Prepared in cooperation with the Metro Wastewater Reclamation District

Biosolids, Crop, and Ground-Water Data for a Biosolids-Application Area Near Deer Trail, Colorado, 2004 Through 2006

Data Series 379

U.S. Department of the Interior
U.S. Geological Survey

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Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
micrometer (m)	0.00003937	inch (in.)
mile (mi)	1.609	kilometer (km)
millimeter (mm)	0.03937	inch (in.)
	Area	
acre	0.004047	square kilometer (km^2)
square foot (ft^2)	0.09290	square meter (m^2)
section (640 acres or 1 square mile)	259.0	square hectometer (hm^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
ounce, fluid (fl. oz)	0.02957	liter (L)
gallon (gal)	3.785	liter (L)
liter (L)	33.82	ounce, fluid (fl. oz)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
pound, avoirdupois (lb)	0.4536	kilogram (kg)
ton, short (2,000 lb)	0.9072	megagram (Mg)
ton, long (2,240 lb)	1.016	megagram (Mg)

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

$$°F=(1.8×°C)+32$$

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

$$°C=(°F-32)/1.8$$

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Biosolids, Crop, and Ground-Water Data for a Biosolids-Application Area Near Deer Trail, Colorado, 2004 Through 2006

By Tracy J.B. Yager, David B. Smith, and James G. Crock

Abstract

From 2004 through 2006, the U.S. Geological Survey monitored the chemical composition of biosolids, crops, dust, and ground water related to biosolids applications near Deer Trail, Colorado, in cooperation with the Metro Wastewater Reclamation District. This monitoring effort was a continuation of the monitoring program begun in 1999 in cooperation with the Metro Wastewater Reclamation District and the North Kiowa Bijou Groundwater Management District. The monitoring program addresses concerns from the public about the chemical effects from applications of biosolids to farmland in the Deer Trail, Colorado, area. This report presents chemical data from 2004 through 2006 for biosolids, crops, and alluvial and bedrock ground water. The chemical data include the constituents of highest concern to the public (arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, and plutonium) in addition to many other constituents. The ground-water section also includes climate and water-level data.

Introduction

Since 1993, the Metro Wastewater Reclamation District (Metro District) has been applying biosolids resulting from municipal sewage treatment in Denver, Colo., to their property near Deer Trail, Colo. (fig. 1; this figure and all other figures and tables are located in the Data Section at the back of the report). The biosolids are trucked about 75 mi east from Denver to the Metro District property and are applied to nonirrigated farmland. The first property the Metro District acquired near Deer Trail was about 15 mi^2. In 1995, the Metro District traded some of the property and acquired additional property in the same area. The resulting boundaries of the original property became known as the Metro District central property (fig. 1). The new properties consisted of about 14.5 mi^2 known as the north property and about 50 mi^2 known as the south property (fig. 1). In 1999, the three Metro District properties together, known as the METROGRO Farm, encompassed almost 70 mi^2 of farmland in Arapahoe and Elbert Counties. The three Metro District properties and surrounding private property are considered the study area (fig. 1).

The study area is located on the eastern plains of Colorado about 10 mi east of Deer Trail. The study area is on the eastern margin of the Denver Basin, a bowl-shaped sequence of sedimentary rocks that was formed in an ocean or near-ocean environment. The geology of the study area consists of interbedded shale, siltstone, and sandstone, which may be overlain by clay, windblown silt and sand, or alluvial sand and gravel (Sharps, 1980; Major and others, 1983; Robson and Banta, 1995). The primary water-supply aquifer is the Laramie-Fox Hills aquifer, which is a bedrock aquifer that ranges from 0 to about 200 ft thick in the study area and is the bottom aquifer in the Denver Basin aquifer sequence (Robson and others, 1981; Robson and Banta, 1995; Yager and Arnold, 2003). Multiple alluvial aquifers are present in the study area. These aquifers are associated with the surficial drainage network and contain water of variable quality, are of limited extent, and generally yield little water (Stevens and others, 2003; Yager and Arnold, 2003). The study area is within the South Platte River drainage basin; all streams in this area drain northward to the South Platte River (U.S. Geological Survey, 1974; Seaber and others, 1987; Yager and Arnold, 2003). Short segments of some of the streams are intermittent, but in general, the streams are ephemeral and flow only after storms. No surface water flows off the Metro District properties except after storms. Most ponds in the area have been created by detention structures. Soils in the area generally are sandy or loamy on flood plains and stream terraces, clayey to loamy on gently sloping to rolling uplands, and sandy and shaley on steeper uplands (Larsen and others, 1966; Larsen and Brown, 1971).

Land use in the study area historically was rangeland or cropland and pasture (U.S. Geological Survey, 1980). Some petroleum exploration was done in the area historically (Drew and others, 1979), but no oil or gas production took place on the Metro District properties during 2004 through 2006. Land use in the study area during 2004 through 2006 was rangeland or cropland. Cattle and sheep are the primary domesticated animals grazing the area, and wheat is the primary crop. Farmland was not irrigated. Land use on the Metro District properties during 2004 through 2006 was primarily cropland (with only biosolids applied as a fertilizer) and some rangeland. Pesticides and other fertilizers also may have been applied to the Metro District properties historically, but little information is available about these applications. Herbicides and other chemicals were applied to the study area during 2004 through 2006 for farming purposes. Animal waste related to grazing domestic livestock and applications of pesticides and fertilizers (organic and inorganic) can affect soil and water quality (Adeyinka and Mustapha, 2005) and therefore can affect crops, dust, water quality in alluvial and bedrock aquifers, and streambed-sediment chemistry.

Biosolids are applied by the Metro District to their properties near Deer Trail (figs. 1 and 2) according to agronomic loading rates (table 1; Colorado Department of Public Health and Environment, 2003). Land-applied biosolids must meet Colorado regulatory limits (Colorado Department of Public Health and Environment, 2003); otherwise, agronomic loading rates could be exceeded and soils could become overloaded. Soil quality either can be improved by biosolids applications through increased nutrients and organic matter or degraded through accumulation of excessive nutrients, metals, or other chemicals.

The U.S. Geological Survey (USGS) has collected data in the study area since 1993. From 1993 to 1999, the USGS, in cooperation with the Metro District, monitored the quality of shallow ground water on the Metro District central property. Public concern about applications of biosolids to farmland increased in the late 1990’s after the Metro District agreed to accept treated ground water from the Lowry Landfill Superfund site in Denver. The concern was that water from the Lowry Superfund site might contain radionuclides that then would contaminate the Metro District biosolids and the study area. In January 1999, the USGS began an expanded monitoring program for 1999 through 2004, in cooperation with the Metro District and the North Kiowa Bijou Groundwater Management District, to address this and other concerns from stakeholders. A subsequent phase of the expanded monitoring program near Deer Trail continues with selected monitoring from 2005 through 2010. Conclusions from the 1999–2003 phase (Yager and others, 2004d) were used to determine monitoring components, analytes, sites, and frequency. The USGS refers to the 1999–2004 monitoring program and continued USGS monitoring efforts in the study area as the “expanded monitoring program.”

The expanded monitoring program near Deer Trail is distinct from, but builds on, the first USGS monitoring program near Deer Trail on the Metro District central property (1993–1999). Relative to the previous program, the expanded program included a larger study area (fig. 1) (all three Metro District properties and private-property locations), more monitoring components (biosolids, soil, crops, and streambed sediments in addition to ground water), a more comprehensive list of chemical constituents, expanded statistical analyses of data, and an extended monitoring period (1999–present [2008]). In 2005, the monitoring program was further expanded to include a monitoring component to characterize dust during 2006 and 2007 and analysis of nitrogen isotopes and organic wastewater compounds in biosolids, biosolids leachates, and ground water. Both programs used Metro District and USGS funds. Both programs were designed, accomplished, and interpreted independently by the USGS, and quality-assured USGS data and reports were released to the public and the Metro District at the same time. Selected monitoring results for 1993 through 1999 and a detailed discussion of hydrogeology of the study area are reported by Yager and Arnold (2003). Monitoring results for 1999 are reported by Stevens and others (2003). Monitoring results for 2000 are reported by Yager and others (2004a). Monitoring results for 2001 are reported by Yager and others (2004b). Monitoring results for 2002 through 2003 are reported by Yager and others (2004c). Interpretive information for the 1999 through 2003 data is reported by Yager and others (2004d). Selected data for 1999 through 2006 also were published in the “USGS Expanded Monitoring Program Near Deer Trail” progress reports (*http://co.water.usgs.gov/projects/CO406/pubsprogress.html* accessed 5/7/2008).

The expanded monitoring program near Deer Trail addresses concerns about biosolids applications and other farming-related effects on the environment and increases scientific insight about Denver Basin hydrology. The objectives of this USGS program are to (1) evaluate the combined effects of biosolids applications, land use, and natural processes on soils, crops, dust, the bedrock aquifer, alluvial aquifers, and streambed sediments by comparing chemical data to (a) regulatory standards, (b) data from a site where biosolids are not applied (a control site), or (c) earlier data from the same site (trends); (2) monitor biosolids for trace elements and radioactivity and compare trace-element concentrations and radioactivity with regulatory standards; and (3) characterize the hydrology of the study area. Radioactivity analyses were included in the biosolids component because of public concerns about effects from the Lowry Landfill Superfund site. The monitoring of each component (such as crops or ground water) is a stand-alone study that does not necessarily encompass the entire study area. More detailed information about the monitoring of each component is included later in this report.

Purpose and Scope

The purpose of this report is to present data from the expanded monitoring program near Deer Trail for January 2004 through December 2006. This report presents data for all monitoring components of the program that had data collected during 2004 through 2006, except the dust component. The report includes information for biosolids, crops, and (alluvial-aquifer and bedrock-aquifer) ground water. The ground-water section includes meteorologic data, hydrologic data (depth to ground water), and water-quality data (chemistry and field measurements). Data in this report were collected by the USGS after the water transfer from the Lowry Landfill Superfund site to the Metro District plant, which began in July 2000.

This report does not include any statistical comparisons of data to regulatory standards or calculation of trends; plans are to include statistical testing of the data in an interpretive report for the 2004–2010 data prepared after 2010. This report does not include any dust data or any organic wastewater-compound data or isotope data collected during 2004 through 2006 for any monitoring component; plans are to include these data with interpretive information in separate reports. No description, data, or discussion of the soil and streambed-sediment monitoring components are included in this report because no data for these components were collected during 2004 through 2006.

This report is organized by monitoring component because each component is monitored as a separate study. For each monitoring component, the specific objectives, approach, data, and a discussion are included.

Biosolids

Biosolids are solid organic matter recovered from a sewage-treatment process that meets State and Federal regulatory criteria for beneficial use, such as for fertilizer. Land-applied biosolids must meet or exceed Table 1 (formerly known as Grade II), Class B criteria (Colorado Department of Public Health and Environment, 2003). The Metro District applies Table 3 (formerly known as Grade I), Class B biosolids to their properties near Deer Trail. Table 3 Ceiling Concentration Limits are more restrictive than Table 1 Ceiling Concentration Limits. The biosolids-application areas, dates of application, and application rates provided by the Metro District for their properties near Deer Trail are listed in table 1 of this report; application areas (called “Destination Codes” [DC]) are shown in figure 2.

Objectives of Monitoring Biosolids

The biosolids must meet regulatory standards for trace elements. Exceeding these standards could adversely affect the quality of soil on which the biosolids are applied and could alter Metro District plans for the application of biosolids in Arapahoe and Elbert Counties. The composition of biosolids was monitored to provide an independently determined data set against which the Metro District chemical analyses and the regulatory standards for biosolids can be compared. The data also will constitute a chemical baseline against which any future change in the concentration of constituents analyzed for in this study may be recognized, measured, and compared.

Approach for Monitoring Biosolids

Biosolids samples were collected directly from the Metro District facility in Denver rather than from individual trucks or fields near Deer Trail to enable the USGS to obtain a more representative sample. Biosolids samples were analyzed for concentrations of arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, sulfur, zinc, and plutonium. Radioactivity (plutonium) analyses were included in response to public concerns that biosolids radioactivity could increase from the transfer of water from the Lowry Landfill Superfund site to the Metro District. The concentrations in the samples were compared to applicable Colorado standards for biosolids (Colorado Department of Public Health and Environment, 2003).

Sampling Methods for Biosolids

In 2004 through 2006, the USGS received biosolids samples monthly from the Metro District. Each monthly sample consisted of 1- to 2-day composite samples bottled at the Metro District wastewater treatment plant in Denver by Metro District personnel. Biosolids samples were collected in acid-washed, rinsed, 1-gal plastic or glass bottles. The USGS received one to two bottles from each centrifuge that was active at the treatment plant at the time the sample was collected; the treatment plant had a maximum of four centrifuges active at any time. The USGS combined the contents of all sample bottles into a tray and dried the resulting composited sample in a fume hood in the laboratory. Samples usually were dried under an infrared heat lamp to decrease drying time. When the biosolids sample was dried, an aliquot was removed and ground to less than 150   m for chemical analysis. The remaining dried biosolids sample was archived as a single monthly sample.

Analytical Methods for Biosolids

The biosolids samples were processed and analyzed for trace elements at the analytical chemistry laboratories of the USGS Mineral Resources Program (MRPL) in Denver. The biosolids samples were analyzed twice in 2004 and once in subsequent years for radioactivity through a contract with the USGS National Water Quality Laboratory (NWQL) at Eberline Services in California. The methods used to analyze the biosolids for each constituent are listed in table 2.

Quality Assurance for Biosolids

The purpose of the quality-assurance program developed for the biosolids monitoring component was to ensure the analytical results were within acceptable limits of both precision (the reproducibility of results) and accuracy (the degree of conformity of results for a sample having known concentrations). The precision was determined by analyzing the same biosolids sample multiple times, and accuracy was determined by analyzing National Institute of Standards and Technology (NIST) standard reference material SRM 2781, a domestic sewage sludge. This SRM was prepared by NIST from material collected at the Metro District treatment plant in Denver. SRM 2781 has been analyzed extensively by many laboratories throughout the world, and the NIST has certified an acceptable range of values for various constituents in the SRM. The constituents include those of interest in this study. Each biosolids sample was submitted to the laboratories with a sample of the SRM. If the analytical results for the constituent of interest in the SRM were within the acceptable range, the results for the biosolids samples were accepted. Quality-assurance data for the biosolids samples are provided by Crock and others (2008). The analytical quality-assurance practices and procedures of the MRPL are described by Taggart (2002).

Biosolids Data

Data for trace-element concentrations in the 2004 through 2006 biosolids samples are listed in table 3 along with the Colorado standards (Table 1 Ceiling Concentration Limits and Table 3 Pollutant Concentration Limits) for land-applied biosolids. Quality-control data (NIST SRM 2781) associated with the biosolids samples are listed in table 4. Data for plutonium concentrations in the 2004 through 2006 biosolids samples are listed in table 5.

Discussion of Biosolids Data

All trace-element concentrations in the biosolids samples were less than the Colorado standards established by the Table 1 Ceiling Concentration Limits and Table 3 Pollutant Concentration Limits (Colorado Department of Public Health and Environment, 2003). No plutonium standards are applicable to the biosolids. The plutonium data for biosolids (table 5) are similar to the plutonium data for soil in the study area (Stevens and others, 2003; Yager and others, 2004b). The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated minimum detectable concentration (MDC). Relative to the censored form (data reported as less than the MDC), the uncensored form provides more information about the uncertainty and the very small concentrations of plutonium. The negative activity concentration reported for the February 2004 sample (table 5) means the sample count was less than the laboratory background count for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background count was subtracted from the sample count, and the resulting value was converted to activity-concentration units of picocuries per gram.

Crops

As previously mentioned, biosolids can contain elevated concentrations of certain trace elements. The application of biosolids to farmland on which grain crops are grown that eventually will be consumed by animals or humans has led to public concern about the composition of the crops grown on the fields receiving biosolids.

Objectives of Monitoring Crops

Crops are monitored for trace elements to establish independent chemical data sets for the composition of the crops before and after the application of biosolids. The data will enable the USGS to recognize and quantify significant changes in the chemical composition of crops caused by the application of biosolids to agricultural soils or by other natural or human-induced processes.

Approach for Monitoring Crops

In the summer of 2000, the USGS began monitoring crops grown on the same two sites where soils were monitored (figs. 1, 3, and 4). Each of the two soil- and crop-monitoring sites include a biosolids-applied field and two fields that do not receive biosolids and are used as “control” fields to determine the natural variability of soil and crop composition for the duration of the study. The fields at each site are farmed in a similar way as the rest of the Metro District property and have crops planted and harvested approximately every other year. Soils from each of the six fields were sampled in 1999 before biosolids were applied to the two center fields and were sampled again after each harvest through 2003. Plans are to sample soil again in 2010. If a crop sample could not be obtained from the USGS soil- and crop-monitoring fields, occasionally a crop sample was obtained from a biosolids-applied field as near as possible to the USGS soil- and crop-monitoring fields.

The primary crop monitored is winter wheat, although millet and corn also have been grown and sampled. The primary form of the crop that is monitored is mature grain at the time of harvest. Crops grown on fields that receive biosolids applications are monitored along with crops grown on fields that do not receive biosolids applications. The crops from fields that do not receive biosolids applications are used as a reference for comparison. Crop samples were obtained from the monitoring sites in 2000, 2002, 2004, and 2006. The crop samples were analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. During 2001, 2003, and 2005, no crops were grown on either the Arapahoe or Elbert County soil- and crop-monitoring sites. Data will be compared after each sampling and at the conclusion of the study to determine how the concentrations of the constituents of interest vary with time.

Site Selection for Monitoring Crops

Sites were selected in 1999 on Metro District properties where biosolids had never been applied but subsequently were applied to selected fields. One site was selected on the Metro District’s north property in Arapahoe County, and one site was selected on the Metro District’s south property in Elbert County (fig. 1). The Arapahoe County site is located in T. 4 S., R. 58 W., sec. 22 and lies about 0.25 mi west of Badger Creek (fig. 3). The Elbert County site is located in T. 6 S., R. 57 W., sec. 8 and lies immediately west of Beaver Creek (fig. 4). Each of the two soil- and crop-monitoring sites consist of three 20-acre (933-ft by 933-ft) fields separated by 100-ft buffer strips (figs. 3 and 4).

