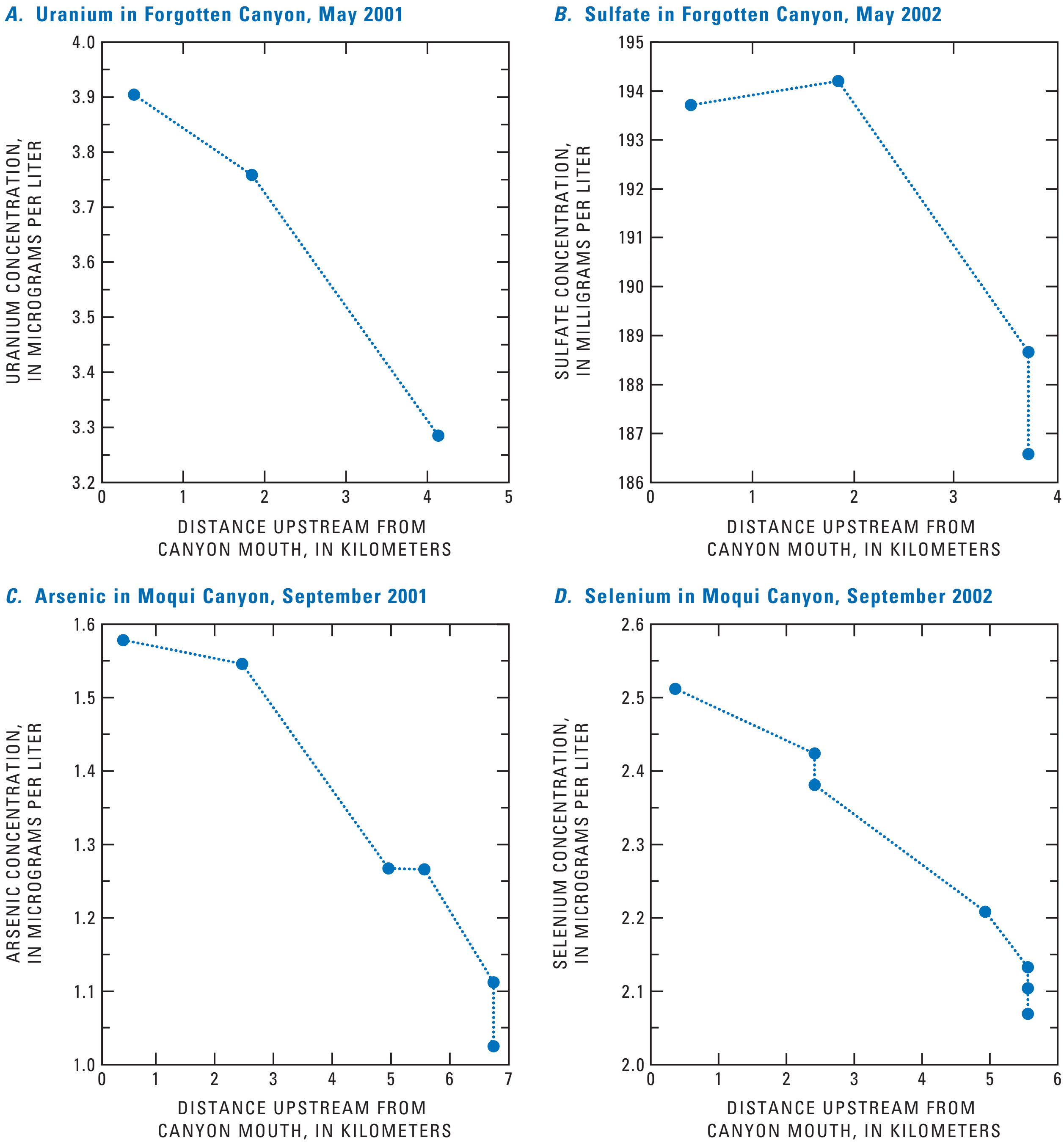


Figure 13. Decreases in concentrations of selected chemical constituents in surface water along Forgotten and Moqui Canyons. *A*, Uranium in Forgotten Canyon, May 2001; *B*, Sulfate in Forgotten Canyon, May 2002; *C*, Arsenic in Moqui Canyon, September 2001; and *D*, Selenium in Moqui Canyon, September 2002.

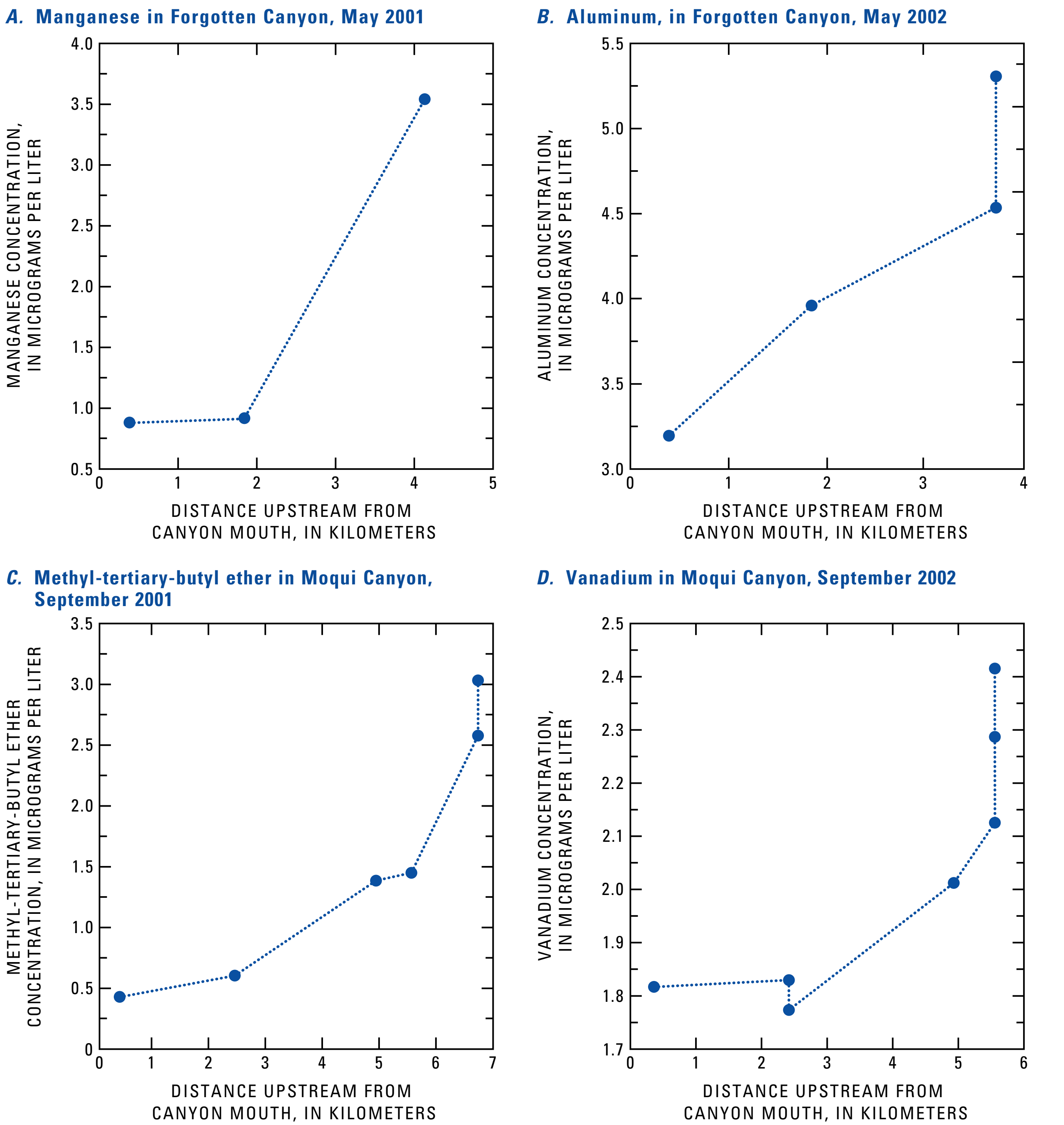


Figure 14. Increases in concentrations of selected chemical constituents in surface water along Forgotten and Moqui Canyons. *A*, Manganese in Forgotten Canyon, May 2001; *B*, Aluminum in Forgotten Canyon, May 2002; *C*, Methyl-tertiary-butyl ether in Moqui Canyon, September 2001; *D*, Vanadium in Moqui Canyon, September 2002.

Shallow- and Deep-Water Chemistry

A thermocline and a chemocline were present in the side canyons during all sampling periods and at all locations except near the headwaters. These conditions are reflected in the chemical differences between the shallow water (upper 1 m within the epilimnion) and deep water (below the thermocline within the hypolimnion) in the main body of Lake Powell and in Knowles, Forgotten, and Moqui Canyons. For most chemical constituents, concentrations measured in shallow-water samples were higher than concentrations in deep-water samples at the same sampling site, especially during the May sampling trips (**fig. 15**). Data from samples collected in September 2001 typically show the opposite trend: concentrations were higher in deep-water samples than in shallow-water samples (fig. 15).

INTERACTION OF SIDE CANYON WATER WITH THE MAIN STEM OF LAKE POWELL

Although Lake Powell is largely uncontaminated, water sampled in this study near Knowles, Forgotten, and Moqui Canyons had high concentrations of major cations and anions (**fig. 16**). For example, Ca concentrations ranged from 50 to 70 mg/L and SO_4 concentrations ranged from 135 to 240 mg/L. These concentrations reflect the composition of Colorado River water that enters the lake. The part of the reservoir sampled in this study did not contain anomalously high concentrations of any trace elements, although concentrations of As, Se, U, and molybdenum (Mo) were higher than those reported for most fresh waters (Hem, 1985).

Although dissolved concentrations of chemical constituents within the main body of Lake Powell tend to be confined to a relatively narrow range, these concentrations are strongly dependent on several factors. The major factors are (1) the sample-collection depth within the water column (for example, shallow water versus deep water, as discussed previously), (2) the seasonality and (or) time the sample was collected, and (3) the location of the side canyon mouths within the spatial area of Lake Powell.

Temporal Chemical Variability of the Main Stem of Lake Powell

In the main stem of Lake Powell near the mouths of Knowles, Forgotten, and Moqui Canyons, concentrations of chemical constituents in surface waters generally varied between the sampling trips. Concentrations in samples collected during May 2001 and May 2002 were intermediate between those collected in September 2001 (lower) and September 2002 (higher; **fig. 17***A*). Among the major constituents, concentrations of Ca, Mg, Na, K, SO_4, and Cl all showed this pattern, which can be attributed to evaporation and (or) drought conditions. During this study, a severe drought occurred throughout the entire drainage basin that supplies water to Lake Powell, resulting in record-low reservoir elevations (**fig. 3**). With near-record annual low flows (see hydrographs for the Colorado River at Cisco, Utah, and the Green River at Green River, Utah, at **http://www.waterdata.usgs.gov/ut/nwis/rt**), it is likely that the Colorado River had high concentrations of most constituents as it entered Lake Powell. At the same time, with decreased sources of water but near-normal releases from Glen Canyon Dam and above average air temperatures, evaporation could have concentrated constituents, especially in September 2002. The patterns of typical elemental concentrations shown in figure 17*A* correspond to lake elevations shown in figure 3—the highest elevations, during September 2001, correspond to the lowest concentrations, and the lowest elevations, during September 2002, correspond to the highest concentrations.

Concentrations of most of the elements typically associated with sediments—Al, Mn, and the REEs—in samples collected during May were higher than those in samples collected during September (fig. 17*B*). This could have occurred because sediment-laden inflows enter Lake Powell during late spring and early summer as overflow-density currents as a result of snowmelt runoff in the Colorado River Basin. Within the lake, only colloidal-sized particles do not settle out in a short time. Owing to their composition, the colloids are a ready source of Al and REEs to the reservoir. In addition, some colloidal particles are so small that they could have passed through some of the filters used in sample collection. The increase in concentrations of colloids, and thus the increase in concentrations of the smaller particles in May, resulted in increased "dissolved" concentrations of Al and REEs in samples collected during May. Alkalinity data also reflect the higher concentrations of these elements in the May samples compared with the September samples.

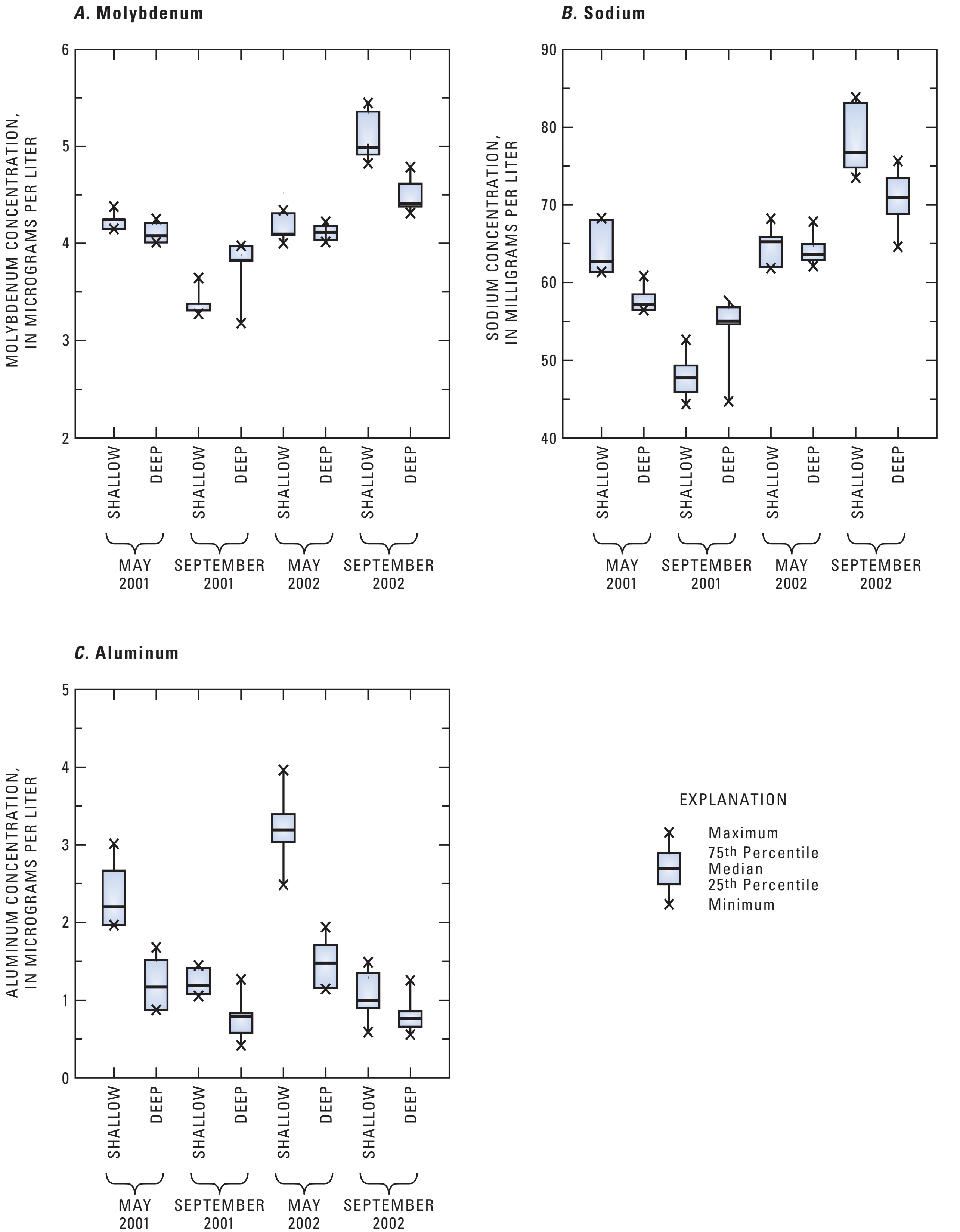


Figure 15. Concentrations of molybdenum, sodium, and aluminum in shallow and deep water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002. *A*, Molybdenum; *B*, Sodium; *C*, Aluminum.

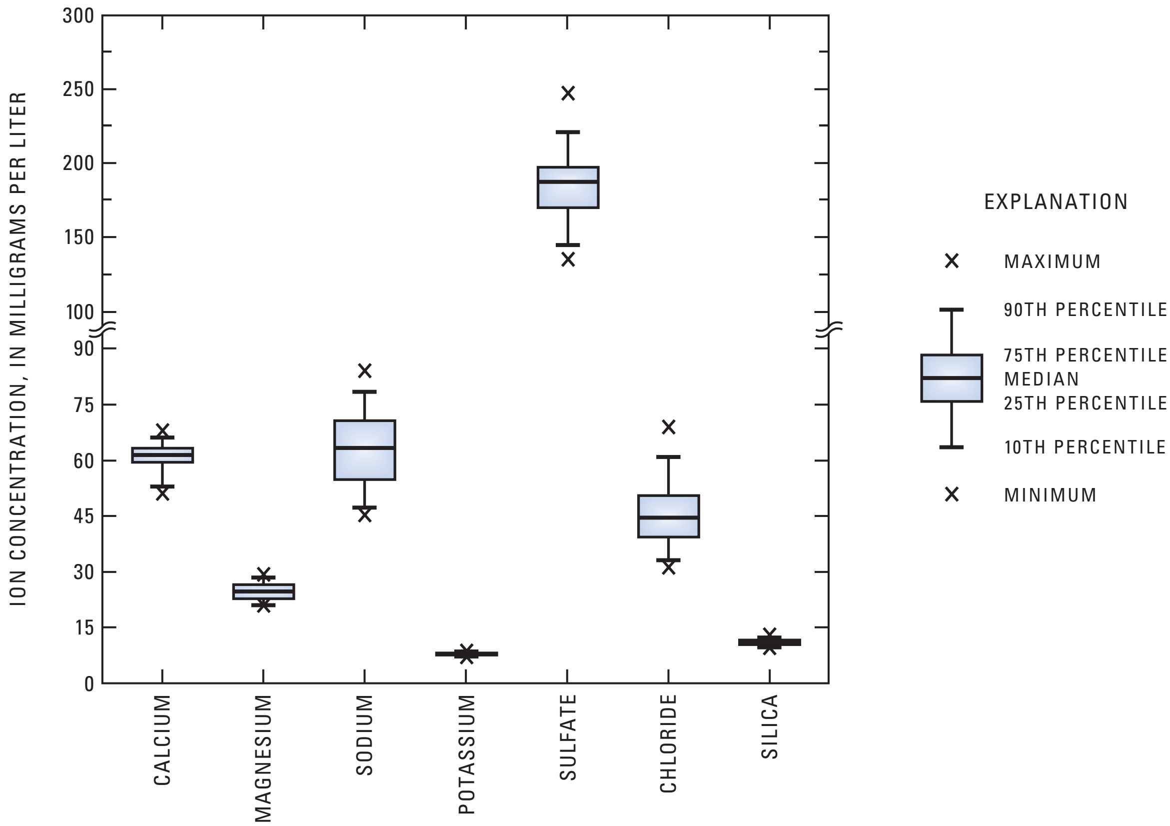


Figure 16. Concentrations of major ions at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002.

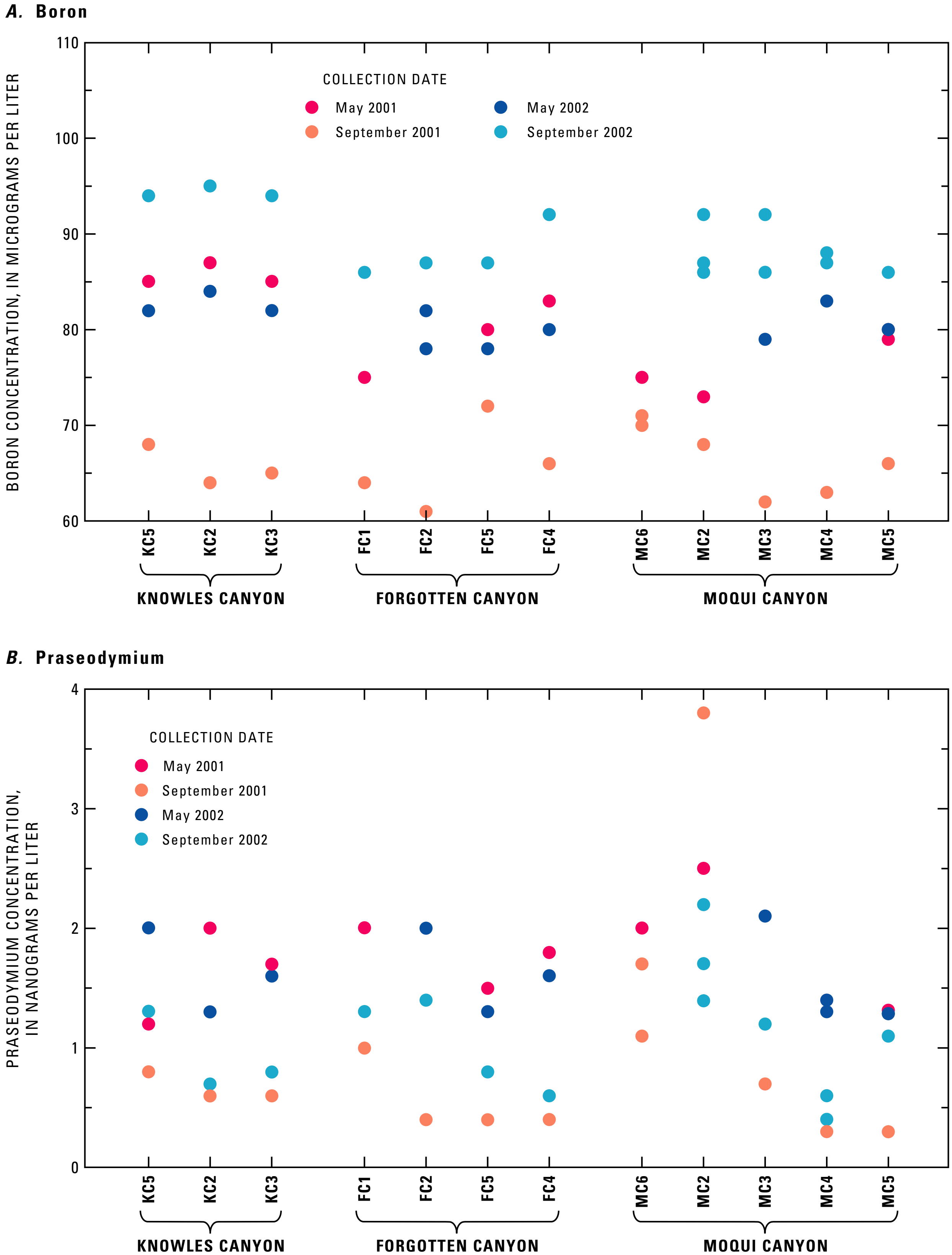


Figure 17. Concentrations of boron and praseodymium in surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002. *A*, Boron; and *B*, Praseodymium.

Constituent concentration data for deep-water samples have far fewer discernible temporal trends than data for shallow-water samples. The most significant trend is that concentrations in 2002 were higher than concentrations in 2001. This is consistent with the drought explanation posited above: the drought, which intensified during 2002, resulted in increased concentrations in the Colorado River. Although deep waters within Lake Powell are thermally and chemically isolated from the shallower waters during the summer months (due to the strong metalimnetic thermal and salinity barrier that prevents mixing), seasonal turnover (mixing) does occur in the lake near Knowles, Forgotten, and Moqui Canyons. The increased concentrations within the Colorado River eventually lead to increased concentrations at depth in the lake. This trend is seen for 13 different constituents, among which are Mg, Na, K, SO_4, boron (B), Sr, and Se.

Spatial Chemical Variability of the Main Stem of Lake Powell

In addition to a seasonal variability in constituent concentrations, Lake Powell also exhibits a chemical gradient along the original channel of the Colorado River, at least throughout the study area from Knowles Canyon to Moqui Canyon. The mouth of Knowles Canyon lies 175.0 km from Glen Canyon Dam; the mouths of Forgotten and Moqui Canyons are 170.9 km and 159.3 km from the Dam, respectively (**fig. 1**). Concentrations of 29 inorganic constituents at shallow water depths decreased from the mouth of Knowles Canyon to the mouth of Moqui Canyon for at least three of the four sampling trips (**fig. 18** and **table 9**). Of the major constituents, only the data for SiO_2 do not show this trend; SiO_2 concentrations increase across the mouths of the canyons. Constituent concentrations (above the LDL) decreased 7 percent, on average, between the mouths of Knowles and Moqui Canyons, and decreased 2 percent, on average, between the mouths of Knowles and Forgotten Canyons.

EFFECTS OF RECREATIONAL USE ON WATER QUALITY AND BED-MATERIAL CHEMISTRY

Recreational activities in the side canyons of Lake Powell include boating, water skiing, use of PWC, houseboat camping, day hiking, swimming, and beach camping. These activities can affect the water quality in Lake Powell and its side canyons through the introduction of chemical compounds:

- Including VOCs, SVOCs, TPHs, and oil and grease, from gasoline-powered motors
- From the use and disposal of insecticides, disinfectants, and solvents
- From the use and disposal of human medical compounds, such as prescription and non-prescription drugs
- From the disposal of human waste products
- From the disposal of food products

Trace Elements

Because concentrations of trace elements generally were low, recreational activities are not believed to contribute significant amounts of metals to the lake (**table 10**). Significant water-chemistry trends, however, were observed (see section entitled “Temporal Chemical Variability of the Main Stem of Lake Powell”). Concentrations of V, Pb, and Mn were elevated at the heads of Forgotten and Moqui Canyons. Although the elevated concentrations cannot be attributed to specific sources on the basis of available information, they likely are the result of human activities in the side canyons.

Volatile Organic Compounds, Total Petroleum Hydrocarbons, and Oil and Grease

Oil and grease (as a single analyte) was detected slightly above the LDL in one sample in Knowles Canyon (site KC5, fig. 1 and **table 11**), during May 2001. Because of the immiscible refractory nature of oil and grease, this may have been a residual from visitor use prior to the study. The low concentrations of benzene, toluene, and MTBE in Knowles Canyon during September 2001 (sites KC3 and KC5, fig. 1 and table 11) probably are the result of analytical measurement artifacts and should not be interpreted as being significant. VOCs were detected in Forgotten and Moqui Canyons, and concentrations were higher during September 2001 and 2002, the high-use period, than during May 2001 and 2002 (**fig. 12** and table 11). Concentrations of benzene, toluene, and ethylbenzene in Forgotten and Moqui Canyons did not exceed maximum contaminant levels (MCLs) of 5 µg/L, 1,000 µg/L, 700 µg/L, and 10,000 µg/L, respectively, for drinking water (U.S. Environmental Protection Agency, 2004).

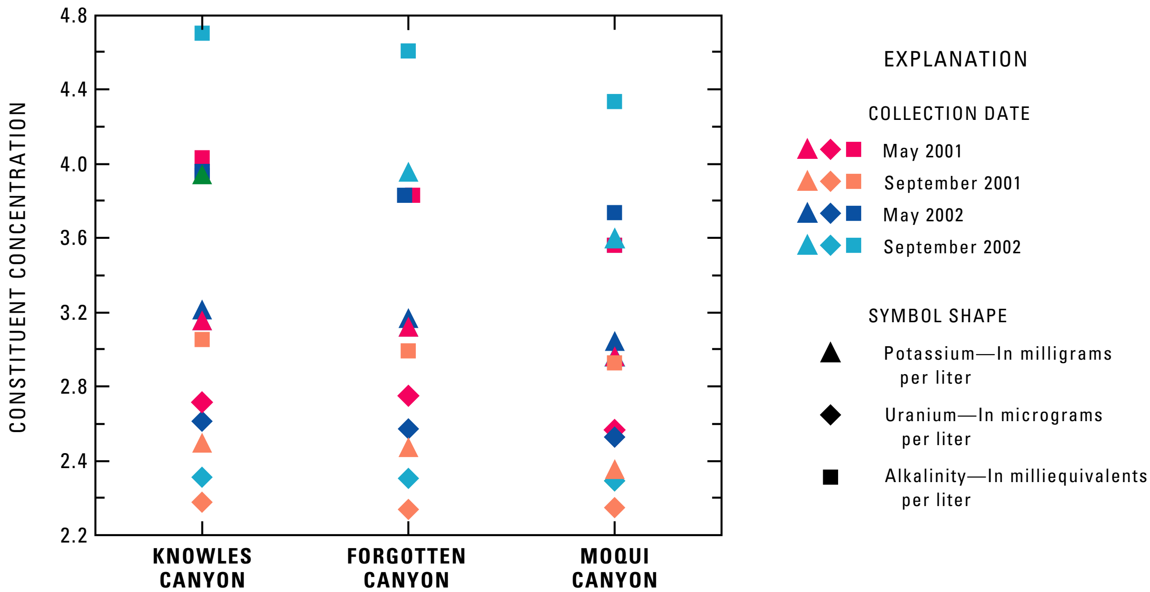


Figure 18. Decreases in concentrations of potassium, uranium, and alkalinity from the mouth of Knowles Canyon to the mouth of Moqui Canyon, May and September 2001 and 2002.

Table 9. Percent difference in concentrations of selected constituents in shallow water between the mouths of Knowles and Moqui Canyons

[Note: positive values indicate that concentrations at the mouth of Knowles were higher than those at Moqui]

Constituent	Percent difference	Constituent	Percent difference	Constituent	Percent difference
Manganese	29	Neodymium	9	Potassium	5
Nitrate	23	Rubidium	9	Molybdenum	5
Cerium	21	Rhenium	9	Bromine	4
Praseodymium	18	Selenium	9	Strontium	4
Lanthanum	15	Magnesium	7	Arsenic	3
Aluminum	14	Lithium	7	Calcium	3
Chlorine	13	Uranium	6	Bicarbonate	2
Antimony	11	Sulfate	6	Barium	1
Yttrium	10	Boron	5	Vanadium	0
Sodium	10	Dissolved organic carbon	5	Silica	-4

Benzene ranged from less than the LDL to 3.1 µg/L during September of 2001 and 2002; concentrations were highest in 2001 (fig. 12 and table 11). The highest concentrations of toluene, ethylbenzene, *o*-xylene, *m* and *p*-xylene, total xylene, and MTBE were 3.8, 0.2, 2.4, 3.5, 5.9, and 3.0 µg/L, respectively, and occurred in Moqui Canyon during September. MTBE, a fuel additive, can enter the lake from fuel transported to the lake but is not used at the Lake Powell marinas. The U.S. Environmental Protection Agency (USEPA) has classified MTBE as a possible carcinogen and issued a nonregulatory drinking-water advisory that recommended keeping concentrations in the range of 20 to 40 µg/L or below for aesthetic concerns (USEPA, 1997). Concentrations of MTBE in the side canyons were far below these concentrations (table 11).

TPHs were not found above the LDLs in Forgotten and Knowles Canyons during the study. TPHs were detected once in Moqui Canyon during September 2002 (table 11). Concentrations of oil and grease were detected slightly above the LDL of 1 mg/L at some sites during 2001; concentrations ranged from 1 to 4 mg/L. During 2002, the LDL was 7 mg/L, and no concentrations were detected above this level (table 11).

Organic Wastewater Compounds

A variety of wastewater contaminants (33 of 79 analyzed) were detected in trace amounts in Knowles, Forgotten, and Moqui Canyons (**table 12**). Concentrations of most of these contaminants were lower than their LDLs and are reported as estimates. Nationwide, many of these contaminants have been detected in rivers and streams (Kolpin and others, 2002). Various wastewater compounds can be introduced unknowingly to Lake Powell from materials used in boat manufacturing (for example flame retardants added to plastics). The accumulative effect of these compounds can be potentially harmful to humans and the biota of water systems.

Trace amounts of cholesterol (biogenic steroid), caffeine (beverages), N,N-diethyl-meta-toluamide (DEET), octylphenol-2 ethoxylate (OPEO-2; a nonionic surfactant), and beta-sitosterol (plant steroid) were among the most frequently detected organic compounds. These compounds were detected in Forgotten and Moqui Canyons, and cholesterol was detected in all three canyons. The concentrations were below LDLs and, therefore, are reported as estimates (table 12). Phenol and diethylhexyl phthalate were detected in all three canyons (table 12). Phenol is used in disinfectants, and diethylhexyl phthalate is used as a plasticizer. Inputs of these organic wastewater compounds from sources other than recreational visitors are unlikely. Environmental processes can attenuate concentrations of many of the trace organic contaminants introduced into Lake Powell. Although dilution plays a significant role in decreasing concentrations, biodegradation, photolysis, volatilization, and sorption also reduce concentrations or remove compounds entirely.

Concentrations of EDTA (table 12), although low, were detected in most of the samples collected from the side canyons. This wastewater indicator cannot be tied to visitor use in the side canyons. The contaminant may be entering Lake Powell from the many wastewater treatment plants along the tributaries within the Colorado River Basin. The NPEC compounds also were detected in some samples collected from the side canyons (table 12).

Four compounds in the hormone and steroid analysis were detected in the three side canyons, including stanalone, estriol, coprostanol, and cholesterol. Stanalone is a semisynthetic analog of DHT (dihydrotestosterone), a byproduct of the male hormone testosterone, and is responsible for the formation of the male primary sex characteristics during embryonic life (MedicineNet.com, 2004). Cholesterol is a common biogenic molecule and is an indicator of effects from all biota, whereas coprostanol is a specific mammal fecal indicator (Writer and others, 1995; Barber and Writer, 1998). Estriol is one of three estrogens normally produced in the body. Other estrogens include estrone and estradiol. Estriol is commonly used in natural hormone replacement therapy, providing the benefits of estrogen without the side effects and risks seen with other estrogens, such as estradiol (Nature's Healthcare, 2004).

Although water-quality regulations have not been established for most of the compounds detected, aquatic toxicity values are available for some of the compounds (Kolpin and others, 2002; Barber and others, 2003). Concentrations of NPEC compounds were significantly lower than those reported by Ahel and others (1994) and Barber and others (2000) for streams affected by wastewater. Although concentrations were well below those considered toxic (McLeese and others, 1981), they may approach values shown to cause feminization of fish populations (White and others, 1994; Jobling and others, 1996; Jobling and others, 1998). White and others (1994) analyzed NPEC compounds for their ability to stimulate vitellogenin gene expression in trout hepatocytes and found that vitellogenin secretion was increased by these compounds in a dose-dependent manner. Also, Jobling and others (1996) exposed the male rainbow trout (*Oncorhynchus mykiss*) to four different alkylphenolic chemicals, which caused synthesis of vitellogenin, a process normally dependent on endogenous estrogens, and a concomitant inhibition of testicular growth.

Bed-Material Chemistry

Bed-material samples collected during this study did not contain unusually high concentrations of inorganic (trace elements and REEs) and organic constituents (SVOCs; **table 13**). For SVOCs, only benzyl-n-butyl-phthalate and bis 2-ethylhexyl phthalate were detected in concentrations above LDLs. Most trace elements and REEs were detected above their LDLs, but in general most of these constituents were detected at low concentrations, and their presence may not be due to visitor use (table 13). The drought-induced drop in the reservoir elevation, however, precluded a thorough temporal comparison of sample analyses. Samples could not be collected at the same, or in most cases even similar, locations related to recreational use of beaches in the study canyons.