Sampling Methods for Crops

In 2000 and 2002, the USGS collected the crop sample directly from the monitoring fields. During 2004 through 2006, the Metro District collected the crop sample. In 2004 and 2006, wheat from the Arapahoe County monitoring site was sampled during the summer. The USGS received a separate grain sample from each of the 20-acre fields harvested (fig. 3). No grain sample could be provided to the USGS from the Elbert County monitoring site during 2004 through 2006; however, a single sample of harvested wheat from a biosolids-applied field (DC 403; fig. 2) near the Elbert County monitoring site (fig. 4) was provided to the USGS in 2006. A single sample of field-dried, harvested corn kernels from a biosolids-applied field (DC 455; fig. 2) in Elbert County also was provided to the USGS in 2006. Samples of mature grain were provided to the USGS by the Metro Disrtrict in cardboard boxes (2004) or clean, white, plastic buckets (2006) from the machine-harvested grain obtained from each field.

Analytical Methods for Crops

The crop samples were processed and analyzed for trace elements at the USGS MRPL in Denver. The crop samples were dried under forced air at room temperature then cleaned using forced air and sieving. The cleaned crop samples were ground to a flour using a commercial table-top grain mill. A split of each ground sample was ashed in a forced-air muffle furnace at 500° C. The ashed grain samples and the dried, unashed grain samples were analyzed by the protocols described in detail by Yager and others (2004a). The analytical methods are summarized in table 2. The analytical quality-assurance practices and procedures of the MRPL are described by Taggart (2002).

Crop Data

Chemical data for wheat grain from the Arapahoe County monitoring site sampled in 2004 and 2006 are listed in table 6. Chemical data for wheat grain from a biosolids-applied field near the Elbert County monitoring site sampled in 2006 are listed in table 6. Chemical data for corn kernels sampled in 2006 from a biosolids-applied field in Elbert County also are included in table 6.

Discussion of Crop Data

All analyses of crop samples met the quality-assurance criteria described by Taggart, 2002. The chemical differences between wheat collected from the 20-acre fields to which biosolids have been applied and wheat from the control fields where no biosolids have been applied are minimal and not significant. Fluctuations generally are within the normal range of uncertainty associated with using a limited number of subsamples to chemically characterize a large population. Few comparisons can be made between the wheat-grain samples of Elbert County relative to the wheat-grain samples of Arapahoe County because only one sample was collected from Elbert County. The single wheat-grain sample from Elbert County did have a lower selenium concentration and a higher zinc concentration than the six wheat-grain samples from Arapahoe County.

The single sample of corn had higher concentrations of copper, lead, molybdenum, nickel, and zinc than the samples of wheat. However, few comparisons can be made between the corn-kernel sample and the wheat-grain samples because only one corn sample was collected and analyzed.

Ground Water

Applications of pesticides, herbicides, or fertilizers (including biosolids) to the land surface can affect the quality of shallow ground water directly by contaminating recharge water at the surface or during infiltration through contaminated soils or sediments (remobilization). These applications also can affect the quality of shallow ground water indirectly by contributions to natural processes such as nitrification. Discharge from contaminated alluvial ground water also could contaminate surface water (ponds or streams) or bedrock water-supply aquifers. For this report, alluvial ground water is defined as the water contained in subsurface, unconsolidated (uncemented), wind- or water-transported sediments in current or historical stream channels or flood plains. Bedrock ground water is defined as the water contained in the fractures or pore spaces of the rock (consolidated sediments) that underlies soil or other uncemented materials; the primary bedrock aquifer in the study area is the Laramie-Fox Hills aquifer (Robson and Banta, 1995).

Objectives of Monitoring Ground Water

Ground water was monitored to characterize the hydrology and water quality of the aquifers; to determine if concentrations of nitrate, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc in the ground water are significantly greater than regulatory standards; and to determine if concentrations of these constituents are increasing with time in ground water at or near the Metro District properties.

Approach for Monitoring Ground Water

Ground-water sites monitored during 2004 through 2006 were USGS monitoring wells in the study area that were installed in 1993–2002 during previous phases of monitoring.

"D"-numbered wells were drilled before 1999 as part of the first monitoring program (except for wells D6A and D25A, which were drilled in 2002), and "DTX"-numbered wells were drilled in 1999 or 2000 (fig. 1). Lithologic and well-completion information for these well locations are provided by Stevens and others (2003), Yager and Arnold (2003), and Yager and others (2004a). During 2004 through 2006, fewer ground-water sites were monitored than during 1999 through 2003. Selected information for all the USGS wells monitored during 2004 through 2006 as part of this program is summarized in table 7.

To characterize hydrology, depth to ground water was measured monthly, meteorologic data were collected, and ground-water altitude was compared at two recharge-evaluation sites. Each recharge-evaluation site consisted of a nested bedrock-aquifer well paired with an alluvial-aquifer well at the same location. Monitoring multiple wells in the same location enabled different zones of ground water to be monitored without having to consider spatial variability and can enable inferences about vertical directions of ground-water flow between zones. Nested wells mean each borehole has two separate piezometers screened at two separate zones; the shallow zone is designated by "A" and the deep zone is designated by "B" after the well name. Therefore, three different aquifer zones are monitored at each of the two recharge-evaluation sites in Muddy Creek downgradient from the Metro District properties in the northwest part of the study area (fig. 1). A fourth aquifer zone (well DTX11) is monitored at the DTX9 recharge site to provide information about a deeper coarse-grained part of the Muddy Creek alluvial aquifer than is monitored by well DTX9. In 2000, electronic data-logger (EDL) equipment was installed to continuously monitor precipitation and water levels in wells DTX9, DTX10, and DTX11 and to provide detailed information about ground-water recharge at that location.

To provide additional detailed information about the hydrology in the study area and the response of ground water to climate variables, data-collection platforms (DCP's) were utilized to collect hourly data. DCP's with various sensors (installed during 1999) at three alluvial-aquifer wells (D25, DTX2, and DTX5) continuously monitored ground-water and meteorological parameters, although recorders were shut off and the equipment removed during 2004 through 2006 at wells D25 and DTX5. The DCP data were transmitted to Denver by satellite and usually were available on the Internet.

To characterize water quality of the aquifers, samples were collected quarterly. During 2004 through 2006, three bedrock-aquifer wells (DTX8, DTX10, and D29; fig. 1) and eight alluvial-aquifer wells (DTX1, DTX2, DTX3, DTX5, DTX6, D6, D17, and D25; fig. 1) were sampled. Ground-water samples were analyzed routinely for physical properties, dissolved major ions and trace elements, and dissolved and total nutrients. Analyses included nitrate, arsenic, cadmium, copper, chromium, lead, mercury, molybdenum, nickel, selenium, and zinc (constituents considered the most important by the stakeholders). To determine if concentrations of these constituents in the ground water of the study area are significantly greater than regulatory standards, selected analytical data are compared to the Colorado standards (Colorado Department of Public Health and Environment, 2004) annually. To determine if concentrations of these constituents are significantly increasing with time in ground water, selected analytical data will be statistically tested for significant upward trends. The data will be statistically compared to regulatory standards and tested for trends after there are enough new data collected.

All ground-water data are maintained in the USGS National Water Information System (NWIS) data base. All ground-water data collected for this program during 1999 through 2003 and interpretive information were published in USGS reports (Stevens and others, 2003; Yager and Arnold, 2003; Yager and others, 2004a, 2004b, 2004c, 2004d) and are available on the Internet (*http://co.water.usgs.gov/projects/CO406/pubs.html* accessed 6/16/08).

Site Selection for Monitoring Ground Water

Shallow aquifers can be recharged by runoff and streamflow or can contribute water to streamflow and ponds. Therefore, the alluvial-aquifer sites for the expanded monitoring program were selected by the USGS according to the following criteria: (1) locations in proximity to a stream channel that could carry runoff from Metro District biosolids-applied fields, (2) locations at the most downstream point of the drainage basin, (3) locations at Metro District property boundaries to represent the condition of ground water leaving the properties and to consider only those effects from activities on Metro District properties and not from other landowners, (4) locations where most of the upstream basin is on Metro District property, (5) locations that represent the larger drainage basins, (6) locations where USGS monitoring wells already existed and where data already had been collected, and (7) locations accessible year round for sampling wells. Alluvial-aquifer locations upgradient from Metro District property boundaries were not monitored because the constituents of concern generally are not conservative along the ground-water flow path; that is, subtracting upgradient concentrations from downgradient concentrations may not represent the effects of biosolids on the ground water for these constituents. Monitoring alluvial ground water near Rattlesnake Creek was a low priority because most of the basin is upstream from the Metro District properties, and that part of the basin that receives biosolids is relatively small. Therefore, the USGS monitored two alluvial-aquifer wells (DTX1 and DTX2) on the Metro District north property and four (DTX3, DTX4, DTX5, and DTX6) on the Metro District south property (fig. 1). All wells on the Metro District central property used for this study (fig. 1; D6, D6A, D11a, D13, D17, D19, D25, D25A, D29, and D30) were installed before 1999 as part of the first monitoring program, except for wells D6A and D25A. Wells D6A and D25A were installed in 2002 to provide additional lithologic information for those locations and to provide ground-water level and water-quality information for a more specific part of the aquifers than monitored by D6 and D25.

Bedrock aquifers can be recharged by alluvial ground water or can be a source of water to alluvial aquifers. Therefore, the bedrock-aquifer sites for the expanded monitoring program were selected by the USGS according to the following criteria: (1) locations where a particular sandstone sequence within the Laramie-Fox Hills aquifer is present at substantial areal extent and thickness (Yager and Arnold, 2003), (2) locations on Metro District property where the bedrock aquifer is present without an alluvial aquifer, (3) locations for recharge-evaluation sites where the bedrock aquifer is present beneath an alluvial aquifer that could be affected by the application of biosolids, (4) locations where USGS monitoring wells already existed and where data already had been collected, and (5) locations accessible year round for sampling wells. The hydrogeologic structure maps that were done in 1999 and are included in Yager and Arnold (2003) were used to locate two recharge-evaluation sites in the northwest part of the study area (fig. 1). In 1999, the USGS installed two nested bedrock-aquifer wells (DTX8 and DTX10) and corresponding alluvial-aquifer wells (DTX7, DTX9, and DTX11) (fig. 1) at locations where the bedrock aquifer is present beneath the Muddy Creek alluvial aquifer; the Muddy Creek alluvial aquifer could be affected by the application of biosolids. Two older USGS bedrock-aquifer monitoring wells (D11a and D29; fig. 1) also were included in this monitoring program because the wells are on Metro District property where the bedrock aquifer is present without an alluvial aquifer, and prior data are available.

This monitoring program included three DCP sites, one on each of the Metro District north, south, and central properties (wells DTX2, DTX5, and D25, respectively). The locations of these DCP sites were selected according to the following criteria: (1) locations where alluvial-aquifer wells are sampled, (2) locations near possible streambed-sediment sampling areas (to indicate likely runoff conditions), (3) locations near other wells so the information may apply to more than one well, (4) locations far enough apart from each other to indicate spatial variability in hydrology, (5) locations needing additional hydrologic information to explain chemical variability (well D25), and (6) locations accessible year round.

Robson and others (1981) showed that recharge of the Laramie-Fox Hills aquifer along the margin of the Denver Basin (such as in the Deer Trail area) can be from deeper parts of the Denver Basin, from alluvial aquifers and surficial features, or from infiltration of precipitation on or near outcrop areas. Recharge of the alluvial aquifers in the Deer Trail area can be from the Laramie-Fox Hills aquifer, from surface-water features, or from infiltration of precipitation (Robson and others, 1981; Yager and Arnold, 2003). For the expanded monitoring program, such interactions were monitored at two recharge-evaluation sites in the northwest part of the study area, each of which included at least one alluvial-aquifer well and one nested bedrock-aquifer well.

In 2005, the results from the 1999 through 2003 phase of monitoring (Yager and others, 2004d) were used to revise the ground-water component for the next phase of monitoring, the 2005 through 2010 monitoring program. Sufficient detailed data were collected at wells DTX5 and D25, so the DCP equipment gradually was removed from these sites during 2005 through 2007. Alluvial-aquifer sites selected for routine water-quality sampling during 2005 through 2010 were those sites where the previous data indicated that constituent concentrations in ground water may be affected by biosolids applications or where constituents of concern were increasing significantly over time (Yager and others, 2004d), and sufficient ground water could be collected routinely for a complete sample. Bedrock-aquifer sites selected for routine water-quality sampling during 2005 through 2010 were those sites where the previous data indicated alluvial-aquifer ground water could affect bedrock-aquifer concentrations (Yager and others, 2004d) and sufficient ground water could be collected routinely for a complete sample. In addition, the 1999 through 2003 data indicated that bedrock-aquifer quality did not fluctuate as much as alluvial-aquifer quality. Therefore, five alluvial-aquifer wells (Wells DTX1, DTX2, D6, D17, and D25; fig. 1) were selected for quarterly sampling, and the shallow zone (“A”) of two bedrock-aquifer wells (DTX8 and DTX10; fig. 1) was selected for annual sampling during 2005 through 2010. The remaining monitoring wells (fig. 1) were used primarily for hydrologic information but selected wells were sampled occasionally if funding was available; water-level data were collected from all the monitoring wells.

Sampling Methods for Ground Water

All data-collection methods used during 2004 through 2006 were the same as the 1999 methods, which are detailed by U.S. Geological Survey (variously dated) and Stevens and others (2003). Monthly water-level measurements were made using a vinyl-coated electric tape. DCP and EDL data were automatically recorded hourly.

Water-quality samples were collected quarterly using standard USGS methods (Horowitz and others, 1994; U.S. Geological Survey, variously dated). Water levels and field measurements such as pH and specific conductance were recorded with the collection of each ground-water sample. Blank and replicate samples were analyzed to evaluate bias and variability of the ground-water data. All sampling equipment was used exclusively by the USGS and was used only in the study area to prevent cross contamination from other sites in other study areas. All samples and sampling equipment were kept at all times in the custody of the USGS in locked facilities.

Analytical Methods for Ground Water

Ground-water samples were analyzed by the USGS NWQL in Denver. The methods used to analyze the 2004 through 2006 ground-water samples are listed in table 8, which includes laboratory MRL’s for the elements of interest.

Quality Assurance for Ground Water

Quality-assurance procedures were implemented during the course of the monitoring program to ensure the quality of the data. Procedures were implemented for water-level measurements, DCP-data collection, ground-water-sampling preparation, field-properties measurements, ground-water sampling, and laboratory analysis. Quality-assurance procedures are detailed in the 1999 data report (Stevens and others, 2003). The analytical quality-assurance practices and procedures of the NWQL are described in Friedman and Erdmann (1982).

Ground-Water Data

Monitoring at ground-water sites during 2004 through 2006 produced meteorologic, hydrologic, and water-quality data. Meteorologic data include precipitation at four sites and air temperature at three sites. Hydrologic data include monthly water levels at all wells, hourly water levels and water temperature at two DCP sites, and hourly water levels at three EDL wells. Water-quality data include analytical results from quarterly sampling.

Meteorologic Data

Precipitation and air temperature were recorded hourly at wells D25, DTX2, and DTX5 (figs. 5 through 7). These meteorologic data were collected throughout 2004, 2005, and 2006 at DTX2 (fig. 6), and 2004 through mid-June 2005 at DTX5 (fig. 7). Precipitation data were collected 2004 through September 2006 at D25, and air-temperature data were collected 2004 through early November 2006 at D25 (fig. 5). Precipitation also was recorded hourly during 2004 through 2006 at the EDL site, the well cluster including well DTX11 (fig. 8).

Hydrologic Data

Monthly water-level data and continuous water-level and water-temperature data were collected from the study area during 2004 through 2006. The monthly water-level data for the USGS monitoring wells are listed as depth to water below measuring point at a specific time (table 9). Any continuous water-level and water-temperature data for the three DCP sites (D25, DTX2, and DTX5; fig. 1) are shown in figures 5 through 7. No continuous water-level data were collected at well D25 during 2004 through 2006 because equipment malfunctioned and could not be repaired. The hydrologic continuous-recorder equipment at D25 and all the continuous-recorder equipment at DTX5 were removed in June 2005. Continuous water-level data for the EDL site (wells DTX9, DTX10, and DTX11; fig. 1) are shown in figure 8. Continuous water-level data are shown in figures 5 though 8 as daily maximum depth to water below land surface.

Water-level data can indicate ground-water recharge information. Water-level altitudes for the paired alluvial-aquifer and bedrock-aquifer wells at the northernmost recharge-evaluation site (wells DTX7 and DTX8) are compared for 2004 through 2006 in figure 9. Water-level altitudes for the paired alluvial-aquifer and bedrock-aquifer wells at the other recharge-evaluation site (wells DTX9, DTX10, and DTX11) are compared for 2004 through 2006 in figure 10.

Water-Quality Data

Water-quality data for ground-water samples collected quarterly from the study area during 2004 through 2006 are listed in table 10. Data are included for field properties, physical properties, major ions, nutrients, and trace elements for eight alluvial-aquifer and three bedrock-aquifer wells. Quality-control water-quality data for the blank samples are listed in table 11, and comparison data for ground-water and replicate samples are listed in table 12.

Discussion of Ground-Water Data

During 2004 through 2006, water levels generally decreased in some wells (DTX2, D11a) or stayed the same (DTX7, DTX8, D6) in other wells (table 9). Water levels increased substantially during June through July 2006 in the USGS monitoring wells on the Metro District’s south property (fig. 1). Well DTX3 recharged substantially for the first time since 2001 after June 15, 2006, but became dry again by mid-September 2006 (table 9). Well DTX4 was dry from July 2004 through mid-May 2006 but recharged substantially during late May through July 2006 (table 9). Water-level data indicate that most wells in the study area also recharged between mid-August and mid-September 2006.

Hydrologic interactions between alluvial and bedrock aquifers can be inferred using water-level data for the same point in time for wells drilled into the aquifers at the same site (figs. 9 and 10). The direction of the vertical movement of ground water, or the recharge direction, may be indicated by noting that water moves from areas of high hydraulic head (high water-level altitude) to areas of low hydraulic head (low water-level altitude).

Concentrations for the blank water-quality samples (table 11) generally indicate little or no contamination bias in the environmental samples. Only a slight high bias is indicated for some major- and trace-element concentrations. The blank samples of type “Q” (table 11) were from the submersible pump, and these data indicate occasional slight contamination bias for calcium, copper, magnesium, manganese, nickel, and zinc values, particularly in June 2006. This pump was used only at wells DTX8A, DTX10A, and D29, so only samples from these wells may be affected. In general, concentrations for the blank samples were much less than those for the ground-water samples.

In 2005, several laboratory issues began affecting the ground-water data. A change in analytical instrumentation resulted in lower minimum reporting levels for some trace elements and lower reported concentrations (such as arsenic). These decreased concentrations in some trace elements likely reflect analytical changes rather than changes in the ground water near Deer Trail. Also, the ground-water samples from this monitoring program caused an interference with some of the trace-element analyses. Samples from all sites were affected, but not all samples were affected every sampling trip. Analyses affected most frequently were those for arsenic, barium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, uranium, and zinc. The interference resulted in variable concentration values that initially were reported by the laboratory as much higher or much lower (not a consistent bias) than historic values. Re-analyses of the samples usually resulted in values that were more appropriate and more consistent with historic values. Because the variability of the results increased substantially for these samples in 2005 and 2006, the results for these constituents are presented with less precision (fewer significant figures) in this report (tables 9 and 11) than the values provided by the laboratory. This "matrix interference" is unlikely to be caused by biosolids applications near Deer Trail, but investigation into the cause of and solution to this interference continued into 2008.

The relative percent differences (RPD) between the ground-water samples and the replicate samples were computed to summarize sample variability (table 12). Some of the larger RPD's can be attributed to the "matrix interference" mentioned previously and indicate that a larger uncertainty or analytical error needs to be attributed to some of these data for 2005 through 2006. However, many of the larger RPD's are unrelated to the interference and are due to values or concentrations near the MRL where precision is expected to be poor. In these instances, concentrations may vary little but result in large RPD's. For example, a ground-water sample concentration of 0.01 mg/L and a replicate-sample concentration of 0.02 mg/L would result in an RPD of 67 percent, but the difference might be considered to be within the precision of the method at that concentration. Data values for individual replicate pairs are listed in table 12 to help the reader determine if large RPD's are the result of substantial differences between replicate-sample concentrations or just small differences between small concentrations. Variability in the data was highest for analyses of acid neutralizing capacity, arsenic, barium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, uranium, and zinc, although rerun analyses improved RPD's for some of these constituents in table 12. Note that most if not all of this variability likely is from the analyses and is not inherently present in the ground water or contributed through field processing. The replicate-sample data indicate generally reproducible analytical results.

The data included in this report indicate alluvial- and bedrock-aquifer hydrology and chemistry are variable in space (from site to site) and in time (from one data-collection time to the next at the same site) in the study area. The distribution of concentrations at each well for selected constituents during 2004 through 2006 compared to Colorado regulatory standards is shown in figure 11. Time-series graphs (concentration plotted with time) of selected constituents for selected wells are included as figure 12. All concentrations of nitrite plus nitrate at well D6 were greater than the Colorado Human Health standard, and concentrations increased with time. Some concentrations of dissolved selenium were greater than the Colorado Agricultural and Human Health standards (fig. 12). Plans are to include the results of statistically comparing the 2004 through 2010 ground-water-quality data to Colorado regulatory standards and the results of statistically significant trends in a USGS interpretive report for the 2004 through 2010 monitoring program.

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Data Section

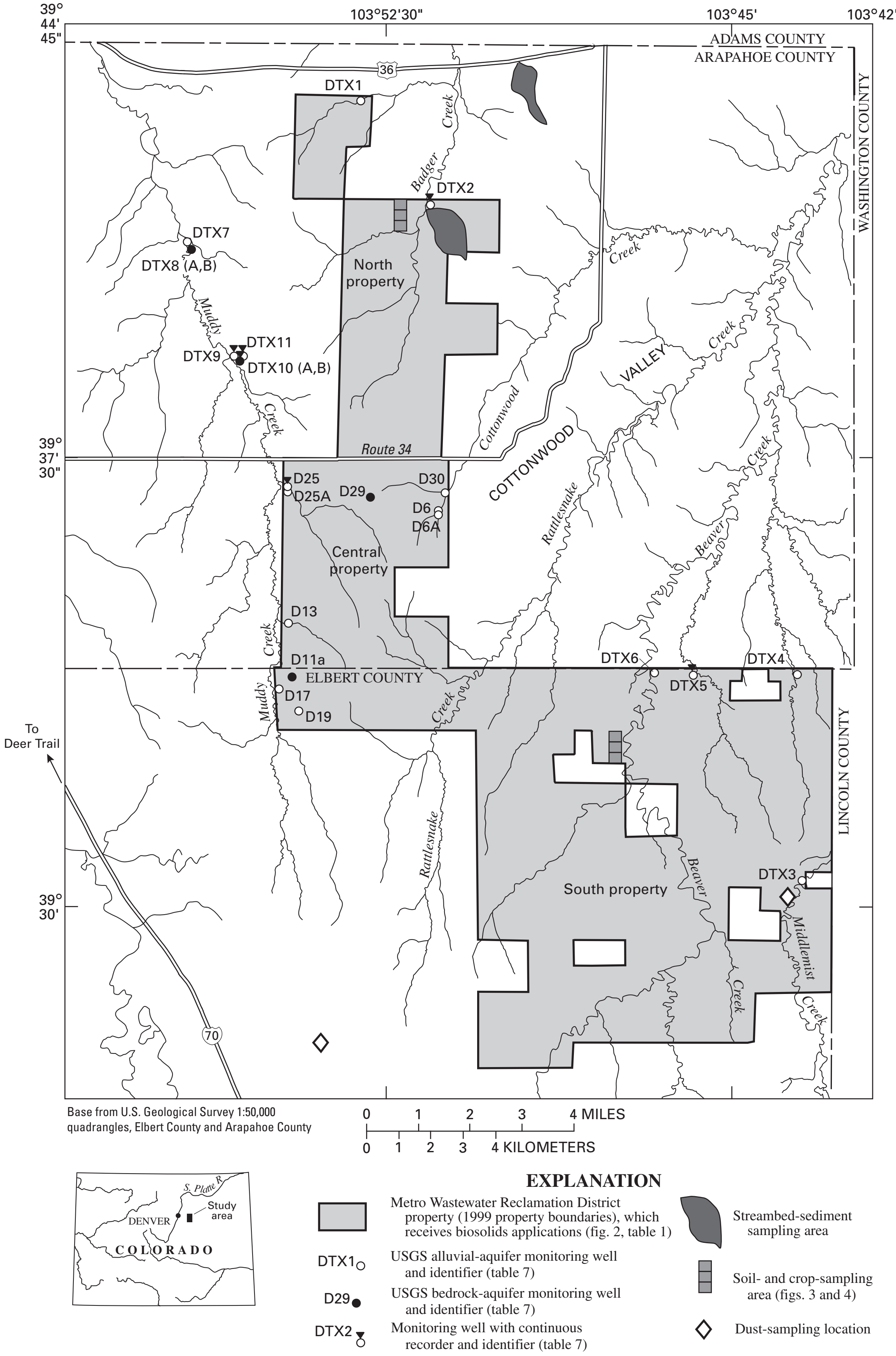

Figure 1. Location of study area and U.S. Geological Survey monitoring sites near Deer Trail, Colorado, 2004 through 2006.

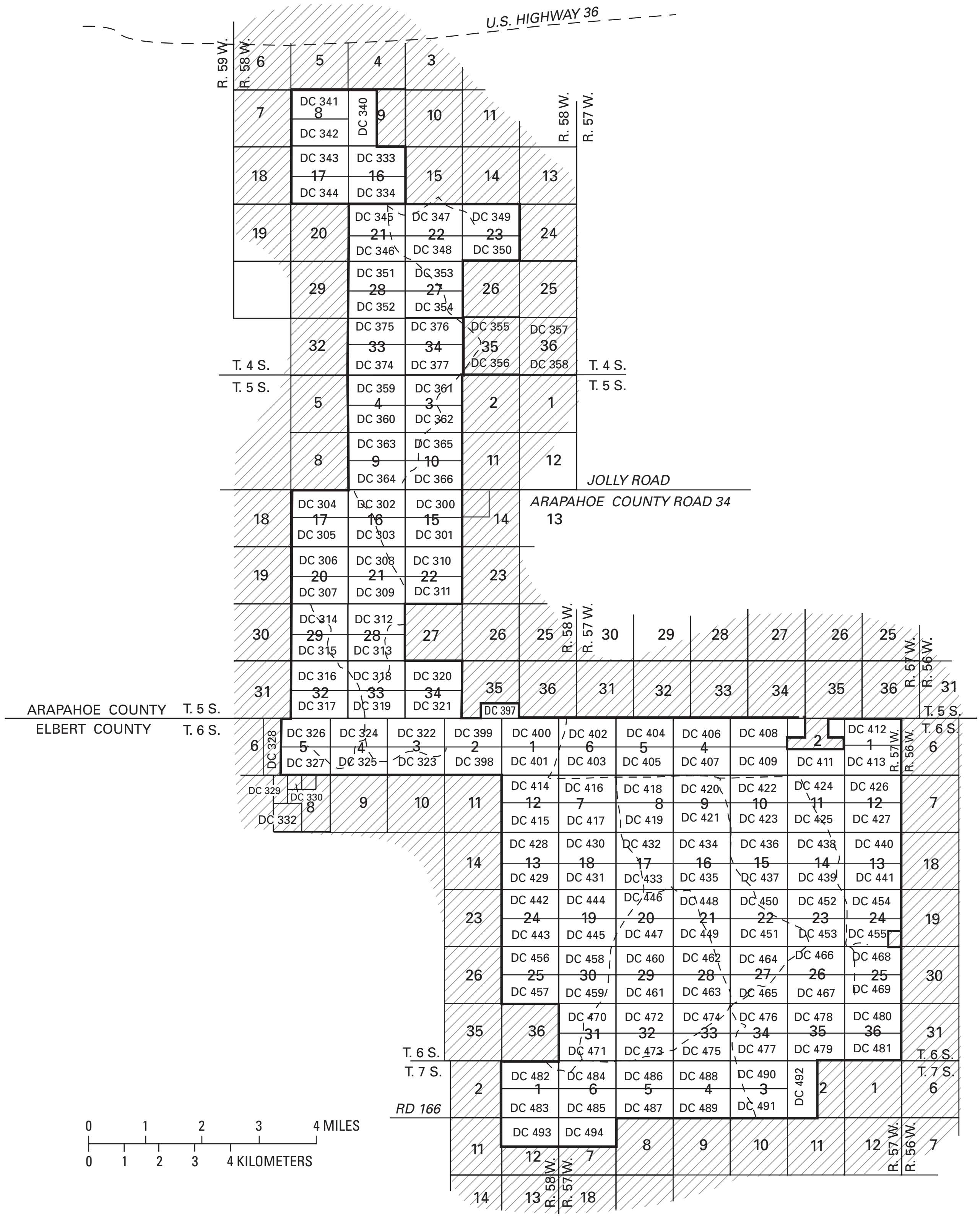

Figure 2. Metro Wastewater Reclamation District biosolids-application areas (METROGRO Farm) near Deer Trail, Colorado, 2004 through 2006 (from Metro Wastewater Reclamation District). (Shaded area was not part of METROGRO Farm during 2004 through 2006; DC, Destination Code)

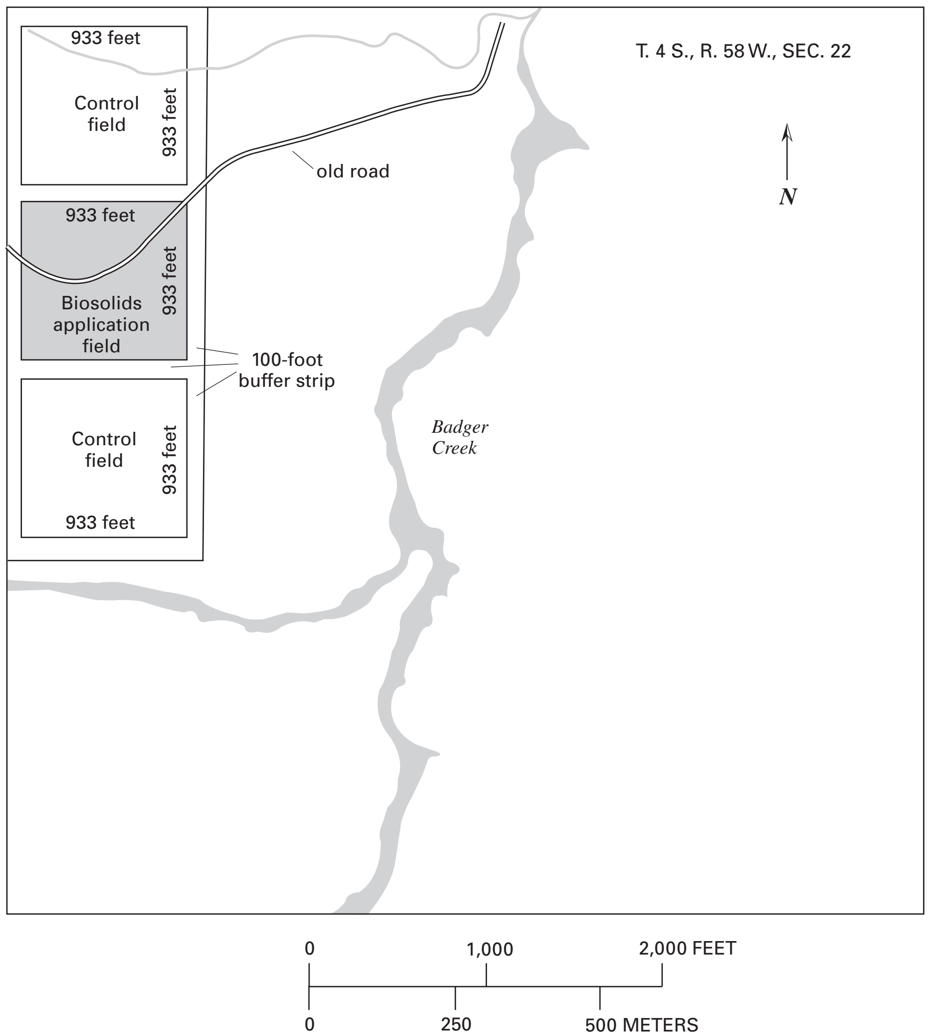

Figure 3. Arapahoe County, Colorado, soil- and crop-monitoring site: T. 4 S., R. 58 W., sec 22 (from Metro Wastewater Reclamation District).

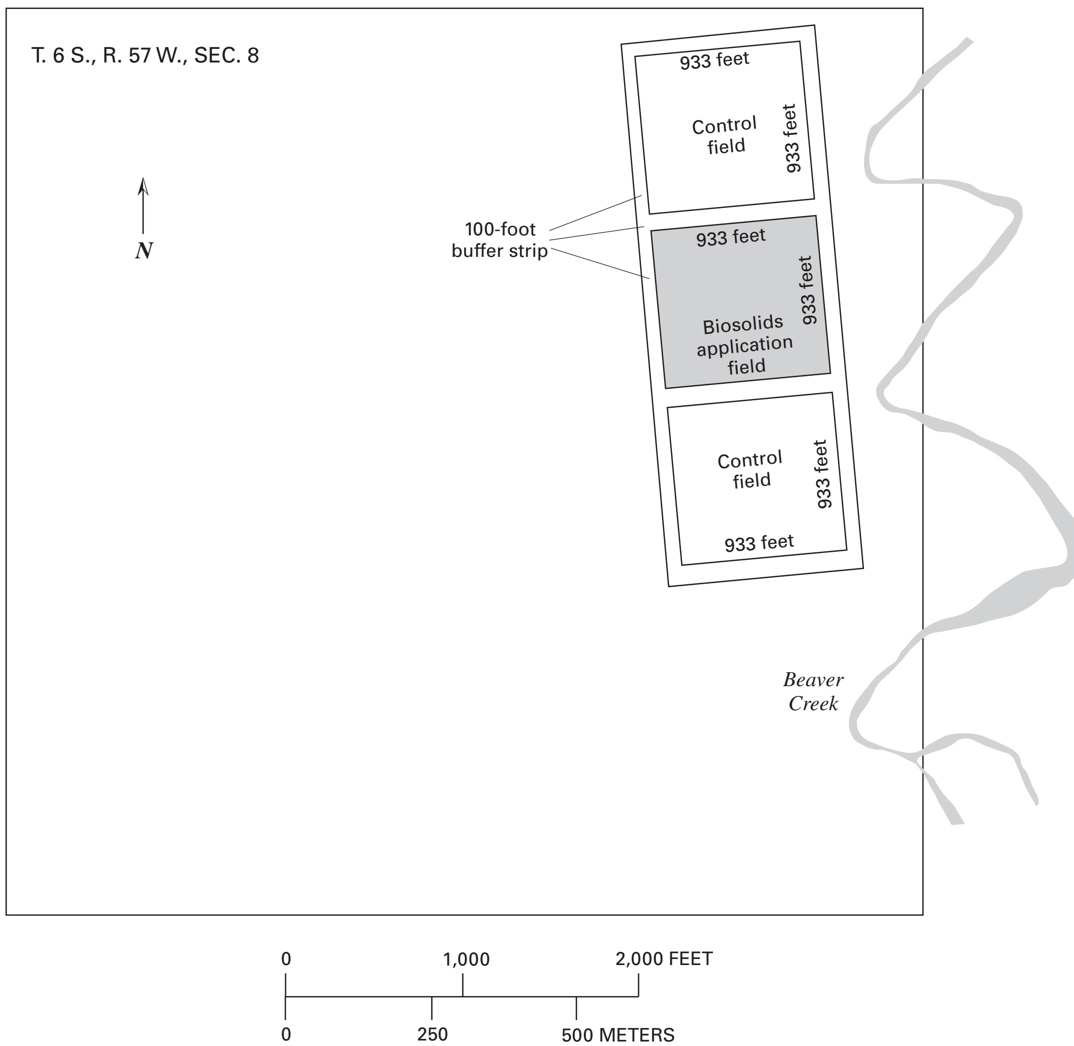

Figure 4. Elbert County, Colorado, soil- and crop-monitoring site: T. 6 S., R. 57 W., sec 8 (from Metro Wastewater Reclamation District).