Bacteria

E. coli concentrations were generally low and typical for Lake Powell (Mark Anderson, aquatic ecologist, Glen Canyon National Recreation Area, written commun., 2004; **table 14**). Of the 183 samples collected, 108, or 59 percent, had no detectable concentrations of *E. coli*. Concentrations were low at all side canyon sites; the highest *E. coli* count was less than one-fourth of the USEPA recommended limit for recreational water of 126 MPN/100 mL (U.S. Environmental Protection Agency, 1986 and 2000). Beach-area water samples had higher *E. coli* concentrations than those samples collected in the main channel of the side canyons. Higher concentrations of bacteria in shallower waters were indicated by a weak but significant inverse correlation between water depth and fecal coliform counts (Spearman rank correlation, $r_s = -0.507$, $p = 0.0189$, $N = 21$) in a previous study (Mark Anderson, aquatic ecologist, Glen Canyon National Recreation Area, written commun., 1998). Three samples collected in Moqui Canyon on September 10, 2002, exceeded the USEPA recommended limits with counts greater than 126 MPN/mL (table 14). Seven samples were collected and processed September 10, 2002, from MC2b (**fig. 1**); the arithmetic mean for the site was 392 MPN/100 mL, which is above the recommended limit of 126 MPN/100 mL.

A sample collected from the beach area at Moqui site MC2 on May 15, 2001, exceeded the maximum detection limit of 2,400 MPN/100 mL, using the Colilert Quanti-Tray method (table 14). Other individual samples from this beach area averaged 8 MPN/100 mL. Spatial variability in bacterial counts at individual sample locations within a particular beach area was reported from a previous study of Lake Powell (Mark Anderson, aquatic ecologist, Glen Canyon National Recreation Area, written commun., 1998).

Average colony counts for all samples were 1 MPN/100 mL (standard deviation of 2.6), 4 MPN/100 mL (standard deviation of 16.3), and 70 MPN/100 mL (standard deviation of 345) for Knowles, Forgotten, and Moqui Canyon beaches, respectively. This increasing trend of colony counts was expected because of the correlative increase in visitor use from Knowles to Moqui Canyon. The high standard deviation of counts in Moqui Canyon is indicative of the episodic nature of *E. coli* contamination in Lake Powell. The highest count in Knowles Canyon was only 11 MPN/100 mL, which was lower than the highest counts in any of the other canyons; the highest counts were from samples collected in Moqui Canyon.

Comparison of average colony counts in Knowles, Forgotten, and Moqui Canyons from high- and low-use periods, however, suggests differences are due to the episodic nature of bacterial counts in Lake Powell and are not necessarily related to visitor use. For example, the high colony counts in 2001 were from samples collected during May, the low-use period. The high colony counts in 2002 were from samples collected during September, the high-use period. It is possible, however, that during May 2001, visitor density in the side canyons was greater than that during September 2001. There could be a correlation between the bacteria colonies and the observance of coprostanol, a chemical compound associated with sewage waste. The many nondetections and few spikes in bacterial counts are difficult to interpret and may not provide conclusive information about the general effects from recreational visitors. The spikes in the data indicate episodic events, and the correlation of these events with other parameters would require many additional data.

CONSIDERATIONS FOR ADDITIONAL MONITORING

GLCA staff currently collect water samples for bacterial analysis from popular beach locations within Lake Powell to ensure public health and determine compliance with State and Federal water-quality standards (Kevin Berghoff, hydrologist, Glen Canyon National Recreation Area, written commun., 1999). With the discovery of human-caused contamination in water and bed material in Knowles, Forgotten, and Moqui Canyons, a strategy of periodic sampling for VOCs, organic wastewater compounds, and other recreational-use related compounds would provide additional documentation of potential health risks.

The potential effect of contaminants found during this study on the biota of Lake Powell is unknown. The USGS and other agencies have investigated the effects of selected organic constituents on the endocrine systems of fish and other aquatic biota (Goodbred and others, 1997). Contaminants detected in Knowles, Forgotten, and Moqui Canyons during this study are also likely to be present in other side canyons of Lake Powell.

Periods of high visitor use would be the best times to collect water and bed-material samples for future comparisons of data with findings from this study and for monitoring of selected chemical constituents. Sampling could be coordinated with the GLCA's current bacteria-sampling program. Side canyons could be selected on the basis of an initial synoptic survey of major side canyon tributaries and used as indicator sites. Establishing baseline chemical conditions (non-visitor use period) at the chosen monitoring sites, however, would be needed to determine future changes and trends in water quality. Various ecological-health indicators related to visitor land use are needed in the monitoring program to identify degradation of terrestrial resources and potential degradation of water resources.

SUMMARY AND CONCLUSIONS

Side canyons of Lake Powell are the most popular recreation areas of the GLCA in Arizona and Utah. There are more than 90 side canyons that are tributary to the main body of Lake Powell. The GLCA receives between 2 and 3 million visitors each year, and visitors typically are concentrated at beaches along the 180-mile long lake that are accessible by boat or automobile. Recreational boating and sport fishing in the lake contribute about 350 million dollars to the local and regional economies.

The USGS documented the effects of visitor use on the water quality of Knowles, Forgotten, and Moqui Canyons of Lake Powell, near Bullfrog Bay, during the summers of 2001 and 2002. Concentrations of many chemical contaminants in Forgotten and Moqui Canyons were higher during September (high-use period) than during May (low-use period) of 2001 and 2002. Knowles Canyon was closed to public access during the study, and concentrations of contaminants in the canyon were generally less than LDLs.

Significant results from the study are:

- General physical and chemical characteristics were similar among the three side canyons—all had well-defined temperature and salinity gradients.
- Water transparency varied between samples collected during May and those collected during September and also from canyon to canyon. In general, the transparency increased from the headwaters to the mouth of each side canyon and decreased between May and September. Transparency in Knowles Canyon was fairly constant during the study. Motorboat activity could have affected the transparency in some reaches of Forgotten and Moqui Canyons.
- Water in the side canyons generally moved very slowly in upstream and downstream directions. Vertical movement of water generally was downward from the surface to the lakebed.
- Concentrations of Se and other trace elements in Forgotten and Moqui Canyons decreased from the mouths to the heads of the canyons. Conversely, concentrations of other trace elements, such as Mn, the REEs, and V, increased from the mouths to the heads of the canyons. Concentrations of As, Se, U, and Mo were higher than those reported for most freshwater bodies.
- Concentrations of most organic constituents in Knowles Canyon were significantly less than concentrations in Forgotten and Moqui Canyons, or the constituents were not detected at all.
- Concentrations of VOCs in Forgotten and Moqui Canyons were higher during the high-use period in September than during the low-use period in May. All VOC concentrations were below USEPA MCLs for drinking water. Reasonable sources of VOCs in the canyons are those associated with human activities.
- TPH and oil and grease were detected in low concentrations in some samples from Forgotten and Moqui Canyons. None were detected in Knowles Canyon above the mouth.
- Thirty-three organic wastewater compounds were detected out of 79 that were analyzed; most of the analytical data were less than the LDLs.

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Hart and others—PHYSICAL AND CHEMICAL CHARACTERISTICS OF KNOWLES, FORGOTTEN, AND MOQUI CANYONS, AND EFFECTS OF RECREATIONAL USE ON WATER QUALITY, LAKE POWELL, ARIZONA AND UTAH—U.S. Geological Survey Scientific Investigations Report 2004–5120

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Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; meq/L, milliequivalents per litter; mg/L, milligrams per liter; <, less than; Stnd dev., standard deviation; DOC, dissolved organic carbon; DIC, dissolved inorganic carbon; µg/L, micrograms per liter; ng/L, nanograms per liter. Dashes indicate no data]

Site name	Date	Total depth (meters)	Sample depth (meters)	Specific conductance (µS/cm)	pH	Secchi-disk depth (meters)	Alkalinity (meq/L)
Field measurements and alkalinity, May 2001							
KC2	05–17–01	9.8	4	--	--	6.1	2.86
KC3	05–17–01	50.0	5	--	--	6.5	2.86
KC3	05–17–01	50.0	25	--	--	--	2.70
KC4	05–17–01	70.1	--	--	--	6.5	--
KC5	05–17–01	9.8	< 1	--	--	--	2.86
KC6[1]	05–17–01	85.3	--	--	--	5.5	--
FC1	05–16–01	1.2	< 1	--	--	0.9	2.67
FC2	05–16–01	19.5	10	--	8.17	6.6	2.59
FC4	05–16–01	80.8	4	--	--	8.0	2.90
FC4	05–16–01	80.8	25	--	--	--	2.78
FC5	05–16–01	51.5	< 1	--	--	--	2.81
FC5	05–16–01	51.5	25	--	--	12.0	2.63
MC2	05–15–01	1.1	< 1	686	8.61	--	6.73
MC3	05–15–01	24.4	13	--	--	6.8	2.47
MC4	05–15–01	67.1	30	--	--	--	2.63
MC5	05–15–01	84.7	1	--	--	--	2.73
MC5	05–15–01	84.7	30	--	--	--	2.69
MC6	05–15–01	1.2	< 1	--	--	--	3.36

Site name	Date	Total depth (meters)	Sample depth (meters)	Specific conductance (µS/cm)	pH	Secchi-disk depth (meters)	Alkalinity (meq/L)
Field measurements and alkalinity, September 2001							
KC2	09–06–01	9.8	1	630	8.9	3.5	2.31
KC3	09–06–01	50.0	1	631	8.9	3.4	2.37
KC3	09–07–01	50.0	30	694	8.42	--	2.56
KC5	09–06–01	9.8	< 1	645	8.92	--	2.31
FC1	09–07–01	2.5	< 1	561	9	2.5	2.31
FC2	09–07–01	19.5	1	587	8.82	4.0	2.32
FC2	09–07–01	19.5	15	563	8.19	--	2.44
FC4	09–07–01	61.0	1	625	8.89	4.3	2.33
FC4	09–07–01	61.0	30	678	8.28	--	2.62
FC5	09–07–01	57.0	1	672	8.79	3.8	2.40
FC5	09–07–01	57.0	30	715	8.47	--	2.62
FC6[1]	09–07–01	--	--	--	--	--	--
MC2	09–05–01	0.6	< 1	618	8.41	0.2	2.71
MC3	09–05–01	26.5	1	592	8.69	4.0	2.47
MC4	09–05–01	66.8	1	--	--	4.3	2.34
MC4	09–05–01	66.8	12	--	--	--	2.41
MC4	09–05–01	66.8	30	--	--	--	2.63
MC5	09–05–01	82.3	1	616	8.9	5.2	2.34
MC5	09–05–01	82.3	30	701	8.42	--	2.61
MC6	09–05–01	1.2	< 1	633	8.65	1.2	2.59
MC6d	09–05–01	--	< 1	634	8.63	--	2.59
MC7[1]	09–05–01	86.6	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Total depth (meters)	Sample depth (meters)	Specific conductance (μS/cm)	pH	Temperature (degrees Celsius)	Secchi-disk depth (meters)	Alkalinity (meq/L)
Field measurements and alkalinity, May 2002								
KC2	05–22–02	--	1	799	8.36	--	2.3	2.76
KC3	05–22–02	--	1	797	8.40	--	3.7	2.77
KC3	05–22–02	--	35	798	7.83	17.6	--	2.70
KC5	05–22–02	--	1	800	7.99	--	2.1	2.66
FC2	05–21–02	13.4	1	760	8.05	21.1	--	2.69
FC2	05–21–02	13.4	1	752	7.95	20.5	--	2.70
FC4	05–21–02	62.8	1	774	8.25	22	7.4	2.73
FC4	05–21–02	62.8	40	780	7.91	18.1	--	2.71
FC5	05–21–02	50.0	1	778	7.99	21	6.6	2.72
FC5	05–21–02	50.0	40	777	--	16.2	--	2.71
MC3	05–20–02	21.3	1	735	8.05	18.5	4.0	2.65
MC4	05–20–02	60.0	1	780	8.13	19.4	7.7	2.68
MC4	05–20–02	60.0	1	--	--	--	--	2.69
MC4	05–20–02	60.0	40	775	7.82	14.9	--	2.69
MC5	05–20–02	78.9	1	767	8.00	17.7	6.7	2.69
MC5	05–20–02	78.9	55	794	7.80	--	--	2.73
MC7[1]	05–20–02	80.8	--	--	--	--	--	--
Field measurements and alkalinity, September 2002								
KC2	09–11–02	--	1	921	8.45	--	1.6	2.49
KC2	09–11–02	--	20	898	8.04	--	--	2.69
KC3	09–11–02	--	1	898	8.43	--	4.0	2.49
KC3	09–11–02	--	20	862	8.06	--	--	2.69
KC4	09–11–02	46.3	--	--	--	--	5.1	--
KC5	09–11–02	--	--	--	--	--	1.1	--
KC5a	09–11–02	--	< 1	906	8.45	--	--	2.49
KC6[1]	09–11–02	--	--	--	--	--	--	--
FC1a	09–10–02	--	< 1	828	8.39	--	--	2.49
FC1b	09–10–02	2.7	--	--	--	--	0.9	--
FC2	09–10–02	7.9	1	829	8.36	--	1.0	2.48
FC3b	09–10–02	18.3	--	--	--	--	--	--
FC4	09–10–02	54.9	1	898	8.43	--	6.2	2.48
FC4	09–10–02	54.9	20	861	7.9	--	--	2.68
FC5	09–10–02	38.1	1	846	8.3	--	4.7	2.46
FC5	09–10–02	38.1	20	844	7.85	--	--	2.68
FC6[1]	09–10–02	70.4	--	--	--	--	--	--
MC2b	09–09–02	7.0	< 1	826	8.18	--	0.9	2.62
MC2b	09–09–02	7.0	< 1	823	8.32	--	--	2.61
MC2c	09–09–02	--	1	836	8.31	--	--	2.53
MC3	09–09–02	15.8	1	854	8.26	--	2.1	2.51
MC4	09–09–02	42.7	1	866	8.16	--	8.7	2.49
MC4	09–09–02	42.7	1	876	8.27	--	--	2.48
MC4	09–09–02	42.7	35	866	8.25	--	--	2.68
MC5	09–09–02	72.5	1	848	8.46	--	3.7	2.47
MC5	09–09–02	72.5	35	813	7.97	--	--	2.66
MC7[1]	09–09–02	73.2	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Calcium (mg/L)		Magnesium (mg/L)		Sodium (mg/L)		Potassium (mg/L)		Sulfate (mg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Major ions and dissolved carbon, May 2001												
KC2	05–17–01	4	61	6	23	1	69	2	3.3	0.1	194	--
KC3	05–17–01	5	63	0	23	0	68	2	3.3	0.1	199	--
KC3	05–17–01	25	59	4	20	1	61	1	3.1	0.1	177	--
KC5	05–17–01	< 1	63	3	24	0	69	1	3.3	0.1	197	1.1
FC1	05–16–01	< 1	60	0	20	1	55	1	3.1	0.1	176	--
FC2	05–16–01	10	58	3	19	1	53	1	2.9	0.1	170	--
FC4	05–16–01	4	65	0	23	0	68	3	3.2	0.1	196	--
FC4	05–16–01	25	60	1	21	1	58	2	3.0	0.1	181	--
FC5	05–16–01	< 1	63	0	22	1	63	1	3.2	0.1	188	4.0
FC5	05–16–01	25	61	1	21	1	56	1	3.0	0.1	172	--
MC2	05–15–01	< 1	60	1	21	1	52	4	3.0	0.2	160	--
MC3	05–15–01	13	58	1	19	0	54	3	2.9	0.1	170	--
MC4	05–15–01	30	59	2	19	1	53	4	3.0	0.1	175	--
MC5	05–15–01	1	63	2	21	1	61	2	3.1	0.1	181	--
MC5	05–15–01	30	59	0	20	1	57	1	3.0	0.1	182	--
MC6	05–15–01	< 1	58	3	21	0	55	1	3.1	0.1	171	5.4
Blank[2]	05–17–01	--	<0.004	0.002	<0.009	0.007	<0.007	0.002	<0.004	0.004	<0.05	--
Blank[3]	05–17–01	--	<0.004	0.001	<0.009	0.006	<0.007	0.003	<0.004	0.004	<0.05	--

Site name	Date	Depth (meters)	Chloride (mg/L)		Silica (mg/L)		DOC (mg/L as carbon)		DIC (mg/L as carbon)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05–17–01	4	47	--	6.9	0.0	3.7	0.1	33	0.0
KC3	05–17–01	5	48	--	6.8	0.1	6.5	0.0	34	0.1
KC3	05–17–01	25	40	--	7.1	0.0	3	0.3	32	0.6
KC5	05–17–01	< 1	48	2.3	7.0	0.1	5.9	0.1	33	0.2
FC1	05–16–01	< 1	33	--	5.8	0.1	3.6	0.1	31	0.3
FC2	05–16–01	10	38	--	6.3	0.1	7.4	0.0	30	0.1
FC4	05–16–01	4	50	--	6.8	0.1	3.5	0.2	34	0.2
FC4	05–16–01	25	40	--	7.0	0.1	3.8	0.2	32	0.4
FC5	05–16–01	< 1	44	1.3	6.6	0.1	5.9	0.0	33	0.1
FC5	05–16–01	25	37	--	7.0	0.0	3.3	0.2	31	0.3
MC2	05–15–01	< 1	34	--	6.4	0.0	--	--	--	--
MC3	05–15–01	13	37	--	6.7	0.0	3.6	0.1	31	0.5
MC4	05–15–01	30	34	--	7.2	0.0	3.1	0.3	31	0.9
MC5	05–15–01	1	41	--	6.6	0.1	3.9	0.2	33	0.0
MC5	05–15–01	30	39	--	7.1	0.0	3.5	0.0	31	0.4
MC6	05–15–01	< 1	37	0.1	5.3	0.0	4.6	0.1	34	0.1
Blank[2]	05–17–01	--	<0.5	--	0.015	0.006	1.5	0.1	1.5	0.0
Blank[3]	05–17–01	--	<0.5	--	0.015	0.001	0.5	0.0	1.8	0.0

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Calcium (mg/L)		Magnesium (mg/L)		Sodium (mg/L)		Potassium (mg/L)		Sulfate (mg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Major ions and dissolved carbon, September 2001												
KC2	09–06–01	1	56	2	18	1	48	1	2.6	0.0	156	1.8
KC3	09–06–01	1	53	1	17	0	49	1	2.6	0.0	158	4.5
KC3	09–07–01	30	59	2	19	1	55	1	2.9	0.0	172	3.1
KC5	09–06–01	< 1	56	4	18	1	48	1	2.7	0.1	157	4.8
FC1	09–07–01	< 1	49	4	17	1	43	1	2.5	0.0	135	1.7
FC2	09–07–01	1	54	2	18	1	44	1	2.5	0.0	137	2.3
FC2	09–07–01	15	52	4	18	2	45	0	2.5	0.1	138	4.3
FC4	09–07–01	1	55	3	18	1	49	0	2.6	0.0	151	0.3
FC4	09–07–01	30	60	2	20	1	57	1	3.0	0.0	175	3.6
FC5	09–07–01	1	58	3	18	1	52	1	2.9	0.0	166	9.3
FC5	09–07–01	30	59	1	19	0	58	1	3.0	0.0	177	7.6
MC2	09–05–01	< 1	53	2	18	1	47	0	2.9	0.0	144	3.7
MC3	09–05–01	1	51	1	17	0	45	3	2.7	0.0	146	0.2
MC4	09–05–01	1	51	0	17	0	46	0	2.4	0.1	149	1.9
MC4	09–05–01	12	55	0	18	0	48	2	2.6	0.0	158	0.9
MC4	09–05–01	30	59	3	19	1	55	2	2.9	0.0	174	0.1
MC5	09–05–01	1	52	1	17	1	48	0	2.5	0.0	150	0.7
MC5	09–05–01	30	56	1	18	0	55	3	2.9	0.1	180	2.9
MC6	09–05–01	< 1	52	1	18	0	49	1	2.9	0.1	150	3.9
MC6d	09–07–01	< 1	50	1	17	0	49	1	2.9	0.1	149	4.3
Blank[2]	09–07–01	--	<0.005	0.002	<0.002	0.003	<0.002	0.004	<0.004	0.002	--	--
Blank[4]	09–07–01	--	0.034	0.006	<0.002	0.004	<0.002	0.002	<0.004	0.002	--	--
Blank[5]	09–07–01	--	0.035	0.003	<0.009	0.007	<0.007	0.003	<0.004	0.003	--	--
Blank[6]	09–07–01	--	0.005	0.002	<0.009	0.003	<0.007	0.003	<0.004	0.002	--	--
Blank[3]	09–07–01	--	0.037	0.001	<0.009	0.005	<0.007	0.003	<0.004	0.004	--	--

Site name	Date	Depth (meters)	Chloride (mg/L)		Silica (mg/L)		DOC (mg/L as carbon)		DIC (mg/L as carbon)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09–06–01	1	37	0.8	7.3	0.0	3.7	0.0	27	0
KC3	09–06–01	1	36	1.7	7.3	0.1	3.8	0.0	28	0
KC3	09–07–01	30	38	1.9	7.3	0.2	3.1	0.1	32	0
KC5	09–06–01	< 1	37	2.0	7.4	0.1	3.6	0.1	27	1
FC1	09–07–01	< 1	28	1.9	8.2	0.1	4.3	0.0	27	0
FC2	09–07–01	1	29	1.6	8.0	0.2	3.6	0.4	28	0
FC2	09–07–01	15	29	2.4	8.6	0.1	3.8	0.2	30	0
FC4	09–07–01	1	35	1.2	7.7	0.2	3.9	0.0	28	0
FC4	09–07–01	30	37	2.7	7.5	0.1	2.9	0.0	32	0
FC5	09–07–01	1	38	3.1	7.7	0.1	3.6	0.2	29	0
FC5	09–07–01	30	36	3.9	7.3	0.1	3.1	0.0	32	0
MC2	09–05–01	< 1	32	0.8	7.8	0.0	4.6	0.1	33	0
MC3	09–05–01	1	30	2.4	7.3	0.3	4.2	0.1	30	0
MC4	09–05–01	1	32	0.4	7.7	0.1	4.0	0.1	28	0
MC4	09–05–01	12	34	3.4	7.6	0.3	3.6	0.1	29	0
MC4	09–05–01	30	37	0.7	7.3	0.3	2.8	0.1	32	0
MC5	09–05–01	1	31	2.2	7.7	0.3	3.8	0.0	28	0
MC5	09–05–01	30	37	1.7	7.3	0.3	3.2	0.1	32	1
MC6	09–05–01	< 1	32	0.9	7.9	0.2	4.4	0.0	31	1
MC6d	09–07–01	< 1	32	0.5	7.9	0.2	4.2	0.2	32	0

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Chloride (mg/L) Average	Chloride (mg/L) Stnd dev.	Silica (mg/L) Average	Silica (mg/L) Stnd dev.	DOC (mg/L as carbon) Average	DOC (mg/L as carbon) Stnd dev.	DIC (mg/L as carbon) Average	DIC (mg/L as carbon) Stnd dev.
Major ions and dissolved carbon, September 2001—Continued										
Blank[2]	09–07–01	--	--	--	<0.006	0.007	0.47	0.03	0.58	0.01
Blank[4]	09–07–01	--	--	--	<0.006	0.002	0.47	0.01	2.6	0.0
Blank[5]	09–07–01	--	--	--	<0.01	0.00	0.80	0.08	1.7	0.1
Blank[6]	09–07–01	--	--	--	<0.01	0.00	0.32	0.00	0.53	0.00
Blank[3]	09–07–01	--	--	--	<0.01	0.01	0.72	0.03	0.70	0.01

Site name	Date	Depth (meters)	Calcium (mg/L) Average	Calcium (mg/L) Stnd dev.	Magnesium (mg/L) Average	Magnesium (mg/L) Stnd dev.	Sodium (mg/L) Average	Sodium (mg/L) Stnd dev.	Potassium (mg/L) Average	Potassium (mg/L) Stnd dev.	Sulfate (mg/L) Average	Sulfate (mg/L) Stnd dev.
Major ions and dissolved carbon, May 2002												
KC2	05–22–02	1	63	1	22	0	70	0	3.4	0.0	199	--
KC3	05–22–02	1	61	1	22	0	68	0	3.3	0.1	194	--
KC3	05–22–02	35	60	2	21	0	63	0	3.2	0.1	192	--
KC5	05–22–02	1	63	1	22	0	70	0	3.5	0.0	196	--
FC2	05–21–02	1	60	2	21	1	64	1	3.4	0.0	187	--
FC2	05–21–02	1	59	2	21	0	62	1	3.3	0.1	189	--
FC4	05–21–02	1	60	1	21	0	66	1	3.3	0.1	194	--
FC4	05–21–02	40	61	2	21	0	65	0	3.2	0.1	189	--
FC5	05–21–02	1	60	1	21	0	65	1	3.3	0.1	194	--
FC5	05–21–02	40	60	1	21	0	64	1	3.2	0.1	193	--
MC3	05–20–02	1	58	1	21	0	61	1	3.3	0.1	183	--
MC4	05–20–02	1	59	1	21	0	62	0	3.2	0.1	187	--
MC4	05–20–02	1	60	1	21	1	62	0	3.2	0.1	170	--
MC4	05–20–02	40	60	2	21	1	62	1	3.2	0.1	172	--
MC5	05–20–02	1	59	1	21	0	62	1	3.2	0.0	182	--
MC5	05–20–02	55	62	1	22	0	68	0	3.3	0.1	193	--
Blank[7]	05–22–02	--	<0.005	0.002	0.003	0.002	<0.2	0.2	<0.004	0.001	< 0.1	--
Blank[3]	05–22–02	--	<0.005	0.003	0.003	0.002	<0.2	0.1	<0.004	0.001	< 0.1	--

Site name	Date	Depth (meters)	Chloride (mg/L) Average	Chloride (mg/L) Stnd dev.	Silica (mg/L) Average	Silica (mg/L) Stnd dev.	DOC (mg/L as carbon) Average	DOC (mg/L as carbon) Stnd dev.	DIC (mg/L as carbon) Average	DIC (mg/L as carbon) Stnd dev.
KC2	05–22–02	1	50	--	6.2	0.0	3.8	0.2	33	0.9
KC3	05–22–02	1	47	--	6.0	0.0	4.0	0.1	33	0.8
KC3	05–22–02	35	45	--	6.9	0.0	4.2	0.0	33	0.2
KC5	05–22–02	1	49	--	6.1	0.0	4.0	0.0	33	0.2
FC2	05–21–02	1	42	--	6.2	0.1	4.1	0.1	33	0.0
FC2	05–21–02	1	43	--	6.1	0.0	4.2	0.0	32	0.1
FC4	05–21–02	1	47	--	6.0	0.0	4.0	0.1	32	1.0
FC4	05–21–02	40	46	--	7.1	0.0	3.6	0.2	33	0.2
FC5	05–21–02	1	45	--	5.9	0.0	4.1	0.1	33	0.4
FC5	05–21–02	40	46	--	7.1	0.1	3.8	0.0	33	0.4
MC3	05–20–02	1	38	--	5.6	0.1	4.8	0.1	33	1.2
MC4	05–20–02	1	42	--	6.0	0.0	4.0	0.0	32	0.3
MC4	05–20–02	1	38	--	5.9	0.2	3.7	0.2	32	0.2
MC4	05–20–02	40	38	--	7.0	0.1	3.8	0.1	33	1.1
MC5	05–20–02	1	41	--	6.3	0.1	3.8	0.2	32	0.4
MC5	05–20–02	55	48	--	7.1	0.0	3.8	--	33	0.8
Blank[7]	05–22–02		<0.1	--	<0.01	0.00	0.6	0.0	1.9	0.0
Blank[3]	05–22–02		<0.1	--	<0.01	0.00	0.3	0.0	2.3	0.0

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Calcium (mg/L) Average	Calcium (mg/L) Stnd dev.	Magnesium (mg/L) Average	Magnesium (mg/L) Stnd dev.	Sodium (mg/L) Average	Sodium (mg/L) Stnd dev.	Potassium (mg/L) Average	Potassium (mg/L) Stnd dev.	Sulfate (mg/L) Average	Sulfate (mg/L) Stnd dev.
Major ions and dissolved carbon, September 2002												
KC5a	09–11–02	< 1	63	0	25	0	78	1	3.8	0.0	214	--
KC2	09–11–02	1	67	0	25	0	82	0	4.0	0.0	250	--
KC2	09–11–02	20	63	1	23	0	73	0	3.5	0.1	210	--
KC3	09–11–02	1	67	1	26	0	84	0	4.0	0.1	206	--
KC3	09–11–02	20	64	1	24	0	76	1	3.6	0.1	204	--
FC1a	09–10–02	< 1	58	1	23	0	71	1	3.7	0.1	207	--
FC2	09–10–02	1	59	0	24	0	73	1	3.9	0.0	206	--
FC4	09–10–02	1	67	0	26	0	83	0	4.0	0.0	236	--
FC4	09–10–02	20	65	0	23	1	73	3	3.6	0.1	211	--
FC5	09–10–02	1	62	1	24	0	77	1	3.8	0.1	219	--
FC5	09–10–02	20	62	0	23	1	71	2	3.5	0.1	200	--
MC2b	09–09–02	< 1	59	0	23	0	72	0	3.7	0.0	189	--
MC2b	09–09–02	< 1	58	2	23	1	72	2	3.8	0.1	189	--
MC2c	09–09–02	1	59	1	23	0	71	1	3.7	0.0	196	--
MC3	09–09–02	1	59	2	23	1	71	3	3.7	0.1	201	--
MC4	09–09–02	1	61	0	24	0	75	0	3.7	0.0	208	--
MC4	09–09–02	1	63	1	24	0	76	2	3.8	0.1	220	--
MC4	09–09–02	35	61	1	23	0	69	1	3.4	0.1	204	--
MC5	09–09–02	1	62	3	23	1	73	4	3.7	0.2	225	--
MC5	09–09–02	35	61	2	21	1	65	4	3.3	0.1	193	--
Blank[7]	09–12–02	--	0.035	0.002	0.026	0.001	<0.3	0.1	0.006	0.000	< 0.1	--
Blank[5]	09–12–02	--	0.034	0.004	0.026	0.001	<0.3	0.3	<0.003	0.002	< 0.1	--
Blank[3]	09–12–02	--	0.035	0.001	0.026	0.000	<0.3	0.2	<0.003	0.001	< 0.1	--

Site name	Date	Depth (meters)	Chloride (mg/L) Average	Chloride (mg/L) Stnd dev.	Silica (mg/L) Average	Silica (mg/L) Stnd dev.	DOC (mg/L as carbon) Average	DOC (mg/L as carbon) Stnd dev.	DIC (mg/L as carbon) Average	DIC (mg/L as carbon) Stnd dev.
KC5a	09–11–02	< 1	58	--	4.9	0.1	3.9	0.1	30	0.4
KC2	09–11–02	1	68	--	4.8	0.0	3.8	0.0	30	0.3
KC2	09–11–02	20	57	--	6.1	0.0	3.6	0.1	33	0.2
KC3	09–11–02	1	55	--	4.9	0.0	4.1	0.1	30	0.2
KC3	09–11–02	20	57	--	6.0	0.1	3.6	0.0	33	0.4
FC1a	09–10–02	< 1	56	--	5.3	0.1	4.1	0.0	30	0.2
FC2	09–10–02	1	56	--	5.2	0.0	4.2	0.0	30	0.2
FC4	09–10–02	1	64	--	4.9	0.1	3.9	0.0	30	0.6
FC4	09–10–02	20	56	--	6.0	0.2	3.6	0.0	33	0.3
FC5	09–10–02	1	60	--	5.1	0.0	3.9	0.0	30	0.3
FC5	09–10–02	20	52	--	6.1	0.2	3.6	0.1	32	0.3
MC2b	09–09–02	< 1	49	--	5.4	0.0	4.3	0.0	31	0.4
MC2b	09–09–02	< 1	48	--	5.4	0.2	4.4	0.1	31	0.2
MC2c	09–09–02	1	46	--	5.3	0.0	4.3	0.1	30	0.3
MC3	09–09–02	1	47	--	5.3	0.1	3.9	0.0	30	0.0
MC4	09–09–02	1	56	--	5.2	0.0	3.9	0.1	30	0.2
MC4	09–09–02	1	59	--	5.3	0.1	3.9	0.0	30	0.3
MC4	09–09–02	35	52	--	6.9	0.0	3.8	0.1	32	0.1
MC5	09–09–02	1	60	--	5.0	0.2	3.9	0.1	29	0.4
MC5	09–09–02	35	46	--	6.6	0.4	3.6	0.0	33	0.3
Blank[7]	09–12–02	--	<0.05	--	<0.03	0.01	0.5	0.0	1.3	0.0
Blank[5]	09–12–02	--	<0.05	--	<0.03	0.00	0.5	0.0	2.1	0.0
Blank[3]	09–12–02	--	<0.05	--	<0.03	0.00	0.5	0.0	3.0	0.0

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Sulfur (mg/L)		Site name	Date	Depth (meters)	Sulfur (mg/L)		Site name	Date	Depth (meters)	Sulfur (mg/L)	
			Average	Stnd dev.				Average	Stnd dev.				Average	Stnd dev.
KC2	05-17-01	4	68	7	KC2	09-05-01	1	54	2	KC5a	09-11-02	< 1	80	0
KC3	05-17-01	5	69	4	KC3	09-05-01	30	52	2	KC2	09-11-02	1	85	0
KC3	05-17-01	25	60	1	KC3	09-05-01	< 1	61	1	KC2	09-11-02	20	71	4
KC5	05-17-01	< 1	71	5	KC5	09-07-01	< 1	54	4	KC3	09-11-02	1	85	2
FC1	05-16-01	< 1	62	2	FC1	09-07-01	1	48	4	KC3	09-11-02	20	75	1
FC2	05-16-01	10	59	3	FC2	09-07-01	30	52	1	FC1a	09-10-02	< 1	72	1
FC4	05-16-01	4	69	1	FC2	09-05-01	< 1	49	4	FC2	09-10-02	1	74	1
FC4	05-16-01	25	63	1	FC4	09-05-01	1	53	3	FC4	09-10-02	1	84	0
FC5	05-16-01	< 1	64	1	FC4	09-05-01	1	61	2	FC4	09-10-02	20	75	0
FC5	05-16-01	25	64	1	FC5	09-05-01	12	57	3	FC5	09-10-02	1	77	1
MC2	05-15-01	< 1	57	1	FC5	09-05-01	30	60	1	FC5	09-10-02	20	73	1
MC3	05-15-01	13	60	1	MC2	09-06-01	1	49	1	MC2b	09-09-02	< 1	72	0
MC4	05-15-01	30	60	3	MC3	09-06-01	1	47	0	MC2b	09-09-02	< 1	72	1
MC5	05-15-01	1	67	2	MC4	09-07-01	30	49	0	MC2c	09-09-02	1	73	0
MC5	05-15-01	30	62	2	MC4	09-06-01	< 1	52	1	MC3	09-09-02	1	73	2
MC6	05-15-01	< 1	59	3	MC4	09-07-01	< 1	59	4	MC4	09-09-02	1	76	1
Blank[2]	05-17-01	--	<0.03	0.02	MC5	09-07-01	1	50	2	MC4	09-09-02	1	78	2
Blank[3]	05-17-01	--	<0.03	0.01	MC5	09-07-01	15	57	2	MC4	09-09-02	35	70	1
					MC6	09-07-01	1	50	1	MC5	09-09-02	1	75	4
					MC6d	09-07-01	30	48	1	MC5	09-09-02	35	68	4
					Blank[2]	09-07-01	--	<0.02	0.01	Blank[3]	09-12-02	--	<0.04	0.02
					Blank[3]	09-07-01	--	<0.03	0.02	Blank[5]	09-12-02	--	<0.04	0.01
					Blank[4]	09-07-01	--	<0.02	0.00	Blank[7]	09-12-02	--	<0.04	0.01
					Blank[5]	09-07-01	--	<0.03	0.02					
					Blank[6]	09-07-01	--	<0.03	0.01					