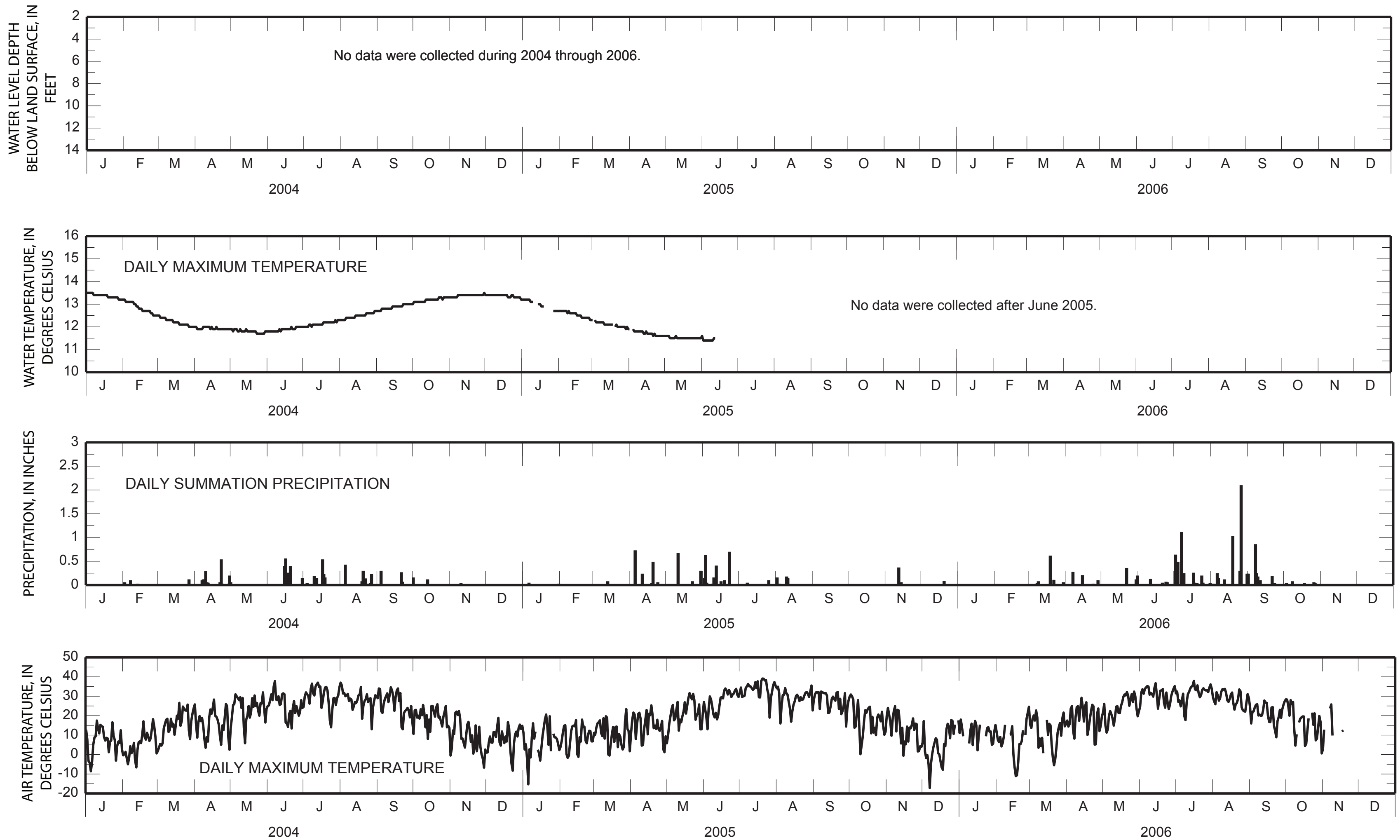

Figure 5. Continuous water-level, water-temperature, precipitation, and air-temperature data for well D25 near Deer Trail, Colorado, 2004 through 2006.

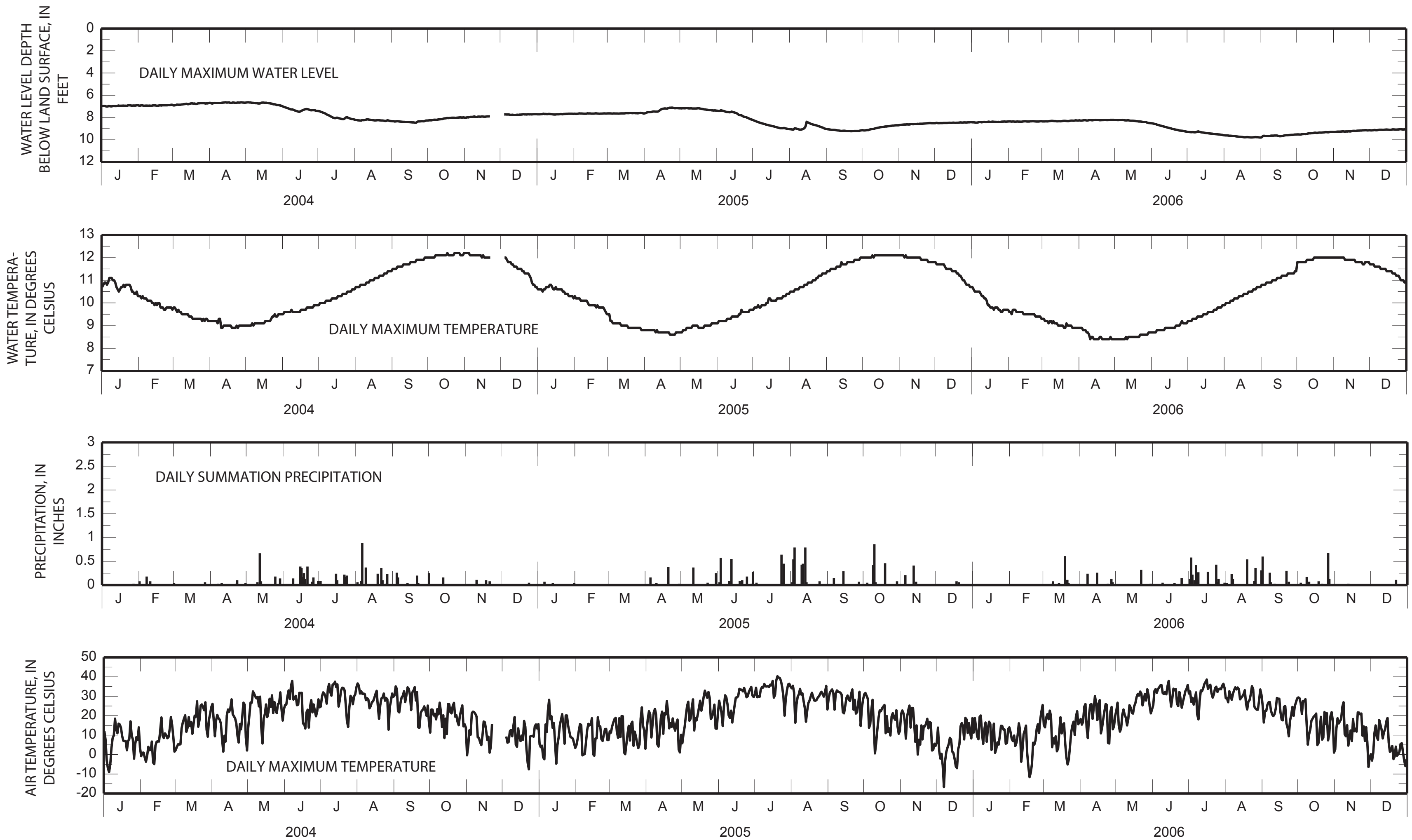

Figure 6. Continuous water-level, water-temperature, precipitation, and air-temperature data for well DTX2 near Deer Trail, Colorado, 2004 through 2006.

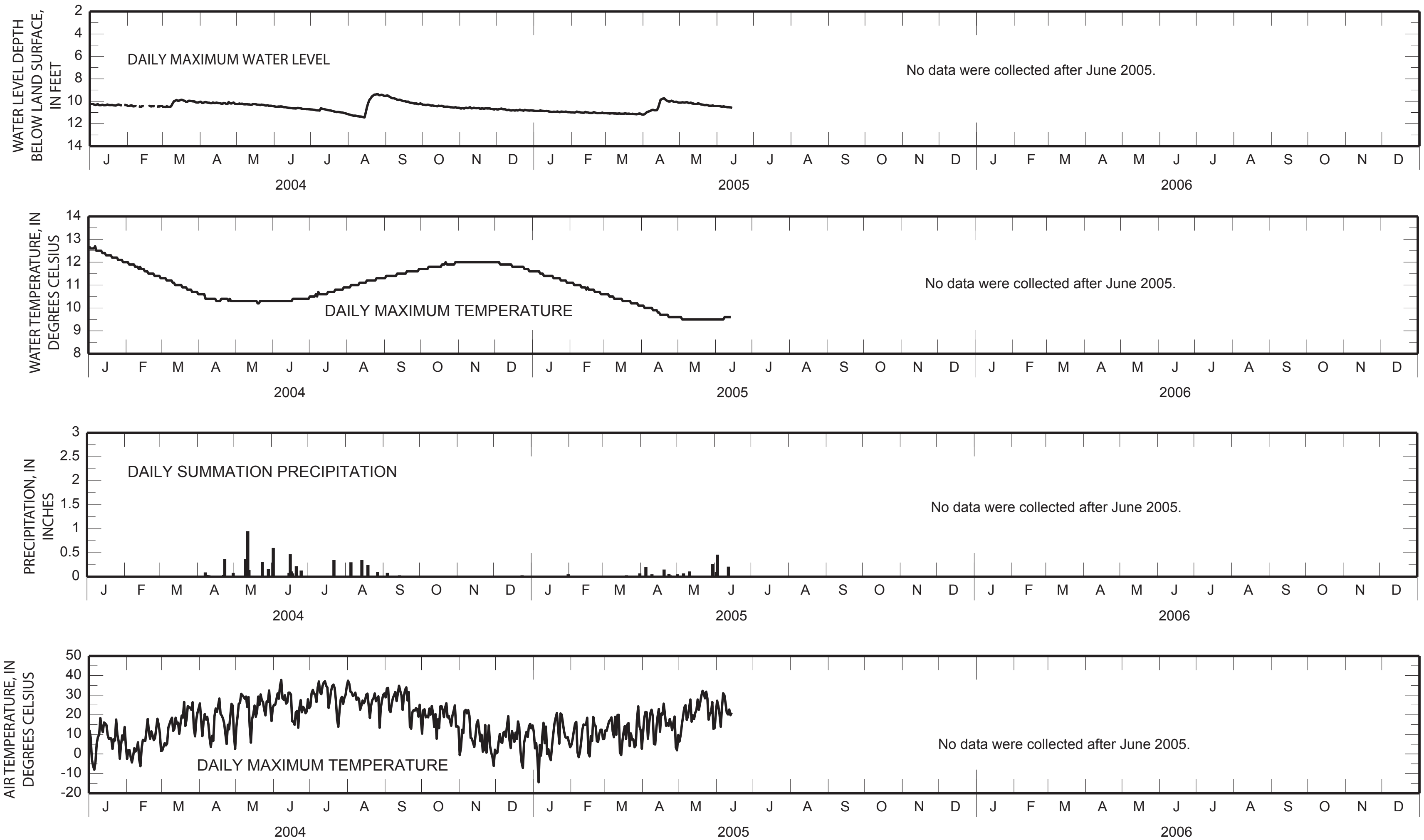

Figure 7. Continuous water-level, water-temperature, precipitation, and air-temperature data for well DTX5 near Deer Trail, Colorado, 2004 through 2006.

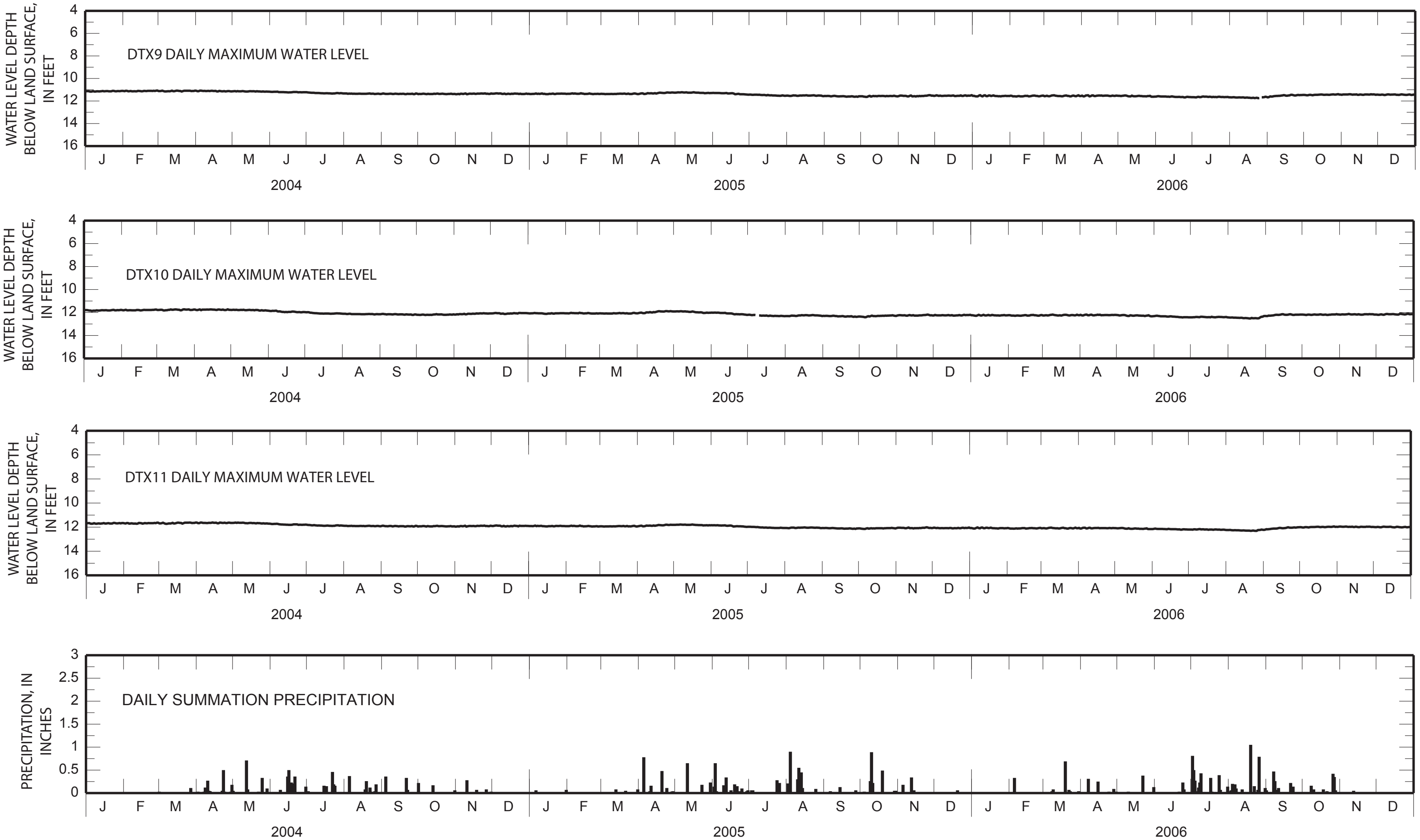

Figure 8. Continuous water-level and precipitation data for wells DTX9, DTX10, and DTX11 (a recharge-evaluation site) near Deer Trail, Colorado, 2004 through 2006.

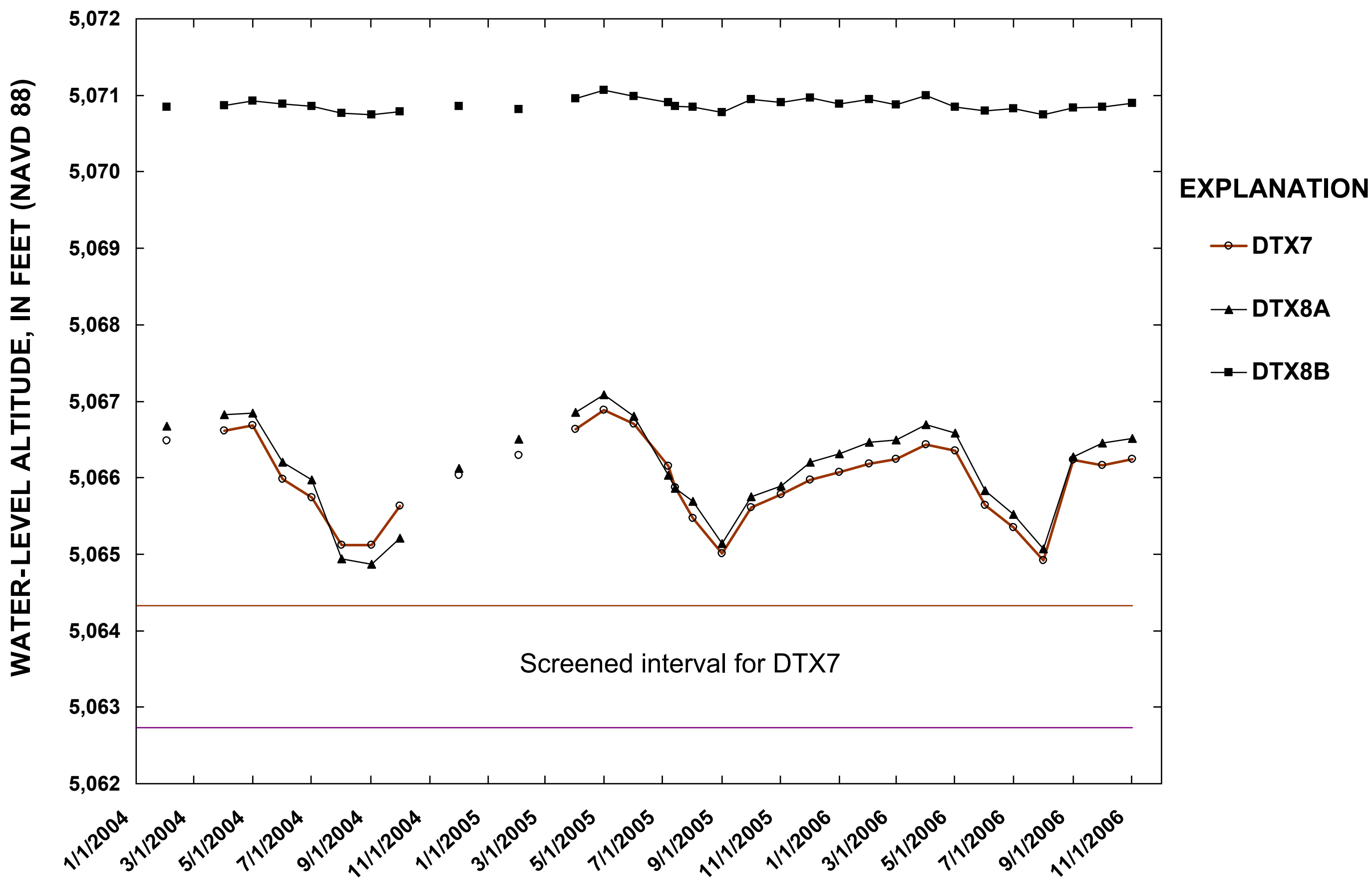

Figure 9. Water-level comparison for the recharge-evaluation site containing wells DTX7 and DTX8 near Deer Trail, Colorado, 2004 through 2006.