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Nitrite (mg/L as N)		Nitrate (mg/L as N)		Ammonium (mg/L as N)		Phosphate (mg/L as P)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Nutrients, May 2001										
KC2	05-17-01	4	0.005	0.002	0.26	0.00	0.03	0.02	0.009	--
KC3	05-17-01	5	0.004	0.001	0.27	0.00	< 0.02	0.01	< 0.008	--
KC3	05-17-01	25	0.005	0.001	0.21	0.01	0.02	0.01	< 0.008	--
KC5	05-17-01	< 1	0.005	0.001	0.27	0.01	< 0.02	0.00	< 0.008	--
FC1	05-16-01	< 1	< 0.002	0.000	0.07	0.02	< 0.02	0.01	< 0.008	--
FC2	05-16-01	10	< 0.002	0.001	0.34	0.00	< 0.02	0.02	< 0.008	--
FC4	05-16-01	4	0.006	0.002	0.25	0.01	< 0.02	0.03	< 0.008	--
FC4	05-16-01	25	0.006	0.001	0.21	0.01	0.02	0.01	< 0.008	--
FC5	05-16-01	< 1	0.005	0.002	0.15	0.01	< 0.02	0.01	< 0.008	--
FC5	05-16-01	25	0.003	0.001	0.17	0.01	< 0.02	0.01	< 0.008	--
MC2	05-15-01	< 1	< 0.002	0.000	<0.02	0.01	< 0.02	0.02	< 0.008	--
MC3	05-15-01	13	< 0.002	0.000	0.15	0.01	0.03	0.01	0.010	--
MC4	05-15-01	30	< 0.002	0.001	0.22	0.01	0.03	0.02	< 0.008	--
MC5	05-15-01	1	0.003	0.002	0.19	0.01	<0.02	0.02	< 0.008	--
MC5	05-15-01	30	< 0.002	0.001	0.25	0.03	<0.02	0.01	< 0.008	--
MC6	05-15-01	< 1	< 0.002	0.001	<0.02	0.01	0.02	0.01	0.010	--
Blank[2]	05-17-01	--	< 0.002	0.001	<0.02	0.00	<0.02	0.01	< 0.008	--
Blank[3]	05-17-01	--	< 0.002	0.000	<0.02	0.01	<0.02	0.01	< 0.008	--
Nutrients, September 2001										
KC2	09-06-01	1	0.003	0.001	0.06	0.01	0.016	0.002	0.07	0.07
KC3	09-06-01	1	0.003	0.000	0.09	0.02	0.024	0.000	< 0.02	0.02
KC3	09-07-01	30	< 0.001	0.000	0.26	0.02	0.018	0.006	< 0.02	0.01
KC5	09-06-01	< 1	0.002	0.000	0.06	0.01	0.024	0.001	< 0.02	0.02
FC1	09-07-01	< 1	< 0.001	0.000	<0.01	--	0.020	0.001	< 0.02	0.01
FC2	09-07-01	1	< 0.001	0.000	0.04	0.01	0.028	0.002	< 0.02	0.01
FC2	09-07-01	15	< 0.001	0.000	<0.01	--	0.14	0.01	< 0.02	0.03
FC4	09-07-01	1	0.002	0.001	0.08	0.01	0.020	0.004	< 0.02	0.01
FC4	09-07-01	30	< 0.001	0.000	0.32	0.01	0.027	0.003	< 0.02	0.07
FC5	09-07-01	1	0.002	0.000	0.16	0.02	0.023	0.000	< 0.02	0.01
FC5	09-07-01	30	< 0.001	0.000	0.30	0.01	0.025	0.004	< 0.02	0.00
MC2	09-05-01	< 1	< 0.001	0.000	< 0.01	--	0.026	0.005	< 0.02	0.02
MC3	09-05-01	1	0.001	0.000	< 0.01	--	0.035	0.011	< 0.02	0.02
MC4	09-05-01	1	0.003	0.000	0.06	0.01	0.026	0.010	< 0.02	0.00
MC4	09-05-01	12	0.001	0.000	0.20	0.01	0.033	0.006	< 0.02	0.02
MC4	09-05-01	30	< 0.001	0.000	0.29	0.03	0.028	0.010	< 0.02	0.00
MC5	09-05-01	1	0.003	0.000	0.08	0.01	0.026	0.008	< 0.02	0.00
MC5	09-05-01	30	< 0.001	0.000	0.27	0.03	0.027	0.009	< 0.02	0.00
MC6	09-05-01	< 1	< 0.001	0.001	< 0.01	--	0.011	0.006	< 0.02	0.01
MC6d	09-07-01	< 1	< 0.001	0.000	0.03	--	0.014	0.005	< 0.02	0.01
Blank[2]	09-07-01	--	< 0.001	0.000	< 0.02	0.01	< 0.005	0.003	< 0.02	0.01
Blank[3]	09-07-01	--	< 0.001	0.000	< 0.02	0.01	< 0.005	0.003	< 0.02	0.00
Blank[4]	09-07-01	--	<0.001	0.001	<0.02	0.00	<0.00	<0.000	<0.02	0.00
Blank[5]	09-07-01	--	< 0.001	0.000	< 0.02	0.00	< 0.005	0.002	< 0.02	0.00
Blank[6]	09-07-01	--	< 0.001	0.000	< 0.02	0.01	< 0.005	0.002	< 0.02	0.00

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Nitrite (mg/L as N)		Nitrate (mg/L as N)		Ammonium (mg/L as N)		Phosphate (mg/L as P)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Nutrients, May 2002										
KC2	05-22-02	1	0.005	0.001	0.20	0.00	0.039	0.005	<0.03	0.01
KC3	05-22-02	1	0.004	0.001	0.20	0.02	0.038	0.008	<0.03	0.01
KC3	05-22-02	35	<0.002	0.000	0.27	0.01	0.037	0.005	<0.03	0.01
KC5	05-22-02	1	0.004	0.000	0.19	0.01	0.032	0.003	<0.03	0.00
FC2	05-21-02	1	0.003	0.002	0.09	0.01	0.041	0.001	<0.03	0.00
FC2	05-21-02	1	0.003	0.001	0.07	0.00	0.047	0.001	<0.03	0.01
FC4	05-21-02	1	0.004	0.001	0.16	0.01	0.041	0.001	<0.03	0.00
FC4	05-21-02	40	<0.002	0.001	0.27	0.00	0.035	0.002	<0.03	0.00
FC5	05-21-02	1	0.004	0.001	0.12	0.01	0.036	0.005	<0.03	0.01
FC5	05-21-02	40	<0.002	0.001	0.29	0.05	0.041	0.005	<0.03	0.01
MC3	05-20-02	1	0.004	0.001	0.05	0.00	0.035	0.005	<0.03	0.02
MC4	05-20-02	1	0.004	0.002	0.11	0.01	0.036	0.006	<0.03	0.02
MC4	05-20-02	1	0.005	0.001	0.11	0.01	0.042	0.015	<0.03	0.02
MC4	05-20-02	40	<0.002	0.001	0.27	0.01	0.036	0.003	<0.03	0.01
MC5	05-20-02	1	0.004	0.001	0.17	0.01	0.038	0.008	<0.03	0.01
MC5	05-20-02	55	<0.002	0.001	0.29	0.03	0.035	0.001	<0.03	0.00
Blank[3]	05-22-02	--	<0.002	0.001	< 0.01	0.01	<0.006	0.005	<0.03	0.00
Blank[7]	05-22-02	--	<0.002	0.000	< 0.01	0.00	<0.006	0.006	<0.03	0.01
Nutrients, September 2002										
KC5a	09-11-02	< 1	0.003	0.001	0.11	--	0.028	0.004	< 0.009	--
KC2	09-11-02	1	0.004	0.001	0.097	--	0.031	0.010	< 0.009	--
KC2	09-11-02	20	< 0.003	0.001	0.37	--	0.020	0.002	< 0.009	--
KC3	09-11-02	1	< 0.003	0.001	0.12	--	0.031	0.007	< 0.009	--
KC3	09-11-02	20	< 0.003	0.001	0.37	--	0.019	0.003	< 0.009	--
FC1a	09-10-02	< 1	< 0.003	0.001	0.039	--	0.051	0.006	< 0.009	--
FC2	09-10-02	1	< 0.003	0.001	0.032	--	0.053	0.005	< 0.009	--
FC4	09-10-02	1	< 0.003	0.001	0.11	--	0.025	0.004	< 0.009	--
FC4	09-10-02	20	< 0.003	0.001	0.36	--	0.018	0.004	< 0.009	--
FC3	09-10-02	1	< 0.003	0.002	0.054	--	0.027	0.004	< 0.009	--
FC5	09-10-02	20	< 0.003	0.001	0.30	--	0.020	0.007	< 0.009	--
MC2b	09-09-02	< 1	< 0.003	0.001	0.010	--	0.026	0.002	< 0.009	--
MC2b	09-09-02	< 1	< 0.003	0.001	0.022	--	0.022	0.003	< 0.009	--
MC2c	09-09-02	1	< 0.003	0.001	0.028	--	0.024	0.004	< 0.009	--
MC3	09-09-02	1	< 0.003	0.001	0.047	--	0.019	0.003	< 0.009	--
MC4	09-09-02	1	< 0.003	0.001	0.061	--	0.026	0.007	< 0.009	--
MC4	09-09-02	1	< 0.003	0.001	0.076	--	0.025	0.006	< 0.009	--
MC4	09-09-02	35	< 0.003	0.001	0.30	--	0.074	0.003	< 0.009	--
MC5	09-09-02	1	< 0.003	0.001	0.087	--	0.026	0.002	< 0.009	--
MC5	09-09-02	35	< 0.003	0.002	0.31	--	0.047	0.010	< 0.009	--
Blank[3]	09-12-02	--	< 0.003	0.001	< 0.005	--	< 0.006	0.003	< 0.009	--
Blank[5]	09-12-02	--	< 0.003	0.001	< 0.005	--	< 0.006	0.004	< 0.009	--
Blank[7]	09-12-02	--	< 0.003	0.002	< 0.005	--	< 0.006	0.002	< 0.009	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

Site name	Date	Depth (meters)	Aluminum (µg/L)		Antimony (µg/L)		Arsenic (µg/L)		Barium (µg/L)		Beryllium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2001												
KC2	05-17-01	4	2.1	0.1	0.21	0.00	1.5	0.0	86	2	<0.006	0.001
KC3	05-17-01	5	2.0	0.1	0.21	0.00	1.5	0.0	85	4	<0.006	0.001
KC3	05-17-01	25	1.7	0.0	0.19	0.00	1.4	0.0	85	2	<0.006	0.002
KC5	05-17-01	< 1	0.6	0.0	0.21	0.00	1.5	0.1	85	1	<0.006	0.002
FC1	05-16-01	< 1	3.6	0.1	0.18	0.00	1.3	0.0	87	1	<0.006	0.001
FC2	05-16-01	10	2.2	0.1	0.19	0.00	1.3	0.1	84	1	<0.006	0.002
FC4	05-16-01	4	2.2	0.1	0.20	0.00	1.5	0.0	83	4	<0.006	0.002
FC4	05-16-01	25	1.2	0.1	0.18	0.00	1.3	0.0	84	1	<0.006	0.002
FC5	05-16-01	< 1	3.0	1.4	0.19	0.00	1.4	0.0	86	1	<0.006	0.003
FC5	05-16-01	25	0.9	0.0	0.18	0.00	1.2	0.0	85	2	<0.006	0.001
MC2	05-15-01	< 1	3.5	0.1	0.19	0.01	1.6	0.0	100	0	<0.006	0.003
MC3	05-15-01	13	2.1	0.1	0.18	0.00	1.3	0.0	87	1	<0.006	0.001
MC4	05-15-01	30	1.6	0.3	0.18	0.01	1.3	0.0	83	2	<0.006	0.002
MC5	05-15-01	1	2.7	0.2	0.18	0.00	1.3	0.0	85	2	<0.006	0.002
MC5	05-15-01	30	1.5	0.1	0.18	0.01	1.3	0.0	83	2	<0.006	0.003
MC6	05-15-01	< 1	2.6	0.3	0.20	0.00	1.5	0.0	97	1	<0.006	0.002
Blank[2]	05-17-01	--	<0.1	0.0	0.003	0.003	<0.03	0.02	0.006	0.009	<0.006	0.001
Blank[3]	05-17-01	--	<0.1	0.0	<0.003	0.002	<0.03	0.01	<0.002	0.002	<0.006	0.002

Site name	Date	Depth (meters)	Bismuth (µg/L)		Boron (µg/L)		Bromine (µg/L)		Cadmium (µg/L)		Cerium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-17-01	4	0.0007	0.0008	87	2	19	6	<0.001	0.001	0.011	0.001
KC3	05-17-01	5	<0.0007	0.0006	85	3	20	5	<0.001	0.002	0.011	0.002
KC3	05-17-01	25	0.0015	0.0005	77	2	18	5	<0.001	0.001	0.0093	0.0015
KC5	05-17-01	< 1	0.0007	0.0008	85	2	20	6	<0.001	0.001	0.0059	0.0001
FC1	05-16-01	< 1	0.0021	0.0010	75	1	17	6	<0.001	0.001	0.010	0.001
FC2	05-16-01	10	<0.0007	0.0001	71	1	16	8	<0.001	0.001	0.0045	0.0005
FC4	05-16-01	4	<0.0007	0.0000	83	4	20	7	<0.001	0.001	0.011	0.002
FC4	05-16-01	25	<0.0007	0.0000	77	2	18	6	<0.001	0.001	0.0056	0.0003
FC5	05-16-01	< 1	<0.0007	0.0002	80	5	18	5	<0.001	0.002	0.0081	0.0012
FC5	05-16-01	25	<0.0007	0.0003	73	4	18	5	<0.001	0.001	0.0039	0.0003
MC2	05-15-01	< 1	<0.0007	0.0001	73	4	18	8	<0.001	0.001	0.012	0.000
MC3	05-15-01	13	<0.0007	0.0003	72	4	16	7	<0.001	0.001	0.0056	0.0003
MC4	05-15-01	30	<0.0007	0.0006	71	4	17	8	<0.001	0.001	0.0049	0.006
MC5	05-15-01	1	0.0010	0.0008	79	2	19	7	<0.001	0.002	0.0071	0.0001
MC5	05-15-01	30	0.0011	0.0011	76	1	17	6	<0.001	0.003	0.0056	0.0005
MC6	05-15-01	< 1	0.0014	0.0007	75	1	17	6	<0.001	0.003	0.012	0.001
Blank[2]	05-17-01	--	<0.0007	0.0003	<1	1	1.0	0.5	<0.001	0.001	<0.0002	0.0002
Blank[3]	05-17-01	--	<0.0007	0.0003	<1	0	2.0	0.4	<0.001	0.001	<0.0002	0.0000

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Cesium (µg/L)		Chromium (µg/L)		Cobalt (µg/L)		Copper (µg/L)		Dysprosium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2001—Continued												
KC2	05-17-01	4	0.005	0.002	<0.04	0.02	<0.002	0.005	0.5	0.1	0.0023	0.0005
KC3	05-17-01	5	0.006	0.001	<0.04	0.03	<0.002	0.004	0.4	0.1	0.0020	0.0003
KC3	05-17-01	25	0.006	0.001	<0.04	0.01	<0.002	0.007	0.4	0.1	0.0026	0.0005
KC5	05-17-01	< 1	0.006	0.001	<0.04	0.01	<0.002	0.006	0.5	0.1	0.0020	0.0004
FC1	05-16-01	< 1	<0.004	0.000	<0.04	0.03	<0.002	0.007	0.3	0.2	0.0023	0.0002
FC2	05-16-01	10	<0.004	0.001	<0.04	0.00	<0.002	0.010	0.4	0.2	0.0021	0.0001
FC4	05-16-01	4	0.005	0.001	<0.04	0.01	<0.002	0.003	0.4	0.2	0.0021	0.0001
FC4	05-16-01	25	0.005	0.001	<0.04	0.01	<0.002	0.006	0.4	0.2	0.0019	0.0001
FC5	05-16-01	< 1	0.004	0.002	<0.04	0.01	<0.002	0.003	0.4	0.1	0.0022	0.0005
FC5	05-16-01	25	<0.004	0.001	<0.04	0.02	<0.002	0.002	0.4	0.1	0.0021	0.0001
MC2	05-15-01	< 1	<0.004	0.000	<0.04	0.01	<0.002	0.018	0.3	0.1	0.0029	0.0003
MC3	05-15-01	13	0.010	0.001	<0.04	0.00	<0.002	0.007	0.4	0.2	0.0019	0.0001
MC4	05-15-01	30	<0.004	0.001	<0.04	0.01	<0.002	0.003	0.5	0.2	0.0026	0.0000
MC5	05-15-01	1	0.007	0.001	<0.04	0.01	<0.002	0.011	0.4	0.2	0.0021	0.0004
MC5	05-15-01	30	0.008	0.003	<0.04	0.02	<0.002	0.006	0.5	0.2	0.0018	0.0001
MC6	05-15-01	< 1	<0.004	0.002	<0.04	0.01	<0.002	0.007	0.2	0.1	0.0031	0.0003
Blank[2]	05-17-01	--	<0.004	0.001	<0.04	0.01	<0.002	0.001	<0.01	0.00	<0.0004	0.0002
Blank[3]	05-17-01	--	<0.004	0.002	<0.04	0.02	<0.002	0.000	<0.01	0.01	<0.0004	0.0001

Site name	Date	Depth (meters)	Erbium (µg/L)		Europium (µg/L)		Gadolinium (µg/L)		Gallium (µg/L)		Germanium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-17-01	4	0.0025	0.0004	<0.0002	0.0003	0.0027	0.0006	0.0014	0.0010	0.017	0.001
KC3	05-17-01	5	0.0024	0.0002	<0.0002	0.0002	0.0031	0.0004	0.0021	0.0016	0.018	0.002
KC3	05-17-01	25	0.0012	0.0001	<0.0002	0.0004	0.0022	0.0005	0.0007	0.0013	0.021	0.000
KC5	05-17-01	< 1	0.0022	0.0002	<0.0002	0.0005	0.0022	0.0005	0.0016	0.0009	0.019	0.003
FC1	05-16-01	< 1	0.0018	0.0007	<0.0002	0.0003	0.0027	0.0003	0.0035	0.0017	0.014	0.003
FC2	05-16-01	10	0.0012	0.0004	<0.0002	0.0006	0.0016	0.0001	0.0025	0.0010	0.015	0.002
FC4	05-16-01	4	0.0011	0.0001	<0.0002	0.0007	0.0022	0.0004	0.0011	0.0007	0.020	0.001
FC4	05-16-01	25	0.0014	0.0001	<0.0002	0.0007	0.0019	0.0005	0.0013	0.0016	0.019	0.002
FC5	05-16-01	< 1	0.0020	0.0001	<0.0002	0.0006	0.0022	0.0006	0.0022	0.0009	0.014	0.001
FC5	05-16-01	25	0.0017	0.0003	<0.0002	0.0003	0.0017	0.0002	0.0028	0.0008	0.015	0.002
MC2	05-15-01	< 1	0.0024	0.0005	<0.0002	0.0012	0.0037	0.0002	0.0033	0.0007	0.022	0.002
MC3	05-15-01	13	0.0019	0.0004	<0.0002	0.0012	0.0021	0.0006	0.0017	0.0012	0.016	0.002
MC4	05-15-01	30	0.0020	0.0002	<0.0002	0.0007	0.0021	0.0004	0.0016	0.0008	0.019	0.001
MC5	05-15-01	1	0.0017	0.0005	<0.0002	0.0002	0.0023	0.0011	0.0020	0.0009	0.016	0.001
MC5	05-15-01	30	0.0017	0.0002	<0.0002	0.0004	0.0022	0.0005	0.0024	0.0005	0.017	0.002
MC6	05-15-01	< 1	0.0016	0.0003	<0.0002	0.0007	0.0031	0.0002	0.0045	0.0016	0.017	0.003
Blank[2]	05-17-01	--	<0.0003	0.0003	<0.0002	0.0001	<0.0006	0.0002	<0.0006	0.0001	<0.004	0.002
Blank[3]	05-17-01	--	<0.0003	0.0001	<0.0002	0.0001	<0.0006	0.0001	<0.0006	0.0004	<0.004	0.002

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Gold (µg/L)		Hafnium (µg/L)		Holmium (µg/L)		Iron (µg/L)		Lanthanum (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2001—Continued												
KC2	05-17-01	4	<0.0004	0.0001	0.0011	0.0006	0.0009	0.0001	1.4	0.1	0.0067	0.0006
KC3	05-17-01	5	<0.0004	0.0001	0.0007	0.0002	0.0009	0.0001	2.1	0.6	0.0080	0.0008
KC3	05-17-01	25	<0.0004	0.0001	0.0007	0.0001	0.0009	0.0001	1.0	0.2	0.0070	0.0006
KC5	05-17-01	< 1	<0.0004	0.0001	0.0005	0.0003	0.0009	0.0001	0.7	0.2	0.0035	0.0002
FC1	05-16-01	< 1	<0.0004	0.0001	0.0013	0.0001	0.0007	0.0001	2.9	0.3	0.0062	0.0006
FC2	05-16-01	10	<0.0004	0.0001	0.0011	0.0004	0.0007	0.0001	1.5	0.1	0.0036	0.0002
FC4	05-16-01	4	<0.0004	0.0001	0.0012	0.0004	0.0008	0.0001	1.4	0.0	0.0058	0.0005
FC4	05-16-01	25	<0.0004	0.0000	0.0008	0.0003	0.0006	0.0001	0.9	0.1	0.013	0.000
FC5	05-16-01	< 1	<0.0004	0.0000	0.0008	0.0001	0.0008	0.0000	1.6	0.2	0.0055	0.0008
FC5	05-16-01	25	<0.0004	0.0002	0.006	0.0003	0.0005	0.0000	1.1	0.3	0.0048	0.0004
MC2	05-15-01	< 1	<0.0004	0.0001	0.0010	0.0003	0.0009	0.0000	2.6	0.8	0.0074	0.0006
MC3	05-15-01	13	<0.0004	0.0000	0.0007	0.0002	0.0006	0.0001	2.2	1.2	0.0045	0.0002
MC4	05-15-01	30	<0.0004	0.0004	0.0011	0.0003	0.0005	0.006	1.0	0.3	0.0054	0.0008
MC5	05-15-01	1	<0.0004	0.0066	0.0009	0.0002	0.0010	0.006	1.5	0.1	0.0053	0.0003
MC5	05-15-01	30	<0.0004	0.0000	0.0006	0.0002	0.0007	0.0001	1.3	0.6	0.0048	0.0001
MC6	05-15-01	< 1	<0.0004	0.0002	0.0007	0.0000	0.0010	0.0000	1.9	0.3	0.0070	0.0004
Blank[2]	05-17-01	--	<0.0004	0.0001	<0.0003	0.0001	<0.0001	0.0001	<0.2	0.1	<0.0002	0.0001
Blank[3]	05-17-01	--	<0.0004	0.0001	<0.0003	0.0002	<0.0001	0.0000	<0.2	0.2	<0.0002	0.0001

Site name	Date	Depth (meters)	Lead (µg/L)		Lithium (µg/L)		Lutetium (µg/L)		Manganese (µg/L)		Mercury (ng/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-17-01	4	0.021	0.002	30	1	0.0006	0.0000	0.9	0.0	0.6	0.0
KC3	05-17-01	5	0.025	0.002	29	0	0.0004	0.0001	0.9	0.0	0.5	0.0
KC3	05-17-01	25	0.031	0.004	27	0	0.0005	0.0002	0.4	0.0	0.5	0.0
KC5	05-17-01	< 1	0.016	0.002	30	1	0.0003	0.0001	1.1	0.0	0.5	0.0
FC1	05-16-01	< 1	0.028	0.002	25	0	0.0003	0.0000	3.5	0.0	1.0	0.0
FC2	05-16-01	10	0.017	0.004	25	0	0.0003	0.0001	0.7	0.1	0.9	0.2
FC4	05-16-01	4	0.018	0.001	29	1	0.0004	0.0000	0.9	0.0	0.4	0.1
FC4	05-16-01	25	0.026	0.003	26	0	0.0002	0.0000	0.3	0.0	0.4	0.2
FC5	05-16-01	< 1	0.027	0.010	27	1	0.0004	0.0001	0.9	0.0	0.5	0.1
FC5	05-16-01	25	0.021	0.001	25	1	0.0003	0.0000	0.3	0.0	0.5	0.2
MC2	05-15-01	< 1	0.018	0.000	24	1	0.0003	0.0001	7.4	0.1	1.0	0.1
MC3	05-15-01	13	0.022	0.003	25	1	0.0003	0.0001	0.6	0.1	0.6	0.2
MC4	05-15-01	30	0.025	0.007	25	1	0.0003	0.0001	0.4	0.0	0.4	0.0
MC5	05-15-01	1	0.027	0.007	27	0	0.0004	0.0000	0.7	0.0	0.5	0.0
MC5	05-15-01	30	0.023	0.004	26	0	0.0004	0.0001	0.3	0.0	0.4	0.1
MC6	05-15-01	< 1	0.032	0.003	25	0	0.0004	0.0001	5.2	0.1	0.8	0.2
Blank[2]	05-17-01	--	<0.009	0.007	<0.03	0.00	<0.0001	0.0000	<0.1	0.0	0.3	0.1
Blank[3]	05-17-01	--	<0.009	0.004	<0.03	0.01	<0.0001	0.0000	<0.1	0.0	<0.2	0.1

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Molybedenum (µg/L)		Neodymium (µg/L)		Nickel (µg/L)		Phosphorus (µg/L)		Praseodymium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2001—Continued												
KC2	05-17-01	4	4.0	0.0	0.0091	0.0001	0.70	0.05	<6	4	0.0020	0.0000
KC3	05-17-01	5	4.1	0.0	0.0074	0.0006	0.69	0.19	<6	5	0.0017	0.0003
KC3	05-17-01	25	4.0	0.1	0.0081	0.0007	0.45	0.05	<6	5	0.0014	0.0002
KC5	05-17-01	< 1	4.1	0.0	0.0061	0.0005	0.66	0.09	<6	4	0.0012	0.0002
FC1	05-16-01	< 1	3.9	0.0	0.0084	0.0012	0.34	0.08	<6	0	0.0020	0.0006
FC2	05-16-01	10	4.1	0.0	0.0044	0.0004	0.46	0.12	<6	4	0.0010	0.0003
FC4	05-16-01	4	4.0	0.0	0.0064	0.0003	0.60	0.03	<6	4	0.0018	0.0001
FC4	05-16-01	25	4.0	0.1	0.0063	0.0004	0.46	0.03	<6	4	0.0013	0.0001
FC5	05-16-01	< 1	4.0	0.0	0.0065	0.0012	0.61	0.08	<6	5	0.0015	0.0002
FC5	05-16-01	25	3.8	0.0	0.0059	0.0000	0.40	0.05	<6	6	0.0010	0.0001
MC2	05-15-01	< 1	3.6	0.1	0.011	0.000	0.55	0.08	<6	4	0.0025	0.0003
MC3	05-15-01	13	3.7	0.0	0.0065	0.0006	0.62	0.04	<6	3	0.0013	0.0002
MC4	05-15-01	30	3.8	0.1	0.0068	0.0005	0.47	0.02	<6	7	0.0012	0.0000
MC5	05-15-01	1	3.9	0.0	0.0066	0.0006	0.45	0.08	<6	4	0.0013	0.0002
Blank[2]	05-17-01	--	<0.06	0.02	<0.0006	0.0001	<0.008	0.00	<6	2	0.0012	0.0001
Blank[3]	05-17-01	--	<0.06	0.03	<0.0006	0.0002	<0.008	0.02	8	2	0.0020	0.0001

Site name	Date	Depth (meters)	Rhenium (µg/L)		Rubidium (µg/L)		Samarium (µg/L)		Scandium(µg/L)		Selenium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-17-01	4	0.066	0.001	1.7	0.0	0.002	0.000	<0.07	0.03	1.8	0.0
KC3	05-17-01	5	0.062	0.003	1.7	0.0	0.002	0.000	<0.07	0.02	1.9	0.1
KC3	05-17-01	25	0.058	0.001	1.5	0.0	0.002	0.000	<0.07	0.00	1.5	0.1
KC5	05-17-01	< 1	0.065	0.002	1.7	0.0	0.003	0.000	<0.07	0.01	1.8	0.1
FC1	05-16-01	< 1	0.054	0.004	1.3	0.0	0.002	0.000	<0.07	0.01	1.4	0.1
FC2	05-16-01	10	0.055	0.002	1.4	0.0	0.002	0.000	<0.02	0.01	1.5	0.1
FC4	05-16-01	4	0.065	0.001	1.7	0.0	0.002	0.000	<0.02	0.01	1.8	0.1
FC4	05-16-01	25	0.056	0.001	1.4	0.0	0.001	0.000	<0.02	0.02	1.5	0.1
FC5	05-16-01	< 1	0.062	0.002	1.5	0.0	0.002	0.001	<0.07	0.04	1.7	0.1
FC5	05-16-01	25	0.057	0.001	1.4	0.0	0.002	0.000	<0.07	0.02	1.5	0.0
MC2	05-15-01	< 1	0.048	0.002	1.1	0.0	0.003	0.001	<0.02	0.00	1.2	0.0
MC3	05-15-01	13	0.056	0.001	1.3	0.0	0.002	0.000	<0.02	0.02	1.5	0.0
MC4	05-15-01	30	0.053	0.002	1.3	0.0	0.002	0.000	<0.02	0.00	1.3	0.0
MC5	05-15-01	1	0.060	0.001	1.5	0.0	0.002	0.000	<0.02	0.01	1.6	0.0
MC5	05-15-01	30	0.057	0.000	1.4	0.0	0.002	0.001	<0.02	0.00	1.4	0.1
MC6	05-15-01	< 1	0.055	0.001	1.2	0.0	0.002	0.000	<0.07	0.02	1.4	0.1
Blank[2]	05-17-01	--	<0.0001	0.0001	<0.0006	0.0003	<0.001	0.000	<0.07	0.01	<0.07	0.00
Blank[3]	05-17-01	--	<0.0001	0.0000	<0.0006	0.0002	<0.001	0.000	<0.07	0.01	<0.07	0.06

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Strontium (µg/L)		Tantalum (µg/L)		Tellurium (µg/L)		Terbium (µg/L)		Thallium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2001—Continued												
KC2	05-17-01	4	720	10	<0.001	0.000	0.009	0.000	0.0006	0.0000	0.009	0.002
KC3	05-17-01	5	730	0	<0.001	0.001	0.012	0.002	0.0005	0.0000	0.008	0.001
KC3	05-17-01	25	710	10	<0.001	0.001	0.011	0.003	0.0005	0.0000	0.010	0.004
KC5	05-17-01	< 1	720	0	<0.001	0.001	0.011	0.007	0.0005	0.0001	0.010	0.004
FC1	05-16-01	< 1	680	0	<0.001	0.000	0.013	0.004	0.0005	0.0001	0.009	0.007
FC2	05-16-01	10	680	10	<0.001	0.001	0.009	0.004	0.0003	0.0001	0.013	0.010
FC4	05-16-01	4	720	0	<0.001	0.001	0.013	0.004	0.0004	0.0000	0.008	0.001
FC4	05-16-01	25	700	0	<0.001	0.001	0.010	0.008	0.0006	0.0000	0.007	0.001
FC5	05-16-01	< 1	720	0	<0.001	0.000	0.011	0.009	0.0005	0.0001	0.007	0.000
FC5	05-16-01	25	690	10	<0.001	0.000	0.007	0.003	0.0004	0.0000	0.010	0.002
MC2	05-15-01	< 1	670	10	<0.001	0.001	0.010	0.005	0.0005	0.0000	<0.005	0.001
MC3	05-15-01	13	690	10	<0.001	0.000	0.007	0.000	0.0005	0.0001	0.006	0.002
MC4	05-15-01	30	690	0	<0.001	0.001	0.010	0.004	0.0004	0.0001	0.007	0.003
MC5	05-15-01	1	700	10	<0.001	0.000	0.009	0.002	0.0004	0.0001	0.009	0.002
MC5	05-15-01	30	690	10	<0.001	0.001	0.006	0.002	0.0005	0.0000	0.007	0.003
MC6	05-15-01	< 1	670	0	<0.001	0.001	0.010	0.001	0.0005	0.0001	0.005	0.004
Blank[2]	05-17-01	--	<0.02	0.01	<0.001	0.000	<0.005	0.003	<0.0001	0.0000	<0.005	0.002
Blank[3]	05-17-01	--	<0.02	0.01	<0.001	0.000	<0.005	0.003	<0.0001	0.0000	<0.005	0.001

Site name	Date	Depth (meters)	Thorium (µg/L)		Thulium (µg/L)		Titanium (µg/L)		Tungsten (µg/L)		Uranium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-17-01	4	0.0013	0.0001	0.0003	0.0000	<0.07	0.22	0.033	0.002	4.1	0.0
KC3	05-17-01	5	0.0013	0.0000	0.0003	0.0001	<0.07	0.14	0.029	0.001	4.1	0.2
KC3	05-17-01	25	0.0011	0.0001	0.0003	0.006	<0.07	0.14	0.033	0.003	3.6	0.1
KC5	05-17-01	< 1	0.0011	0.0002	0.0004	0.0001	<0.07	0.09	0.054	0.009	4.3	0.0
FC1	05-16-01	< 1	0.0014	0.0003	0.0002	0.0001	<0.07	0.21	0.046	0.002	3.3	0.1
FC2	05-16-01	10	0.0013	0.0002	0.0002	0.0001	<0.07	0.20	0.029	0.000	3.4	0.0
FC4	05-16-01	4	0.0013	0.0000	0.0003	0.0001	<0.07	0.38	0.034	0.001	3.9	0.0
FC4	05-16-01	25	0.0009	0.0002	0.0004	0.0000	<0.07	0.05	0.030	0.004	3.5	0.0
FC5	05-16-01	< 1	0.0018	0.0002	0.0003	0.0001	<0.07	0.20	0.035	0.002	3.8	0.0
FC5	05-16-01	25	0.0006	0.0000	0.0003	0.0001	<0.07	0.13	0.030	0.001	3.4	0.0
MC2	05-15-01	< 1	0.0014	0.0001	0.0002	0.006	<0.07	0.05	0.18	0.01	3.1	0.2
MC3	05-15-01	13	0.0012	0.0003	0.0003	0.0000	<0.07	0.12	0.032	0.002	3.4	0.0
MC4	05-15-01	30	0.0009	0.0002	0.0003	0.0001	<0.07	0.33	0.038	0.001	3.3	0.0
MC5	05-15-01	1	0.0011	0.0002	0.0003	0.0000	<0.07	0.27	0.030	0.001	3.6	0.1
MC5	05-15-01	30	0.0010	0.0001	0.0003	0.0001	<0.07	0.20	0.029	0.001	3.5	0.0
MC6	05-15-01	< 1	0.0015	0.0001	0.0003	0.0001	<0.07	0.06	0.083	0.003	3.4	0.0
Blank[2]	05-17-01	--	<0.0002	0.0000	<0.0001	0.006	<0.07	0.04	<0.003	0.002	<0.001	0.001
Blank[3]	05-17-01	--	<0.0002	0.0001	<0.0001	0.0000	<0.07	0.13	<0.003	0.001	<0.001	0.001