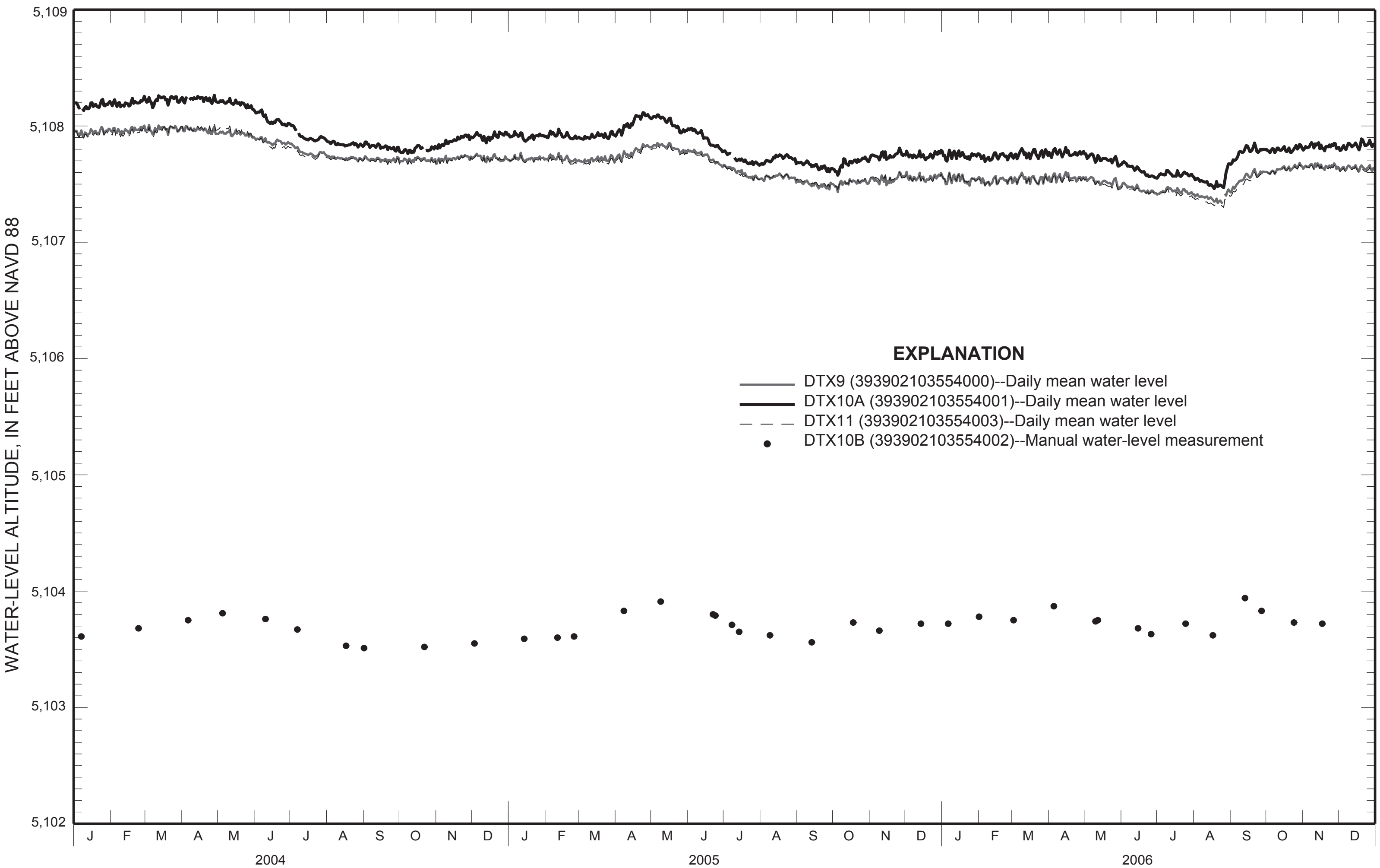

Figure 10. Water-level comparison for the recharge-evaluation site containing wells DTX9, DTX10, and DTX11 near Deer Trail, Colorado, 2004 through 2006.

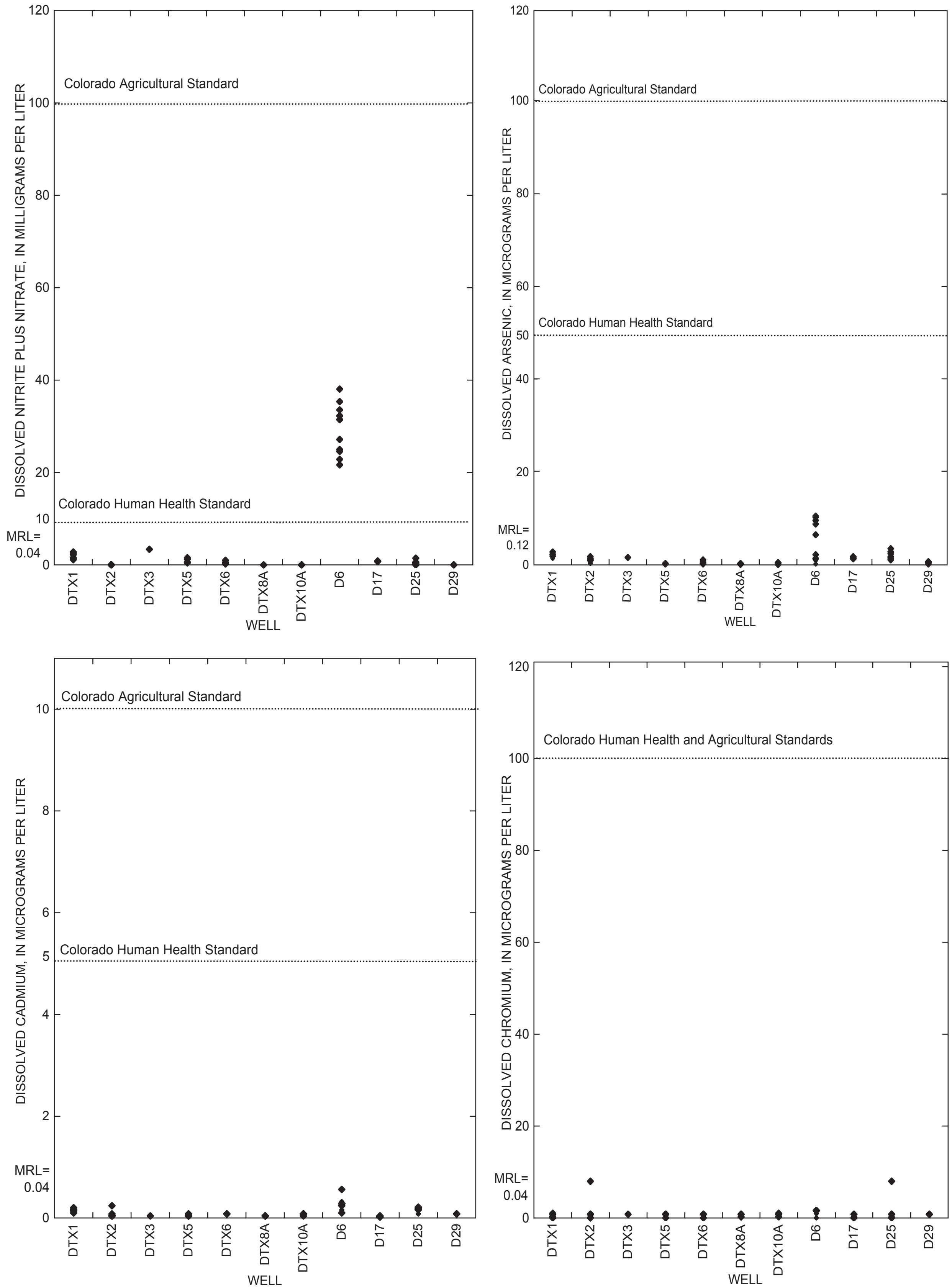

Figure 11. Distribution of ground-water constituent data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 2004 through 2006. (MRL, minimum reporting level)

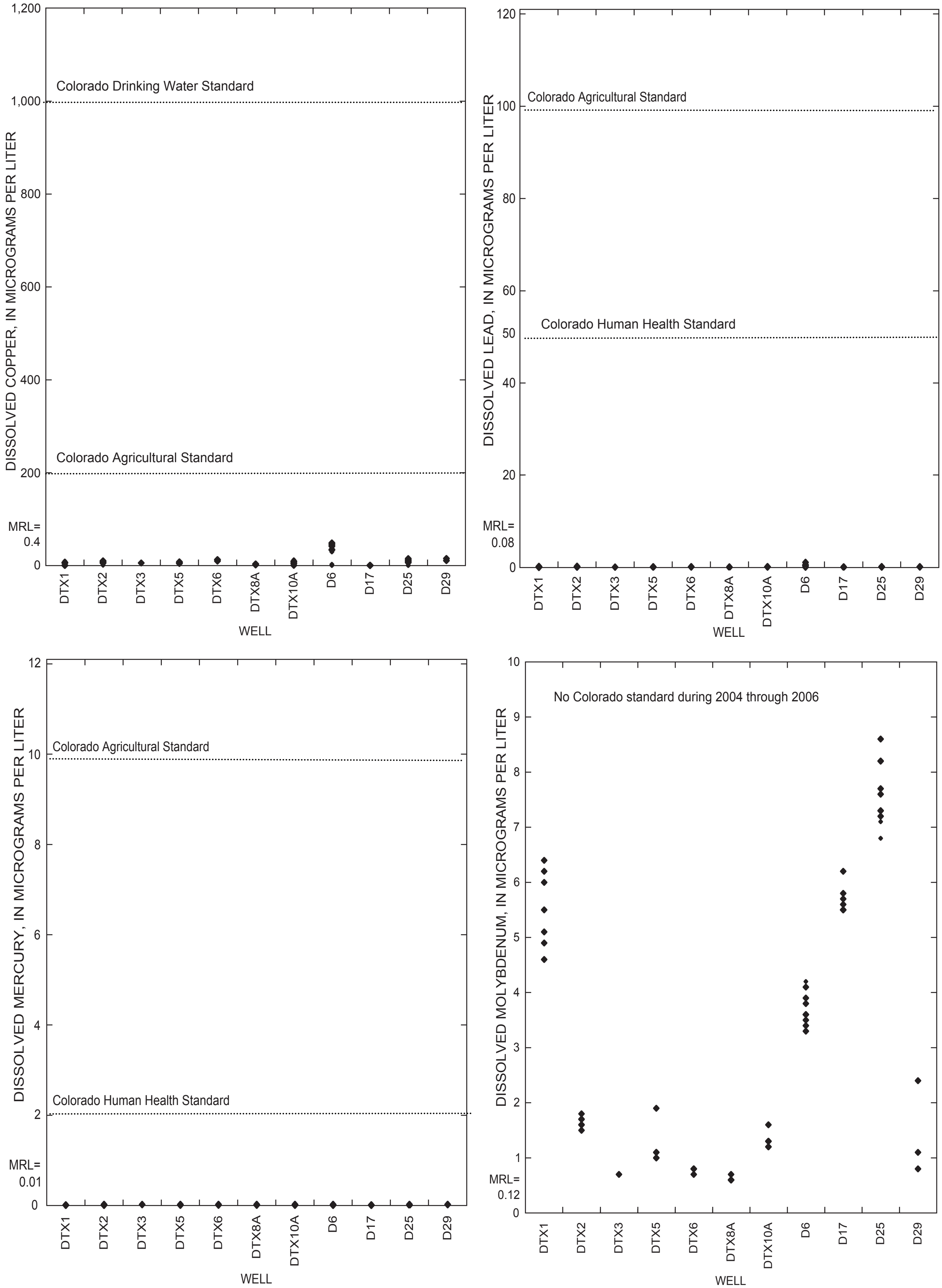

Figure 11. Distribution of ground-water constituent data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 2004 through 2006. (MRL, minimum reporting level).—Continued

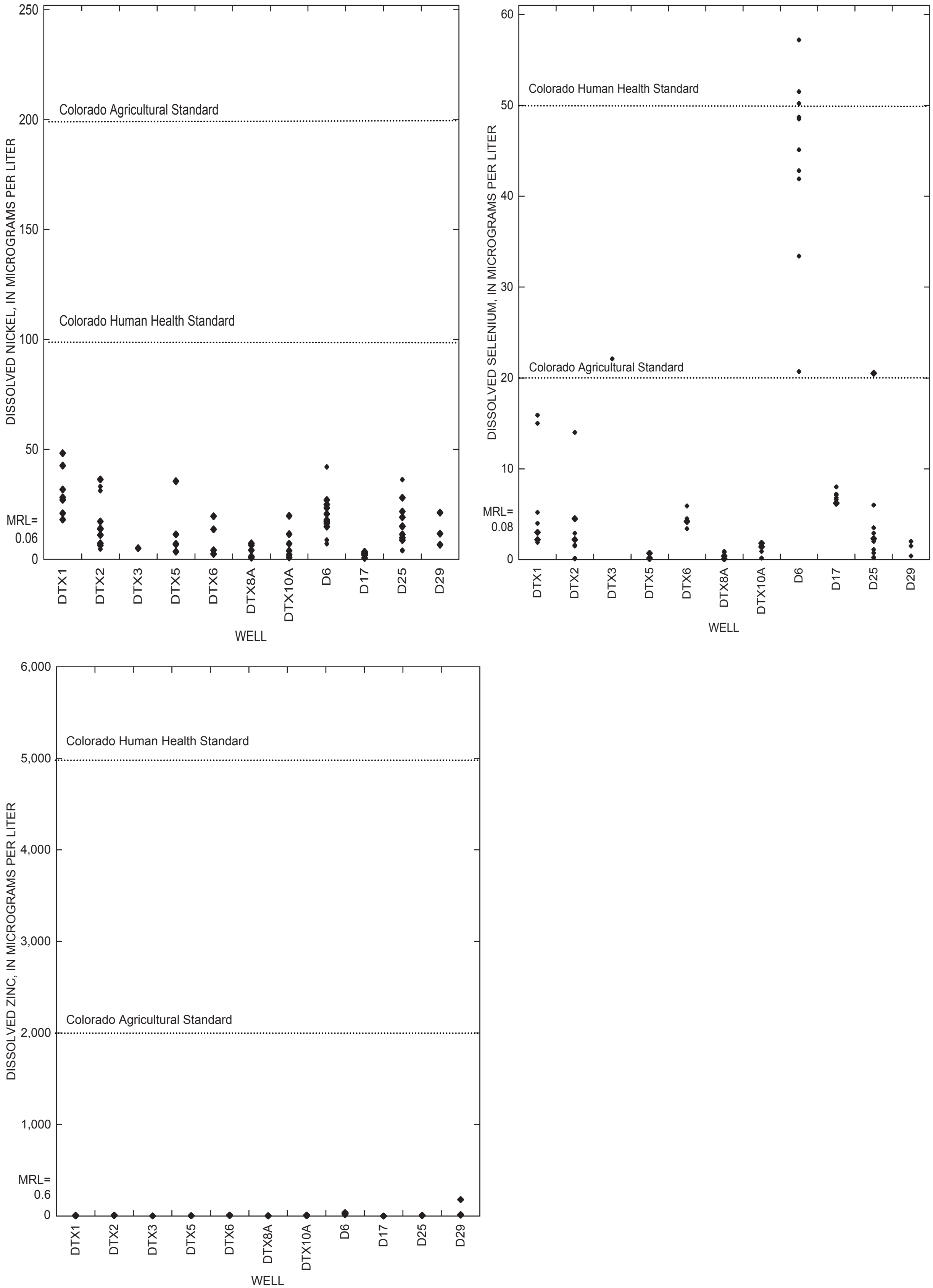

Figure 11. Distribution of ground-water constituent data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 2004 through 2006. (MRL, minimum reporting level).—Continued

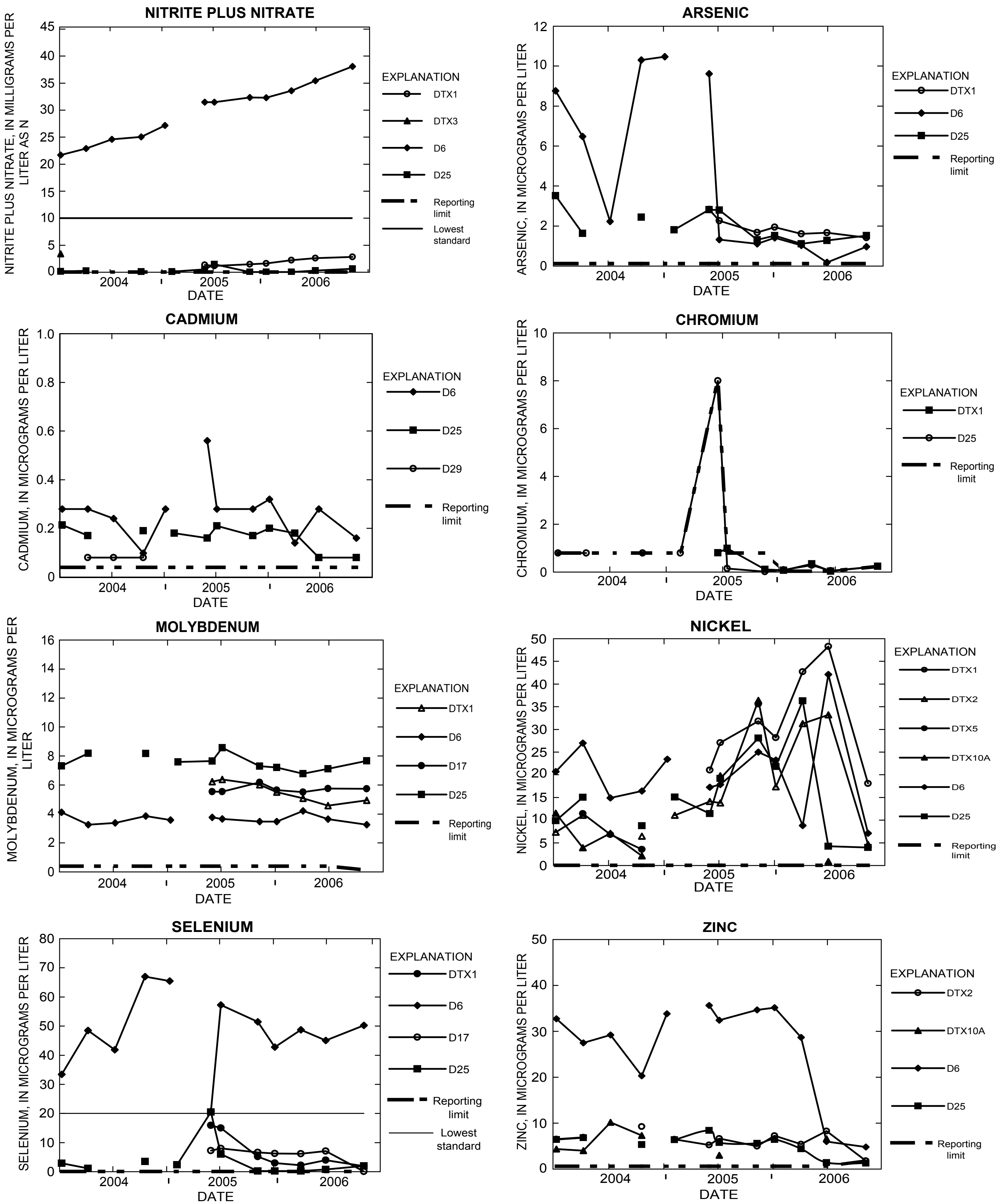

Figure 12. Ground-water concentrations near Deer Trail, Colorado, for selected constituents, 2004 through 2006.

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, Colorado, 2004 through 2006.

[All information provided by the Metro Wastewater Reclamation District; DC, destination code; Ac, acre; wT, wet tons; dT, dry tons; CAKE, Table 3 Class B biosolids; Rec, recommended; N, nitrogen; lbs, pounds; %, percent; P, phosphorous; K, potassium; TKN, Total Kjeldahl Nitrogen; PAN, plant available nitrogen; MAC, biosolids ammended with wood fiber]

DC (fig. 2)	Total DC area, Ac	Application start date	Application stop date	Area applied, Ac	Product applied	Application method	Total wT applied	Actual loading rate, wT/Ac	Total dT applied	Actual loading rate, dT CAKE/ Ac	Rec N loading rate, lbs/Ac	Rec N-based loading rate, dT/Ac	% of Rec N applied	Actual N loading rate, lbs/Ac	Total P applied, lbs/Ac	Total K applied, lbs/Ac	Crop	Reclamation project?	Total Rec N/Crop, lbs/field	TKN fraction of CAKE	PAN, lbs/dT
300	320	09/30/04	10/04/04	133.9	CAKE	SURFACE	847.55	6.33	191.96	1.43	70	3	53	37	79	5	WHEAT	No	9,370	0.064	26
300	320	07/20/06	07/28/06	159.8	CAKE	SURFACE	1,021.84	6.40	247.68	1.55	50	2	76	38	82	5	WHEAT	No	7,989	0.062	25
301	320	10/02/04	10/03/04	84.5	CAKE	SURFACE	532.30	6.30	121.88	1.44	70	3	54	38	79	5	WHEAT	No	5,912	0.066	26
302	320	10/04/04	10/05/04	82.6	CAKE	SURFACE	515.07	6.24	123.83	1.50	75	3	49	37	82	5	WHEAT	No	6,194	0.062	25
302	320	12/15/05	12/16/05	116.3	CAKE	INCORPORATED	443.65	3.82	94.59	0.82	50	2	46	23	43	3	WHEAT	No	5,813	0.070	28
303	320	10/05/04	10/10/04	93.1	CAKE	SURFACE	559.35	6.01	125.71	1.35	75	3	47	35	78	5	WHEAT	No	6,982	0.064	26
304	320	12/06/05	12/15/05	242.4	CAKE	INCORPORATED	2,084.89	8.60	436.38	1.80	55	2	91	50	92	6	WHEAT	No	13,334	0.070	28
306	320	05/14/04	05/14/04	107.6	CAKE	SURFACE	342.44	3.18	68.83	0.64	20	1	85	17	34	2	NATIVE GRASS	No	2,153	0.067	27
306	320	11/05/04	11/06/04	81.1	CAKE	SURFACE	527.35	6.50	125.51	1.55	50	2	86	43	75	4	WHEAT	No	4,057	0.069	28
306	320	10/14/05	10/17/05	107.6	CAKE	SURFACE	675.42	6.28	149.51	1.39	40	1	100	40	75	5	NATIVE GRASS	No	4,305	0.072	29
307	320	05/13/04	05/15/04	115.3	CAKE	SURFACE	362.65	3.15	76.41	0.66	20	1	85	17	35	2	NATIVE GRASS	No	2,306	0.066	26
307	320	11/06/04	11/07/04	83.4	CAKE	SURFACE	345.80	4.15	83.14	1.00	25	1	108	27	48	3	WHEAT	No	2,085	0.069	27
307	320	10/17/05	10/18/05	115.1	CAKE	SURFACE	720.82	6.26	161.41	1.40	40	1	98	39	75	5	NATIVE GRASS	No	4,605	0.069	28
308	320	10/05/04	11/04/04	141.5	CAKE	SURFACE	883.91	6.25	204.30	1.44	70	3	54	38	76	5	WHEAT	No	9,903	0.066	26
309	320	10/07/04	11/04/04	109.0	CAKE	SURFACE	694.92	6.38	160.93	1.48	70	3	57	40	78	4	WHEAT	No	7,629	0.068	27
314	320	04/23/04	05/02/04	180.8	CAKE	SURFACE	1,155.77	6.39	250.80	1.39	40	1	88	35	85	5	NATIVE GRASS	No	7,234	0.064	25
314	320	10/11/05	10/14/05	180.8	CAKE	SURFACE	1,123.88	6.22	247.89	1.37	40	1	98	39	77	5	NATIVE GRASS	No	7,233	0.071	29
315	320	08/05/03	05/13/04	232.5	CAKE/MAC	SURFACE	1,541.93	6.63	334.04	1.35	40	1	90	36	74	6	NATIVE GRASS	No	9,300	0.065	38
315	320	10/18/05	10/22/05	232.5	CAKE	SURFACE	1,460.43	6.28	319.11	1.37	40	1	88	35	74	5	NATIVE GRASS	No	9,300	0.064	26
333	320	06/06/04	07/12/04	293.9	CAKE	SURFACE	2,632.10	8.96	571.29	1.94	55	2	102	56	111	7	WHEAT	No	16,163	0.072	29
334	320	03/03/04	04/21/04	312.6	CAKE	SURFACE	2,764.78	8.85	581.92	1.86	55	2	89	49	106	7	WHEAT	No	17,190	0.066	26
342	320	07/03/06	07/10/06	231.4	CAKE	SURFACE	1,493.30	6.45	347.06	1.50	50	2	76	38	78	5	WHEAT	No	11,572	0.063	25
344	279.2	07/13/06	07/19/06	251.3	CAKE	INCORPORATED	1,607.30	6.40	387.26	1.54	75	3	52	39	83	5	WHEAT	No	18,846	0.063	25
345	320	11/07/04	04/07/05	102.8	CAKE	INCORPORATED	648.07	6.30	132.65	1.29	55	2	62	34	78	4	WHEAT	No	5,654	0.067	27

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, Colorado, 2004 through 2006.—Continued

[All information provided by the Metro Wastewater Reclamation District; DC, destination code; Ac, acre; wT, wet tons; dT, dry tons; CAKE, Table 3 Class B biosolids; Rec, recommended; N, nitrogen; lbs, pounds; %, percent; P, phosphorous; K, potassium; TKN, Total Kjeldahl Nitrogen; PAN, plant available nitrogen; MAC, biosolids ammended with wood fiber]

DC (fig. 2)	Total DC area, Ac	Application start date	Application stop date	Area applied, Ac	Product applied	Application method	Total wT applied	Actual loading rate, wT/Ac	Total dT applied	Actual loading rate, dT CAKE/ Ac	Rec N loading rate, lbs/Ac	Rec N-based loading rate, dT/Ac	% of Rec N applied	Actual N loading rate, lbs/Ac	Total P applied, lbs/Ac	Total K applied, lbs/Ac	Crop	Reclamation project?	Total Rec N/Crop, lbs/field	TKN fraction of CAKE	PAN, lbs/dT
347	320	07/12/04	07/14/04	123.4	CAKE	SURFACE	821.87	6.66	183.87	1.49	40	2	98	39	75	5	WHEAT	No	4,937	0.066	26
347	320	07/30/04	08/01/04	145.8	CAKE	SURFACE	973.62	6.68	199.16	1.36	40	2	80	32	70	5	WHEAT	No	5,834	0.059	24
348	320	07/14/04	07/19/04	152.2	CAKE	SURFACE	1,342.51	8.82	300.08	1.97	55	2	91	50	104	7	WHEAT	No	8,368	0.064	26
348	320	07/29/04	08/03/04	113.7	CAKE	SURFACE	996.72	8.77	197.21	1.73	55	2	76	42	89	7	WHEAT	No	6,253	0.061	25
349	320	06/25/04	07/10/04	275.1	CAKE	SURFACE	2,485.60	9.04	569.51	2.07	55	2	98	54	109	7	WHEAT	No	15,129	0.065	26
350	320	06/10/04	06/25/04	248.1	CAKE	SURFACE	2,240.51	9.03	490.37	1.98	55	2	96	53	117	7	WHEAT	No	13,644	0.068	27
351	320	08/14/04	08/15/04	51.2	CAKE	SURFACE	460.61	9.00	89.61	1.76	55	2	82	45	103	7	WHEAT	No	2,814	0.064	26
352	323.9	08/03/04	08/14/04	323.9	CAKE	SURFACE	2,935.11	9.06	644.17	1.99	55	2	89	49	112	8	WHEAT	No	17,815	0.062	25
353	320	07/17/04	07/29/04	254.1	CAKE	SURFACE	2,307.84	9.08	518.15	2.04	55	2	95	52	107	8	WHEAT	No	13,977	0.064	25
361	320	09/03/04	09/07/04	27.1	CAKE	SURFACE	182.13	6.72	40.88	1.51	40	2	95	38	82	6	WHEAT	No	1,084	0.063	25
362	320	09/07/04	09/07/04	93.4	CAKE	SURFACE	359.59	3.85	79.47	0.85	25	1	88	22	48	3	WHEAT	No	2,335	0.066	26
363	320	09/17/04	09/28/04	170.0	CAKE	SURFACE	1,511.29	8.89	332.12	1.95	55	2	93	51	107	7	WHEAT	No	9,350	0.066	26
364	320	09/15/04	09/28/04	184.4	CAKE	SURFACE	1,638.12	8.88	339.63	1.84	55	2	93	51	105	8	WHEAT	No	10,143	0.069	28
365	320	09/07/04	09/11/04	138.6	CAKE	SURFACE	1,220.53	8.81	273.18	1.97	55	2	96	53	112	8	WHEAT	No	7,624	0.067	27
366	320	09/11/04	09/15/04	143.3	CAKE	SURFACE	1,287.11	8.98	260.55	1.82	55	2	87	48	103	7	WHEAT	No	7,882	0.066	26
374	320	07/27/04	09/26/04	310.4	CAKE	SURFACE	1,934.09	6.23	391.65	1.26	40	2	78	31	69	5	NATIVE GRASS	No	12,416	0.062	25
375	320	06/29/04	09/24/04	210.0	CAKE	SURFACE	1,309.61	6.24	290.86	1.39	40	2	88	35	75	5	NATIVE GRASS	No	8,400	0.063	25
376	320	05/16/04	06/28/04	303.6	CAKE	SURFACE	1,932.09	6.36	426.60	1.41	40	1	93	37	71	5	NATIVE GRASS	No	12,144	0.066	26
377	320	05/16/04	09/11/04	287.0	CAKE	SURFACE	1,822.85	6.35	406.52	1.42	40	2	95	38	78	5	NATIVE GRASS	No	11,480	0.068	27
400	320	05/16/05	06/08/05	243.1	CAKE	SURFACE	1,551.00	6.38	341.78	1.41	55	2	65	36	83	5	WHEAT	No	13,373	0.063	25
401	320	06/13/05	06/20/05	351.3	CAKE	SURFACE	2,186.09	6.22	502.44	1.43	50	2	68	34	78	6	WHEAT	No	17,567	0.060	24
402	338	06/06/05	06/11/05	230.0	CAKE	SURFACE	1,477.92	6.43	292.90	1.27	40	2	78	31	71	5	WHEAT	No	9,199	0.060	24
403	338	06/11/05	06/16/05	276.1	CAKE	SURFACE	1,279.30	4.63	279.30	1.01	40	2	60	24	55	4	WHEAT	No	11,045	0.059	24
406	320	01/20/04	01/21/04	156.9	CAKE	SURFACE	625.94	3.99	140.50	0.90	50	2	48	24	58	3	WHEAT	No	7,844	0.066	26
408	360	01/23/04	01/30/04	296.2	CAKE	SURFACE	2,348.17	7.93	527.51	1.78	50	2	86	43	108	7	WHEAT	No	14,812	0.061	24
409	360	01/31/04	02/12/04	306.0	CAKE	SURFACE	2,539.89	8.30	545.15	1.78	55	2	84	46	103	8	WHEAT	No	16,831	0.064	26
410	139.21	01/21/04	01/22/04	68.1	CAKE	SURFACE	501.86	7.37	111.72	1.65	50	2	86	43	103	7	WHEAT	No	3,403	0.065	26
411	350	10/07/06	10/16/06	323.5	CAKE	SURFACE	1,365.81	4.22	309.47	0.96	0	0	0	33	48	3	WHEAT	No	0	0.061	34
415	320	05/13/05	05/16/05	136.3	CAKE	SURFACE	884.30	6.49	179.74	1.32	40	1	88	35	82	5	NATIVE GRASS	No	5,452	0.065	26
420	320	03/23/04	06/06/04	264.2	CAKE	SURFACE	2,396.23	9.07	516.03	1.95	55	2	100	55	117	7	WHEAT	No	14,532	0.070	28
421	320	03/09/04	03/23/04	248.9	CAKE	SURFACE	995.13	4.00	203.59	0.82	25	1	88	22	50	3	WHEAT	No	6,222	0.067	27

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, Colorado, 2004 through 2006.—Continued

[All information provided by the Metro Wastewater Reclamation District; DC, destination code; Ac, acre; wT, wet tons; dT, dry tons; CAKE, Table 3 Class B biosolids; Rec, recommended; N, nitrogen; lbs, pounds; %, percent; P, phosphorous; K, potassium; TKN, Total Kjeldahl Nitrogen; PAN, plant available nitrogen; MAC, biosolids ammended with wood fiber]

DC (fig. 2)	Total DC area, Ac	Application start date	Application stop date	Area applied, Ac	Product applied	Application method	Total wT applied	Actual loading rate, wT/Ac	Total dT applied	Actual loading rate, dT CAKE/ Ac	Rec N loading rate, lbs/Ac	Rec N-based loading rate, dT/Ac	% of Rec N applied	Actual N loading rate, lbs/Ac	Total P applied, lbs/Ac	Total K applied, lbs/Ac	Crop	Reclamation project?	Total Rec N/Crop, lbs/field	TKN fraction of CAKE	PAN, lbs/dT
422	320	02/12/04	02/19/04	254.8	CAKE	SURFACE	2,107.15	8.27	450.10	1.77	55	2	82	45	101	8	WHEAT	No	14,014	0.064	26
423	320	02/19/04	02/25/04	259.8	CAKE	SURFACE	2,063.48	7.94	454.94	1.75	50	2	86	43	98	7	WHEAT	No	12,988	0.061	25
424	320	10/16/06	10/24/06	315.1	CAKE	SURFACE	1,334.32	4.23	306.68	0.97	40	1	88	35	52	3	WHEAT	No	12,604	0.065	36
425	320	10/24/06	11/08/06	316.5	CAKE	SURFACE	1,324.15	4.18	295.88	0.93	40	1	93	37	44	3	WHEAT	No	12,662	0.071	39
428	320	04/08/05	04/09/05	97.7	CAKE	SURFACE	629.56	6.45	137.35	1.40	40	1	90	36	88	5	NATIVE GRASS	No	3,906	0.064	26
429	320	04/09/05	05/13/05	144.4	CAKE	SURFACE	454.97	3.15	100.57	0.70	20	1	85	17	41	2	NATIVE GRASS	No	2,887	0.062	25
434	320	02/26/04	03/09/04	195.6	CAKE	SURFACE	1,807.45	9.24	400.15	2.05	55	2	98	54	119	8	WHEAT	No	10,757	0.066	26
435	320	02/25/04	02/26/04	34.0	CAKE	SURFACE	290.75	8.55	67.36	1.97	55	2	93	51	110	8	WHEAT	No	1,870	0.064	26
438	320	11/08/06	11/10/06	168.3	CAKE	SURFACE	711.49	4.23	162.62	0.97	40	1	105	42	43	4	WHEAT	No	6,732	0.078	43
442	320	05/03/05	05/12/05	126.1	CAKE	SURFACE	801.51	6.36	171.16	1.36	40	1	90	36	79	5	NATIVE GRASS	No	5,044	0.066	26
443	320	05/02/05	05/03/05	48.4	CAKE	SURFACE	312.90	6.47	69.94	1.45	40	1	98	39	89	5	NATIVE GRASS	No	1,936	0.067	27
448	320	01/16/04	01/19/04	134.0	CAKE	SURFACE	1,080.68	8.07	231.58	1.73	50	2	94	47	118	6	WHEAT	No	6,698	0.067	27
449	320	11/20/03	01/16/04	99.4	CAKE	SURFACE	891.63	8.97	190.37	1.91	55	2	93	51	116	7	WHEAT	No	5,466	0.066	27
450	320	11/10/06	11/13/06	95.4	CAKE	SURFACE	394.79	4.14	88.83	0.93	40	1	95	38	41	3	WHEAT	No	3,816	0.073	41
451	320	11/20/03	01/15/04	27.9	CAKE	SURFACE	179.73	6.44	38.90	1.40	40	1	93	37	85	5	WHEAT	No	1,116	0.066	27
451	320	11/14/06	11/16/06	173.2	CAKE	SURFACE	703.99	4.07	150.27	0.87	40	1	83	33	47	3	WHEAT	No	6,926	0.069	38
453	320	11/16/06	11/17/06	62.8	CAKE	SURFACE	243.76	3.88	51.17	0.81	40	1	80	32	44	3	WHEAT	No	2,512	0.070	39
460	320	11/18/06	11/20/06	118.2	CAKE	SURFACE	488.22	4.13	105.64	0.89	40	1	88	35	48	3	WHEAT	No	4,729	0.071	40
461	320	11/17/06	11/18/06	113.6	CAKE	SURFACE	471.85	4.15	98.19	0.86	40	1	85	34	47	3	WHEAT	No	4,544	0.070	39
462	320	11/27/06	12/04/06	232.0	CAKE	SURFACE	971.35	4.19	210.02	0.91	40	1	85	34	51	3	WHEAT	No	9,281	0.066	38
463	320	11/20/06	11/27/06	185.6	CAKE	SURFACE	786.50	4.24	172.16	0.93	40	1	90	36	49	3	WHEAT	No	7,425	0.068	38
464	320	11/13/06	11/14/06	83.0	CAKE	SURFACE	342.66	4.13	77.35	0.93	40	1	90	36	41	3	WHEAT	No	3,320	0.069	39
465	320	12/04/06	12/04/06	66.7	CAKE	SURFACE	255.76	3.83	53.71	0.80	40	1	78	31	44	3	WHEAT	No	2,670	0.067	38
474	320	12/05/06	12/06/06	141.2	CAKE	SURFACE	575.40	4.07	127.07	0.90	40	1	85	34	49	3	WHEAT	No	5,649	0.067	38
476	320	12/11/06	12/12/06	109.8	CAKE	INCORPORATED	459.56	4.19	104.32	0.95	40	1	90	36	52	3	WHEAT	No	4,392	0.066	37
477	320	12/08/06	12/11/06	220.9	CAKE	INCORPORATED	930.84	4.21	213.90	0.97	40	1	90	36	53	3	WHEAT	No	8,835	0.066	37
490	320	12/06/06	12/08/06	141.2	CAKE	INCORPORATED	557.93	3.95	126.82	0.90	40	1	85	34	49	3	WHEAT	No	5,646	0.067	38

Table 2. Methods used to analyze biosolids samples collected at the Metro Wastewater Reclamation District and crop samples collected near Deer Trail, Colorado, 2004 through 2006.