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Vanadium (µg/L)		Ytterbium (µg/L)		Yttrium (µg/L)		Zinc (µg/L)		Zirconium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2001—Continued												
KC2	05-17-01	4	1.7	0.1	0.0021	0.0002	0.026	0.000	0.8	0.1	0.023	0.002
KC3	05-17-01	5	1.7	0.1	0.0021	0.0001	0.025	0.001	1.1	0.1	0.023	0.002
KC3	05-17-01	25	1.6	0.0	0.0028	0.0001	0.024	0.000	1.0	0.2	0.027	0.009
KC5	05-17-01	< 1	1.8	0.0	0.0020	0.0004	0.022	0.000	0.9	0.2	0.022	0.01
FC1	05-16-01	< 1	1.9	0.0	0.0020	0.0001	0.024	0.000	0.8	0.1	0.022	0.002
FC2	05-16-01	10	1.7	0.0	0.0017	0.0003	0.017	0.001	0.8	0.1	0.023	0.003
FC4	05-16-01	4	1.7	0.1	0.0022	0.0002	0.023	0.001	0.8	0.1	0.028	0.001
FC4	05-16-01	25	1.7	0.1	0.0022	0.0003	0.021	0.000	1.2	0.1	0.017	0.002
FC5	05-16-01	< 1	1.7	0.1	0.0019	0.0004	0.021	0.001	0.8	0.1	0.026	0.009
FC5	05-16-01	25	1.6	0.1	0.0020	0.0003	0.019	0.001	1.5	0.0	0.017	0.000
MC2	05-15-01	< 1	2.5	0.1	0.0021	0.0004	0.029	0.001	1.0	0.1	0.025	0.005
MC3	05-15-01	13	1.8	0.0	0.0020	0.0007	0.020	0.001	1.5	0.2	0.017	0.001
MC4	05-15-01	30	1.7	0.1	0.0017	0.0001	0.019	0.001	1.0	0.3	0.021	0.001
MC5	05-15-01	1	1.7	0.1	0.0016	0.0006	0.022	0.001	1.4	0.3	0.021	0.002
MC5	05-15-01	30	1.7	0.1	0.0021	0.0002	0.020	0.000	2.0	0.5	0.024	0.005
MC6	05-15-01	< 1	2.5	0.1	0.0014	0.0002	0.028	0.001	1.1	0.1	0.028	0.002
Blank[2]	05-17-01	--	<0.1	0.0	<0.0003	0.0002	<0.0002	0.0001	<0.3	0.1	<0.0006	0.0004
Blank[3]	05-17-01	--	<0.1	00	<0.0003	0.0001	<0.0002	0.0001	0.4	0.0	<0.0006	<0.0002

Site name	Date	Depth (meters)	Aluminum (µg/L)		Antimony (µg/L)		Arsenic (µg/L)		Barium (µg/L)		Beryllium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001												
KC2	09-06-01	1	1.9	0.5	0.20	0.00	1.4	0.0	71	1	<0.01	0.01
KC3	09-06-01	1	1.4	0.1	0.21	0.00	1.4	0.0	72	1	<0.01	0.00
KC3	09-07-01	30	0.8	0.4	0.20	0.01	1.3	0.1	79	3	<0.01	0.00
KC5	09-06-01	< 1	1.8	0.3	0.21	0.00	1.4	0.1	72	2	<0.01	0.00
FC1	09-07-01	< 1	2.2	0.1	0.23	0.00	1.4	0.0	72	2	<0.01	0.01
FC2	09-07-01	1	1.2	0.2	0.24	0.00	1.3	0.1	71	3	<0.01	0.00
FC2	09-07-01	15	0.8	0.3	0.23	0.00	1.3	0.1	71	1	<0.01	0.00
FC4	09-07-01	1	1.1	0.1	0.21	0.00	1.3	0.0	73	2	<0.01	0.01
FC4	09-07-01	30	0.4	0.1	0.20	0.00	1.2	0.0	84	1	<0.01	0.00
FC5	09-07-01	1	1.4	0.2	0.21	0.00	1.4	0.0	78	2	<0.01	0.01
FC5	09-07-01	30	0.8	0.2	0.19	0.01	1.2	0.1	82	1	<0.01	0.00
MC2	09-05-01	< 1	3.4	1.5	0.23	0.00	1.0	0.1	100	0	<0.01	0.00
MC4	09-05-01	1	1.4	0.4	0.22	0.01	1.3	0.1	70	3	<0.01	0.00
MC4	09-05-01	12	1.3	0.2	0.22	0.00	1.3	0.0	76	1	<0.01	0.01
MC4	09-05-01	30	1.3	0.3	0.19	0.00	1.2	0.1	86	3	<0.01	0.00
MC5	09-05-01	1	1.1	0.2	0.22	0.01	1.3	0.1	73	2	0.010	0.004
MC3	09-05-01	1	1.7	0.5	0.24	0.01	1.0	0.1	86	0	<0.01	0.01
MC5	09-05-01	30	0.6	0.1	0.20	0.00	1.2	0.1	80	1	<0.01	0.00
MC6	09-05-01	< 1	2.3	0.3	0.25	0.00	0.87	0.05	92	1	<0.01	0.00
MC6d	09-07-01	< 1	2.1	0.2	0.25	0.00	0.78	0.07	90	4	<0.01	0.00
Blank[2]	09-07-01	--	<0.3	0.2	0.0025	0.0015	<0.02	0.04	0.009	0.016	<0.01	0.01
Blank[3]	09-07-01	--	<0.1	0.0	0.005	0.004	<0.03	0.02	0.059	0.004	<0.006	0.000
Blank[4]	09-07-01	--	<0.3	0.1	0.0014	0.0005	<0.02	0.03	0.042	0.005	<0.01	0.00
Blank[5]	09-07-01	--	<0.1	0.0	<0.003	0.000	<0.03	0.03	0.041	0.004	<0.006	0.003
Blank[6]	09-07-01	--	<0.1	0.1	0.003	0.004	<0.03	0.02	0.020	0.005	<0.006	0.002

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Bismuth (µg/L)		Boron (µg/L)		Bromine (µg/L)		Cadmium (µg/L)		Cerium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
KC2	09-06-01	1	0.0016	0.0004	64	3	14	4	<0.002	0.003	0.0031	0.0006
KC3	09-06-01	1	0.0024	0.0007	65	5	14	5	<0.002	0.001	0.0024	0.0006
KC3	09-07-01	30	0.0026	0.0005	71	2	16	4	<0.002	0.003	0.0051	0.0005
KC5	09-06-01	< 1	0.0026	0.0006	68	2	14	3	<0.002	0.000	0.0057	0.0004
FC1	09-07-01	< 1	0.0026	0.0002	64	3	12	3	<0.002	0.002	0.0046	0.0003
FC2	09-07-01	1	0.0020	0.0007	61	2	13	4	<0.002	0.006	0.0021	0.0002
FC2	09-07-01	15	0.0020	0.0010	64	4	12	4	<0.002	0.003	0.0041	0.0004
FC4	09-07-01	1	0.0022	0.0003	66	5	14	3	<0.002	0.004	0.0020	0.0006
FC4	09-07-01	30	0.0021	0.0009	74	3	16	3	<0.002	0.003	0.0034	0.0003
FC5	09-07-01	1	0.0024	0.0003	72	1	15	3	0.007	0.001	0.0024	0.0006
FC5	09-07-01	30	0.0027	0.0006	75	2	15	3	<0.002	0.001	0.0053	0.0017
MC2	09-05-01	< 1	0.0021	0.0001	68	2	14	6	<0.002	0.001	0.020	0.001
MC3	09-05-01	1	0.0023	0.0008	62	5	13	6	0.006	0.004	0.0032	0.0005
MC4	09-05-01	1	0.0025	0.0006	63	2	12	6	<0.002	0.003	0.0019	0.0004
MC4	09-05-01	12	0.0019	0.0008	62	3	13	6	<0.002	0.000	0.0017	0.0004
MC4	09-05-01	30	0.0032	0.0005	70	4	15	5	<0.002	0.003	0.0050	0.0006
MC5	09-05-01	1	0.0022	0.0001	66	0	14	5	<0.002	0.003	0.0019	0.0003
MC5	09-05-01	30	0.0019	0.0006	73	5	15	5	<0.002	0.001	0.0036	0.0001
MC6	09-05-01	< 1	0.0029	0.0003	71	2	13	4	<0.002	0.002	0.0084	0.0007
MC6d	09-07-01	< 1	0.0031	0.0014	70	4	14	5	<0.002	0.002	0.0060	0.0002
Blank[2]	09-07-01	--	0.0011	0.0007	<3	3	1.1	0.4	<0.002	0.001	<0.0002	0.0003
Blank[3]	09-07-01	--	0.0016	0.0008	<1	1	1.5	0.8	<0.002	0.000	0.0007	0.0004
Blank[4]	09-07-01	--	0.0009	0.0000	<3	2	0.9	0.1	<0.002	0.001	0.0006	0.0003
Blank[5]	09-07-01	--	0.0010	0.0004	<1	1	1.0	0.2	<0.001	0.001	0.0004	0.0003
Blank[6]	09-07-01	--	0.0014	0.0001	<1	0	1.0	0.1	<0.001	0.001	0.0004	0.0005

Site name	Date	Depth (meters)	Cesium (µg/L)		Chromium (µg/L)		Cobalt (µg/L)		Copper (µg/L)		Dysprosium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09-06-01	1	0.012	0.001	<0.03	0.20	<0.001	0.006	0.9	0.1	0.0010	0.0002
KC3	09-06-01	1	0.012	0.006	<0.03	0.32	<0.001	0.005	1.0	0.1	0.0008	0.0002
KC3	09-07-01	30	0.010	0.004	<0.03	0.32	<0.001	0.009	0.7	0.1	0.0019	0.0001
KC5	09-06-01	< 1	0.014	0.007	<0.03	0.22	<0.001	0.001	1.0	0.1	0.0015	0.0002
FC1	09-07-01	< 1	0.27	0.06	<0.03	0.24	<0.001	0.004	0.7	0.1	0.0016	0.0004
FC2	09-07-01	1	0.009	0.003	<0.03	0.27	<0.001	0.007	0.9	0.0	0.0010	0.0004
FC2	09-07-01	15	0.012	0.004	<0.03	0.22	<0.001	0.010	0.3	0.1	0.0020	0.0002
FC4	09-07-01	1	0.008	0.001	<0.03	0.18	<0.001	0.004	0.9	0.0	0.0009	0.0001
FC4	09-07-01	30	0.006	0.002	<0.03	0.24	<0.001	0.003	0.6	0.1	0.0019	0.0003
FC5	09-07-01	1	0.013	0.002	<0.03	0.15	<0.001	0.004	0.9	0.1	0.0009	0.0001
FC5	09-07-01	30	0.008	0.003	<0.03	0.23	<0.001	0.005	0.7	0.1	0.0017	0.0004
MC2	09-05-01	< 1	0.014	0.011	<0.03	0.29	<0.001	0.007	0.3	0.1	0.0038	0.0007
MC3	09-05-01	1	0.010	0.004	<0.03	0.30	<0.001	0.012	0.8	0.1	0.0012	0.0002
MC4	09-05-01	1	0.014	0.007	<0.03	0.25	<0.001	0.012	0.9	0.1	<0.0005	0.0002
MC4	09-05-01	12	0.010	0.004	<0.03	0.25	<0.001	0.014	0.9	0.1	0.0016	0.0001
MC4	09-05-01	30	0.008	0.000	<0.03	0.28	<0.001	0.008	0.6	0.1	0.0024	0.0001
MC5	09-05-01	1	0.008	0.001	<0.03	0.23	<0.001	0.008	0.9	0.1	0.0008	0.0002
MC5	09-05-01	30	0.005	0.001	<0.03	0.31	<0.001	0.008	0.6	0.1	0.0021	0.0004
MC6	09-05-01	< 1	0.004	0.001	<0.03	0.27	<0.001	0.012	0.4	0.1	0.0026	0.0005

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Cesium (µg/L)		Chromium (µg/L)		Cobalt (µg/L)		Copper (µg/L)		Dysprosium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
MC6d	09-07-01	< 1	0.003	0.003	<0.03	0.25	<0.001	0.012	0.5	0.1	0.0024	0.0002
Blank[2]	09-07-01	--	0.006	0.008	<0.03	0.07	<0.001	0.000	<0.02	0.02	<0.0005	0.0002
Blank[3]	09-07-01	--	<0.002	0.002	<0.03	0.05	<0.001	0.000	<0.02	0.00	<0.0005	0.0002
Blank[4]	09-07-01	--	<0.004	0.001	<0.04	0.03	<0.002	0.000	<0.01	0.01	<0.0004	0.0002
Blank[5]	09-07-01	--	<0.004	0.002	<0.04	0.06	<0.002	0.001	<0.01	0.00	<0.0004	0.0000
Blank[6]	09-07-01	--	<0.004	0.001	<0.04	0.01	<0.002	0.000	<0.01	0.00	<0.0004	0.0003

Site name	Date	Depth (meters)	Erbium (µg/L)		Europium (µg/L)		Gadolinium (µg/L)		Gallium (µg/L)		Germanium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09-06-01	1	0.0006	0.0001	<0.0001	0.0003	0.0016	0.0003	0.005	0.001	0.013	0.001
KC3	09-06-01	1	0.0005	0.0003	<0.0001	0.0010	0.0007	0.0001	0.005	0.000	0.012	0.001
KC3	09-07-01	30	0.0021	0.0001	<0.0001	0.0001	0.0016	0.0001	0.007	0.001	0.014	0.002
KC5	09-06-01	< 1	0.0010	0.0002	<0.0001	0.0003	0.0019	0.0005	0.003	0.001	0.013	0.001
FC1	09-07-01	< 1	0.0011	0.0004	<0.0001	0.0002	0.0015	0.0000	0.007	0.001	0.015	0.001
FC2	09-07-01	1	0.0008	0.0002	<0.0001	0.0004	0.0008	0.0002	0.005	0.001	0.014	0.002
FC2	09-07-01	15	0.0016	0.0002	<0.0001	0.0003	0.0018	0.0001	0.004	0.001	0.017	0.003
FC4	09-07-01	1	0.0004	0.0001	<0.0001	0.0005	0.0006	0.0002	0.007	0.000	0.016	0.001
FC4	09-07-01	30	0.0019	0.0002	<0.0001	0.0004	0.0016	0.0001	0.002	0.001	0.012	0.002
FC5	09-07-01	1	0.0009	0.0005	<0.0001	0.0005	0.0010	0.0000	0.006	0.001	0.014	0.001
FC5	09-07-01	30	0.0017	0.0000	<0.0001	0.0007	0.0046	0.0004	0.006	0.001	0.013	0.003
MC2	09-05-01	< 1	0.0024	0.0002	<0.0001	0.0007	0.0046	0.0004	0.006	0.001	0.020	0.003
MC3	09-05-01	1	0.0011	0.0003	<0.0001	0.0000	0.0016	0.0003	0.005	0.001	0.012	0.000
MC4	09-05-01	1	0.0005	0.0001	<0.0001	0.0001	0.0007	0.0001	0.005	0.000	0.015	0.002
MC4	09-05-01	12	0.0013	0.0002	<0.0001	0.0004	0.0016	0.0001	0.007	0.001	0.013	0.001
MC4	09-05-01	30	0.0014	0.0002	<0.0001	0.0000	0.0019	0.0005	0.003	0.001	0.013	0.003
MC5	09-05-01	1	0.0006	0.0002	<0.0001	0.0004	0.0011	0.0001	0.006	0.001	0.016	0.002
MC5	09-05-01	30	0.0018	0.0001	<0.0001	0.0002	0.0015	0.0003	0.004	0.001	0.013	0.001
MC6	09-05-01	< 1	0.0019	0.0005	<0.0001	0.0001	0.0028	0.0006	0.006	0.001	0.019	0.001
MC6d	09-07-01	< 1	0.0016	0.0008	<0.0001	0.0004	0.0025	0.0006	0.007	0.001	0.018	0.002
Blank[2]	09-07-01	--	<0.0003	0.0001	<0.0001	0.0001	0.0011	0.0001	0.006	0.001	<0.003	0.001
Blank[3]	09-07-01	--	<0.0003	0.0002	<0.0002	0.0001	0.0015	0.0000	0.007	0.001	<0.004	0.001
Blank[4]	09-07-01	--	<0.0003	0.0002	<0.0001	0.0002	0.0015	0.0003	0.004	0.001	<0.003	0.001
Blank[5]	09-07-01	--	<0.0003	0.0003	<0.0002	0.0001	0.0028	0.0006	0.006	0.001	<0.004	0.001
Blank[6]	09-07-01	--	<0.0003	0.0002	<0.0002	0.0002	0.0025	0.0006	0.007	0.001	<0.004	0.001

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Gold (μg/L)		Hafnium (μg/L)		Holmium (μg/L)		Iron (μg/L)		Lanthanium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
KC2	09-06-01	1	<0.0007	0.0004	<0.0005	0.0000	0.0002	0.0000	3.3	3.9	0.0020	0.0000
KC3	09-06-01	1	<0.0007	0.0003	0.0008	0.0003	0.0002	0.0001	0.8	0.1	0.0087	0.0006
KC3	09-07-01	30	<0.0007	0.0003	0.0007	0.0002	0.0004	0.0000	2.5	0.8	0.0051	0.0001
KC5	09-06-01	< 1	<0.0007	0.0004	0.0009	0.0001	0.0003	0.0001	2.4	1.0	0.0041	0.0006
FC1	09-07-01	< 1	<0.0007	0.0003	<0.0005	0.0002	0.0004	0.0001	2.3	0.3	0.0034	0.0003
FC2	09-07-01	1	<0.0007	0.0005	<0.0005	0.0001	0.0002	0.0000	0.7	0.0	0.0025	0.0005
FC2	09-07-01	15	<0.0007	0.0001	<0.0005	0.0001	0.0005	0.0000	3.1	0.0	0.0032	0.0002
FC4	09-07-01	1	<0.0007	0.0001	<0.0005	0.0001	0.0002	0.0001	1.6	1.3	0.0030	0.0006
FC4	09-07-01	30	<0.0007	0.0004	<0.0005	0.0002	0.0006	0.0001	1.6	0.9	0.0032	0.0002
FC5	09-07-01	1	<0.0007	0.0001	<0.0005	0.0003	0.0003	0.0001	0.8	0.0	0.0016	0.0002
FC5	09-07-01	30	<0.0007	0.0002	<0.0005	0.0003	0.0005	0.0002	1.7	0.2	0.0042	0.0008
MC2	09-05-01	< 1	<0.0007	0.0007	0.0006	0.0002	0.0008	0.0001	2.3	0.2	0.012	0.000
MC3	09-05-01	1	<0.0007	0.0002	0.0007	0.0003	0.0005	0.0002	0.9	0.2	0.0035	0.0002
MC4	09-05-01	1	<0.0007	0.0004	0.0009	0.0000	0.0002	0.0001	1.0	0.1	0.0015	0.0003
MC4	09-05-01	12	<0.0007	0.0004	<0.0005	0.0002	0.0005	0.0000	3.2	3.5	0.0020	0.0001
MC4	09-05-01	30	<0.0007	0.0002	<0.0005	0.0004	0.0007	0.0001	1.5	0.1	0.0042	0.0003
MC5	09-05-01	1	<0.0007	0.0005	0.0007	0.0002	0.0002	0.0001	1.2	1.2	0.0014	0.0005
MC5	09-05-01	30	<0.0007	0.0001	<0.0005	0.0003	0.0005	0.0001	1.7	1.5	0.0090	0.0005
MC6	09-05-01	< 1	<0.0007	0.0002	0.0006	0.0001	0.0004	0.0000	1.7	0.0	0.0048	0.0003
MC6d	09-07-01	< 1	<0.0007	0.0003	0.0009	0.0003	0.0004	0.0000	2.2	0.7	0.0047	0.0006
Blank[2]	09-07-01	--	<0.0007	0.0003	<0.0005	0.0001	0.0000	0.0001	<0.2	0.0	<0.0002	0.0001
Blank[3]	09-07-01	--	<0.0004	0.0001	0.0003	0.0002	<0.0001	0.0000	<0.2	0.3	0.0004	0.0003
Blank[4]	09-07-01	--	<0.0007	0.0004	<0.0005	0.0002	0.0000	0.0000	<0.2	0.2	0.0004	0.0002
Blank[5]	09-07-01	--	<0.0004	0.0001	<0.0003	0.0002	<0.0001	0.0000	1.0	0.4	0.0003	0.0001
Blank[6]	09-07-01	--	<0.0004	0.0001	<0.0003	0.0002	<0.0001	0.0000	<0.2	0.1	0.0002	0.0002

Site name	Date	Depth (meters)	Lead (μg/L)		Lithium (μg/L)		Lutetium (μg/L)		Manganese (μg/L)		Mercury (ng/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09-06-01	1	0.024	0.002	21	0	0.0001	0.0001	0.4	0.0	0.5	0.1
KC3	09-06-01	1	0.025	0.007	22	0	0.0001	0.0001	0.3	0.0	1.0	0.2
KC3	09-07-01	30	0.025	0.006	23	1	0.0003	0.0001	0.5	0.0	0.3	0.2
KC5	09-06-01	< 1	0.021	0.002	22	0	<0.0001	0.0000	1.1	0.0	1.1	0.1
FC1	09-07-01	< 1	0.032	0.005	20	1	<0.0001	0.0000	1.1	0.1	0.4	0.2
FC2	09-07-01	1	0.024	0.005	20	0	<0.0001	0.0001	0.3	0.0	2.3	0.1
FC2	09-07-01	15	0.033	0.003	22	1	0.0003	0.0000	21	0	0.8	0.2
FC4	09-07-01	1	0.020	0.004	21	1	0.0001	0.0000	0.2	0.0	0.4	0.2
FC4	09-07-01	30	0.018	0.005	23	0	0.0003	0.0001	0.4	0.0	0.4	0.1
FC5	09-07-01	1	0.025	0.001	23	0	0.0002	0.0001	0.2	0.0	0.4	0.1
FC5	09-07-01	30	0.027	0.000	25	2	0.0003	0.0001	0.4	0.0	1.4	0.3
MC2	09-05-01	< 1	0.035	0.004	21	1	0.0004	0.0001	16	0	0.7	0.1

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Lead (μg/L)		Lithium (μg/L)		Lutetium (μg/L)		Manganese (μg/L)		Mercury (ng/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
MC3	09-05-01	1	0.031	0.003	21	1	0.0002	0.0001	0.3	0.0	0.9	0.2
MC4	09-05-01	1	0.023	0.006	21	0	0.0001	0.0001	0.2	0.0	0.6	0.1
MC4	09-05-01	12	0.055	0.002	23	1	0.0002	0.0001	0.2	0.0	0.4	0.2
MC4	09-05-01	30	0.026	0.003	24	1	0.0004	0.0000	0.4	0.0	0.8	0.2
MC5	09-05-01	1	0.016	0.002	21	1	<0.0001	0.0000	0.2	0.0	0.4	0.2
MC5	09-05-01	30	0.023	0.004	25	1	0.0003	0.0001	0.2	0.0	0.6	0.2
MC6	09-05-01	< 1	0.030	0.002	23	1	0.0002	0.0000	0.8	0.0	1.1	0.0
MC6d	09-07-01	< 1	0.017	0.001	24	0	0.0002	0.0000	0.4	0.0	0.5	0.1
Blank[2]	09-07-01	--	<0.007	0.007	<0.01	0.01	<0.0001	0.0001	<0.1	0.0	0.6	0.2
Blank[3]	09-07-01	--	<0.009	0.006	<0.03	0.00	<0.0001	0.0000	<0.1	0.0	0.3	0.1
Blank[4]	09-07-01	--	<0.007	0.003	<0.01	0.01	<0.0001	0.0000	<0.1	0.0	1.0	0.1
Blank[5]	09-07-01	--	<0.009	0.005	<0.03	0.00	<0.0001	0.0000	<0.1	0.0	0.6	0.1
Blank[6]	09-07-01	--	<0.009	0.005	<0.03	0.01	<0.0001	0.0001	<0.1	0.1	0.4	0.1

Site name	Date	Depth (meters)	Molybdenum (μg/L)		Neodymium (μg/L)		Nickel (μg/L)		Phosphorus (μg/L)		Praseodymium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09-06-01	1	3.1	0.0	0.0022	0.0004	0.18	0.08	<4	1	0.0006	0.0001
KC3	09-06-01	1	3.1	0.0	0.0023	0.0003	0.18	0.13	<4	1	0.0006	0.0001
KC3	09-07-01	30	3.6	0.1	0.0057	0.0008	0.14	0.13	<4	3	0.0012	0.0001
KC5	09-06-01	< 1	3.1	0.0	0.0054	0.0008	0.12	0.07	<4	2	0.0008	0.0000
FC1	09-07-01	< 1	3.0	0.1	0.0052	0.0008	0.13	0.10	<4	1	0.0010	0.0000
FC2	09-07-01	1	3.1	0.1	0.0027	0.0011	0.23	0.14	<4	2	0.0004	0.0002
FC2	09-07-01	15	3.0	0.0	0.0054	0.0006	0.22	0.09	<4	1	0.0008	0.0001
FC4	09-07-01	1	3.2	0.1	0.0023	0.0005	0.20	0.01	<4	2	0.0004	0.0000
FC4	09-07-01	30	3.7	0.0	0.0053	0.0012	0.05	0.07	<4	2	0.0009	0.0000
FC5	09-07-01	1	3.4	0.0	0.0023	0.0008	0.06	0.04	<4	2	0.0004	0.0000
FC5	09-07-01	30	3.7	0.0	0.0050	0.0001	0.03	0.11	<4	1	0.0008	0.0000
MC2	09-05-01	< 1	3.2	0.1	0.017	0.000	0.08	0.12	<4	2	0.0038	0.0001
MC3	09-05-01	1	3.2	0.1	0.0036	0.0004	0.18	0.11	<4	3	0.0007	0.0001
MC4	09-05-01	1	3.1	0.1	0.0014	0.0003	0.21	0.07	<4	1	0.0003	0.0001
MC4	09-05-01	12	3.3	0.0	0.0027	0.0005	0.18	0.15	<4	1	0.0005	0.0001
MC4	09-05-01	30	3.7	0.1	0.0054	0.0005	0.03	0.13	<4	3	0.0010	0.0000
MC5	09-05-01	1	3.2	0.0	0.0019	0.0004	0.19	0.07	<4	2	0.0003	0.0001
MC5	09-05-01	30	3.7	0.0	0.0050	0.0007	0.03	0.11	<4	0	0.0008	0.0001
MC6	09-05-01	< 1	3.4	0.0	0.0094	0.0001	<0.01	0.10	<4	1	0.0017	0.0001
MC6d	09-07-01	< 1	3.4	0.0	0.0072	0.0001	<0.01	0.02	<4	1	0.0011	0.0000
Blank[2]	09-07-01	--	<0.02	0.02	<0.0006	0.0002	<0.01	0.00	<4	1	<0.0001	0.0001
Blank[3]	09-07-01	--	<0.06	0.04	0.0006	0.0004	0.03	0.01	<6	1	<0.0001	0.0001
Blank[4]	09-07-01	--	<0.02	0.01	<0.0006	0.0007	<0.01	0.01	<4	1	<0.0001	0.0001
Blank[5]	09-07-01	--	<0.06	0.03	<0.0006	0.0006	<0.01	0.01	<6	1	<0.0001	0.0001
Blank[6]	09-07-01	--	<0.06	0.02	<0.0006	0.0006	0.40	0.43	<6	1	<0.0001	0.0001
											0.0006	0.0001

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Rhenium (µg/L)		Rubidium (µg/L)		Samarium (µg/L)		Scandium (µg/L)		Selenium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
KC2	09-06-01	1	0.059	0.001	1.6	0.0	0.0012	0.0003	0.05	0.02	1.9	0.1
KC3	09-06-01	1	0.058	0.001	1.7	0.0	0.0008	0.0003	<0.02	0.00	2.0	0.0
KC3	09-07-01	30	0.056	0.002	1.5	0.0	0.0018	0.0004	0.05	0.02	1.9	0.1
KC5	09-06-01	< 1	0.057	0.002	1.6	0.0	0.0014	0.0003	0.02	0.02	2.0	0.0
FC1	09-07-01	< 1	0.045	0.002	1.4	0.0	0.0015	0.0003	<0.02	0.00	1.6	0.0
FC2	09-07-01	1	0.048	0.001	1.5	0.0	0.0012	0.0003	<0.02	0.04	1.7	0.2
FC2	09-07-01	15	0.045	0.002	1.5	0.0	0.0015	0.0005	<0.02	0.02	1.1	0.0
FC4	09-07-01	1	0.057	0.000	1.6	0.1	0.0012	0.0001	<0.02	0.02	1.9	0.0
FC4	09-07-01	30	0.056	0.002	1.5	0.0	0.0018	0.0003	<0.02	0.04	1.8	0.0
FC5	09-07-01	1	0.064	0.001	1.7	0.0	0.0016	0.0003	0.03	0.02	2.2	0.0
FC5	09-07-01	30	0.057	0.001	1.5	0.0	0.0018	0.0005	<0.02	0.01	1.8	0.0
MC2	09-05-01	< 1	0.048	0.001	1.1	0.0	0.0054	0.0009	<0.02	0.00	1.4	0.1
MC3	09-05-01	1	0.046	0.001	1.4	0.0	0.0018	0.0005	<0.02	0.00	1.7	0.0
MC4	09-05-01	1	0.050	0.001	1.5	0.0	0.0008	0.0005	0.04	0.03	1.8	0.1
MC4	09-05-01	12	0.057	0.001	1.6	0.0	0.0016	0.0003	0.03	0.00	2.0	0.1
MC4	09-05-01	30	0.055	0.002	1.4	0.0	0.0021	0.0004	<0.02	0.00	1.8	0.1
MC5	09-05-01	1	0.052	0.001	1.5	0.0	0.0006	0.0003	0.03	0.03	1.8	0.1
MC5	09-05-01	30	0.054	0.002	1.4	0.0	0.0010	0.0001	0.03	0.00	1.7	0.1
MC6	09-05-01	< 1	0.049	0.001	1.3	0.0	0.0027	0.0003	0.06	0.01	1.6	0.0
MC6d	09-07-01	< 1	0.049	0.004	1.3	0.0	0.0024	0.0006	0.03	0.05	1.6	0.1
Blank[2]	09-07-01	--	<0.0002	0.0001	<0.0007	0.0003	<0.0005	0.0000	<0.02	0.00	<0.1	0.0
Blank[3]	09-07-01	--	<0.0001	0.0001	0.0015	0.0003	<0.001	0.000	<0.07	0.01	<0.07	0.02
Blank[4]	09-07-01	--	<0.0002	0.0001	0.0014	0.0002	<0.0005	0.0002	<0.02	0.01	<0.1	0.0
Blank[5]	09-07-01	--	<0.0001	0.0000	0.0012	0.0000	<0.001	0.000	<0.07	0.01	<0.07	0.02
Blank[6]	09-07-01	--	<0.0001	0.0001	0.0008	0.0004	<0.001	0.000	<0.07	0.01	<0.07	0.06

Site name	Date	Depth (meters)	Strontium (µg/L)		Tantalum (µg/L)		Tellurium (µg/L)		Terbium (µg/L)		Thallium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09-05-01	1	580	0	<0.0005	0.0003	0.007	0.004	0.0001	0.0000	0.0083	0.0001
KC3	09-05-01	30	600	0	<0.0005	0.0004	0.009	0.002	0.0001	0.0001	0.0099	0.0011
KC3	09-05-01	< 1	640	0	<0.0005	0.0003	0.007	0.002	0.0004	0.0000	0.010	0.002
KC5	09-07-01	< 1	600	0	<0.0005	0.0003	0.007	0.001	0.0003	0.0000	0.0094	0.0004
FC1	09-07-01	1	520	0	<0.0005	0.0006	<0.006	0.003	0.0002	0.0000	0.0051	0.0012
FC2	09-07-01	30	530	0	<0.0005	0.0006	0.006	0.005	0.0002	0.0000	0.010	0.003
FC2	09-05-01	< 1	530	0	<0.0005	0.0005	<0.006	0.002	0.0004	0.0000	0.0077	0.0033
FC4	09-05-01	1	580	10	<0.0005	0.0004	0.007	0.001	0.0002	0.0000	0.0094	0.0007
FC4	09-05-01	1	660	0	<0.0005	0.0011	0.010	0.004	0.0003	0.0001	0.0089	0.0003
FC5	09-05-01	12	650	0	<0.0005	0.0002	<0.006	0.008	0.0002	0.0001	0.011	0.000
FC5	09-05-01	30	680	0	<0.0005	0.0001	0.013	0.004	0.0004	0.0001	0.0092	0.0022
MC2	09-06-01	1	550	10	<0.0005	0.0004	0.016	0.003	0.0006	0.0000	0.0038	0.0005
MC3	09-06-01	1	540	10	0.0007	0.0001	0.012	0.005	0.0003	0.0001	0.0080	0.0006

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Strontium (μg/L)		Tantalum (μg/L)		Tellurium (μg/L)		Terbium (μg/L)		Thallium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
MC4	09-07-01	30	560	0	0.0005	0.0007	<0.006	0.001	0.0001	0.0000	0.0094	0.0019
MC4	09-06-01	< 1	610	0	<0.0005	0.0009	0.013	0.004	0.0002	0.0000	0.016	0.007
MC4	09-07-01	< 1	660	10	<0.0005	0.0003	0.012	0.001	0.0003	0.0001	0.0085	0.0019
MC5	09-07-01	1	560	10	<0.0005	0.0006	<0.006	0.003	0.0001	0.0001	0.010	0.002
MC5	09-07-01	15	660	10	<0.0005	0.0002	0.012	0.002	0.0003	0.0000	0.0078	0.0011
MC6	09-07-01	1	550	0	<0.0005	0.0003	0.011	0.006	0.0005	0.0002	0.0037	0.0021
MC6d	09-07-01	30	560	0	<0.0005	0.0004	0.013	0.002	0.0003	0.0000	0.0072	0.0059
Blank[2]	09-07-01	--	<0.01	0.01	<0.0005	0.0007	<0.006	0.001	<0.0001	0.0000	<0.0006	0.0010
Blank[3]	09-07-01	--	0.24	0.00	<0.001	0.001	<0.005	0.001	<0.0001	0.0001	<0.005	0.003
Blank[4]	09-07-01	--	0.22	0.02	<0.0005	0.0001	<0.006	0.003	<0.0001	0.0000	0.0007	0.0020
Blank[5]	09-07-01	--	0.25	0.02	<0.001	0.001	<0.005	0.002	<0.0001	0.0001	<0.005	0.003
Blank[6]	09-07-01	--	0.05	0.00	<0.001	0.001	<0.005	0.004	0.0001	0.0000	<0.005	0.002

Site name	Date	Depth (meters)	Thorium (μg/L)		Thulium (μg/L)		Titanium (μg/L)		Tungsten (μg/L)		Uranium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	09-05-01	1	0.0018	0.0001	<0.0001	0.0001	<0.08	0.15	0.03	0.01	3.1	0.0
KC3	09-05-01	30	0.0017	0.0002	<0.0001	0.0001	<0.08	0.29	0.65	0.01	3.2	0.1
KC3	09-05-01	< 1	0.0023	0.0002	0.0002	0.0000	<0.08	0.27	0.04	0.01	3.3	0.1
KC5	09-07-01	< 1	0.0017	0.0001	0.0002	0.0000	<0.08	0.37	2.0	0.1	3.1	0.1
FC1	09-07-01	1	0.0020	0.0002	<0.0001	0.0000	<0.08	0.12	0.03	0.00	2.7	0.1
FC2	09-07-01	30	0.0018	0.0001	<0.0001	0.0001	<0.08	0.21	0.65	0.04	2.8	0.1
FC2	09-05-01	< 1	0.0013	0.0004	0.0001	0.0001	<0.08	0.26	0.04	0.00	2.7	0.0
FC4	09-05-01	1	0.0014	0.0005	0.0001	0.0001	<0.08	0.13	1.9	0.0	3.1	0.1
FC4	09-05-01	1	0.0013	0.0001	0.0003	0.0001	<0.08	0.11	0.03	0.01	3.4	0.0
FC5	09-05-01	12	0.0011	0.0001	0.0001	0.0001	<0.08	0.11	0.36	0.02	3.4	0.1
FC5	09-05-01	30	0.0013	0.0001	0.0003	0.0001	<0.08	0.15	0.04	0.00	3.4	0.0
MC2	09-06-01	1	0.0031	0.0002	0.0003	0.0001	<0.08	0.03	0.04	0.02	2.9	0.1
MC3	09-06-01	1	0.0018	0.0001	0.0001	0.0001	<0.08	0.08	4.0	0.0	3.0	0.1
MC4	09-07-01	30	0.0012	0.0001	<0.0001	0.0000	<0.08	0.16	0.04	0.02	2.8	0.0
MC4	09-06-01	< 1	0.0019	0.0000	<0.0001	0.0000	<0.08	0.14	4.5	0.0	3.2	0.2
MC4	09-07-01	< 1	0.0013	0.0000	0.0002	0.0000	<0.08	0.22	0.11	0.00	3.3	0.1
MC5	09-07-01	1	0.0013	0.0000	<0.0001	0.0001	<0.08	0.35	1.3	0.1	3.1	0.1
MC5	09-07-01	15	0.0010	0.0002	0.0002	0.0001	<0.08	0.04	0.09	0.01	3.3	0.1
MC6	09-07-01	1	0.0017	0.0001	0.0003	0.0001	<0.08	0.07	3.5	0.0	3.1	0.1
MC6d	09-07-01	30	0.0032	0.0002	0.0002	0.0001	<0.08	0.21	0.09	0.01	3.1	0.1
Blank[2]	09-07-01	--	<0.0001	0.0000	<0.0001	0.0000	<0.08	0.06	<0.02	0.01	<0.001	0.001
Blank[3]	09-07-01	--	<0.0002	0.0001	<0.0001	0.0000	<0.07	0.03	0.026	0.003	<0.001	0.003
Blank[4]	09-07-01	--	<0.0001	0.0001	<0.0001	0.0000	<0.08	0.06	<0.02	0.00	<0.001	0.001
Blank[5]	09-07-01	--	<0.0002	0.0001	<0.0001	0.0000	<0.07	0.04	0.011	0.002	<0.001	0.001
Blank[6]	09-07-01	--	<0.0002	0.0001	<0.0001	0.0000	<0.07	0.03	0.009	0.005	<0.001	0.001

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Vanadium (μg/L)		Ytterbium (μg/L)		Yttrium (μg/L)		Zinc (μg/L)		Zirconium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2001—Continued												
KC2	09-05-01	1	1.9	0.1	0.0006	0.0003	0.0072	0.0006	0.9	0.2	0.020	0.003
KC3	09-05-01	30	1.9	0.0	0.0004	0.0003	0.0058	0.0004	0.9	0.5	0.026	0.002
KC3	09-05-01	< 1	1.5	0.0	0.0013	0.0003	0.019	0.001	1.3	0.0	0.024	0.002
KC5	09-07-01	< 1	2.0	0.0	0.0008	0.0001	0.010	0.001	3.3	3.0	0.020	0.002
FC1	09-07-01	1	1.9	0.0	0.0008	0.0002	0.011	0.000	0.5	0.1	0.024	0.001
FC2	09-07-01	30	1.7	0.0	0.0007	0.0004	0.0083	0.0001	1.5	0.3	0.021	0.002
FC2	09-05-01	< 1	1.5	0.0	0.0016	0.0002	0.018	0.000	0.9	0.2	0.022	0.001
FC4	09-05-01	1	1.9	0.0	0.0008	0.0001	0.0077	0.0004	1.1	0.1	0.025	0.002
FC4	09-05-01	1	1.4	0.0	0.0015	0.0003	0.020	0.001	1.2	0.3	0.017	0.002
FC5	09-05-01	12	1.9	0.0	0.0008	0.0005	0.0086	0.0003	2.0	0.2	0.017	0.002
FC5	09-05-01	30	1.4	0.0	0.0016	0.0005	0.020	0.001	1.0	0.2	0.019	0.001
MC2	09-06-01	1	2.5	0.2	0.0020	0.0003	0.029	0.001	0.7	0.3	0.034	0.010
MC3	09-06-01	1	2.1	0.2	0.0009	0.0001	0.014	0.000	1.3	0.0	0.023	0.002
MC4	09-07-01	30	1.9	0.1	0.0007	0.0001	0.0060	0.0004	0.8	0.3	0.032	0.002
MC4	09-06-01	< 1	1.9	0.0	0.0015	0.0002	0.015	0.001	2.4	1.7	0.021	0.001
MC4	09-07-01	< 1	1.5	0.0	0.0016	0.0004	0.020	0.000	2.2	0.4	0.023	0.001
MC5	09-07-01	1	1.9	0.0	0.0007	0.0004	0.0060	0.0005	0.9	0.3	0.025	0.001
MC5	09-07-01	15	1.4	0.1	0.0013	0.0001	0.017	0.001	0.8	0.0	0.020	0.001
MC6	09-07-01	1	2.6	0.1	0.0012	0.0004	0.023	0.000	0.6	0.6	0.022	0.001
MC6d	09-07-01	30	2.5	0.0	0.0009	0.0001	0.019	0.000	0.5	0.2	0.026	0.001
Blank[2]	09-07-01	--	<0.1	0.0	<0.0002	0.0001	<0.0003	0.0001	<0.3	0.2	<0.003	0.001
Blank[3]	09-07-01	--	<0.1	0.0	<0.0003	0.0001	0.0004	0.0001	<0.3	0.1	0.0078	0.0029
Blank[4]	09-07-01	--	<0.1	0.0	<0.0002	0.0002	<0.0003	0.0001	<0.3	0.7	0.004	0.001
Blank[5]	09-07-01	--	<0.1	0.0	<0.0003	0.0000	<0.0002	0.0000	<0.3	0.1	0.0028	0.0002
Blank[6]	09-07-01	--	<0.1	0.0	<0.0003	0.0000	0.0003	0.0002	<0.3	0.2	0.0035	0.0010

Site name	Date	Depth (meters)	Aluminum (μg/L)		Antimony (μg/L)		Arsenic (μg/L)		Barium (μg/L)		Beryllium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2002												
KC2	05-22-02	1	3.5	0.1	0.21	0.00	1.6	0.0	91	0	<0.01	0.00
KC3	05-22-02	40	3.0	0.1	0.22	0.00	1.6	0.0	91	1	<0.01	0.00
KC3	05-22-02	1	1.5	0.1	0.19	0.01	1.5	0.0	87	2	<0.01	0.01
KC5	05-22-02	55	5.1	0.2	0.22	0.00	1.6	0.0	92	0	<0.01	0.00
FC2	05-21-02	1	5.3	0.1	0.20	0.00	1.7	0.1	92	1	<0.01	0.00
FC2	05-21-02	40	4.5	0.4	0.20	0.01	1.6	0.1	89	0	<0.01	0.01
FC4	05-21-02	1	3.2	0.1	0.20	0.00	1.6	0.0	89	1	<0.01	0.00
FC4	05-21-02	40	1.1	0.2	0.20	0.02	1.5	0.0	86	1	<0.01	0.00
FC5	05-21-02	1	4.0	0.4	0.20	0.01	1.6	0.0	89	2	<0.01	0.00
FC5	05-21-02	1	1.9	0.1	0.19	0.01	1.6	0.0	87	1	<0.01	0.01
MC3	05-20-02	1	6.2	0.1	0.19	0.00	1.5	0.1	82	1	<0.01	0.00
MC4	05-20-02	1	3.4	0.0	0.19	0.00	1.6	0.0	87	1	<0.01	0.00
MC4	05-20-02	35	3.4	0.2	0.19	0.00	1.6	0.0	87	3	<0.01	0.01
MC4	05-20-02	1	1.7	0.2	0.18	0.01	1.5	0.0	86	2	<0.01	0.00
MC5	05-20-02	1	2.5	0.2	0.19	0.00	1.6	0.0	89	2	<0.01	0.00
MC5	05-20-02	1	1.2	0.2	0.19	0.00	1.6	0.0	86	1	<0.01	0.00
Blank[3]	05-22-02	--	<0.05	0.02	<0.002	0.003	<0.02	0.02	<0.01	0.00	<0.01	0.01
Blank[7]	05-22-02	--	<0.05	0.03	<0.002	0.006	<0.02	0.00	<0.01	0.01	<0.01	0.00
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Bismuth (μg/L)		Boron (μg/L)		Bromine (μg/L)		Cadmium (μg/L)		Cerium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2002—Continued												
KC2	05-22-02	1	<0.004	0.001	84	4	17	0	<0.009	0.002	0.0096	0.0010
KC3	05-22-02	40	<0.004	0.003	82	3	17	1	<0.009	0.001	0.011	0.002
KC3	05-22-02	1	<0.004	0.001	80	2	16	0	<0.009	0.002	0.0079	0.0004
KC5	05-22-02	55	<0.004	0.003	82	4	16	1	<0.009	0.002	0.012	0.001
FC2	05-21-02	1	<0.004	0.004	82	1	17	0	<0.009	0.002	0.011	0.000
FC2	05-21-02	40	<0.004	0.004	78	3	15	0	<0.009	0.003	0.0096	0.0004
FC4	05-21-02	1	<0.004	0.003	80	3	16	0	<0.009	0.004	0.010	0.001
FC4	05-21-02	40	<0.004	0.003	80	1	16	1	<0.009	0.004	0.0055	0.0006
FC5	05-21-02	1	<0.004	0.003	78	2	16	0	<0.009	0.004	0.0097	0.0012
FC5	05-21-02	1	<0.004	0.003	80	1	17	1	<0.009	0.001	0.0079	0.0003
MC3	05-20-02	1	<0.004	0.001	79	7	16	1	<0.009	0.003	0.014	0.000
MC4	05-20-02	1	<0.004	0.001	83	1	15	0	<0.009	0.004	0.0078	0.0002
MC4	05-20-02	35	<0.004	0.002	83	2	15	0	<0.009	0.003	0.0074	0.0006
MC4	05-20-02	1	<0.004	0.005	82	4	16	1	<0.009	0.002	0.0062	0.0010
MC5	05-20-02	1	<0.004	0.003	80	2	16	0	<0.009	0.003	0.0087	0.0009
MC5	05-20-02	1	<0.004	0.002	84	2	17	0	<0.009	0.003	0.0059	0.0010
Blank[3]	05-22-02	--	0.005	0.003	<3	1	0.7	0.3	<0.009	0.001	<0.0002	0.0001
Blank[7]	05-22-02	--	<0.004	0.003	<3	1	<0.3	0.1	<0.009	0.002	<0.0002	0.0001
Blank[8]	05-22-02	--	--	--	79	7	16	1	<0.009	0.003	--	--

Site name	Date	Depth (meters)	Cesium (μg/L)		Chromium (μg/L)		Cobalt (μg/L)		Copper (μg/L)		Dysprosium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-22-02	1	<0.02	0.00	0.3	0.1	0.066	0.001	0.45	0.05	0.0019	0.0002
KC3	05-22-02	40	<0.02	0.00	<0.2	0.0	0.082	0.002	0.51	0.06	0.0021	0.0011
KC3	05-22-02	1	<0.02	0.00	<0.2	0.0	0.051	0.004	0.45	0.01	0.0019	0.0002
KC5	05-22-02	55	<0.02	0.01	<0.2	0.1	0.095	0.002	0.47	0.02	0.0026	0.0007
FC2	05-21-02	1	<0.02	0.00	<0.2	0.1	0.073	0.006	0.51	0.09	0.0028	0.0004
FC2	05-21-02	40	<0.02	0.01	<0.2	0.0	0.067	0.002	0.44	0.07	0.0027	0.0000
FC4	05-21-02	1	<0.02	0.01	<0.2	0.1	0.067	0.010	0.49	0.04	0.0022	0.0002
FC4	05-21-02	40	<0.02	0.01	<0.2	0.1	0.054	0.003	0.48	0.05	0.0020	0.0004
FC5	05-21-02	1	<0.02	0.00	<0.2	0.1	0.064	0.001	0.47	0.06	0.0021	0.0002
FC5	05-21-02	1	<0.02	0.00	<0.2	0.1	0.056	0.003	0.46	0.05	0.0021	0.0002
MC3	05-20-02	1	<0.02	0.00	<0.2	0.1	0.066	0.007	0.53	0.13	0.0019	0.0001
MC4	05-20-02	1	<0.02	0.00	<0.2	0.1	0.064	0.003	0.68	0.27	0.0022	0.0001
MC4	05-20-02	35	<0.02	0.00	<0.2	0.1	0.059	0.006	0.53	0.10	0.0020	0.0001
MC4	05-20-02	1	<0.02	0.00	<0.2	0.0	0.067	0.002	0.48	0.08	0.0021	0.0002
MC5	05-20-02	1	<0.02	0.01	<0.2	0.0	0.062	0.005	0.51	0.07	0.0019	0.0003
MC5	05-20-02	1	<0.02	0.00	<0.2	0.1	0.059	0.003	0.70	0.10	0.0020	0.0000
Blank[3]	05-22-02	--	<0.02	0.00	<0.2	0.0	<0.003	0.001	<0.05	0.01	<0.0004	0.0001
Blank[7]	05-22-02	--	<0.02	0.01	<0.2	0.1	<0.003	0.001	<0.05	0.01	<0.0004	0.0002
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Erbium (μg/L)		Europium (μg/L)		Gadolinium (μg/L)		Gallium (μg/L)		Germanium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2002—Continued												
KC2	05-22-02	1	0.0015	0.0004	0.0023	0.0006	0.0016	0.0006	0.0011	0.0007	0.017	0.003
KC3	05-22-02	40	0.0024	0.0008	0.0036	0.0002	0.0025	0.0006	0.0010	0.0015	0.015	0.006
KC3	05-22-02	1	0.0021	0.0002	0.0017	0.0005	0.0024	0.0003	<0.0009	0.0010	0.015	0.001
KC5	05-22-02	55	0.0020	0.0006	0.0026	0.0013	0.0025	0.0002	<0.0009	0.0005	0.017	0.002
FC2	05-21-02	1	0.0012	0.0002	0.0042	0.0005	0.0024	0.0002	0.0015	0.0005	0.020	0.004
FC2	05-21-02	40	0.0014	0.0004	0.0032	0.0001	0.0024	0.0010	0.0023	0.0006	0.016	0.002
FC4	05-21-02	1	0.0020	0.0005	0.0032	0.0008	0.0022	0.0006	0.0011	0.0001	0.022	0.002
FC4	05-21-02	40	0.0021	0.0005	0.0026	0.0000	0.0029	0.0005	0.0012	0.0008	0.019	0.003
FC5	05-21-02	1	0.0017	0.0004	0.0029	0.0007	0.0021	0.0003	0.0011	0.0011	0.019	0.001
FC5	05-21-02	1	0.0022	0.0002	0.0012	0.0017	0.0018	0.0005	<0.0009	0.0001	0.018	0.002
MC3	05-20-02	1	0.0012	0.0001	0.0020	0.0009	0.0027	0.0005	0.0019	0.0015	0.012	0.001
MC4	05-20-02	1	0.0020	0.0005	0.0021	0.0025	0.0014	0.0000	0.0010	0.0005	0.016	0.001
MC4	05-20-02	35	0.0014	0.0003	0.0027	0.0001	0.0021	0.0006	0.0011	0.0008	0.017	0.000
MC4	05-20-02	1	0.0017	0.0007	0.0022	0.0007	0.0025	0.0003	<0.0009	0.0001	0.017	0.000
MC5	05-20-02	1	0.0021	0.0002	0.0023	0.0000	0.0021	0.0005	<0.0009	0.0010	0.015	0.006
MC5	05-20-02	1	0.0015	0.0001	0.0037	0.0023	0.0015	0.0004	<0.0009	0.0012	0.022	0.000
Blank[3]	05-22-02	--	<0.0005	0.0002	<0.0002	0.0001	<0.0005	0.0001	<0.0009	0.0008	<0.004	0.001
Blank[7]	05-22-02	--	<0.0005	0.0003	<0.0002	0.0000	<0.0005	0.0003	<0.0009	0.0004	<0.004	0.002
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

Site name	Date	Depth (meters)	Gold (μg/L)		Hafnium (μg/L)		Holmium (μg/L)		Iron (μg/L)		Lanthanum (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-22-02	1	0.0002	0.0001	0.0009	0.0003	0.0006	0.0001	2.3	0.2	0.0070	0.0004
KC3	05-22-02	40	<0.0002	0.0001	0.0008	0.0001	0.0007	0.0002	1.9	0.1	0.0061	0.0005
KC3	05-22-02	1	<0.0002	0.0001	0.0005	0.0004	0.0006	0.0001	1.3	0.2	0.0078	0.0003
KC5	05-22-02	55	<0.0002	0.0001	0.0007	0.0006	0.0009	0.0001	2.7	0.0	0.0078	0.0016
FC2	05-21-02	1	<0.0002	0.0001	<0.0004	0.0002	0.0008	0.0001	5.0	0.9	0.0079	0.0005
FC2	05-21-02	40	<0.0002	0.0001	<0.0004	0.0001	0.0006	0.0001	3.9	0.2	0.0068	0.0008
FC4	05-21-02	1	<0.0002	0.0000	0.0009	0.0005	0.0007	0.0001	1.9	0.0	0.0072	0.0008
FC4	05-21-02	40	<0.0002	0.0001	0.0005	0.0002	0.0006	0.0000	0.9	0.2	0.0054	0.0004
FC5	05-21-02	1	<0.0002	0.0002	0.0005	0.0003	0.0007	0.0001	2.6	0.3	0.0053	0.0004
FC5	05-21-02	1	<0.0002	0.0001	<0.0004	0.0002	0.0005	0.0000	2.2	0.5	0.0061	0.0007
MC3	05-20-02	1	<0.0002	0.0001	0.0008	0.0004	0.0007	0.0000	5.6	0.9	0.0076	0.0009
MC4	05-20-02	1	<0.0002	0.0001	0.0005	0.0005	0.0006	0.0002	2.6	0.2	0.0058	0.0001
MC4	05-20-02	35	0.0003	0.0001	0.0007	0.0003	0.0006	0.0000	3.4	0.3	0.0056	0.0000
MC4	05-20-02	1	<0.0002	0.0002	0.0007	0.0001	0.0007	0.0002	1.2	0.2	0.0070	0.0004
MC5	05-20-02	1	<0.0002	0.0000	0.0005	0.0002	0.0006	0.0001	1.8	0.3	0.0064	0.0008
MC5	05-20-02	1	<0.0002	0.0001	<0.0004	0.0006	0.0007	0.0001	2.9	1.6	0.0051	0.0002
Blank[3]	05-22-02	--	<0.0002	0.0001	<0.0004	0.0001	<0.0002	0.0001	<0.3	0.2	<0.0002	0.0001
Blank[7]	05-22-02	--	<0.0002	0.0002	<0.0004	0.0004	<0.0002	0.0000	<0.3	0.2	<0.0002	0.0001
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Lead (µg/L)		Lithium (µg/L)		Lutetium (µg/L)		Manganese (µg/L)		Mercury (ng/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2002—Continued												
KC2	05-22-02	1	0.011	0.004	30	1	0.0002	0.0001	0.93	0.01	0.4	0.1
KC3	05-22-02	40	0.006	0.005	30	0	0.0004	0.0000	0.90	0.02	0.4	0.2
KC3	05-22-02	1	<0.003	0.004	29	1	0.0004	0.0000	0.27	0.02	0.4	0.0
KC5	05-22-02	55	0.016	0.002	30	0	0.0005	0.0000	1.5	0.0	0.4	0.0
FC2	05-21-02	1	0.021	0.005	30	0	0.0005	0.0001	1.0	0.0	0.5	0.0
FC2	05-21-02	40	0.015	0.001	29	0	0.0004	0.0001	0.98	0.03	0.4	0.2
FC4	05-21-02	1	0.007	0.005	29	1	0.0005	0.0000	0.77	0.01	0.5	0.1
FC4	05-21-02	40	<0.003	0.004	29	0	0.0005	0.0001	0.26	0.03	1.2	0.2
FC5	05-21-02	1	0.012	0.001	28	0	0.0003	0.0001	0.98	0.03	0.5	0.2
FC5	05-21-02	1	0.011	0.006	29	1	0.0005	0.0002	2.0	0.0	0.3	0.2
MC3	05-20-02	1	0.015	0.002	29	0	0.0004	0.0001	1.6	0.1	0.5	0.1
MC4	05-20-02	1	0.008	0.006	29	2	0.0003	0.0001	0.98	0.08	0.5	0.2
MC4	05-20-02	35	0.014	0.003	30	0	0.0004	0.0001	0.91	0.03	0.5	0.1
MC4	05-20-02	1	<0.003	0.000	29	2	0.0004	0.0000	0.56	0.02	0.4	0.2
MC5	05-20-02	1	0.010	0.002	28	1	0.0004	0.0001	0.50	0.02	0.4	0.1
MC5	05-20-02	1	0.004	0.002	31	0	0.0004	0.0000	0.35	0.02	0.4	0.1
Blank[3]	05-22-02	--	0.004	0.012	0.03	0.05	<0.0001	0.0000	<0.05	0.02	0.3	0.2
Blank[7]	05-22-02	--	<0.003	0.005	<0.01	0.00	<0.0001	0.0000	<0.05	0.01	0.4	0.1
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	0.2	0.1

Site name	Date	Depth (meters)	Molybdenum (µg/L)		Neodymium (µg/L)		Nickel (µg/L)		Phosphorus (µg/L)		Praseodymium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-22-02	1	5.0	0.1	0.0075	0.0020	1.7	0.0	<7	7	0.0013	0.0001
KC3	05-22-02	40	4.1	0.1	0.0082	0.0014	1.9	0.2	<7	3	0.0016	0.0000
KC3	05-22-02	1	4.0	0.1	0.0057	0.0007	1.6	0.1	<7	5	0.0015	0.0004
KC5	05-22-02	55	4.0	0.1	0.010	0.001	1.9	0.2	7	8	0.0020	0.0005
FC2	05-21-02	1	3.9	0.1	0.011	0.001	1.6	0.2	<7	4	0.0020	0.0000
FC2	05-21-02	40	3.8	0.1	0.0096	0.0015	1.5	0.0	<7	7	0.0020	0.0002
FC4	05-21-02	1	4.1	0.0	0.0074	0.0004	1.8	0.1	<7	3	0.0016	0.0002
FC4	05-21-02	40	3.8	0.1	0.0061	0.0002	1.6	0.1	<7	3	0.0012	0.0002
FC5	05-21-02	1	3.9	0.0	0.0067	0.0007	1.5	0.1	<7	2	0.0013	0.0001
FC5	05-21-02	1	3.9	0.1	0.0068	0.0000	1.8	0.2	<7	2	0.0014	0.0002
MC3	05-20-02	1	3.7	0.1	0.010	0.001	1.7	0.2	<7	5	0.0021	0.0002
MC4	05-20-02	1	3.8	0.0	0.0076	0.0007	1.9	0.0	<7	4	0.0014	0.0001
MC4	05-20-02	35	3.8	0.1	0.0082	0.0014	1.6	0.1	<7	4	0.0013	0.0003
MC4	05-20-02	1	3.8	0.1	0.0063	0.0009	1.9	0.0	<7	1	0.0011	0.0001
MC5	05-20-02	1	3.8	0.0	0.0076	0.0014	1.7	0.1	<7	5	0.0013	0.0002
MC5	05-20-02	1	3.9	0.0	0.0076	0.0008	1.7	0.1	<7	4	0.0012	0.0004
Blank[3]	05-22-02	--	0.2	0.3	<0.0005	0.0005	<0.02	0.00	<7	1	<0.0002	0.0001
Blank[7]	05-22-02	--	<0.1	0.1	<0.0005	0.0002	<0.02	0.00	<7	2	<0.0002	0.0000
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Rhenium (μg/L)		Rubidium (μg/L)		Samarium (μg/L)		Scandium (μg/L)		Selenium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2002—Continued												
KC2	05-22-02	1	0.068	0.002	1.7	0.0	0.0024	0.0006	0.17	0.03	2.0	0.0
KC3	05-22-02	1	0.068	0.001	1.7	0.0	0.0025	0.0009	0.17	0.11	2.0	0.1
KC3	05-22-02	35	0.065	0.001	1.6	0.0	0.0015	0.0006	0.22	0.03	2.0	0.0
KC5	05-22-02	1	0.068	0.002	1.7	0.0	0.0022	0.0001	0.21	0.07	2.0	0.1
FC2	05-21-02	1	0.062	0.002	1.5	0.0	0.0032	0.0007	0.16	0.05	1.8	0.0
FC2	05-21-02	1	0.061	0.000	1.6	0.0	0.0028	0.0002	0.21	0.06	1.9	0.0
FC4	05-21-02	1	0.066	0.001	1.7	0.0	0.0026	0.0006	0.23	0.04	2.0	0.0
FC4	05-21-02	40	0.065	0.000	1.6	0.0	0.0020	0.0007	0.30	0.03	1.9	0.1
FC5	05-21-02	1	0.063	0.001	1.6	0.0	0.0028	0.0005	0.21	0.04	1.9	0.0
FC5	05-21-02	40	0.065	0.000	1.6	0.0	0.0023	0.0006	0.22	0.03	1.9	0.0
MC3	05-20-02	1	0.060	0.001	1.4	0.0	0.0027	0.0005	0.29	0.06	1.8	0.1
MC4	05-20-02	1	0.061	0.004	1.5	0.0	0.0020	0.0003	0.22	0.06	1.8	0.1
MC4	05-20-02	1	0.062	0.003	1.5	0.0	0.0023	0.0009	0.20	0.04	1.9	0.0
MC4	05-20-02	40	0.063	0.001	1.5	0.0	0.0017	0.0007	0.24	0.06	1.9	0.0
MC5	05-20-02	1	0.062	0.001	1.6	0.0	0.0021	0.0008	0.20	0.04	1.8	0.0
MC5	05-20-02	55	0.067	0.001	1.6	0.0	0.0025	0.0000	0.20	0.05	2.0	0.1
Blank[3]	05-22-02	--	<0.0002	0.0000	<0.003	0.000	<0.0009	0.0004	<0.08	0.05	<0.08	0.02
Blank[7]	05-22-02	--	<0.0002	0.0001	<0.003	0.000	<0.0009	0.0003	<0.08	0.07	<0.08	0.04
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

Site name	Date	Depth (meters)	Strontium (μg/L)		Tantalum (μg/L)		Tellurium (μg/L)		Terbium (μg/L)		Thallium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-20-02	1	780	0	<0.0004	0.0002	0.016	0.003	0.0005	0.0001	0.009	0.000
KC3	05-20-02	40	760	0	<0.0004	0.0001	0.016	0.005	0.0007	0.0002	0.011	0.003
KC3	05-20-02	1	760	10	<0.0004	0.0001	0.015	0.004	0.0005	0.0001	0.008	0.002
KC5	05-20-02	55	770	0	<0.0004	0.0002	0.015	0.002	0.0006	0.0002	0.008	0.002
FC2	05-21-02	1	760	20	<0.0004	0.0003	0.011	0.001	0.0006	0.0001	0.006	0.001
FC2	05-21-02	40	750	0	<0.0004	0.0002	0.018	0.003	0.0004	0.0001	0.011	0.007
FC4	05-21-02	1	760	0	<0.0004	0.0001	0.013	0.003	0.0006	0.0001	0.013	0.007
FC4	05-21-02	40	760	10	<0.0004	0.0003	0.015	0.005	0.0005	0.0000	0.008	0.002
FC5	05-20-02	1	760	0	<0.0004	0.0001	0.016	0.003	0.0006	0.0000	0.006	0.000
FC5	05-20-02	1	770	0	<0.0004	0.0001	0.013	0.008	0.0006	0.0001	0.010	0.003
MC3	05-22-02	1	700	0	<0.0004	0.0002	0.014	0.006	0.0007	0.0002	0.005	0.001
MC4	05-22-02	1	740	0	<0.0004	0.0001	0.011	0.002	0.0005	0.0001	0.007	0.001
MC4	05-22-02	35	730	0	<0.0004	0.0001	0.015	0.002	0.0006	0.0002	0.007	0.001
MC4	05-22-02	1	750	20	<0.0004	0.0002	0.015	0.004	0.0004	0.0000	0.008	0.003
MC5	05-21-02	1	750	0	<0.0004	0.0001	0.015	0.003	0.0005	0.0000	0.008	0.001
MC5	05-21-02	1	760	0	<0.0004	0.0001	0.012	0.003	0.0005	0.0001	0.008	0.002
Blank[3]	05-22-02	--	0.04	0.00	<0.0004	0.0002	<0.006	0.003	<0.0001	0.0000	0.002	0.002
Blank[7]	05-22-02	--	<0.03	0.01	<0.0004	0.0002	<0.006	0.001	<0.0001	0.0000	<0.001	0.001
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Thorium (µg/L)		Thulium (µg/L)		Titanium (µg/L)		Tungsten (µg/L)		Uranium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, May 2002—Continued												
KC2	05-20-02	1	0.0060	0.0022	0.0003	0.0000	<0.3	0.2	0.051	0.001	3.9	0.0
KC3	05-20-02	40	0.0097	0.0040	0.0003	0.0001	<0.3	0.1	0.032	0.001	4.0	0.0
KC3	05-20-02	1	0.0074	0.0031	0.0003	0.0001	<0.3	0.0	0.040	0.001	3.9	0.0
KC5	05-20-02	55	0.017	0.002	0.0003	0.0000	<0.3	0.2	0.037	0.001	4.0	0.1
FC2	05-21-02	1	0.0089	0.0026	0.0003	0.0000	<0.3	0.0	0.037	0.002	3.9	0.0
FC2	05-21-02	40	0.017	0.012	0.0003	0.0000	<0.3	0.1	0.038	0.001	3.7	0.1
FC4	05-21-02	1	0.016	0.014	0.0003	0.0000	<0.3	0.0	0.044	0.002	3.9	0.0
FC4	05-21-02	40	0.0026	0.0004	0.0004	0.0001	<0.3	0.1	0.034	0.004	3.8	0.0
FC5	05-20-02	1	0.0050	0.0023	0.0003	0.0000	<0.3	0.1	0.037	0.001	3.8	0.0
FC5	05-20-02	1	0.013	0.010	0.0002	0.0000	<0.3	0.3	0.034	0.001	3.9	0.0
MC3	05-22-02	1	0.0075	0.0027	0.0003	0.0000	<0.3	0.1	0.039	0.008	3.7	0.1
MC4	05-22-02	1	0.0058	0.0020	0.0003	0.0001	<0.3	0.2	0.050	0.003	3.8	0.1
MC4	05-22-02	35	0.0063	0.0020	0.0002	0.0001	<0.3	0.1	0.045	0.006	3.7	0.0
MC4	05-22-02	1	0.0044	0.0011	0.0002	0.0000	<0.3	0.2	0.031	0.001	3.8	0.1
MC5	05-21-02	1	0.012	0.005	0.0005	0.0000	<0.3	0.2	0.036	0.000	3.8	0.1
MC5	05-21-02	1	0.0058	0.0037	0.0002	0.0000	<0.3	0.2	0.032	0.002	4.1	0.0
Blank[3]	05-22-02	--	0.0023	0.0033	<0.0001	0.0000	<0.3	0.1	<0.002	0.001	<0.002	0.002
Blank[7]	05-22-02	--	0.0010	0.0017	<0.0001	0.0000	<0.3	0.1	<0.002	0.001	<0.002	0.001
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