[HG, hydride generation; AAS, atomic absorption spectrophotometry; ICP, inductively coupled plasma; MS, mass spectrometry; AES, atomic emission spectrometry; CV, continuous flow-cold vapor]

Constituent	Medium	Analytical method	Reference
Arsenic	Biosolids and crops	HG-AAS	Taggart (2002)
Cadmium	Biosolids	ICP-MS	Taggart (2002)
Cadmium	Crops	ICP-AES	Taggart (2002)
Copper	Biosolids	ICP-MS	Taggart (2002)
Copper	Crops	ICP-AES	Taggart (2002)
Lead	Biosolids	ICP-MS	Taggart (2002)
Lead	Crops	ICP-AES	Taggart (2002)
Mercury	Biosolids and crops	CV-AAS	Taggart (2002)
Molybdenum	Biosolids	ICP-MS	Taggart (2002)
Molybdenum	Crops	ICP-AES	Taggart (2002)
Nickel	Biosolids	ICP-MS	Taggart (2002)
Nickel	Crops	ICP-AES	Taggart (2002)
Selenium	Biosolids and crops	HG-AAS	Taggart (2002)
Sulfur	Biosolids and crops	Combustion	Taggart (2002)
Zinc	Biosolids	ICP-MS	Taggart (2002)
Zinc	Crops	ICP-AES	Taggart (2002)
Plutonium-238, Total	Biosolids	Radiological method	Whittaker and Grothaus (1979); Lyon (1980)
Plutonium-239+240, Total	Biosolids	Radiological method	Whittaker and Grothaus (1979); Lyon (1980)

Table 3. Chemical data for biosolids samples collected at the Metro Wastewater Reclamation District, 2004 through 2006.

[“Table 1 Ceiling Concentration Limits” and “Table 3 Pollutant Concentration Limits” from Colorado Department of Public Health and Environment (2003); ppm, parts per million; %, percent]

Sample date	Arsenic, ppm	Cadmium, ppm	Copper, ppm	Lead, ppm	Mercury, ppm	Molybdenum, ppm	Nickel, ppm	Selenium, ppm	Sulphur, %	Zinc, ppm
January 2004	2.0	2.0	607	46	1.5	35.8	19	7.4	1.39	636
February 2004	2.1	2.2	542	44	1.5	20.4	22	7.5	1.27	565
March 2004	1.7	2.3	615	41	1.6	24.7	20	7.6	1.44	604
April 2004	1.7	2.2	641	46	1.8	30.9	20	8.9	1.48	659
May 2004	1.8	2.5	640	45	2.0	29.8	20	10	1.60	707
June 2004	1.9	2.1	648	47	1.4	35.3	19	9.7	1.60	728
July 2004	2.1	2.0	644	48	1.8	36.5	20	11	1.66	742
August 2004	2.3	2.3	668	56	1.4	31.1	26	10	1.53	747
September 2004	2.1	2.1	625	45	1.3	32.8	21	11	1.56	692
October 2004	1.9	2.0	642	46	1.9	34.4	22	10	1.56	708
November 2004	3.7	2.1	632	48	1.7	28.1	21	11	1.54	688
December 2004	1.7	2.0	565	49	1.6	25.4	20	9.3	1.49	666
January 2005	1.4	2.1	633	50	1.1	28.6	24	8.2	1.38	772
February 2005	1.4	2.1	563	48	1.0	24.8	20	7.6	1.46	675
March 2005	1.5	2.0	577	50	1.1	25.2	21	8.2	1.35	673
April 2005	1.4	1.7	553	42	1.0	25.4	18	8.2	1.49	656
May 2005	1.5	1.7	600	43	0.85	22.4	20	9.4	1.55	679
June 2005	1.6	1.6	606	46	2.3	22.4	20	10	1.42	664
July 2005	2.4	2.1	622	56	1.3	25.4	21	11	1.73	811
August 2005	2.4	2.0	643	49	2.4	31.1	23	10	1.74	794
September 2005	2.4	2.0	633	44	1.4	33.6	20	9.5	1.74	803
October 2005	2.3	2.0	632	44	1.3	35.7	20	9.6	1.62	750
November 2005	2.0	2.0	621	48	1.4	34.0	19	9.4	1.64	772
December 2005	1.9	1.8	566	41	0.87	24.3	17	7.9	1.51	702
January 2006	1.6	1.7	653	45	0.81	25.4	19	8.0	1.47	684
February 2006	1.5	1.8	708	44	1.1	22.7	19	8.2	1.41	696
March 2006	1.7	1.8	709	47	0.81	21.9	19	6.9	1.45	716
April 2006	1.4	1.8	784	52	0.90	23.9	20	7.4	1.44	794
May 2006	1.9	1.8	845	47	5.2	32.2	22	8.8	1.54	819
June 2006	2.1	1.7	815	52	1.1	44.1	23	9.1	1.59	831
July 2006	1.9	1.8	661	52	0.79	40.7	21	10	1.59	769
August 2006	1.8	1.4	554	72	0.91	28.6	21	7.4	1.34	609
September 2006	2.0	1.8	641	51	0.83	35.1	20	10	1.72	728
October 2006	1.9	1.8	670	51	0.96	30.0	21	11	1.65	787
November 2006	1.9	1.9	681	52	0.81	26.4	22	9.6	1.57	750
December 2006	1.5	1.7	617	46	0.66	22.1	17	9.4	1.49	690
“Table 1 Ceiling Concentration Limits”	75	85	4,300	840	57	75	420	100	None	7,500
“Table 3 Pollutant Concentration Limits”	41	39	1,500	300	17	None	420	100	None	2,800

Table 4. Quality-control data associated with biosolids samples collected at the Metro Wastewater Reclamation District, 2004 through 2006.

[Data from Crock and others, 2008. Data are for NIST 2781, a standard reference material prepared by the National Institute of Standards and Technology from domestic sewage sludge; ppm, parts per million; %, percent; ±, plus or minus the analytical uncertainty; --, no value]

Analysis date	Arsenic, ppm	Cadmium, ppm	Copper, ppm	Lead, ppm	Mercury, ppm	Molybdenum, ppm	Nickel, ppm	Selenium, ppm	Sulphur, %	Zinc, ppm
2004	7.8	11.7	593	222	4.1	37.3	72	14	1.47	1,150
2005	4.6	11.0	617	199	3.1	41.9	76	14	1.46	1,190
2005	8.7	12.3	560	168	3.8	38.3	70	14	1.51	1,230
2006	7.1	11.1	685	188	3.8	40.6	87	14	1.44	1,320
2006	6.5	10.8	600	185	2.4	37.3	71	15	1.48	1,120
NIST 2781 Recommended or Certified Value										
	7.82 ± 0.28	12.78 ± 0.72	627.4 ± 13.5	202.1 ± 6.5	3.64 ± 0.25	46.7 ± 3.2	80.2 ± 2.3	16.0 ± 1.6	--	1,273 ± 53

Table 5. Plutonium data for biosolids samples collected at the Metro Wastewater Reclamation District, 2004 through 2006.

[pCi/g, picocuries per gram; +/-, plus or minus the analytical uncertainty; analytical uncertainty is the 1-sigma total combined standard uncertainty provided by the laboratory]

Sample date	Plutonium 238, pCi/g	Plutonium 238, minimum detectable concentration, pCi/g	Plutonium 239+240, pCi/g	Plutonium 239+240, minimum detectable concentration, pCi/g
February 2004	0.017 +/- 0.017	0.10	-0.0042 +/- 0.0085	0.10
August 2004	0.004 +/- 0.014	0.10	0 +/- 0.0070	0.10
February 2005	0.004 +/- 0.012	0.10	0 +/- 0.0040	0.10
January 2006	0.016 +/- 0.012	0.10	0 +/- 0.0080	0.10

Table 6. Chemical data for crop samples collected near Deer Trail, Colorado, 2004 through 2006.

[No samples were collected in 2005; sampled fields are shown in figure 2 (DC 403 and DC 455 fields) or figure 3 (Arapahoe County fields); data are reported as dry weight; DC, Destination Code; ppm, parts per million; %, percent; <, less than; --, no data]

Sample location	Sample type	Harvest year	Arsenic, ppm	Cadmium, ppm	Copper, ppm	Lead, ppm	Mercury, ppm	Molybdenum, ppm	Nickel, ppm	Selenium, ppm	Sulfur, %	Zinc, ppm
Arapahoe County north field (control)	Wheat grain	2004	< 0.1	0.04	5.3	<0.004	<0.02	0.59	<0.02	1.1	0.19	0.40
Arapahoe County middle field (biosolids applied)	Wheat grain	2004	<0 .1	0.08	4.6	<0.004	<0.02	0.62	<0.02	0.98	0.16	0.33
Arapahoe County south field (control)	Wheat grain	2004	< 0.1	0.03	4.6	<0.004	<0.02	0.75	<0.02	0.76	0.16	0.31
Arapahoe County north field (control)	Wheat grain	2006	<0.05	0.001	0.12	<0.008	<0.03	0.017	0.02	0.83	0.21	0.44
Arapahoe County middle field (biosolids applied)	Wheat grain	2006	<0.05	0.001	0.07	<0.008	<0.03	0.021	0.02	0.80	0.22	0.51
Arapahoe County south field (control)	Wheat grain	2006	<0.05	0.001	0.05	<0.008	<0.03	0.017	0.02	0.93	0.20	0.44
Elbert County DC 403 field (biosolids applied)	Wheat grain	2006	0.05	0.001	0.05	<0.008	<0.03	0.033	0.05	0.28	0.22	1.1
Elbert County DC 455 field (biosolids applied)	Corn kernels	2006	<0.05	0.09	10	0.3	--	1	0.8	--	--	44

Table 7. Information for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.

[Wells shown in bold routinely are sampled for water quality; all wells have 2-inch-diameter casing; latitude and longitude are in the format degrees minutes seconds referenced to NAD 83; Elev., elevation in feet above NAVD 88; stickup, the length of well casing above ground, and measuring point is at the top of the stickup; bmp, below measuring point; HUC, Hydrologic Unit Code (Seaber and others, 1987); NWIS, U.S. Geological Survey National Water Information System database; ID, identification number; Metro, Metro Wastewater Redamation District; L, alluvial; R, bedrock]

Well	Latitude	Longitude	Elev. of stickup (feet)	Elev. of land surface (feet)	Property owner	County	Drill date	Current stickup (feet)	Total depth (feet bmp)	Screen top (feet bmp)	Screen bottom (feet bmp)	Screen-slot size (inch)	Screen length (feet)	Sump length (feet)	Aquifer type	HUC	NWIS station ID
DTX1	39 43 33	103 52 51	4,909	4,906	Metro	Arapahoe	02/16/99	2.56	25.50	20.59	22.19	0.010	1.60	3.31	L	10190012	394333103525100
DTX2[1]	39 41 49	103 51 38	4,903	4,900	Metro	Arapahoe	02/16/99	3.23	20.50	15.59	17.19	0.010	1.60	3.31	L	10190012	394148103513300
DTX3	39 30 24	103 43 28	5,195	5,192	Metro	Elbert	02/12/99	3.11	18.71	13.80	15.40	0.010	1.60	3.31	L	10190013	393024103432800
DTX4	39 33 58	103 43 42	4,957	4,954	Metro	Elbert	02/10/99	2.70	16.72	11.81	13.41	0.010	1.60	3.31	L	10190013	393358103434200
DTX5[1]	39 33 58	103 45 48	4,975	4,973	Metro	Elbert	02/10/99	2.30	20.90	16.09	17.69	0.010	1.60	3.21	L	10190013	393358103454800
DTX6	39 33 58	103 46 48	4,970	4,968	Metro	Elbert	02/09/99	[2]2.36	39	34	36	0.010	1.60	3.31	L	10190013	393358103464800
DTX7	39 40 54	103 56 46	5,076	5,073	Price	Arapahoe	02/18/99	2.77	16.10	11.19	12.79	0.010	1.60	3.31	L	10190011	394054103564600
DTX8A	39 40 54	103 56 45	5,076	5,074	Price	Arapahoe	03/02/99	2.46	77.52	67.56	71.83	0.010	4.27	5.69	R	10190011	394054103564501
DTX8B	39 40 54	103 56 45	5,076	5,074	Price	Arapahoe	03/02/99	2.49	177.48	167.52	171.79	0.010	4.27	5.69	R	10190011	394054103564502
DTX9[1]	39 39 02	103 55 40	5,121	5,119	Weisensee	Arapahoe	02/17/99	2.46	30.15	22.72	24.32	0.010	1.60	5.83	L	10190011	393902103554000
DTX10A[1]	39 39 02	103 55 40	5,122	5,120	Weisensee	Arapahoe	03/04/99	2.03	61.97	52.01	56.28	0.010	4.27	5.69	R	10190011	393902103554001
DTX10B	39 39 02	103 55 40	5,122	5,120	Weisensee	Arapahoe	03/04/99	2.11	121.73	111.77	116.04	0.010	4.27	5.69	R	10190011	393902103554002
DTX11[1]	39 39 02	103 55 40	5,122	5,120	Weisensee	Arapahoe	01/19/00	2.24	32	28	30	0.020	2	2.35	L	10190011	393902103554003
D6	39 36 33	103 51 22	5,128.78	5,126	Metro	Arapahoe	09/12/93	2.65	25	15	25	0.010	10	0.3	L	10190013	393633103512300
D6A	39 36 33	103 51 22	5,129	5,126	Metro	Arapahoe	02/06/02	2.42	32.96	28.42	30.71	0.010	2.29	2.25	L	10190013	393633103512301
D11a	39 33 45	103 54 23	5,377	5,374	Metro	Elbert	10/23/97	2.46	143	113	123	0.010	10	20.38	R	10190011	393334103543600
D13	39 34 42	103 54 38	5,235.33	5,234	Metro	Arapahoe	04/04/94	1.81	16	6	16	0.010	10	0.3	L	10190011	393439103543400
D17	39 33 34	103 54 36	5,277.73	5,276	Metro	Elbert	04/05/94	1.90	21	11	21	0.010	10	0.3	L	10190011	393327103541200
D19	39 33 17	103 54 18	5,304.24	5,303	Metro	Elbert	04/05/94	1.69	30	20	30	0.010	10	0.3	R	10190011	393311103541800
D25[1]	39 37 02	103 54 42	5,167.13	5,165	Metro	Arapahoe	05/01/95	2.23	23	13	23	0.010	10	0.3	L	10190011	393702103544100
D25A	39 37 02	103 54 42	5,167	5,165	Metro	Arapahoe	02/05/02	2.57	24.67	20.13	22.42	0.010	2.29	2.25	L	10190011	393702103544102
D29	39 36 41	103 52 48	5,371	5,369	Metro	Arapahoe	11/04/97	2.38	183	148	158	0.010	10	25.38	R	10190013	393632103524300
D30	39 36 55	103 51 22	5,096.43	5,094	Metro	Arapahoe	05/05/95	1.98	19	9	19	0.010	10	0.3	L	10190013	393655103512200

[1]Well had continuous-recorder equipment any time during 2004 through 2006.

[2]DTX6 stickup went from 2.43 to 2.36 feet between mid-October 2002 and early November 2002.

Table 8. Methods used to analyze ground-water samples collected near Deer Trail, Colorado, 2004 through 2006.