Site name	Date	Depth (meters)	Vanadium (µg/L)		Ytterbium (µg/L)		Yttrium (µg/L)		Zinc (µg/L)		Zirconium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC2	05-22-02	1	1.9	0.0	0.0013	0.0001	0.021	0.001	0.3	0.0	0.054	0.004
KC3	05-22-02	1	1.9	0.0	0.0021	0.0004	0.026	0.002	0.2	0.1	0.028	0.010
KC3	05-22-02	35	1.9	0.0	0.0021	0.0004	0.022	0.000	0.2	0.0	0.022	0.001
KC5	05-22-02	1	1.9	0.0	0.0024	0.0005	0.027	0.001	0.4	0.0	0.042	0.006
FC2	05-21-02	1	2.2	0.0	0.0021	0.0001	0.025	0.001	0.2	0.1	0.023	0.005
FC2	05-21-02	1	2.1	0.0	0.0020	0.0004	0.025	0.001	0.1	0.1	0.041	0.028
FC4	05-21-02	1	1.9	0.0	0.0018	0.0003	0.023	0.000	0.2	0.1	0.028	0.004
FC4	05-21-02	40	1.8	0.1	0.0019	0.0001	0.024	0.001	0.2	0.1	0.015	0.001
FC5	05-21-02	1	1.9	0.0	0.0021	0.0004	0.022	0.001	0.2	0.1	0.032	0.004
FC5	05-21-02	40	1.9	0.1	0.0017	0.0003	0.024	0.001	0.4	0.1	0.020	0.007
MC3	05-20-02	1	2.1	0.1	0.0013	0.0001	0.020	0.000	0.3	0.1	0.027	0.004
MC4	05-20-02	1	1.9	0.0	0.0024	0.0004	0.021	0.000	0.5	0.1	0.022	0.002
MC4	05-20-02	1	1.9	0.0	0.0020	0.0004	0.021	0.001	0.5	0.1	0.023	0.002
MC4	05-20-02	40	1.9	0.0	0.0017	0.0001	0.022	0.000	0.2	0.0	0.022	0.003
MC5	05-20-02	1	1.9	0.1	0.0020	0.0000	0.024	0.002	0.2	0.0	0.026	0.004
MC5	05-20-02	55	1.9	0.1	0.0023	0.0002	0.024	0.001	0.5	0.0	0.028	0.016
Blank[3]	05-22-02	--	<0.05	0.02	<0.0001	0.0001	<0.0001	0.0000	<0.1	0.0	0.003	0.001
Blank[7]	05-22-02	--	<0.05	0.01	<0.0001	0.0003	<0.0001	0.0001	<0.1	0.0	<0.002	0.001
Blank[8]	05-22-02	--	--	--	--	--	--	--	--	--	--	--

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Aluminum (μg/L)		Antimony (μg/L)		Arsenic (μg/L)		Barium (μg/L)		Beryllium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002												
KC5a	09-11-02	< 1	1.2	0.2	0.35	0.00	0.84	0.01	100	0	<0.009	0.002
KC2	09-11-02	1	1.1	0.1	0.35	0.01	1.6	0.0	110	0	<0.009	0.003
KC2	09-11-02	20	0.86	0.17	0.25	0.00	1.6	0.0	94	2	<0.009	0.006
KC3	09-11-02	1	1.5	0.0	0.34	0.01	1.6	0.0	110	0	<0.009	0.002
KC3	09-11-02	20	0.77	0.10	0.26	0.01	1.6	0.0	96	1	<0.009	0.002
FC1a	09-10-02	< 1	1.5	0.2	0.31	0.01	1.7	0.1	100	0	<0.009	0.003
FC2	09-10-02	1	1.3	0.2	0.31	0.01	1.7	0.0	100	0	<0.009	0.002
FC4	09-10-02	1	0.90	0.12	0.34	0.00	1.6	0.1	110	0	<0.009	0.004
FC4	09-10-02	20	0.66	0.20	0.26	0.01	1.6	0.0	93	2	<0.009	0.004
FC5	09-10-02	1	1.00	0.13	0.31	0.00	1.7	0.0	99	2	<0.009	0.004
FC5	09-10-02	20	0.55	0.12	0.25	0.00	1.6	0.0	95	2	<0.009	0.005
MC2b	09-09-02	< 1	3.8	0.1	0.28	0.00	1.3	0.0	100	1	<0.009	0.001
MC2b	09-09-02	< 1	2.6	0.2	0.28	0.01	1.4	0.0	99	7	<0.009	0.002
MC2c	09-09-02	1	2.4	0.2	0.29	0.01	1.2	0.1	100	3	<0.009	0.004
MC3	09-09-02	1	1.4	0.2	0.28	0.01	1.3	0.1	99	2	<0.009	0.004
MC4	09-09-02	1	0.59	0.19	0.30	0.01	1.6	0.0	99	1	<0.009	0.006
MC4	09-09-02	1	0.64	0.20	0.30	0.01	1.6	0.0	99	3	<0.009	0.004
MC4	09-09-02	35	1.3	0.2	0.24	0.00	1.5	0.0	120	0	<0.009	0.003
MC5	09-09-02	1	1.4	0.3	0.31	0.00	1.6	0.0	100	0	<0.009	0.004
MC5	09-09-02	35	0.86	0.22	0.22	0.00	1.5	0.0	100	0	<0.009	0.001
Blank[3]	09-12-02	--	<0.08	0.02	<0.003	0.000	<0.05	0.03	0.08	0.00	<0.009	0.003
Blank[5]	09-12-02	--	<0.08	0.02	<0.003	0.001	<0.05	0.03	0.09	0.01	<0.009	0.003
Blank[7]	09-12-02	--	<0.08	0.01	0.003	0.001	<0.05	0.03	0.10	0.02	<0.009	0.002

Site name	Date	Depth (meters)	Bismuth (μg/L)		Boron (μg/L)		Bromine (μg/L)		Cadmium (μg/L)		Cerium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	0.0018	0.0006	94	2	20	0	0.005	0.002	0.0074	0.0012
KC2	09-11-02	1	0.0018	0.0015	95	2	19	1	<0.002	0.001	0.0038	0.0004
KC2	09-11-02	20	0.0045	0.0017	84	2	18	1	0.004	0.001	0.0066	0.0007
KC3	09-11-02	1	0.0096	0.0083	94	3	18	0	<0.002	0.001	0.0050	0.0009
KC3	09-11-02	20	0.0019	0.0021	83	3	18	2	0.004	0.002	0.0082	0.0018
FC1a	09-10-02	< 1	0.0017	0.0011	86	0	18	0	0.003	0.002	0.0062	0.0005
FC2	09-10-02	1	0.0020	0.0016	87	1	18	0	<0.002	0.002	0.0091	0.0032
FC4	09-10-02	1	0.0021	0.0020	92	2	19	0	<0.002	0.003	0.0029	0.0003
FC4	09-10-02	20	0.0023	0.0024	84	3	17	0	<0.002	0.001	0.0040	0.0006
FC5	09-10-02	1	0.0011	0.0008	87	2	18	0	<0.002	0.001	0.0038	0.0008
FC5	09-10-02	20	0.0013	0.0005	81	0	17	1	<0.002	0.002	0.0043	0.0015
MC2b	09-09-02	< 1	0.0035	0.0027	87	2	17	2	0.005	0.002	0.013	0.001
MC2b	09-09-02	< 1	0.0030	0.0014	92	1	18	0	<0.002	0.000	0.012	0.002
MC3	09-09-02	1	0.0029	0.0016	86	1	17	2	0.005	0.003	0.0059	0.0017
MC4	09-09-02	1	0.0043	0.0031	88	3	17	1	<0.002	0.000	0.0021	0.0002
MC4	09-09-02	1	0.0012	0.0015	87	2	18	1	<0.002	0.003	0.0018	0.0005
MC4	09-09-02	35	0.0038	0.0034	81	1	16	0	0.006	0.001	0.012	0.000
MC5	09-09-02	1	0.0035	0.0014	86	1	17	1	<0.002	0.000	0.0040	0.0004
MC5	09-09-02	35	0.0019	0.0008	80	3	16	1	<0.002	0.003	0.0069	0.0003
Blank[3]	09-12-02	--	0.0013	0.0018	0.10	0.02	<0.009	0.002	0.0051	0.0026	<0.0004	0.0002
Blank[5]	09-12-02	--	0.0026	0.0015	0.09	0.01	<0.009	0.003	0.0026	0.0015	<0.0004	0.0001
Blank[7]	09-12-02	--	0.0051	0.0026	0.08	0.00	<0.009	0.003	0.0013	0.0018	<0.0004	0.0006

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Cesium (µg/L)		Chromium (µg/L)		Cobalt (µg/L)		Copper (µg/L)		Dysprosium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002—Continued												
KC5a	09-11-02	< 1	<0.03	0.01	<0.5	0.2	0.067	0.020	0.27	0.01	0.0030	0.0001
KC2	09-11-02	1	<0.03	0.01	<0.5	0.2	0.059	0.005	0.31	0.03	0.0015	0.0003
KC2	09-11-02	20	<0.03	0.01	<0.5	0.2	0.046	0.005	0.37	0.07	0.0024	0.0005
KC3	09-11-02	1	<0.03	0.01	<0.5	0.0	0.079	0.034	0.31	0.00	0.0014	0.0005
KC3	09-11-02	20	<0.03	0.01	<0.5	0.3	0.053	0.030	0.33	0.01	0.0020	0.0002
FC1a	09-10-02	< 1	<0.03	0.02	<0.5	0.3	0.042	0.007	0.24	0.05	0.0021	0.0004
FC2	09-10-02	1	<0.03	0.01	<0.5	0.3	0.039	0.013	0.21	0.05	0.0028	0.0001
FC4	09-10-02	1	<0.03	0.02	<0.5	0.2	0.057	0.012	0.37	0.04	0.0015	0.0004
FC4	09-10-02	20	<0.03	0.01	<0.5	0.2	0.051	0.018	0.36	0.00	0.0017	0.0004
FC5	09-10-02	1	<0.03	0.01	<0.5	0.2	0.056	0.012	0.34	0.04	0.0018	0.0000
FC5	09-10-02	20	<0.03	0.00	<0.5	0.2	0.038	0.000	0.25	0.05	0.0020	0.0003
MC2b	09-09-02	< 1	<0.03	0.01	<0.5	0.1	0.065	0.035	0.50	0.02	0.0030	0.0002
MC2b	09-09-02	< 1	<0.03	0.01	<0.5	0.3	0.041	0.003	0.35	0.08	0.0026	0.0009
MC2c	09-09-02	1	<0.03	0.01	<0.5	0.3	0.041	0.008	0.45	0.16	0.0020	0.0004
MC3	09-09-02	1	<0.03	0.01	<0.5	0.3	0.036	0.012	0.32	0.05	0.0025	0.0008
MC4	09-09-02	1	<0.03	0.00	<0.5	0.2	0.040	0.003	0.40	0.03	0.0010	0.0004
MC4	09-09-02	1	<0.03	0.01	<0.5	0.3	0.053	0.014	0.37	0.06	0.0011	0.0005
MC4	09-09-02	35	<0.03	0.01	<0.5	0.3	0.085	0.020	0.19	0.10	0.0031	0.0001
MC5	09-09-02	1	<0.03	0.02	<0.5	0.3	0.045	0.005	0.34	0.08	0.0019	0.0004
MC5	09-09-02	35	<0.03	0.01	<0.5	0.3	0.060	0.004	0.28	0.05	0.0020	0.0007
Blank[3]	09-12-02	--	<0.03	0.01	<0.5	0.2	<0.003	0.002	<0.03	0.00	<0.0004	0.0002
Blank[5]	09-12-02	--	<0.03	0.00	<0.5	0.3	<0.003	0.003	<0.03	0.00	<0.0004	0.0002
Blank[7]	09-12-02	--	<0.03	0.01	<0.5	0.2	<0.003	0.001	0.03	0.05	<0.0004	0.0002

Site name	Date	Depth (meters)	Erbium (µg/L)		Europium (µg/L)		Gadolinium (µg/L)		Gallium (µg/L)		Germanium (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	0.0016	0.0007	0.0020	0.0041	0.0023	0.0005	<0.0008	0.0008	0.022	0.004
KC2	09-11-02	1	0.0012	0.0004	<0.0002	0.0015	0.0017	0.0003	<0.0008	0.0001	0.019	0.004
KC2	09-11-02	20	0.0018	0.0003	0.0009	0.0016	0.0023	0.0009	<0.0008	0.0015	0.020	0.004
KC3	09-11-02	1	0.0009	0.0003	0.0066	0.0063	0.0017	0.0007	<0.0008	0.0012	0.016	0.001
KC3	09-11-02	20	0.0017	0.0005	0.0014	0.0036	0.0021	0.0005	<0.0008	0.0006	0.017	0.004
FC1a	09-10-02	< 1	0.0014	0.0001	<0.0002	0.0014	0.0022	0.0003	<0.0008	0.0009	0.020	0.003
FC2	09-10-02	1	0.0010	0.0004	0.0005	0.0029	0.0026	0.0011	<0.0008	0.0012	0.019	0.004
FC4	09-10-02	1	0.0005	0.0000	<0.0002	0.0021	0.0011	0.0005	<0.0008	0.0019	0.018	0.002
FC4	09-10-02	20	0.0012	0.0000	0.0006	0.0047	0.0018	0.0001	<0.0008	0.0002	0.016	0.002
FC5	09-10-02	1	0.0008	0.0002	0.0028	0.0039	0.0019	0.0004	<0.0008	0.0011	0.020	0.003
FC5	09-10-02	20	0.0015	0.0002	0.0017	0.0030	0.0022	0.0001	<0.0008	0.0006	0.017	0.000
MC2b	09-09-02	< 1	0.0015	0.0002	0.0005	0.0035	0.0029	0.0008	<0.0008	0.0019	0.017	0.003
MC2b	09-09-02	< 1	0.0016	0.0005	<0.0002	0.0003	0.0037	0.0005	<0.0008	0.0011	0.017	0.005
MC2c	09-09-02	1	0.0011	0.0008	<0.0002	0.0001	0.0020	0.0005	<0.0008	0.0025	0.015	0.003
MC3	09-09-02	1	0.0012	0.0003	<0.0002	0.0015	0.0012	0.0003	<0.0008	0.0016	0.020	0.004
MC4	09-09-02	1	0.0008	0.0003	<0.0002	0.0007	<0.0007	0.0001	<0.0008	0.0016	0.022	0.001
MC4	09-09-02	1	<0.0004	0.0003	<0.0002	0.0003	0.0010	0.0005	<0.0008	0.0010	0.020	0.002
MC4	09-09-02	35	0.0021	0.0001	<0.0002	0.0016	0.0031	0.0002	<0.0008	0.0009	0.019	0.002
MC5	09-09-02	1	0.0007	0.0002	<0.0002	0.0013	0.0012	0.0006	<0.0008	0.0010	0.020	0.005
MC5	09-09-02	35	0.0017	0.0002	<0.0002	0.0026	0.0021	0.0004	<0.0008	0.0012	0.018	0.002
Blank[3]	09-12-02	--	<0.0004	0.0002	<0.0002	0.0002	<0.0007	0.0001	<0.0008	0.0001	<0.006	0.003
Blank[5]	09-12-02	--	<0.0004	0.0001	<0.0002	0.0001	<0.0007	0.0002	<0.0008	0.0008	<0.006	0.002
Blank[7]	09-12-02	--	<0.0004	0.0002	<0.0002	0.0002	<0.0007	0.0001	<0.0008	0.0007	<0.006	0.004

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Gold (µg/L)		Hafnium (µg/L)		Holmium (µg/L)		Iron (µg/L)		Lanthanum (µg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002—Continued												
KC5a	09-11-02	< 1	<0.0003	0.0004	<0.0005	0.0005	0.0006	0.0002	1.0	0.3	0.0053	0.0000
KC2	09-11-02	1	<0.0003	0.0001	0.0007	0.0004	0.0006	0.0001	0.3	0.1	0.0047	0.0004
KC2	09-11-02	20	<0.0003	0.0002	<0.0005	0.0002	0.0007	0.0001	0.9	0.2	0.012	0.001
KC3	09-11-02	1	<0.0003	0.0000	<0.0005	0.0004	0.0006	0.0002	1.2	0.4	0.0045	0.0006
KC3	09-11-02	20	<0.0003	0.0001	<0.0005	0.0006	0.0006	0.0001	1.1	0.1	0.0067	0.0005
FC1a	09-10-02	< 1	<0.0003	0.0002	0.0007	0.0004	0.0009	0.0000	1.3	0.8	0.0050	0.0006
FC2	09-10-02	1	<0.0003	0.0003	0.0007	0.0001	0.0006	0.0001	1.1	0.3	0.0057	0.0004
FC4	09-10-02	1	<0.0003	0.0001	<0.0005	0.0007	0.0006	0.0001	0.6	0.4	0.0041	0.0005
FC4	09-10-02	20	<0.0003	0.0000	<0.0005	0.0002	0.0007	0.0001	0.7	0.1	0.0045	0.0002
FC5	09-10-02	1	<0.0003	0.0001	0.0008	0.0002	0.0005	0.0001	0.5	0.4	0.0044	0.0002
FC5	09-10-02	20	<0.0003	0.0004	<0.0005	0.0003	0.0006	0.0000	0.9	0.3	0.0041	0.0000
MC2b	09-09-02	< 1	<0.0003	0.0001	0.0007	0.0003	0.0008	0.0001	3.7	0.4	0.0098	0.0001
MC2b	09-09-02	< 1	<0.0003	0.0002	0.0009	0.0000	0.0007	0.0001	2.3	0.2	0.0080	0.0002
MC2c	09-09-02	1	<0.0003	0.0001	0.0031	0.0004	0.0005	0.0001	2.9	0.4	0.011	0.000
MC3	09-09-02	1	<0.0003	0.0000	<0.0005	0.0003	0.0006	0.0001	2.3	0.0	0.0065	0.0000
MC4	09-09-02	1	<0.0003	0.0001	<0.0005	0.0001	0.0004	0.0001	1.9	2.5	0.0037	0.0003
MC4	09-09-02	1	<0.0003	0.0002	<0.0005	0.0003	0.0005	0.0000	<0.3	0.2	0.0031	0.0008
MC4	09-09-02	35	<0.0003	0.0002	0.0006	0.0002	0.0009	0.0001	1.7	0.1	0.0094	0.0004
MC5	09-09-02	1	<0.0003	0.0002	<0.0005	0.0004	0.0006	0.0001	1.0	0.2	0.0052	0.0001
MC5	09-09-02	35	<0.0003	0.0002	<0.0005	0.0003	0.0006	0.0003	1.7	0.7	0.0049	0.0001
Blank[3]	09-12-02	--	<0.0003	0.0002	<0.0005	0.0003	<0.0001	0.0001	<0.3	0.3	<0.0004	0.0001
Blank[5]	09-12-02	--	<0.0003	0.0000	<0.0005	0.0006	<0.0001	0.0001	<0.3	0.1	<0.0004	0.0001
Blank[7]	09-12-02	--	<0.0003	0.0002	<0.0005	0.0005	<0.0001	0.0000	<0.3	0.1	<0.0004	0.0003

Site name	Date	Depth (meters)	Lead (µg/L)		Lithium (µg/L)		Lutetium (µg/L)		Manganese (µg/L)		Mercury (ng/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	0.015	0.001	37	0	0.0003	0.0002	1.5	0.0	0.3	0.2
KC2	09-11-02	1	0.013	0.000	38	1	0.0002	0.0002	0.16	0.00	0.1	0.1
KC2	09-11-02	20	0.048	0.004	33	1	0.0002	0.0000	0.46	0.05	0.2	0.0
KC3	09-11-02	1	0.029	0.014	37	0	0.0002	0.0001	0.24	0.03	0.3	0.1
KC3	09-11-02	20	0.014	0.003	32	0	0.0004	0.0001	0.42	0.04	0.2	0.1
FC1a	09-10-02	< 1	0.014	0.001	33	0	<0.0001	0.0000	5.4	0.1	0.3	0.1
FC2	09-10-02	1	0.013	0.000	34	0	<0.0001	0.0001	0.33	0.03	0.4	0.0
FC4	09-10-02	1	0.023	0.000	36	1	0.0003	0.0001	0.22	0.01	0.2	0.0
FC4	09-10-02	20	0.020	0.009	32	1	0.0004	0.0001	0.38	0.01	0.3	0.2
FC5	09-10-02	1	0.010	0.003	34	0	<0.0001	0.0000	0.22	0.06	0.3	0.1
FC5	09-10-02	20	0.014	0.002	32	0	0.0003	0.0001	0.37	0.03	0.1	0.1
MC2b	09-09-02	< 1	0.028	0.003	32	0	0.0002	0.0001	0.69	0.01	0.4	0.1
MC2b	09-09-02	< 1	0.016	0.004	31	1	<0.0001	0.0000	0.56	0.06	0.9	0.2
MC2c	09-09-02	1	0.032	0.003	31	1	<0.0001	0.0001	0.25	0.00	0.5	0.2
MC3	09-09-02	1	0.023	0.003	32	1	<0.0001	0.0001	0.30	0.02	0.3	0.1
MC4	09-09-02	1	0.017	0.002	34	0	<0.0001	0.0000	0.11	0.02	0.3	0.1
MC4	09-09-02	1	0.013	0.000	35	0	0.0002	0.0000	0.09	0.09	0.3	0.1
MC4	09-09-02	35	0.015	0.003	31	0	0.0004	0.0000	37	1	0.3	0.2

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Lead (μg/L)		Lithium (μg/L)		Lutetium (μg/L)		Manganese (μg/L)		Mercury (ng/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002—Continued												
MC5	09-09-02	1	0.016	0.003	33	1	0.0002	0.0002	0.28	0.21	0.2	0.1
MC5	09-09-02	35	0.012	0.002	31	0	0.0004	0.0000	18	1	0.4	0.1
Blank[3]	09-12-02	--	0.003	0.001	<0.04	0.02	<0.0001	0.0000	0.20	0.04	0.6	0.1
Blank[5]	09-12-02	--	0.008	0.001	<0.04	0.01	<0.0001	0.0000	0.23	0.07	0.5	0.2
Blank[7]	09-12-02	--	0.029	0.002	<0.04	0.00	<0.0001	0.0001	0.22	0.03	0.4	0.1

Site name	Date	Depth (meters)	Molybdenum (μg/L)		Nickel (μg/L)		Phosphorus (μg/L)		Praseodymium (μg/L)		Rhenium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	5.1	0.0	0.0058	0.0005	<7	11	0.0013	0.0003	0.089	0.001
KC2	09-11-02	1	5.2	0.0	0.0040	0.0003	<7	3	0.0007	0.0002	0.096	0.005
KC2	09-11-02	20	4.5	0.0	0.0081	0.0024	<7	3	0.0012	0.0003	0.071	0.001
KC3	09-11-02	1	5.1	0.1	0.0051	0.0003	<7	3	0.0008	0.0000	0.091	0.001
KC3	09-11-02	20	4.4	0.3	0.0062	0.0011	<7	9	0.0012	0.0001	0.071	0.001
FC1a	09-10-02	< 1	4.4	0.1	0.0071	0.0012	<7	0	0.0013	0.0001	0.072	0.001
FC2	09-10-02	1	4.4	0.0	0.0071	0.0005	<7	7	0.0014	0.0001	0.073	0.001
FC4	09-10-02	1	5.0	0.0	0.0042	0.0008	<7	4	0.0006	0.0001	0.086	0.001
FC4	09-10-02	20	4.3	0.1	0.0058	0.0002	<7	7	0.0010	0.0003	0.074	0.001
FC5	09-10-02	1	4.6	0.1	0.0054	0.0006	<7	4	0.0008	0.0001	0.079	0.001
FC5	09-10-02	20	4.2	0.1	0.0062	0.0004	<7	1	0.0010	0.0002	0.071	0.001
MC2b	09-09-02	< 1	4.3	0.1	0.013	0.001	<7	3	0.0022	0.0002	0.071	0.001
MC2b	09-09-02	< 1	4.5	0.0	0.0098	0.0014	<7	1	0.0017	0.0001	0.071	0.001
MC2c	09-09-02	1	4.6	0.2	0.0089	0.0011	8	4	0.0014	0.0001	0.072	0.001
MC3	09-09-02	1	4.3	0.1	0.0065	0.0006	<7	2	0.0012	0.0002	0.074	0.001
MC4	09-09-02	1	4.6	0.1	0.0039	0.0003	<7	4	0.0006	0.0001	0.078	0.003
MC4	09-09-02	1	4.7	0.1	0.0038	0.0009	<7	6	0.0004	0.0000	0.080	0.001
MC4	09-09-02	35	4.1	0.1	0.014	0.000	<7	6	0.0026	0.0001	0.069	0.002
MC5	09-09-02	1	4.7	0.0	0.0053	0.0003	<7	2	0.0011	0.0002	0.083	0.004
MC5	09-09-02	35	4.1	0.1	0.0081	0.0015	<7	1	0.0023	0.0001	0.067	0.000
Blank[3]	09-12-02	--	<0.06	0.02	<0.0004	0.0001	<7	2	<0.0002	0.0001	--	--
Blank[5]	09-12-02	--	<0.06	0.02	<0.0004	0.0007	<7	5	<0.0002	0.0000	<0.0001	0.0001
Blank[7]	09-12-02	--	<0.06	0.07	<0.0004	0.0002	<7	4	<0.0002	0.0001	<0.0001	0.0002

Site name	Date	Depth (meters)	Rubidium (μg/L)		Samarium (μg/L)		Scandium (μg/L)		Selenium (μg/L)		Strontium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	2.3	0.0	0.002	0.002	0.20	0.02	2.7	0.1	830	10
KC2	09-11-02	1	2.4	0.0	0.002	0.001	0.22	0.02	2.8	0.0	870	0
KC2	09-11-02	20	1.9	0.0	0.002	0.000	0.23	0.04	2.4	0.1	790	10
KC3	09-11-02	1	2.3	0.0	0.002	0.001	0.17	0.02	2.6	0.0	860	10
KC3	09-11-02	20	1.9	0.0	0.002	0.000	0.21	0.03	2.5	0.2	790	0
FC1a	09-10-02	< 1	2.0	0.0	0.002	0.001	0.17	0.04	2.3	0.2	760	10
FC2	09-10-02	1	2.1	0.0	0.003	0.000	0.11	0.04	2.3	0.1	760	10
FC4	09-10-02	1	2.3	0.0	0.001	0.001	0.30	0.05	2.8	0.0	860	10
FC4	09-10-02	20	1.9	0.0	0.002	0.001	0.30	0.03	2.4	0.1	790	10
FC5	09-10-02	1	2.1	0.0	0.002	0.001	0.23	0.04	2.4	0.1	800	0

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Rubidium (μg/L)		Samarium (μg/L)		Scandium (μg/L)		Selenium (μg/L)		Strontium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002—Continued												
FC5	09-10-02	20	1.8	0.0	0.003	0.001	0.25	0.05	2.1	0.1	780	0
MC2b	09-09-02	< 1	1.7	0.1	0.003	0.001	0.24	0.04	2.0	0.1	740	30
MC2b	09-09-02	< 1	1.8	0.0	0.002	0.001	0.19	0.17	2.1	0.1	760	0
MC2c	09-09-02	1	1.8	0.0	0.003	0.001	0.16	0.02	2.1	0.1	760	10
MC3	09-09-02	1	1.9	0.0	0.003	0.001	0.16	0.08	2.2	0.1	770	10
MC4	09-09-02	1	2.1	0.0	0.001	0.001	0.15	0.03	2.3	0.1	810	0
MC4	09-09-02	1	2.1	0.0	<0.001	0.000	0.27	0.09	2.4	0.1	800	0
MC4	09-09-02	35	1.5	0.0	0.005	0.000	0.18	0.00	1.9	0.0	760	10
MC5	09-09-02	1	2.1	0.0	0.003	0.001	0.18	0.14	2.5	0.0	820	10
MC5	09-09-02	35	1.6	0.0	0.003	0.001	0.20	0.00	2.1	0.1	770	10
Blank[3]	09-12-02	--	--	--	--	--	<0.08	0.05	<0.2	0.1	0.40	0.04
Blank[5]	09-12-02	--	0.003	0.001	<0.001	0.000	<0.08	0.01	<0.2	0.0	0.39	0.03
Blank[7]	09-12-02	--	0.003	0.000	<0.001	0.001	<0.08	0.05	<0.2	0.1	0.38	0.01

Site name	Date	Depth (meters)	Tantalum (μg/L)		Tellurium (μg/L)		Terbium (μg/L)		Thallium (μg/L)		Thorium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	<0.0008	0.0005	0.021	0.001	0.0008	0.0002	0.009	0.003	0.012	0.001
KC2	09-11-02	1	<0.0008	0.0004	0.024	0.006	0.0005	0.0001	0.007	0.001	0.011	0.004
KC2	09-11-02	20	<0.0008	0.0005	0.017	0.006	0.0008	0.0000	0.005	0.001	0.005	0.000
KC3	09-11-02	1	<0.0008	0.0002	0.022	0.001	0.0007	0.0001	0.009	0.001	0.015	0.007
KC3	09-11-02	20	<0.0008	0.0007	0.017	0.003	0.0007	0.0001	0.007	0.001	0.011	0.007
FC1a	09-10-02	< 1	<0.0008	0.0006	0.016	0.002	0.0006	0.0001	0.007	0.001	0.011	0.004
FC2	09-10-02	1	<0.0008	0.0002	0.015	0.005	0.0005	0.0002	0.006	0.001	0.014	0.008
FC4	09-10-02	1	<0.0008	0.0006	0.025	0.001	0.0006	0.0000	0.009	0.001	0.005	0.002
FC4	09-10-02	20	<0.0008	0.0003	0.018	0.005	0.0004	0.0000	0.008	0.001	0.007	0.001
FC5	09-10-02	1	<0.0008	0.0002	0.017	0.006	0.0005	0.0000	0.008	0.002	0.012	0.006
FC5	09-10-02	20	<0.0008	0.0008	0.011	0.001	0.0004	0.0001	0.006	0.001	0.009	0.001
MC2b	09-09-02	< 1	<0.0008	0.0002	0.029	0.002	0.0006	0.0002	0.007	0.002	0.019	0.003
MC2b	09-09-02	< 1	<0.0008	0.0003	0.021	0.005	0.0005	0.0001	0.005	0.000	0.012	0.002
MC2c	09-09-02	1	<0.0008	0.0005	0.018	0.002	0.0006	0.0001	0.005	0.001	0.014	0.007
MC3	09-09-02	1	<0.0008	0.0004	0.021	0.003	0.0004	0.0000	0.009	0.000	0.020	0.002
MC4	09-09-02	1	<0.0008	0.0004	0.018	0.004	0.0005	0.0000	0.010	0.003	0.024	0.002
MC4	09-09-02	1	<0.0008	0.0001	0.018	0.001	0.0003	0.0001	0.007	0.002	0.004	0.004
MC4	09-09-02	35	<0.0008	0.0004	0.011	0.003	0.0005	0.0000	0.006	0.000	0.013	0.007
MC5	09-09-02	1	<0.0008	0.0005	0.022	0.004	0.0005	0.0001	0.010	0.003	0.011	0.002
MC5	09-09-02	35	<0.0008	0.0007	0.013	0.003	0.0004	0.0001	0.008	0.001	0.011	0.002
Blank[3]	09-12-02	--	<0.0008	0.0001	<0.005	0.003	<0.0001	0.0000	<0.001	0.004	<0.001	0.001
Blank[5]	09-12-02	--	<0.0008	0.0002	<0.005	0.002	<0.0001	0.0000	<0.001	0.001	<0.001	0.001
Blank[7]	09-12-02	--	<0.0008	0.0003	<0.005	0.002	<0.0001	0.0001	<0.001	0.002	<0.001	0.001

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Thulium (μg/L)		Titanium (μg/L)		Tungsten (μg/L)		Uranium (μg/L)		Vanadium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002—Continued												
KC5a	09-11-02	< 1	<0.0002	0.0001	<0.3	0.2	0.048	0.001	4.6	0.0	2.3	0.0
KC2	09-11-02	1	0.0002	0.0001	<0.3	0.1	0.048	0.003	4.8	0.1	2.4	0.0
KC2	09-11-02	20	0.0003	0.0000	<0.3	0.0	0.035	0.001	4.2	0.1	2.1	0.0
KC3	09-11-02	1	<0.0002	0.0000	<0.3	0.1	0.042	0.003	4.7	0.1	2.0	0.0
KC3	09-11-02	20	<0.0002	0.0000	<0.3	0.1	0.041	0.000	4.2	0.1	1.8	0.1
FC1a	09-10-02	< 1	<0.0002	0.0001	<0.3	0.1	0.046	0.002	4.1	0.0	1.8	0.0
FC2	09-10-02	1	<0.0002	0.0001	<0.3	0.1	0.046	0.001	4.2	0.1	1.9	0.1
FC4	09-10-02	1	0.0003	0.0001	<0.3	0.1	0.044	0.002	4.6	0.1	1.8	0.1
FC4	09-10-02	20	0.0002	0.0001	<0.3	0.2	0.036	0.003	4.1	0.1	1.8	0.0
FC5	09-10-02	1	<0.0002	0.0000	<0.3	0.0	0.041	0.002	4.3	0.0	2.4	0.1
FC5	09-10-02	20	0.0002	0.0000	<0.3	0.1	0.035	0.004	4.0	0.0	2.1	0.0
MC2b	09-09-02	< 1	<0.0002	0.0001	<0.3	0.1	0.053	0.001	4.0	0.0	1.7	0.0
MC2b	09-09-02	< 1	<0.0002	0.0000	<0.3	0.1	0.058	0.004	4.2	0.1	1.7	0.1
MC2c	09-09-02	1	<0.0002	0.0001	<0.3	0.0	0.049	0.000	4.1	0.1	1.9	0.0
MC3	09-09-02	1	<0.0002	0.0000	<0.3	0.2	0.042	0.009	4.2	0.1	1.7	0.0
MC4	09-09-02	1	<0.0002	0.0001	<0.3	0.1	0.040	0.006	4.4	0.1	1.9	0.0
MC4	09-09-02	1	<0.0002	0.0001	<0.3	0.1	0.044	0.008	4.4	0.0	1.7	0.0
MC4	09-09-02	35	0.0004	0.0001	<0.3	0.0	0.038	0.002	4.0	0.0	1.7	0.0
MC5	09-09-02	1	<0.0002	0.0001	<0.3	0.2	0.043	0.002	4.4	0.0	1.7	0.0
MC5	09-09-02	35	0.0002	0.0000	<0.3	0.1	0.042	0.000	4.0	0.1	1.7	0.0
Blank[3]	09-12-02	--	<0.0002	0.0001	<0.3	0.1	0.044	0.002	<0.003	0.002	<0.1	0.0
Blank[5]	09-12-02	--	<0.0002	0.0001	<0.3	0.1	0.043	0.002	<0.003	0.001	<0.1	0.1
Blank[7]	09-12-02	--	<0.0002	0.0000	<0.3	0.0	0.043	0.001	<0.003	0.001	<0.1	0.0

Site name	Date	Depth (meters)	Ytterbium (μg/L)		Yttrium (μg/L)		Zinc (μg/L)		Zirconium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5a	09-11-02	< 1	0.0014	0.0002	0.027	0.000	1.0	0.1	0.038	0.003
KC2	09-11-02	1	0.0013	0.0002	0.022	0.000	0.3	0.0	0.036	0.003
KC2	09-11-02	20	0.0013	0.0001	0.023	0.001	2.6	0.2	0.10	0.00
KC3	09-11-02	1	0.0010	0.0003	0.018	0.001	0.9	0.0	0.018	0.002
KC3	09-11-02	20	0.0008	0.0002	0.013	0.001	1.6	0.0	0.017	0.005
FC1a	09-10-02	< 1	0.0006	0.0002	0.012	0.000	0.6	0.1	0.018	0.007
FC2	09-10-02	1	0.0023	0.0006	0.032	0.000	1.0	0.0	0.027	0.006
FC4	09-10-02	1	0.0013	0.0003	0.015	0.001	1.5	0.1	0.024	0.002
FC4	09-10-02	20	0.0020	0.0003	0.024	0.000	0.7	0.1	0.029	0.001
FC5	09-10-02	1	0.0011	0.0005	0.021	0.001	2.0	0.1	0.022	0.006
FC5	09-10-02	20	0.0013	0.0003	0.021	0.001	0.7	0.1	0.031	0.002
MC2b	09-09-02	< 1	0.0009	0.0004	0.016	0.001	1.2	0.0	0.029	0.002
MC2b	09-09-02	< 1	0.0021	0.0002	0.020	0.001	2.2	0.1	0.020	0.000
MC2c	09-09-02	1	0.0014	0.0001	0.018	0.000	1.1	0.1	0.025	0.001

See footnotes at end of table.

Table 10. Field measurements, major ions, dissolved carbon, nutrients, and trace and rare earth elements in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Ytterbium (μg/L)		Yttrium (μg/L)		Zinc (μg/L)		Zirconium (μg/L)	
			Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
Trace and Rare Earth Elements, September 2002—Continued										
MC3	09-09-02	1	0.0018	0.0004	0.019	0.001	3.0	0.1	0.021	0.004
MC4	09-09-02	1	0.0013	0.0003	0.022	0.001	4.8	0.1	0.022	0.000
MC4	09-09-02	1	0.0014	0.0004	0.016	0.001	1.4	0.0	0.023	0.003
MC4	09-09-02	35	0.0021	0.0009	0.024	0.001	1.7	0.1	0.027	0.006
MC5	09-09-02	1	0.0015	0.0001	0.019	0.001	0.7	0.0	0.024	0.006
MC5	09-09-02	35	0.0025	0.0005	0.021	0.001	0.8	0.1	0.023	0.001
Blank[3]	09-12-02	--	<0.0004	0.0001	<0.0003	0.0001	<0.1	0.0	<0.002	0.000
Blank[5]	09-12-02	--	<0.0004	0.0002	<0.0003	0.0003	0.6	0.1	<0.002	0.001
Blank[7]	09-12-02	--	<0.0004	0.0001	<0.0003	0.0001	<0.1	0.0	0.003	0.005

[1]Main lake channel at mouth of canyon.
[2]MilliQ water deionizing system.
[3]Process.
[4]Churn.
[5]Holding bottle.
[6]Filter.
[7]Deionized water from carboy.

Table 11. Volatile organic compounds, total petroleum hydrocarbons, and oil and grease in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

[TPH, total petroleum hydrocarbons; µg/L, micrograms per liter, <, less than; e, estimated. Dashes indicate no data]

Site name	Date	Depth (meters)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	o-xylene (µg/L)	m- and p-xylene (µg/L)	Xylenes, total (µg/L)	Methyl-t-butyl ether (MTBE) (µg/L)	Tetra-chloro-ethylene (µg/L)	Bromo-form (µg/L)	TPH (mg/L)	Oil/grease (mg/L)
May 2001													
KC2	05-17-01	4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	--	<1
KC3	05-17-01	5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	<1
KC3	05-17-01	25	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	--	--
KC5	05-17-01	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	2
FC1	05-16-01	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.5	<0.5	<2	--
FC2	05-16-01	10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	4
FC4	05-16-01	4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	2
FC4	05-16-01	25	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	--	--
MC2	05-15-01	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.5	<0.5	<2	--
MC3	05-15-01	13	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	--	<1
MC5	05-15-01	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	e0.1	<0.5	<0.5	<2	1
MC5	05-15-01	30	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	--	--
MC6	05-15-01	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.5	<0.5	<2	--
September 2001													
KC2	09-06-01	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.5	<0.5	<2	<1
KC3	09-06-01	1	e0.1	0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.5	<0.5	<2	<1
KC5	09-06-01	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	e0.1	<0.5	<0.5	--	--
FC1	09-07-01	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.0	<0.5	<0.5	<2	<1
FC2	09-07-01	1	0.4	0.7	<0.2	0.2	0.3	0.5	1.1	<0.5	<0.5	<2	2
FC4	09-07-01	1	0.3	0.6	<0.2	<0.2	e0.1	e0.1	0.6	<0.5	<0.5	<2	<1
FC5	09-07-01	1	0.2	0.5	<0.2	<0.2	e0.1	e0.1	0.4	<0.5	<0.5	<2	<1
MC2	09-05-01	< 1	0.5	0.6	<0.2	0.3	e0.1	0.4	1.5	<0.5	<0.5	<2	1
MC3	09-05-01	1	0.9	2.4	0.2	0.4	0.7	1.1	1.4	<0.5	<0.5	<2	1
MC4	09-05-01	1	0.8	2.8	0.2	0.4	0.4	0.9	0.6	<0.5	<0.5	<2	<1
MC5	09-05-01	1	0.3	1.1	e0.1	e0.1	0.2	0.3	0.4	<0.5	<0.5	2	<1
MC6	09-05-01	< 1	0.5	<0.2	<0.2	e0.1	<0.2	e0.1	2.6	<0.5	<0.5	<2	<1
MC6d	09-07-01	< 1	3.1	3.8	0.2	2.4	3.5	5.9	3.0	<0.5	<0.5	--	--

Table 11. Volatile organic compounds, total petroleum hydrocarbons, and oil and grease in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Benzene (μg/L)	Toluene (μg/L)	Ethyl-benzene (μg/L)	o-xylene (μg/L)	m- and p-xylene (μg/L)	Xylenes, total (μg/L)	Methyl-t-butyl ether (MTBE) (μg/L)	Tetra-chloro-ethylene (μg/L)	Bromo-form (μg/L)	TPH (mg/L)	Oil/grease (mg/L)
							May 2002						
KC2	05-22-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	<7
KC3	05-22-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	<7
KC5	05-22-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	--	--
FC2	05-21-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.5	<0.5	<2	<7
FC4	05-21-02	1	0.2	0.3	<0.2	0.1	0.3	0.5	0.2	<0.5	<0.5	<2	<7
FC5	05-21-02	1	0.4	0.8	0.2	0.3	0.8	1.1	0.3	<0.5	<0.5	<2	e5
MC3	05-20-02	1	0.2	0.2	<0.2	0.1	0.2	0.4	0.4	<0.5	<0.5	<2	e5
MC4	05-20-02	1	0.3	0.3	<0.2	0.2	0.6	0.8	0.3	<0.5	<0.5	<2	<7
MC5	05-20-02	1	e0.1	0.2	<0.2	<0.2	0.2	0.2	<0.2	<0.5	<0.5	<2	<7
							September 2002						
KC5a	09-12-02	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	<7
KC2	09-12-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	--	--	<2	<7
KC3	09-12-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	--	--	<2	<7
KC4	09-12-02	<1	0.1	<0.2	<0.2	<0.2	< 0.2	< 0.2	< 0.2	--	--	--	--
FC1a	09-10-02	< 1	e0.1	0.4	<0.2	0.1	0.3	0.4	0.2	<0.5	<0.5	<2	<7
FC2	09-10-02	1	0.3	0.7	0.1	0.2	0.5	0.8	0.3	<0.5	<0.5	3	<7
FC4	09-10-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	<7
FC5	09-10-02	1	0.2	0.4	<0.2	0.1	0.3	0.4	0.2	<0.5	<0.5	<2	<7
FC5	09-10-02	20	--	--	--	--	--	--	--	<0.5	<0.5	--	--
MC2b	09-10-02	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	--	--	<2	e4
MC2b[1]	09-10-02	< 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.5	<0.5	<2	<7
MC3	09-10-02	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	--	--	<2	<7
MC4	09-10-02	1	0.5	0.9	e0.1	0.2	0.5	0.7	<0.2	<0.5	<0.5	<2	<7
MC4[1]	09-10-02	1	0.4	0.7	<0.2	0.2	0.3	0.5	<0.2	--	--	<2	<7
MC5	09-10-02	1	e0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<2	<7

[1]Duplicate.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

[<, less than; e, estimated; BHA, butylaten-hydroxyanisol; EDTA, ethylenediaminetetraacetic acid; NP1EC, nonylphenolmonoethoxycarboxylic acid; NP2EC, nonylphenoldiethoxycarboxylic acid; NP3EC, nonylphenotriethoxycarboxylic acid, NP4EC, nonylphenoltetraethoxycarboxlic acid,NTA, nitrilotriacetic acid; OPEO1, octylphenol-monoethoxylate; OPEO2, octylphenol-2ethoxylate; NPEO1, nonylphenol-monorthoxylate; PBDE, polybrominated diphenylether. Dashes indicate no data]

Site name	Date	Depth (meters)	Time	Cumene (μg/L)	Phenol (μg/L)	1,4-dichloro-benzene (μg/L)	d-limonene (μg/L)	Aceto-phenone (μg/L)	para-cresol (μg/L)	Isopho-rone (μg/L)	Camphor (μg/L)	Isoborneol (μg/L)
						Organic Wastewater Compounds, 2001						
KC2	05-17-01	4	1030	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC3	05-17-01	5	1130	<0.5	e15	<0.5	<0.5	<0.5	<1	e0.5	<0.5	<0.5
KC3	05-17-01	25	1200	<0.5	e29	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC5	05-17-01	<1	0930	<0.5	e0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC2	09-06-01	1	1500	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC3	09-06-01	1	1600	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC3	09-06-01	30	1610	--	--	--	--	--	--	--	--	--
KC5	09-06-01	<1	1430	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC1	05-16-01	<1	0900	<0.5	e0.4	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC2	05-16-01	10	1000	e0.29	e13	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC4	05-16-01	4	1120	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC4	05-16-01	25	1130	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--
FC5	09-07-01	25	1310	--	--	--	--	--	--	--	--	--
FC1	09-07-01	<1	0830	<0.5	e0.4	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC2	09-07-01	1	0900	<0.5	e0.6	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC2	09-07-01	15	0920	--	--	--	--	--	--	--	--	--
FC4	09-07-01	1	1030	<0.5	e0.6	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC4	09-07-01	30	1050	--	--	--	--	--	--	--	--	--
FC5	09-07-01	1	1100	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC5	09-7-01	30	1120	--	--	--	--	--	--	--	--	--
MC2	05-15-01	<1	1000	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC3	05-15-01	13	1330	<0.5	e0.3	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC4	05-15-01	30	1745	--	--	--	--	--	--	--	--	--
MC5	05-15-01	1	1630	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC5	05-15-01	30	1645	<0.5	e1.4	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC6	05-15-01	<1	1200	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC2	09-05-01	<1	1310	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC3	09-05-01	1	1600	<0.5	e0.3	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC4	09-05-01	1	1700	<0.5	e0.4	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	--	--	--	--	--	--	--	--	--
MC5	09-07-01	1	1200	<0.5	e0.7	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC5	09-07-01	30	1220	--	--	--	--	--	--	--	--	--
MC6	09-05-01	<1	1500	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC6d	09-05-01	0.1	1530	<0.5	e0.3	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Cumene (µg/L)	Phenol (µg/L)	1,4-dichloro-benzene (µg/L)	d-limonene (µg/L)	Aceto-phenone (µg/L)	para-cresol (µg/L)	Isopho-rone (µg/L)	Camphor (µg/L)	Isoborneol (µg/L)
Organic Wastewater Compounds, 2002												
KC2	05-22-02	1	1525	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC3	05-22-02	1	1545	<0.5	e0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<0.5	e0.3	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC5	09-12-02	<1	1145	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<0.5	e0.3	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	<0.5	e0.4	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC2	09-11-02	1	1345	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC4	09-11-02	1	1450	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	<0.5
FC5	09-11-02	20	1425	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC3	05-21-02	1	1300	<0.5	e0.5	<0.5	<0.5	<0.5	e0.9	<0.5	<0.5	<0.5
MC4	05-21-02	1	1200	<0.5	e0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<0.5	e0.6	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC2c	09-10-02	1	1500	<0.5	e1.8	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<0.5	e0.6	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
MC5	09-11-02	35	1030	--	--	--	--	--	--	--	--	--

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Menthol (µg/L)	Naphth-alene (µg/L)	Methyl salicylate (µg/L)	Dichlor-vos (µg/L)	Isoqui-noline (µg/L)	Indole (µg/L)	2-methyl-naphtha-lene (µg/L)	1-methyl-naphtha-lene (µg/L)	Skatol (µg/L)	2,6-dimethyl-naphtha-lene (µg/L)
						Organic Wastewater Compounds, 2001							
KC2	05-17-01	4	1030	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC3	05-17-01	5	1130	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC3	05-17-01	25	1200	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC5	05-17-01	<1	0930	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC2	09-06-01	1	1500	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC3	09-06-01	1	1600	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC3	09-06-01	30	1610	--	--	--	--	--	--	--	--	--	--
KC5	09-06-01	<1	1430	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC1	05-16-01	<1	0900	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC2	05-16-01	10	1000	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC4	05-16-01	4	1120	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC4	05-16-01	25	1130	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--	--
FC5	05-16-01	25	1310	--	--	--	--	--	--	--	--	--	--
FC1	09-07-01	<1	0830	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC2	09-07-01	1	0900	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC2	09-07-01	15	0920	--	--	--	--	--	--	--	--	--	--
FC4	09-07-01	1	1030	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC4	09-07-01	30	1050	--	--	--	--	--	--	--	--	--	--
FC5	09-07-01	1	1100	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC5	090-7-01	30	1120	--	--	--	--	--	--	--	--	--	--
MC2	05-15-01	<1	1000	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC3	05-15-01	13	1330	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC4	05-15-01	30	1745	--	--	--	--	--	--	--	--	--	--
MC5	05-15-01	1	1630	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC5	05-15-01	30	1645	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC6	05-15-01	<1	1200	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC2	09-05-01	<1	1310	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC3	09-05-01	1	1600	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC4	09-05-01	1	1700	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	--	--	--	--	--	--	--	--	--	--
MC5	09-07-01	1	1200	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC5	09-07-01	30	1220	--	--	--	--	--	--	--	--	--	--
MC6	09-05-01	<1	1500	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
													<0.5

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Menthol (μg/L)	Naphth-alene (μg/L)	Methyl salicylate (μg/L)	Dichlor-vos (μg/L)	Isoqui-noline (μg/L)	Indole (μg/L)	2-methyl-naphtha-lene (μg/L)	1-methyl-naphtha-lene (μg/L)	Skatol (μg/L)	2,6-dimethyl-naphtha-lene (μg/L)
Organic Wastewater Compounds, 2002													
KC2	05-22-02	1	1525	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC3	05-22-02	1	1545	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC5	09-12-02	<1	1145	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC2	09-11-02	1	1345	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC4	09-11-02	1	1450	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
FC5	09-11-02	20	1425	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC3	05-21-02	1	1300	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC4	05-21-02	1	1200	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC2c	09-10-02	1	1500	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<1	<0.5

See footnote at end of table. --

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	BHA (µg/L)	5-methyl-1H-benzo-triazle (µg/L)	N,N-di-ethyltolu-amide (DEET) (µg/L)	4-tert-octyl-phenol (µg/L)	Benzo-phenone (µg/L)	Tributyl-phosphate (µg/L)	Ethyl citrate (µg/L)	Cotinine (µg/L)	Para-nonyl-phenol (total) (µg/L)	Prometon (µg/L)
Organic Wastewater Compounds, 2001													
KC2	05-17-01	4	1030	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC3	05-17-01	5	1130	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC3	05-17-01	25	1200	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC5	05-17-01	<1	0930	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC2	09-06-01	1	1500	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC3	09-06-01	1	1600	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC3	09-06-01	30	1610	--	--	--	--	--	--	--	--	--	--
KC5	09-06-01	<1	1430	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC1	05-16-01	<1	0900	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC2	05-16-01	10	1000	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC4	05-16-01	4	1120	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC4	05-16-01	25	1130	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--	--
FC5	05-16-01	25	1310	--	--	--	--	--	--	--	--	--	--
FC1	09-07-01	<1	0830	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC2	09-07-01	1	0900	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC2	09-07-01	15	0920	--	--	--	--	--	--	--	--	--	--
FC4	09-07-01	1	1030	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC4	09-07-01	30	1050	--	--	--	--	--	--	--	--	--	--
FC5	09-07-01	1	1100	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC5	090-7-01	30	1120	--	--	--	--	--	--	--	--	--	--
MC2	05-15-01	<1	1000	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	e0.5	<0.5
MC3	05-15-01	13	1330	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC4	05-15-01	30	1745	--	--	--	--	--	--	--	--	--	--
MC5	05-15-01	1	1630	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC5	05-15-01	30	1645	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC6	05-15-01	<1	1200	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC2	09-05-01	<1	1310	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC3	09-05-01	1	1600	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC4	09-05-01	1	1700	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	--	--	--	--	--	--	--	--	--	--
MC5	09-07-01	1	1200	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC5	09-07-01	30	1220	--	--	--	--	--	--	--	--	--	--
MC6	09-05-01	<1	1500	<5	<2	e0.1	e0.1	<0.5	<0.5	<0.5	<1	<5	<0.5
													<0.5

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	BHA (μg/L)	5-methyl-1H-benzo-triazle (μg/L)	N,N-die-thyltolu-amide (DEET) (μg/L)	4-tert-octyl-phenol (μg/L)	Benzo-phenone (μg/L)	Tributyl-phosphate (μg/L)	Ethyl citrate (μg/L)	Cotinine (μg/L)	Para-nonyl-phenol (total) (μg/L)	Prometon (μg/L)
Organic Wastewater Compounds, 2002													
KC2	05-22-02	1	1525	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC3	05-22-02	1	1545	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC5	09-12-02	<1	1145	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	e0.4	<5	<0.5
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	<5	<2	<0.5	<1	<0.5	e0.2	<0.5	<1	<5	<0.5
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<5	<2	e0.1	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC2	09-11-02	1	1345	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC4	09-11-02	1	1450	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
FC5	09-11-02	20	1425	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC3	05-21-02	1	1300	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC4	05-21-02	1	1200	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC2c	09-10-02	1	1500	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<5	<2	<0.5	<1	<0.5	<0.5	<0.5	<1	<5	<0.5

See footnote at end of table.

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Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Tri (2-chloro-ethyl) phosphate (μg/L)	Penta-chloro-phenol (μg/L)	4-n-octyl-phenol (μg/L)	Diazinon (μg/L)	Phenan-threne (μg/L)	OPEO1 (μg/L)	Anthra-cene (μg/L)	Caffeine (μg/L)	Tonalide (AHTN) (μg/L)	Carbazole (μg/L)
Organic Wastewater Compounds, 2001													
KC2	05-17-01	4	1030	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC3	05-17-01	5	1130	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC3	05-17-01	25	1200	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC5	05-17-01	<1	0930	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC2	09-06-01	1	1500	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC3	09-06-01	1	1600	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.2	<0.5	<0.5
KC3	09-06-01	30	1610	--	--	--	--	--	--	--	--	--	--
KC5	09-06-01	<1	1430	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
FC1	05-16-01	<1	0900	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC2	05-16-01	10	1000	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC4	05-16-01	4	1120	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC4	05-16-01	25	1130	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--	--
FC5	05-16-01	25	1310	--	--	--	--	--	--	--	--	--	--
FC1	09-07-01	<1	0830	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
FC2	09-07-01	1	0900	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC2	09-07-01	15	0920	--	--	--	--	--	--	--	--	--	--
FC4	09-07-01	1	1030	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC4	09-07-01	30	1050	--	--	--	--	--	--	--	--	--	--
FC5	09-07-01	1	1100	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC5	090-7-01	30	1120	--	--	--	--	--	--	--	--	--	--
MC2	05-15-01	<1	1000	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC3	05-15-01	13	1330	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC4	05-15-01	30	1745	--	--	--	--	--	--	--	--	--	--
MC5	05-15-01	1	1630	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC5	05-15-01	30	1645	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC6	05-15-01	<1	1200	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC2	09-05-01	<1	1310	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC3	09-05-01	1	1600	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
MC4	09-05-01	1	1700	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	--	--	--	--	--	--	--	--	--	--
MC5	09-07-01	1	1200	<0.5	e0.2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	e0.1
MC5	09-07-01	30	1220	--	--	--	--	--	--	--	--	--	--
MC6	09-05-01	<1	1500	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
													<0.5

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Tri (2-chloro-ethyl) phosphate (μg/L)	Penta-chloro-phenol (μg/L)	4-n-octyl-phenol (μg/L)	Diazinon (μg/L)	Phenan-threne (μg/L)	OPEO1 (μg/L)	Anthra-cene (μg/L)	Caffeine (μg/L)	Tonalide (AHTN) (μg/L)	Carbazole (μg/L)
							Organic Wastewater Compounds, 2002						
KC2	05-22-02	1	1525	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC3	05-22-02	1	1545	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
KC5	09-12-02	<1	1145	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	e0.1	<2	<1	<0.5	e0.1	<1	<0.5	<0.5	e0.1	<0.5
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC2	09-11-02	1	1345	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC4	09-11-02	1	1450	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
FC5	09-11-02	20	1425	<0.5	<2	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MC3	05-21-02	1	1300	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC4	05-21-02	1	1200	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	e0.1	<0.5	<0.5
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC2c	09-10-02	1	1500	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<0.5	<2	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5

See footnote at end of table.

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Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Galaxolide (HHCB) (μg/L)	4-cumyl-phenol (μg/L)	Carbaryl (μg/L)	Metalaxyl (μg/L)	Bromacil (μg/L)	Metola-chlor (μg/L)	Chlorpy-rifos (μg/L)	Anthra-quinone (μg/L)	Fluor-anthene (μg/L)	Triclosan (μg/L)
Organic Wastewater Compounds, 2001													
KC2	05-17-01	4	1030	<0.5	< 1	< 1	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<1
KC3	05-17-01	5	1130	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC3	05-17-01	25	1200	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC5	05-17-01	<1	0930	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC2	09-06-01	1	1500	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC3	09-06-01	1	1600	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC3	09-06-01	30	1610	--	--	--	--	--	--	--	--	--	--
KC5	09-06-01	<1	1430	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC1	05-16-01	<1	0900	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC2	05-16-01	10	1000	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC4	05-16-01	4	1120	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC4	05-16-01	25	1130	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--	--
FC5	05-16-01	25	1310	--	--	--	--	--	--	--	--	--	--
FC1	09-07-01	<1	0830	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC2	09-07-01	1	0900	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC2	09-07-01	15	0920	--	--	--	--	--	--	--	--	--	--
FC4	09-07-01	1	1030	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC4	09-07-01	30	1050	--	--	--	--	--	--	--	--	--	--
FC5	09-07-01	1	1100	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC5	090-7-01	30	1120	--	--	--	--	--	--	--	--	--	--
MC2	05-15-01	<1	1000	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC3	05-15-01	13	1330	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	e0.1	<0.5	<1
MC4	05-15-01	30	1745	--	--	--	--	--	--	--	--	--	--
MC5	05-15-01	1	1630	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC5	05-15-01	30	1645	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC6	05-15-01	<1	1200	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC2	09-05-01	<1	1310	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC3	09-05-01	1	1600	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC4	09-05-01	1	1700	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	e0.1
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	--	--	--	--	--	--	--	--	--	--
MC5	09-07-01	1	1200	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	e0.1	<1
MC5	09-07-01	30	1220	--	--	--	--	--	--	--	--	--	--
MC6	09-05-01	<1	1500	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
													<1

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Galaxolide (HHCB) (µg/L)	4-cumyl-phenol (µg/L)	Carbaryl (µg/L)	Metalaxyl (µg/L)	Bromacil (µg/L)	Metola-chlor (µg/L)	Chlorpy-rifos (µg/L)	Anthra-quinone (µg/L)	Fluor-anthene (µg/L)	Triclosan (µg/L)
Organic Wastewater Compounds, 2002													
KC2	05-22-02	1	1525	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC3	05-22-02	1	1545	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC5	09-12-02	<1	1145	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--	--
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<0.5	<1	<1	<0.5	e0.2	<0.5	<0.5	<0.5	<0.5	<1
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	e0.1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC2	09-11-02	1	1345	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC4	09-11-02	1	1450	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
FC5	09-11-02	20	1425	<0.5	<1	<1	<1.0	<0.5	<0.5	<0.5	<0.5	<5	<0.5
MC3	05-21-02	1	1300	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC4	05-21-02	1	1200	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC2c	09-10-02	1	1500	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1
													--

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Pyrene (μg/L)	Bisphenol A (μg/L)	OPEO2 (μg/L)	NPEO2 (total) (μg/L)	Tri (dichlor-isopropyl) phosphate (μg/L)	Ethanol, 2,butoxy-phosphate (μg/L)	Triphenyl phosphate (μg/L)	Esterone (μg/L)	17B-estradiol (μg/L)	17-alpha-ethynyl esterdiol (μg/L)
Organic Wastewater Compounds, 2001													
KC2	05-17-01	4	1030	<0.5	<1	<1	<5	<0.5	2.9	<0.5	<5	<5	<5
KC3	05-17-01	5	1130	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
KC3	05-17-01	25	1200	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
KC5	05-17-01	<1	0930	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
KC2	09-06-01	1	1500	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
KC3	09-06-01	1	1600	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
KC3	09-06-01	30	1610	<0.5	<1	<1	<5	<0.5	--	--	--	--	--
KC5	09-06-01	<1	1430	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC1	05-16-01	<1	0900	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC2	05-16-01	10	1000	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC4	05-16-01	4	1120	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC4	05-16-01	25	1130	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--	--
FC5	05-16-01	25	1310	<0.5	<1	<1	<5	1.4	--	--	--	--	--
FC1	09-07-01	<1	0830	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC2	09-07-01	1	0900	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
FC2	09-07-01	15	0920	<0.5	<1	<1	<5	<0.5	--	--	--	--	--
FC4	09-07-01	1	1030	--	--	--	--	--	<0.5	<0.5	<5	e0.1	<5
FC4	09-07-01	30	1050	<0.5	<1	<1	<5	<0.5	--	--	--	--	--
FC5	09-07-01	1	1100	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
FC5	090-7-01	30	1120	<0.5	<1	<1	<5	<0.5	--	--	--	--	--
MC2	05-15-01	<1	1000	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC3	05-15-01	13	1330	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
MC4	05-15-01	30	1745	<0.5	<1	<1	<5	<0.5	--	--	--	--	--
MC5	05-15-01	1	1630	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC5	05-15-01	30	1645	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC6	05-15-01	<1	1200	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC2	09-05-01	<1	1310	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC3	09-05-01	1	1600	<0.5	<1	<1	<5	e0.1	<0.5	<0.5	<5	<5	<5
MC4	09-05-01	1	1700	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	e0.1	<1	<1	<5	<0.5	--	--	--	--	--
MC5	09-07-01	1	1200	--	--	--	--	--	<0.5	<0.5	<5	<5	<5
MC5	09-07-01	30	1220	<0.5	<1	<1	<5	<0.5	--	--	--	--	--
MC6	09-05-01	<1	1500	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
													<5

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Pyrene (μg/L)	Bisphenol A (μg/L)	OPEO2 (μg/L)	NPEO2 (total) (μg/L)	Tri (dichlor-isopropyl) phosphate (μg/L)	Ethanol, 2,butoxy-phosphate (μg/L)	Triphenyl phosphate (μg/L)	Esterone (μg/L)	17B-estradiol (μg/L)	17-alpha-ethynyl esterdiol (μg/L)
Organic Wastewater Compounds, 2002													
KC2	05-22-02	1	1525	<0.5	<1	<1	<5	<0.5	e0.1	<0.5	<5	<5	<5
KC3	05-22-02	1	1545	<0.5	e0.1	<1	<5	<0.5	e0.1	<0.5	<5	<5	<5
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<0.5	e0.1	<1	<5	<0.5	e0.1	<0.5	<5	<5	<5
KC5	09-12-02	<1	1145	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<0.5	<1	<1	<5	<0.5	e0.1	<0.5	<5	<5	<5
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<0.5	e0.1	<1	e1.4	<0.5	e0.2	<0.5	<5	<5	<5
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	<0.5	<1	<1	<5	e0.1	e0.5	<0.5	<5	<5	<5
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<0.5	<1	e0.1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC2	09-11-02	1	1345	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC4	09-11-02	1	1450	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
FC5	09-11-02	20	1425	<1	<1	<0.5	<1	<5	<0.5	<0.5	<10	<5	<10
MC3	05-21-02	1	1300	<0.5	<1	<1	<5	<0.5	e0.1	<0.5	<5	<5	<5
MC4	05-21-02	1	1200	<0.5	<1	<1	<5	<0.5	e0.2	0.7	<5	<5	<5
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<0.5	<1	<1	<5	<0.5	e0.2	<0.5	<5	<5	<5
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC2c	09-10-02	1	1500	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	<5	<5
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<0.5	<1	<1	<5	<0.5	<0.5	<0.5	<5	e0.2	<5

See footnote at end of table. --

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Equilenin (μg/L)	Benzo(a)-pyrene (μg/L)	3-beta-copro-stanol (μg/L)	Choles-terol (μg/L)	Beta-sitosterol (μg/L)	Stigma-stanol (μg/L)	3,4-dichloro-phenyl isocyanate (μg/L)	Diethyl phthalate (μg/L)	Atrazine (μg/L)	NPE01 (total) (μg/L)
Organic Wastewater Compounds, 2001													
KC2	05-17-01	4	1030	<5	<0.5	<2	29	<2	<2	--	--	--	--
KC3	05-17-01	5	1130	<5	<0.5	<2	54	<2	<2	--	--	--	--
KC3	05-17-01	25	1200	<5	<0.5	<2	38	<2	<2	--	--	--	--
KC5	05-17-01	<1	0930	<5	<0.5	<2	<2	<2	<2	--	--	--	--
KC2	09-06-01	1	1500	<5	<0.5	<2	e0.5	<2	<2	--	--	--	--
KC3	09-06-01	1	1600	<5	<0.5	<2	e0.6	<2	<2	--	--	--	--
KC3	09-06-01	30	1610	--	--	--	--	--	--	--	--	--	--
KC5	09-06-01	<1	1430	<5	<0.5	<2	<2	<2	<2	--	--	--	--
FC1	05-16-01	<1	0900	<5	<0.5	<2	e0.6	<2	<2	--	--	--	--
FC2	05-16-01	10	1000	<5	<0.5	<2	38	<2	<2	--	--	--	--
FC4	05-16-01	4	1120	<5	<0.5	<2	e1.3	<2	<2	--	--	--	--
FC4	05-16-01	25	1130	<5	<0.5	<2	e0.6	<2	<2	--	--	--	--
FC5	05-16-01	0.1	1300	--	--	--	--	--	--	--	--	--	--
FC5	05-16-01	25	1310	--	--	--	--	--	--	--	--	--	--
FC1	09-07-01	<1	0830	<5	<0.5	<2	<2	<2	<2	--	--	--	--
FC2	09-07-01	1	0900	<5	<0.5	<2	<2	<2	<2	--	--	--	--
FC2	09-07-01	15	0920	--	--	--	--	--	--	--	--	--	--
FC4	09-07-01	1	1030	<5	<0.5	<2	<2	<2	<2	--	--	--	--
FC4	09-07-01	30	1050	--	--	--	--	--	--	--	--	--	--
FC5	09-07-01	1	1100	<5	<0.5	<2	<2	<2	<2	--	--	--	--
FC5	090-7-01	30	1120	--	--	--	--	--	--	--	--	--	--
MC2	05-15-01	<1	1000	<5	<0.5	<2	e1.0	e0.9	<2	--	--	--	--
MC3	05-15-01	13	1330	<5	<0.5	<2	e0.7	<2	<2	--	--	--	--
MC4	05-15-01	30	1745	--	--	--	--	--	--	--	--	--	--
MC5	05-15-01	1	1630	<5	<0.5	<2	<2	<2	<2	--	--	--	--
MC5	05-15-01	30	1645	<5	<0.5	<2	<2	<2	<2	--	--	--	--
MC6	05-15-01	<1	1200	<5	<0.5	<2	2	<2	<2	--	--	--	--
MC2	09-05-01	<1	1310	<5	<0.5	<2	e0.8	2	<2	--	--	--	--
MC3	09-05-01	1	1600	<5	<0.5	<2	e0.6	<2	<2	--	--	--	--
MC4	09-05-01	1	1700	<5	<0.5	<2	e1.0	<2	<2	--	--	--	--
MC4	09-05-01	12	1750	--	--	--	--	--	--	--	--	--	--
MC4	09-05-01	30	1730	--	--	--	--	--	--	--	--	--	--
MC5	09-07-01	1	1200	<5	e0.1	<2	<2	<2	<2	--	--	--	--
MC5	09-07-01	30	1220	--	--	--	--	--	--	--	--	--	--
MC6	09-05-01	<1	1500	<5	<0.5	<2	e1.1	e1.0	<2	--	--	--	--

See footnote at end of table. --

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Equilenin (μg/L)	Benzo(a)-pyrene (μg/L)	3-beta-copro-stanol (μg/L)	Choles-terol (μg/L)	Beta-sitosterol (μg/L)	Stigma-stanol (μg/L)	3,4-dichloro-phenyl isocyanate (μg/L)	Diethyl phthalate (μg/L)	Atrazine (μg/L)	NPE01 (total) (μg/L)
Organic Wastewater Compounds, 2002													
KC2	05-22-02	1	1525	<5	<0.5	<2	<2	<2	<2	<0.5	<0.5	<0.5	<5
KC3	05-22-02	1	1545	<5	<0.5	<2	e0.7	<2	<2	<0.5	<0.5	<0.5	<5
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	<5	e0.1	<2	e0.7	<2	<2	<0.5	<0.5	<0.5	<5
KC5	09-12-02	<1	1145	<5	<0.5	<2	e0.6	<2	<2	<0.5	<0.5	<0.5	<5
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<5	<0.5	<2	e0.9	<2	<2	<0.5	<0.5	<0.5	<5
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<5	<0.5	<2	<2	<2	<2	<0.5	<0.5	<0.5	<5
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	<5	<0.5	<2	<2	<2	<2	<0.5	e0.7	<0.5	e0.4
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<5	<0.5	<2	e0.7	<2	<2	<0.5	<0.5	<0.5	<5
FC2	09-11-02	1	1345	<5	<0.5	<2	e1.0	<2	<2	<0.5	<0.5	<0.5	<5
FC4	09-11-02	1	1450	<5	<0.5	<2	e0.7	<2	<2	<0.5	<0.5	<0.5	<5
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<5	<0.5	<2	<2	<2	<2	<0.5	<0.5	<0.5	<5
FC5	09-11-02	20	1425	<5	<10	<10	<2	e0.6	<2	0.7	<0.5	<0.5	<0.5
MC3	05-21-02	1	1300	<5	<0.5	<2	e0.5	<2	<2	<0.5	<0.5	<0.5	<5
MC4	05-21-02	1	1200	<5	e0.1	<2	e0.5	<2	<2	<0.5	<0.5	<0.5	<5
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	<5	<0.5	<2	<2	<2	<2	<0.5	<0.5	<0.5	<5
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<5	<0.5	<2	e1.0	<2	<2	<0.5	<0.5	<0.5	<5
MC2c	09-10-02	1	1500	<5	<0.5	<2	e0.8	<2	<2	<0.5	<0.5	<0.5	<5
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	<5	<0.5	<2	e0.5	<2	<2	<0.5	0.7	<0.5	<5
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<5	<0.5	<2	<2	<2	<2	<0.5	<0.5	<0.5	<5

See footnote at end of table. --

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Time	Diethyl-hexyl phthalate (µg/L)	PBDE4-3 (µg/L)	PBDE4-2 (µg/L)	PBDE5-1 (µg/L)	PBDE5-3 (µg/L)	PBDE6-1 (µg/L)	PBDE6-2 (µg/L)	PBDE5-2 (µg/L)	PBDE4-1 (µg/L)
Organic Wastewater Compounds, 2002												
KC2	05-22-02	1	1525	<0.5	--	--	--	--	--	--	--	--
KC3	05-22-02	1	1545	<0.5	--	--	--	--	--	--	--	--
KC3	05-22-02	35	1600	--	--	--	--	--	--	--	--	--
KC5	05-22-02	1	1500	e11	--	--	--	--	--	--	--	--
KC5	09-12-02	<1	1145	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
KC5a	09-12-02	1	1245	--	--	--	--	--	--	--	--	--
KC2	09-12-02	20	1255	--	--	--	--	--	--	--	--	--
KC2	09-12-02	1	1330	--	--	--	--	--	--	--	--	--
KC3	09-12-02	20	1340	--	--	--	--	--	--	--	--	--
FC2	05-22-02	1	1130	<0.5	--	--	--	--	--	--	--	--
FC2[1]	05-22-02	1	1135	--	--	--	--	--	--	--	--	--
FC4	05-22-02	1	1300	<0.5	--	--	--	--	--	--	--	--
FC4	05-22-02	40	1310	--	--	--	--	--	--	--	--	--
FC5	05-22-02	1	1220	e9.6	--	--	--	--	--	--	--	--
FC5	05-22-02	40	1230	--	--	--	--	--	--	--	--	--
FC1a	09-11-02	<1	1315	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
FC2	09-11-02	1	1345	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
FC4	09-11-02	1	1450	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
FC4	09-11-02	20	1500	--	--	--	--	--	--	--	--	--
FC5	09-11-02	1	1415	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
FC5	09-11-02	20	1425	<10	<0.5	<10	<5	<1	<10	<10	<5	<1
MC3	05-21-02	1	1300	<0.5	--	--	--	--	--	--	--	--
MC4	05-21-02	1	1200	<0.5	--	--	--	--	--	--	--	--
MC4[1]	05-21-02	1	1320	--	--	--	--	--	--	--	--	--
MC4	05-21-02	40	1330	--	--	--	--	--	--	--	--	--
MC5	05-21-02	1	1400	e4.3	--	--	--	--	--	--	--	--
MC5	05-21-02	55	1450	--	--	--	--	--	--	--	--	--
MC2b	09-10-02	<1	1300	--	--	--	--	--	--	--	--	--
MC2b[1]	09-10-02	<1	1300	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
MC2c	09-10-02	1	1500	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
MC3	09-10-02	1	1510	--	--	--	--	--	--	--	--	--
MC4	09-10-02	1	1530	e5.5	<10	<10	<10	<10	<10	<10	<10	<10
MC4[1]	09-10-02	1	1540	--	--	--	--	--	--	--	--	--
MC4	09-10-02	35	1600	--	--	--	--	--	--	--	--	--
MC5	09-11-02	1	1020	<0.5	<10	<10	<10	<10	<10	<10	<10	<10
MC5	09-11-02	35	1030	--	--	--	--	--	--	--	--	--

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	NTA (μg/L)	EDTA (μg/L)	NP1EC (μg/L)	NP2EC (μg/L)	NP3EC (μg/L)	NP4EC (μg/L)
				Propyl Esters				
KC2	05-17-01	5	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
KC3	05-17-01	<1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
KC5	05-17-01	1	<0.5	0.5	<0.4	<0.4	<0.4	<0.4
KC2	09-06-01	1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4
KC3	09-06-01	1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4
KC5	09-06-01	1	<0.5	<0.1	0.5	<0.4	<0.4	<0.4
KC2	09-12-02	4	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
KC5a	09-12-02	1	<0.5	0.5	<0.4	<0.4	<0.4	<0.4
FC1	05-16-01	4	<0.5	0.4	<0.4	<0.4	<0.4	<0.4
FC4	05-16-01	0.1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
FC5	05-16-01	1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
FC1	09-06-01	1	<0.5	0.2	<0.4	<0.4	<0.4	<0.4
FC2	09-06-01	1	<0.5	0.2	<0.4	<0.4	<0.4	<0.4
FC4	09-06-01	1	<0.5	0.2	0.7	1.1	<0.4	<0.4
FC5	09-06-01	<1	<0.5	0.2	<0.4	<0.4	<0.4	<0.4
FC1a	09-11-01	1	<0.5	0.5	<0.4	<0.4	<0.4	<0.4
FC2	09-11-02	1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
FC4	09-11-02	4	--	--	--	--	--	--
MC2	05-15-01	1	<0.5	0.2	<0.4	<0.4	<0.4	<0.4
MC5	05-15-01	1	<0.5	0.4	<0.4	<0.4	<0.4	<0.4
MC6	05-15-01	1	<0.5	0.3	<0.4	<0.4	<0.4	<0.4
MC2	09-05-01	1	<0.5	0.2	<0.4	<0.4	<0.4	<0.4
MC3	09-05-01	1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4
MC4	09-05-01	1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4
MC5	09-07-01	1	<0.5	0.2	<0.4	<0.4	<0.4	<0.4
MC6	09-05-01	1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4
MC6d	09-05-01	1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4
MC2	09-10-02	<1	<0.5	0.7	<0.4	<0.4	<0.4	<0.4
MC2b[1]	09-10-02	<1	<0.5	0.5	<0.4	<0.4	<0.4	<0.4
MC2c	09-10-02	1	<0.5	0.4	<0.4	<0.4	<0.4	<0.4
MC3	09-10-02	1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
MC4	09-10-02	<1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
MC4[1]	09-10-02	1	<0.5	0.6	<0.4	<0.4	<0.4	<0.4
MC5	09-11-02	1	<0.5	0.5	<0.4	<0.4	<0.4	<0.4
MC5[1]	09-11-02	1	<0.5	0.5	<0.4	<0.4	<0.4	<0.4
Lab DI blank	09-12-02	<1	<0.5	<0.1	<0.4	<0.4	<0.4	<0.4

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	Diethyl-stilbestrol (μg/L)	*cis*-Andros-terone (μg/L)	17-alpha-estradiol (μg/L)	Epites-tosterone (μg/L)	Stanalone(μg/L)	17-beta-estradiol (μg/L)	Estrone (μg/L)	Equilin (μg/L)	Testos-terone (μg/L)	4-andoten-3, 17-dione (μg/L)
						Hormones and Steroids						
KC2	05-17-01	4	<1	<1	<1	<1	2	<1	<1	<1	<1	<1
KC3	05-17-01	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
KC3	05-17-01	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
KC5	05-17-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
KC2	05-17-01	4	<1	<1	<1	<1	<1	<1	<1	<1	<1	195
KC3	05-17-01	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	426
KC3	05-17-01	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	351
KC5	05-17-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	264
FC1	05-16-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FC2	05-16-01	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FC4	05-16-01	4	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FC4	05-16-01	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FC1	05-16-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	314
FC2	05-16-01	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	291
FC4	05-16-01	4	<1	<1	<1	<1	<1	<1	<1	<1	<1	691
FC4	05-16-01	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	281
MC2	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MC3	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MC5	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MC5	05-15-01	30	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MC6	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MC2	05-15-01	1	<1	<1	<1	<1	<1	<1	5	<1	<1	515
MC3	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	319
MC5	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	288
MC5	05-15-01	30	<1	<1	<1	<1	<1	<1	4	<1	<1	175
MC6	05-15-01	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1550

See footnote at end of table.

Table 12. Organic wastewater compounds, propyl esters, hormone and steroid compounds, and surrogate standard recovery for propyl esters in shallow surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date	Depth (meters)	n-nonylphenol-diethoxycarboxylate (percent recovery)	D4-17-estradiol (percent recovery)	D3-testosterone (percent recovery)	D7-cholesterol (percent recovery)
Surrogates of Propyl Esters						
KC2	05-17-01	4	71	109	124	177
KC3	05-17-01	5	66	113	137	176
KC3	05-17-01	25	--	115	120	197
KC5	05-17-01	<1	61	115	141	161
KC2	09-06-01	1	67	52	92	67
KC3	09-06-01	1	63	56	110	68
KC5	09-06-01	<1	60	--	--	--
KC2	09-12-02	1	48	--	--	--
KC5a	09-12-02	<1	80	--	--	--
FC1	05-16-01	<1	65	109	133	168
FC2	05-16-01	10	--	113	140	174
FC4	05-16-01	4	74	114	142	169
FC4	05-16-01	25	--	108	134	178
FC5	05-16-01	0.1	71	--	--	--
FC1	09-06-01	<1	48	61	112	71
FC2	09-06-01	1	57	57	100	81
FC4	09-06-01	<1	61	64	110	81
FC5	09-06-01	1	53	57	98	74
FC1a	09-11-02	<1	52	--	--	--
FC2	09-11-02	1	38	--	--	--
FC4	09-11-02	1	--	--	--	--
MC2	05-15-01	<1	62	108	134	141
MC3	05-15-01	<1	--	82	121	138
MC5	05-15-01	1	74	92	142	159
MC5	05-15-01	30	--	108	138	153
MC6	05-15-01	<1	76	121	142	158
MC2	09-05-01	<1	84	54	97	65
MC3	09-05-01	1	93	41	77	50
MC4	09-05-01	1	69	48	89	55
MC5	09-07-01	1	81	43	74	55
MC6	09-05-01	<1	76	52	92	67
MC6d	09-05-01	<1	76	--	--	--
MC2b	09-10-02	<1	9	--	--	--
MC2b[1]	09-10-02	<1	39	--	--	--
MC2C	09-10-02	1	46	--	--	--
MC3	09-10-02	1	54	--	--	--
MC4	09-10-02	1	45	--	--	--
MC4[1]	09-10-02	1	44	--	--	--
MC5	09-11-02	1	41	59	105	70
MC5[1]	09-11-02	1	37	--	--	--
Lab DI blank	09-12-02	<1	<0.5	--	--	--
Lab DI spike	09-12-02	<1	13	--	--	--

[1]Duplicate

Table 13. Semivolatile organic compounds and trace and rare earth elements in bed material at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

[µg/kg, micrograms per kilogram; wt%, weight percent; Stnd dev., standard deviation; µg/g, micrograms per gram]

Site name	Date[1]	1,6-dimethyl-napthalene (µg/kg)	2,6-dimethyl-napthalene (µg/kg)	Benzyl*n*-butylphthalate (µg/kg)	Bis(2-ethyl)-phthalate (µg/kg)	Diethyl-phthalate (µg/kg)	Dibutyl-phthalate (µg/kg)	Dioctyl-phthalate (µg/kg)
KC5	05-17-01	<50	<50	<50	trace	<50	<50	<50
KC5	09-06-01	<50	<50	trace	trace	<50	trace	trace
KC5a	09-12-02	<50	trace	trace	trace	trace	trace	trace
FC1	05-16-01	<50	<50	trace	trace	<50	<50	<50
FC1	09-07-01	<50	<50	trace	154	<50	trace	trace
FC1a	09-11-02	<50	<50	trace	trace	<50	trace	trace
MC2	05-15-01	<50	<50	trace	trace	<50	<50	<50
MC6	05-15-01	<50	<50	trace	64	<50	<50	<50
MC2	09-05-01	<50	<50	trace	trace	trace	trace	trace
MC6	09-05-01	<50	<50	trace	59	trace	trace	trace
MC2b	09-10-02	trace	trace	58	86	trace	trace	trace
MC2b[2]	09-10-02	<50	trace	trace	66	<50	trace	trace

Site name	Date[1]	Fluoranthene (µg/kg)	Naphthalene (µg/kg)	p-cresol (µg/kg)	Phenanthrene (µg/kg)	Phenol (µg/kg)	Pyrene (µg/kg)	Sample weight (grams)
KC5	05-17-01	<50	<50	<50	<50	<50	<50	23
KC5	09-06-01	<50	<50	<50	<50	trace	<50	23
KC5a	09-12-02	<50	<50	<50	trace	<50	<50	23
FC1	05-16-01	<50	<50	<50	<50	<50	<50	24
FC1	09-07-01	<50	<50	<50	<50	trace	<50	23
FC1a	09-11-02	<50	trace	<50	<50	<50	<50	25
MC2	05-15-01	<50	<50	<50	<50	trace	<50	25
MC6	05-15-01	<50	<50	<50	<50	<50	<50	23
MC2	09-05-01	trace	<50	<50	<50	trace	<50	23
MC6	09-05-01	<50	<50	<50	<50	trace	<50	23
MC2b	09-10-02	trace	trace	<50	trace	<50	trace	22

Site name	Date[1]	Aluminum (wt %)		Antimony (µg/g)		Arsenic (µg/g)		Barium (µg/g)		Beryllium (µg/g)		Bismuth (µg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	1.63	0.03	0.22	0.01	1.5	0.1	297	5	0.43	0.04	0.021	0.007
KC5	09-06-01	1.73	0.23	<0.2	0.2	1.49	0.65	425	190	0.47	0.13	0.050	0.043
KC5a	09-12-02	1.26	0.13	<0.2	0.0	1.1	0.1	254	30	0.28	0.05	0.009	0.010
FC1	05-16-01	1.16	0.21	<0.2	0.20	0.9	0.1	253	19	0.28	0.03	0.019	0.006
FC1	09-07-01	1.14	0.05	<0.2	0.0	0.73	0.07	272	15	0.28	0.05	0.006	0.007
FC1a	09-11-02	0.83	0.11	<0.2	0.3	0.8	0.3	248	80	0.23	0.02	0.05	0.06
MC2	05-15-01	1.09	0.36	0.23	0.04	0.81	0.38	217	45	0.28	0.15	0.013	0.015
MC6	05-15-01	1.26	0.30	0.20	0.06	0.96	0.23	259	28	0.34	0.09	0.051	0.043
MC2	09-05-01	1.24	0.21	<0.2	0.01	0.81	0.09	289	23	0.29	0.07	0.009	0.010
MC6	09-05-01	1.28	0.36	<0.2	0.25	0.9	0.3	296	73	0.31	0.07	0.012	0.012
MC2b	09-10-02	1.17	0.23	<0.2	0.03	1.1	0.1	248	28	0.25	0.06	0.014	0.015
MC2b[2]	09-10-02	1.16	0.20	0.35	0.18	1.0	0.4	248	49	0.27	0.04	0.023	0.038

See footnotes at end of table.

Table 13. Semivolatile organic compounds and trace and rare earth elements in bed material at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date[1]	Boron (μg/g)		Cadmium (μg/g)		Cerium (μg/g)		Cesium (μg/g)		Chromium (μg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	40	10	0.10	0.03	12	1	1.5	0.1	8.0	1.6
KC5	09-06-01	34	17	0.13	0.08	14.6	6.5	4.3	2.7	8.9	4.4
KC5a	09-12-02	29	9	0.08	0.01	9	3	1.1	0.1	3.5	0.9
FC1	05-16-01	18	6	0.04	0.01	6.7	1.4	1.0	0.3	3.1	0.6
FC1	09-07-01	13	2	0.03	0.00	6.3	0.7	1.2	0.2	2.5	0.4
FC1a	09-11-02	22	12	0.11	0.02	5.5	1.0	19	31	1.7	0.4
MC2	05-15-01	24	18	0.03	0.04	6.9	3.2	1.01	0.45	3.4	3.0
MC6	05-15-01	29	8	0.05	0.05	7.5	0.4	1.2	0.2	4.5	1.5
MC2	09-05-01	24	6	0.02	0.02	7.0	2.5	1.16	0.25	4.2	1.3
MC6	09-05-01	25	15	0.10	0.05	7.6	1.7	3.4	4.0	3.6	1.4
MC2b	09-10-02	33	11	0.06	0.02	10	2	3.6	2.5	4.1	0.7
MC2b[2]	09-10-02	36	6	0.08	0.02	10	2	1.8	1.1	3.6	0.8

Site name	Date[1]	Cobalt (μg/g)		Copper (μg/g)		Dysprosium (μg/g)		Erbium (μg/g)		Europium (μg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	1.8	0.2	5.1	0.2	0.79	0.07	0.49	0.08	0.27	0.02
KC5	09-06-01	3.1	2.4	6.3	2.8	0.97	0.54	0.61	0.34	0.32	0.14
KC5a	09-12-02	1.7	0.5	4.0	0.6	0.56	0.12	0.35	0.07	0.21	0.03
FC1	05-16-01	0.78	0.06	3.3	0.5	0.42	0.07	0.25	0.05	0.17	0.02
FC1	09-07-01	0.78	0.13	3.2	0.3	0.37	0.07	0.24	0.03	0.16	0.01
FC1a	09-11-02	1.2	0.6	3.0	0.2	0.7	0.6	0.36	0.25	0.26	0.21
MC2	05-15-01	0.91	0.66	3.4	2.1	0.42	0.22	0.27	0.14	0.16	0.06
MC6	05-15-01	1.1	0.3	4.5	0.6	0.40	0.08	0.24	0.04	0.16	0.04
MC2	09-05-01	0.97	0.10	6.5	4.4	0.44	0.15	0.27	0.09	0.18	0.06
MC6	09-05-01	1.1	0.4	8	6	0.47	0.13	0.30	0.08	0.19	0.05
MC2b	09-10-02	1.5	0.1	4.1	0.5	0.64	0.12	0.36	0.05	0.21	0.03

Site name	Date[1]	Gadolinium (μg/g)		Gallium (μg/g)		Germanium (μg/g)		Hafnium (μg/g)		Holmium (μg/g)		Iron (wt %)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	0.87	0.11	3.7	0.1	1.02	0.05	1.5	0.3	0.16	0.01	0.44	0.05
KC5	09-06-01	1.06	0.59	3.9	0.8	1.02	0.07	1.7	1.0	0.20	0.11	0.57	0.28
KC5a	09-12-02	0.65	0.17	2.5	0.3	0.92	0.03	0.82	0.20	0.11	0.03	0.31	0.04
FC1	05-16-01	0.47	0.04	2.6	0.4	0.97	0.05	0.68	0.14	0.085	0.017	0.21	0.03
FC1	09-07-01	0.40	0.09	2.6	0.1	0.94	0.02	0.52	0.10	0.080	0.015	0.21	0.04
FC1a	09-11-02	0.8	0.8	1.7	0.2	0.83	0.05	0.52	0.03	0.13	0.11	0.20	0.05
MC2	05-15-01	0.43	0.21	2.6	1.1	0.97	0.07	0.79	0.43	0.089	0.044	0.25	0.16
MC6	05-15-01	0.45	0.07	3.1	0.6	0.98	0.05	0.76	0.20	0.079	0.013	0.28	0.08
MC2	09-05-01	0.49	0.17	2.8	0.2	0.95	0.01	0.67	0.10	0.09	0.03	0.24	0.03
MC6	09-05-01	0.50	0.11	2.6	0.9	0.96	0.07	0.88	0.30	0.09	0.02	0.25	0.08
MC2b	09-10-02	0.70	0.15	2.6	0.5	0.95	0.09	0.79	0.05	0.14	0.03	0.28	0.04
MC2b[2]	09-10-02	0.8	0.2	2.4	0.3	0.92	0.03	0.97	0.51	0.14	0.03	0.28	0.03

See footnotes at end of table.

Table 13. Semivolatile organic compounds and trace and rare earth elements in bed material at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date[1]	Lanthanum (µg/g)		Lithium (µg/g)		Lutetium (µg/g)		Manganese (µg/g)		Molybdenum (µg/g)		Neodymium (µg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	6.0	0.7	19	1	0.085	0.016	156	55	0.6	0.6	5.7	0.7
KC5	09-06-01	7.3	3.1	18	6	0.096	0.051	252	238	0.5	0.7	6.9	3.5
KC5a	09-12-02	4.5	1.2	12	2	0.055	0.010	139	7	1.2	1.3	4.3	1.4
FC1	05-16-01	3.6	0.7	12	2	0.042	0.009	60	8	<0.3	0.0	3.1	0.4
FC1	09-07-01	3.3	0.3	11	1	0.038	0.006	67	21	<0.3	0.0	2.9	0.4
FC1a	09-11-02	3.7	1.7	7.7	1.0	0.043	0.019	149	67	0.4	0.5	4.3	3.4
MC2	09-05-01	4.0	0.7	11	4	0.049	0.015	92	32	0.6	0.7	3.3	0.8
MC6	05-15-01	3.6	1.7	8.9	2.9	0.045	0.021	67	42	0.8	0.4	3.0	1.4
MC2	05-15-01	3.7	0.2	12	3	0.041	0.007	90	37	1.1	1.1	3.2	0.2
MC6	09-05-01	3.7	1.3	7.5	0.6	0.044	0.014	87	10	<0.1	0.4	3.2	1.2
MC2b	09-10-02	5.5	1.3	8.6	0.7	0.061	0.010	191	71	<0.3	0.0	4.6	1.1
MC2b[2]	09-10-02	4.8	0.8	7.9	0.9	0.067	0.008	182	83	<0.3	0.4	4.5	1.3

Site name	Date[1]	Nickel (µg/g)		Phosphorus (µg/g)		Praseodymium (µg/g)		Rhenium (µg/g)		Rubidium (µg/g)		Samarium (µg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	4.3	0.2	123	7	1.4	0.2	<0.003	0.000	48	2	1.07	0.12
KC5	09-06-01	5.1	2.0	138	85	1.77	0.86	<0.003	0.000	51	3	1.41	0.77
KC5a	09-12-02	2.8	0.5	82	85	1.1	0.3	<0.003	0.000	39	5	0.81	0.21
FC1	05-16-01	2.2	0.5	117	36	0.81	0.13	<0.003	0.000	40	8	0.59	0.08
FC1	09-07-01	1.9	0.3	<47	6	0.76	0.09	<0.003	0.000	41	2	0.55	0.09
FC1a	09-11-02	2.0	0.3	78	82	1.0	0.7	<0.003	0.000	28	4	0.9	0.8
MC2	05-15-01	2.6	1.4	88	102	0.78	0.37	<0.003	0.000	37	9	0.57	0.27
MC6	05-15-01	2.6	0.7	140	37	0.84	0.06	<0.003	0.000	39	6	0.60	0.06
MC2	09-05-01	2.8	1.4	72	16	0.83	0.31	<0.003	0.000	40	8	0.64	0.26
MC6	09-05-01	2.6	0.9	92	11	0.9	0.2	<0.003	0.000	42	11	0.63	0.17
MC2b	09-10-02	2.5	0.4	65	71	1.2	0.3	<0.003	0.000	35	8	0.87	0.19
MC2b[2]	09-10-02	2.9	1.5	106	27	1.1	0.3	<0.003	0.000	36	8	0.9	0.3

Site name	Date[1]	Scandium (µg/g)		Selenium (µg/g)		Strontium (µg/g)		Tantalum (µg/g)		Tellurium (µg/g)		Terbium (µg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	3	0	<0.7	0.0	75	16	0.38	0.01	<0.05	0.00	0.13	0.01
KC5	09-06-01	2.9	1.3	<0.7	0.0	71	11	0.41	0.16	<0.01	0.06	0.176	0.106
KC5a	09-12-02	2.1	0.3	<0.7	0.0	58	9	0.21	0.03	<0.05	0.00	0.10	0.02
FC1	05-16-01	3	1	<0.7	0.0	39	2	0.18	0.04	<0.05	0.00	0.070	0.009
FC1	09-07-01	<1	0	<0.7	0.9	40	0	0.19	0.02	<0.05	0.00	0.062	0.012
FC1a	09-11-02	1.8	0.5	<0.7	0.0	43	17	0.13	0.00	<0.01	0.06	0.12	0.11
MC2	05-15-01	2	1	<0.7	0.0	37	19	0.21	0.13	<0.01	0.06	0.071	0.039
MC6	05-15-01	2	1	<0.7	0.0	48	15	0.27	0.07	<0.01	0.06	0.069	0.014
MC2	09-05-01	2	0	<0.7	0.0	45	6	0.23	0.05	<0.05	0.00	0.074	0.028
MC6	09-05-01	2	0	<0.7	0.0	63	31	0.21	0.09	<0.01	0.06	0.079	0.022
MC2b	09-10-02	2	0	<0.7	0.0	57	14	0.26	0.06	<0.01	0.06	0.11	0.02
MC2b[2]	09-10-02	2	0	<0.7	0.0	61	23	0.24	0.04	<0.05	0.00	0.12	0.03

See footnotes at end of table.

Table 13. Semivolatile organic compounds and trace and rare earth elements in bed material at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Date[1]	Thallium (µg/g)		Thorium (µg/g)		Thulium (µg/g)		Titanium (µg/g)		Tungsten (µg/g)		Uranium (µg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	0.27	0.03	1.8	0.3	0.072	0.008	0.072	0.007	0.22	0.02	0.70	0.14
KC5	09-06-01	0.28	0.05	2.1	1.0	0.086	0.046	0.073	0.033	0.26	0.13	0.73	0.29
KC5a	09-12-02	0.25	0.06	1.3	0.2	0.050	0.016	0.036	0.009	0.12	0.01	0.47	0.09
FC1	05-16-01	0.21	0.03	1.0	0.2	0.038	0.008	0.033	0.009	0.11	0.04	0.40	0.02
FC1	09-07-01	0.21	0.02	0.77	0.11	0.035	0.006	0.026	0.005	0.09	0.01	0.35	0.08
FC1a	09-11-02	0.16	0.02	0.63	0.15	0.050	0.031	0.021	0.001	0.07	0.01	0.34	0.13
MC2	05-15-01	0.21	0.05	0.99	0.53	0.042	0.022	0.038	0.025	0.13	0.09	0.38	0.21
MC6	05-15-01	0.32	0.13	1.09	0.32	0.037	0.008	0.047	0.014	0.15	0.07	0.45	0.11
MC2	09-05-01	0.22	0.03	0.82	0.34	0.039	0.011	0.042	0.010	0.56	0.42	0.39	0.05
MC6	09-05-01	0.26	0.11	0.9	0.2	0.044	0.012	0.041	0.019	0.37	0.39	0.45	0.16
MC2b	09-10-02	0.18	0.03	1.2	0.4	0.058	0.011	0.038	0.008	0.16	0.08	0.43	0.03
MC2b[2]	09-10-02	0.19	0.07	1.2	0.1	0.064	0.009	0.038	0.005	0.13	0.00	0.51	0.08

Site name	Date[1]	Vanadium (µg/g)		Ytterbium (µg/g)		Yttrium (µg/g)		Zinc (µg/g)		Zirconium (µg/g)	
		Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.	Average	Stnd dev.
KC5	05-17-01	10.7	1.5	0.50	0.08	4.6	0.5	9	1	42	9
KC5	09-06-01	12.5	7.3	0.58	0.27	5.3	2.8	17	12	43	24
KC5a	09-12-02	6.6	1.2	0.35	0.08	3.1	0.6	9	1	22	5
FC1	05-16-01	4.7	0.9	0.26	0.06	2.4	0.4	3.8	0.9	19	5
FC1	09-07-01	4.2	1.0	0.24	0.04	2.0	0.3	3.4	0.2	14	3
FC1a	09-11-02	3.9	1.3	0.30	0.17	3.9	3.5	19	5	14	1
MC2	05-15-01	5.2	3.9	0.28	0.15	2.4	1.2	4.4	3.8	21	12
MC6	05-15-01	6.3	1.9	0.24	0.04	2.2	0.4	6.6	1.2	21	6
MC2	09-05-01	5.8	0.8	0.26	0.08	2.5	0.9	3.1	1.6	18	3
MC6	09-05-01	5.3	2.4	0.32	0.09	3.0	1.1	32	41	25	9
MC2b	09-10-02	8	4	0.40	0.09	3.6	0.7	7.0	3.3	21	3
MC2b[2]	09-10-02	6.5	1.2	0.43	0.05	3.9	0.8	18	12	27	13

[1]No sediment samples collected in May 2002.

[2]Duplicate sample.

Table 14. *E. coli* in surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002

[MPN, most probable number; mL, milliliter]

Site name	Process date	MPN per 100 mL	Site name	Process date	MPN per 100 mL	Site name	Process date	MPN per 100 mL
				May 2001				
KC5[1]	05–17–01	0	FC1[1]	05–16–01	0	MC2[1]	05–15–01	4
KC5[1]	05–17–01	1	FC1[1]	05–16–01	5	MC2[1]	05–15–01	4
KC5[1]	05–17–01	2	FC1[1]	05–16–01	2	MC6[1]	05–15–01	0
KC5[1]	05–17–01	2	FC2[2]	05–16–01	0	MC6[1]	05–15–01	22
KC5[1]	05–17–01	1	FC2[2]	05–16–01	1	MC6[1]	05–15–01	2
KC5[1]	05–17–01	0	FC2[2]	05–16–01	1	MC6[1]	05–15–01	12
KC5[1]	05–17–01	0	FC5[2]	05–16–01	0	MC6[1]	05–15–01	3
KC2[2]	05–17–01	0	FC5[2]	05–16–01	0	MC6[1]	05–15–01	1
KC2[2]	05–17–01	0	FC5[2]	05–16–01	0	MC3[2]	05–15–01	0
KC2[2]	05–17–01	0	FC4[2]	05–16–01	0	MC3[2]	05–15–01	9
KC3[2]	05–17–01	0	FC4[2]	05–16–01	0	MC3[2]	05–15–01	6
KC3[2]	05–17–01	0	FC4[2]	05–16–01	0	MC4[2]	05–15–01	1
KC3[2]	05–17–01	0	MC2[1]	05–15–01	13	MC4[2]	05–15–01	0
FC1[1]	05–16–01	1	MC2[1]	05–15–01	11	MC4[2]	05–15–01	0
FC1[1]	05–16–01	2	MC2[1]	05–15–01	2,419	MC5[2]	05–15–01	0
FC1[1]	05–16–01	0	MC2[1]	05–15–01	12	MC5[2]	05–15–01	0
FC1[1]	05–16–01	1	MC2[1]	05–15–01	7	MC5[2]	05–15–01	0
				September 2001				
KC5	09–06–01	0	FC1[1]	09–07–01	2	MC2[1]	09–05–01	1
KC5	09–06–01	0	FC1[1]	09–07–01	1	MC2[1]	09–05–01	0
KC5	09–06–01	0	FC1[1]	09–07–01	0	MC2[1]	09–05–01	1
KC5	09–06–01	0	FC2[2]	09–07–01	0	MC2[1]	09–05–01	9
KC5	09–06–01	0	FC2[2]	09–07–01	1	MC6[1]	09–05–01	0
KC5	09–06–01	0	FC2[2]	09–07–01	1	MC6[1]	09–05–01	2
KC5	09–06–01	0	FC3[2]	09–07–01	0	MC6[1]	09–05–01	0
KC2[2]	09–06–01	1	FC3[2]	09–07–01	0	MC3[2]	09–05–01	0
KC2[2]	09–06–01	0	FC3[2]	09–07–01	0	MC3[2]	09–05–01	0
KC2[2]	09–06–01	0	FC3[2]	09–07–01	0	MC3[2]	09–05–01	0
KC2[2]	09–06–01	0	FC3[2]	09–07–01	0	MC4[2]	09–05–01	0
KC2[2]	09–06–01	0	FC3[2]	09–07–01	0	MC4[2]	09–05–01	0
KC2[2]	09–06–01	0	MC5[2]	09–07–01	0	MC4[2]	09–05–01	0
FC1[1]	09–07–01	1	MC5[2]	09–07–01	1	MC5[2]	09–05–01	0
FC1[1]	09–07–01	1	MC5[2]	09–07–01	0	MC5[2]	09–05–01	0
FC1[1]	09–07–01	0	MC2[1]	09–05–01	0	MC5[2]	09–05–01	0
FC1[1]	09–07–01	2	MC2[1]	09–05–01	1			

See footnotes at end of table.

Table 14. *E. coli* in surface water at Knowles, Forgotten, and Moqui Canyons, May and September 2001 and 2002—Continued

Site name	Process date	MPN per 100 mL	Site name	Process date	MPN per 100 mL	Site name	Process date	MPN per 100 mL
May 2002								
KC5[2]	05–22–02	0	FC2[2]	05–22–02	0	MC4[2]	05–21–02	0
KC5[2]	05–22–02	0	FC2[2]	05–22–02	0	MC4[2]	05–21–02	0
KC5[2]	05–22–02	0	FC2[2]	05–22–02	0	MC4[2]	05–21–02	0
KC2[2]	05–22–02	0	FC5[2]	05–22–02	0	MC3[2]	05–21–02	0
KC2[2]	05–22–02	0	FC5[2]	05–22–02	0	MC3[2]	05–21–02	0
KC2[2]	05–22–02	1	FC5[2]	05–22–02	0	MC3[2]	05–21–02	0
KC3[2]	05–22–02	0	FC4[2]	05–22–02	0	MC5[2]	05–21–02	0
KC3[2]	05–22–02	0	FC4[2]	05–22–02	0	MC5[2]	05–21–02	0
KC3[2]	05–22–02	0	FC4[2]	05–22–02	0	MC5[2]	05–21–02	0
September 2002								
KC5[1]	09–12–02	9	FC1c[1]	09–11–02	2	MC2b[1]	09–10–02	135
KC5[1]	09–12–02	5	FC1c[1]	09–11–02	4	MC2b[1]	09–10–02	1,733
KC5[1]	09–12–02	11	FC2	09–11–02	15	MC2b	09–10–02	39
KC5[1]	09–12–02	4	FC2	09–11–02	9	MC2b[1]	09–10–02	44
KC5[1]	09–12–02	11	FC2	09–11–02	13	MC2c[1]	09–10–02	12
KC5[1]	09–12–02	1	FC5	09–11–02	0	MC2c[1]	09–10–02	21
KC5[1]	09–12–02	0	FC5	09–11–02	0	MC2c[1]	09–10–02	24
KC3	09–12–02	0	FC5	09–11–02	1	MC2c[1,3]	09–10–02	26
KC3	09–12–02	0	FC5	09–11–02	0	MC3[1]	09–10–02	7
KC3	09–12–02	0	FC4	09–11–02	0	MC3[1,3]	09–10–02	7
KC6	09–12–02	0	FC4	09–11–02	0	MC3[1]	09–10–02	7
KC6	09–12–02	0	FC4	09–11–02	0	MC3[1]	09–10–02	5
KC6	09–12–02	0	MC5	09–11–02	1	MC4[1,3]	09–10–02	0
FC1[1]	09–11–02	4	MC5	09–11–02	0	MC4[1]	09–10–02	0
FC1a[1]	09–11–02	124	MC5	09–11–02	2	MC4[1]	09–10–02	0
FC1[1]	09–11–02	4	MC2b[1]	09–10–02	12	MC4[1]	09–10–02	0
FC1b[1]	09–11–02	7	MC2b[1]	09–10–02	727			
FC1[1]	09–11–02	7	MC2b[1]	09–10–02	52			

[1]Samples collected along beach areas at sample sites (see figure 1).
[2]Samples collected in main channel of side canyons at sample sites (see figure 1).
[3]Composite samples.