[MRL, minimum reporting level (dilutions for samples having high specific conductance may result in higher MRL's for some samples); µS/cm, microsiemens per centimeter at 25°C; mg/L milligrams per liter; ICP, inductively coupled plasma; AES, atomic-emission spectrometry; IC, ion chromatography; °C, degrees Celsius; ASF, automated segmented-flow spectrophotometry; µg/L, micrograms per liter; MS, mass spectroscopy; cICP, collision-cell inductively coupled plasma; CVAF, cold-vapor atomic fluorescence spectrometry]

Property or constituent	Units	Analytical method	MRL	Method reference
Major ions and mineral characteristics				
Specific conductance, laboratory	µS/cm	Wheatstone bridge	2.6	Fishman and Friedman (1989)
pH, laboratory	units	Electrometric electrode	0.1	Fishman and Friedman (1989)
Calcium, dissolved	mg/L	ICP-AES	.02	Fishman (1993)
Magnesium dissolved	mg/L	ICP-AES	.008	Fishman (1993)
Sodium, dissolved	mg/L	ICP-AES	.20	Fishman (1993)
Potassium, dissolved	mg/L	ICP-AES	.04	American Public Health Association (1998)
Acid-neutralizing capacity, lab, as $CaCO_3$	mg/L	Electrometric titration	2	Fishman and Friedman (1989)
Sulfate, dissolved	mg/L	IC	.18	Fishman and Friedman (1989)
Chloride, dissolved	mg/L	IC	.1	Fishman and Friedman (1989)
Fluoride, dissolved	mg/L	ASF, ion-selective electrode	.10	Fishman and Friedman (1989)
Bromide, dissolved	mg/L	Ion chromatography	.016	Fishman and Friedman (1989)
Silica, dissolved	mg/L	ICP-AES	.018	Fishman (1993)
Dissolved solids, residue at 180°C	mg/L	Gravimetric	10	Fishman and Friedman (1989)
Nutrients				
Nitrite plus nitrate, dissolved as N	mg/L	Colorimetry, ASF, cadmium reduction, diazotization	.04	Fishman (1993)
Nitrogen, ammonia, dissolved as N	mg/L	Colorimetry, ASF, salicylate-hypochlorite	.04	Fishman (1993)
Nitrogen, ammonia plus organic, total as N	mg/L	Colorimetry, ASF, microkjeldahl digestion	.10	Patton and Truitt (2000)
Nitrogen, ammonia plus organic, dissolved as N	mg/L	Colorimetry, ASF, microkjeldahl digestion	.10	Patton and Truitt (2000)
Phosphorus, total as P	mg/L	Colorimetry, ASF, microkjeldahl digestion	.04	Patton and Truitt (1992)
Phosphorus, dissolved as P	mg/L	Colorimetry, ASF, microkjeldahl digestion	.04	Patton and Truitt (1992)

Table 8. Methods used to analyze ground-water samples collected near Deer Trail, Colorado, 2004 through 2006.—Continued

[MRL, minimum reporting level (dilutions for samples having high specific conductance may result in higher MRL's for some samples); µS/cm, microsiemens per centimeter at 25°C; mg/L milligrams per liter; ICP, inductively coupled plasma; AES, atomic-emission spectrometry; IC, ion chromatography; °C, degrees Celsius; ASF, automated segmented-flow spectrophotometry; µg/L, micrograms per liter; MS, mass spectroscopy; cICP, collision-cell inductively coupled plasma; CVAF, cold-vapor atomic fluorescence spectrometry]

Property or constituent	Units	Analytical method	MRL	Method reference
		Trace elements		
Aluminum, dissolved as Al	µg/L	ICP-MS	1.6	Faires (1993)
Antimony, dissolved as Sb	µg/L	ICP-MS	.06	Faires (1993)
Arsenic, dissolved as As	µg/L	cICP-MS[1]	.12	Garbarino and others (2006)
Barium, dissolved as Ba	µg/L	ICP-MS	.08	Faires (1993)
Beryllium, dissolved as Be	µg/L	ICP-MS	.06	Faires (1993)
Boron, dissolved as B	µg/L	ICP-AES	1.8	Struzeski and others (1996)
Cadmium, dissolved as Cd	µg/L	ICP-MS	.04	Faires (1993)
Chromium, dissolved as Cr	µg/L	cICP-MS[1]	.04	Garbarino and others (2006)
Cobalt, dissolved as Co	µg/L	cICP-MS[1]	.014	Garbarino and others (2006)
Copper, dissolved as Cu	µg/L	cICP-MS[1]	.4	Garbarino and others (2006)
Iron, dissolved as Fe	µg/L	ICP-AES	6	Fishman (1993)
Lead, dissolved as Pb	µg/L	ICP-MS	.08	Faires (1993)
Manganese, dissolved as Mn	µg/L	ICP-MS	.2	Faires (1993)
Mercury, dissolved as Hg	µg/L	CVAF	.01	Gabarino and Damrau (2001)
Molybdenum, dissolved as Mo	µg/L	ICP-MS	.12	Faires (1993)
Nickel, dissolved as Ni	µg/L	cICP-MS[1]	.06	Garbarino and others (2006)
Selenium, dissolved as Se	µg/L	cICP-MS[1]	.08	Garbarino and others (2006)
Silver, dissolved as Ag	µg/L	ICP-MS	.1	Faires (1993)
Strontium, dissolved as Sr	µg/L	ICP-AES	.6	Fishman (1993)
Tungsten, dissolved as W	µg/L	cICP-MS[1]	.06	Garbarino and others (2006)
Zinc, dissolved as Zn	µg/L	cICP-MS[1]	.6	Garbarino and others (2006)
		Radioactivity		
Uranium, natural, dissolved	µg/L	ICP-MS	.04	Faires (1993)

[1]Method was ICP-MS (Faires, 1993) until October 2005.

Table 9. Monthly water-level data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.

[W.L. bmp, depth to water level below measuring point, in feet, measured with an electric tape; *, water level is below the screened interval of the well; --, no data; uncertainty of the water-level measurements is 0.02 foot or less]

Well	January (01/07/04-01/09/04) W.L. bmp	February (02/24/04) W.L. bmp	April (04/05/04-04/08/04) W.L. bmp	May (05/05/04) W.L. bmp	June (06/10/04) W.L. bmp	July (07/06/04-07/08/04) W.L. bmp	August (08/17/04) W.L. bmp	September (09/01/04) W.L. bmp	October (10/19/04-10/22/04) W.L. bmp	December (12/03/04) W.L. bmp
DTX 1	13.31	13.35	13.23	13.35	13.93	14.43	14.97	15.01	15.17	15.06
DTX2	6.76	9.88	9.67	9.63	10.27	10.66	11.24	11.26	11.01	10.74
DTX3	15.11	15.34	15.54*	15.67*	15.83*	15.96*	16.12*	16.13*	16.20*	16.23*
DTX4	--	13.18	12.86	12.94	13.34	13.47*	13.48*	13.51*	13.50*	13.51*
DTX5	--	12.86	12.46	12.62	12.89	13.22	12.43	11.90	12.88	13.10
DTX6	--	23.54	23.59	23.60	23.62	23.70	23.02	22.03	23.37	23.57
DTX7	--	9.04	8.91	8.84	9.54	9.78	10.40	10.40	9.89	9.49
DTX8A	--	9.33	9.18	9.16	9.80	10.03	11.06	11.13	10.79	9.88
DTX8B	--	5.20	5.18	5.12	5.16	5.19	5.28	5.30	5.26	5.19
DTX9	--	13.54	13.55	13.57	13.62	13.69	13.80	13.80	13.78	13.78
DTX10A	13.79	13.80	13.77	13.79	13.94	14.02	14.16	14.17	14.16	14.09
DTX10B	--	18.41	18.34	18.28	18.33	18.42	18.56	18.58	18.57	18.54
DTX11	--	13.88	13.88	13.86	13.95	14.05	14.13	14.13	14.11	14.11
D6	10.01	10.18	10.18	10.21	10.21	10.20	10.32	10.28	10.38	10.46
D6A	9.90	10.02	10.06	10.03	10.07	10.09	10.17	10.18	10.30	10.36
D11a	--	112.73	112.79	112.74	112.63	112.77	112.81	112.89	112.81	112.94
D13	--	8.47	8.24	8.16	8.35	8.40	9.06	9.26	9.07	8.63
D17	--	12.75	12.65	12.63	12.60	12.64	12.90	12.98	13.04	12.99
D19	--	21.91	21.92	21.95	21.97	22.01	22.04	22.04	22.06	22.09
D25	12.47	12.35	12.23	12.19	12.43	12.69	13.11	13.23	13.25	13.02
D25A	12.68	12.53	12.44	12.39	12.64	12.91	13.32	13.42	13.44	13.22
D29	--	154.04	153.89	153.98	153.77	154.23	154.05	154.20	153.87	154.04
D30	6.18	5.75	5.69	5.59	6.22	6.33	5.47	5.78	6.07	5.68

Table 9. Monthly water-level data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[W.L. bmp, depth to water level below measuring point, in feet, measured with an electric tape; *, water level is below the screened interval of the well; --, no data; uncertainty of the water-level measurements is 0.02 foot or less]

Well	January (01/11/05, 01/14/05) W.L. bmp	February (02/11/05) W.L. bmp	April (04/8/05) W.L. bmp	May (05/9/05) W.L. bmp	June (06/21/05-06/23/05) W.L. bmp	July (07/13/05-07/14/05) W.L. bmp	August (08/09/05) W.L. bmp	September (09/13/05) W.L. bmp	October (10/18/05) W.L. bmp	November (11/07/05-11/09/05) W.L. bmp	December (12/14/05) W.L. bmp
DTX 1	--	15.06	15.05	14.96	14.62	14.71	13.50	13.33	13.27	13.21	13.16
DTX2	10.70	10.64	10.45	10.16	10.77	11.67	12.05	12.19	11.84	11.61	11.48
DTX3	--	16.25*	16.28*	16.29*	16.29*	16.39*	16.40*	16.40*	16.38*	16.39*	16.39*
DTX4	--	13.50*	13.51*	13.51*	13.51*	13.63*	13.64*	13.64*	13.65*	13.65*	13.65*
DTX5	13.22	13.39	13.15	12.53	13.17	13.49	13.93	14.10	14.19	14.22	14.30
DTX6	--	23.75	23.75	23.63	22.86	22.77	22.98	22.87	23.20	23.30	23.47
DTX7	--	9.23	8.89	8.64	8.82	9.65	10.05	10.51	9.91	9.74	9.55
DTX8A	--	9.50	9.15	8.91	9.20	10.14	10.31	10.86	10.25	10.11	9.80
DTX8B	--	5.23	5.09	4.98	5.06	5.19	5.20	5.27	5.10	5.14	5.08
DTX9	13.81	13.80	13.75	13.69	13.82	13.91	11.68	14.01	13.99	14.28	13.98
DTX10A	14.11	14.08	14.00	13.94	14.17	14.28	12.36	14.35	14.31	14.30	14.27
DTX10B	18.50	18.49	18.26	18.18	18.29	18.44	18.47	18.53	18.36	18.43	18.37
DTX11	14.14	14.14	14.09	14.03	14.15	14.24	12.09	14.33	14.31	14.32	14.32
D6	10.39	10.53	10.36	10.01	10.09	10.30	10.47	10.60	10.63	10.59	10.69
D6A	10.31	10.36	10.26	9.91	9.96	10.15	10.31	10.49	10.51	10.51	10.57
D11a	--	112.87	112.65	112.99	112.97	113.02	113.12	113.23	113.09	113.38	113.33
D13	--	8.19	7.89	7.25	7.92	8.55	9.09	9.56	9.20	8.74	8.41
D17	--	12.85	12.76	12.46	12.36	12.49	12.97	13.25	13.30	13.25	13.19
D19	--	22.14	22.17	22.18	22.20	22.23	22.24	22.27	22.29	22.30	23.32
D25	12.90	12.82	12.69	12.47	12.63	13.09	13.47	13.63	13.58	13.45	13.28
D25A	--	13.03	12.90	12.68	12.83	13.31	13.64	13.82	13.43	13.34	13.18
D29	153.65	154.03	153.72	153.89	154.24	154.05	154.00	153.99	153.93	154.19	154.01
D30	--	5.33	5.01	4.62	5.08	6.09	6.82	7.38	7.16	6.97	6.78

Table 9. Monthly water-level data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[W.L. bmp, depth to water level below measuring point, in feet, measured with an electric tape; *, water level is below the screened interval of the well; --, no data; uncertainty of the water-level measurements is 0.02 foot or less]

Well	January (01/04/06-01/06/06) W.L. bmp	February (02/01/06) W.L. bmp	March (03/03/06) W.L. bmp	April (04/04/06, 04/05/06) W.L. bmp	May (05/10/06) W.L. bmp	June (06/15/06) W.L. bmp	July (07/25/06) W.L. bmp	August (08/17/06) W.L. bmp	September (09/13/06) W.L. bmp	October (10/24/06) W.L. bmp	November (11/17/06) W.L. bmp
DTX 1	13.20	13.13	13.15	13.10	13.11	13.51	13.84	13.96	14.07	14.27	14.31
DTX2	11.46	11.34	11.34	11.22	11.24	11.91	12.49	12.76	12.61	12.32	12.20
DTX3	16.39*	16.39*	16.39*	16.40*	16.39*	16.39*	13.13	14.29	15.53*	15.97*	15.98*
DTX4	13.65*	13.65*	13.65*	13.66*	13.65*	11.67	7.89	10.20	7.91	9.57	9.77
DTX5	14.35	14.40	14.51	14.53	14.65	11.91	5.87	8.13	5.67	7.68	8.23
DTX6	23.55	23.62	23.69	23.75	23.78	23.00	22.07	22.11	21.59	21.83	21.95
DTX7	9.45	9.34	9.28	9.09	9.17	9.88	10.17	10.60	9.29	9.36	9.28
DTX8A	9.69	9.54	9.51	9.31	9.42	10.17	10.48	10.93	9.73	9.55	9.49
DTX8B	5.16	5.10	5.17	5.05	5.20	5.25	5.22	5.30	5.21	5.20	5.15
DTX9	13.97	13.95	13.98	13.94	14.00	14.07	14.10	14.15	13.95	13.86	13.88
DTX10A	14.26	14.23	14.28	14.21	14.31	14.37	14.42	14.52	14.20	14.19	14.20
DTX10B	18.37	18.31	18.34	18.22	18.35	18.41	18.37	18.47	18.15	18.36	18.37
DTX11	14.30	14.28	14.31	14.28	14.33	14.40	14.44	14.51	14.31	14.19	14.21
D6	10.68	10.66	10.70	10.63	10.71	10.73	10.76	10.65	10.04	9.80	9.90
D6A	10.59	10.51	10.60	10.55	10.58	10.65	10.65	10.57	9.96	9.71	9.78
D11a	113.13	113.06	113.37	113.08	113.47	113.27	113.38	113.42	113.36	113.37	113.66
D13	8.26	8.11	7.98	7.77	7.79	8.40	8.96	9.56	9.40	8.96	8.62
D17	13.15	13.09	13.05	13.00	12.92	12.98	13.23	13.42	13.48	13.47	13.38
D19	22.33	22.35	22.37	22.39	22.42	22.45	22.50	22.51	22.50	22.51	22.51
D25	13.23	13.13	13.10	13.01	12.97	13.30	13.62	13.78	9.77	10.43	10.73
D25A	13.13	13.03	12.99	12.92	12.88	13.21	13.52	13.66	9.69	10.35	10.65
D29	154.21	153.68	154.12	153.93	154.16	153.77	153.86	153.95	153.88	153.86	154.09
D30	6.68	6.57	6.50	6.30	6.38	7.39	7.42	7.99	5.71	5.79	5.70

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Acid neutralizing capacity, titration, field (mg/L as $CaCO_3$)	Water temperature (°C)	Water level before sampling, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Specific conductance, laboratory (µS/cm)	pH, laboratory (standard units)	Hardness, total (mg/L as $CaCO_3$)
DTX3	01/08/04	1020	1,870	7.2	--	--	15.11	7.0	2,000	7.3	1,000
D17	06/02/05	0950	490	7.6	199	11.6	12.38	.5	436	7.8	230
D17	07/06/05	0940	490	7.6	179	12.3	12.43	.8	441	7.7	230
D17	11/08/05	1205	490	7.6	219	14.4	13.25	.4	472	7.8	230
D17	01/04/06	1355	480	7.5	199	12.7	13.15	.9	491	8.0	240
D17	04/04/06	1410	480	7.6	190	11.8	13.00	.8	478	7.8	230
D17	06/27/06	1400	500	7.5	220	12.6	13.07	.4	482	7.8	220
D17	11/15/06	1455	480	7.5	190	13.0	13.39	1.0	484	7.7	220
DTX5	04/05/04	1415	2,260	7.1	--	10.9	12.46	.8	2,150	7.2	1,200
DTX5	07/06/04	1350	2,530	6.9	--	11.9	13.22	.6	2,460	7.2	1,400
DTX5	07/08/04	1350	2,590	7.0	--	13.5	13.24	.5	--	--	1,400
DTX5	10/21/04	1050	2,190	7.1	--	13.1	12.88	.8	2,140	7.4	1,200
DTX5	11/07/05	1130	2,600	7.0	266	13.2	14.22	.7	2,540	7.1	1,400
DTX6	04/06/04	1345	4,130	7.2	--	13.8	23.59	1.8	4,020	7.4	2,300
DTX6	07/08/04	1420	4,340	7.1	--	16.3	23.71	2.1	4,120	7.3	2,300
DTX6	10/21/04	1235	4,150	7.1	--	13.5	23.37	2.4	4,120	7.4	2,400
DTX6	11/07/05	1415	4,000	7.1	277	14.4	23.30	2.0	3,980	7.3	2,200
D29	04/05/04	1040	3,700	6.7	--	16.1	153.89	3.6	3,730	7.0	3,100
D29	07/06/04	1130	4,070	6.7	--	19.8	154.23	4.1	4,080	6.8	3,000
D29	10/20/04	1215	3,950	6.7	--	21.8	153.87	3.0	3,920	7.0	2,800
DTX10A	01/07/04	1230	2,520	7.4	--	11.5	13.79	--	3,110	7.3	1,900
DTX10A	04/06/04	1050	3,160	7.2	--	13.7	13.77	.7	3,120	7.2	2,000
DTX10A	07/07/04	1320	3,310	7.2	--	13.8	14.02	.6	3,070	7.2	1,900
DTX10A	10/22/04	1110	3,130	7.2	--	17.1	14.16	4.6	3,160	7.3	2,000
DTX10A	07/08/05	1100	3,300	6.8	211	19.3	14.25	3.3	3,040	7.2	1,700
DTX10A	06/26/06	1120	3,200	7.0	250	18.2	14.43	1.5	3,180	7.2	1,800
DTX1	06/02/05	1355	4,100	7.0	300	11.8	15.09	.5	3,850	7.4	2,100
DTX1	07/05/05	1430	4,110	7.1	306	11.7	14.64	1.0	3,780	7.4	2,200
DTX1	11/08/05	1500	4,100	7.1	316	12.9	13.21	.4	4,010	7.3	2,100
DTX1	01/05/06	1145	3,900	7.2	318	11.7	13.20	.7	4,090	7.5	2,200
DTX1	04/05/06	1325	4,060	7.0	280	11.5	13.10	.6	3,960	7.3	2,000
DTX1	06/26/06	1435	4,070	7.0	310	11.6	13.65	.4	3,990	7.3	2,000
DTX1	11/14/06	1330	4,020	7.0	--	12.0	14.29	.6	4,060	7.3	1,900

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Acid neutralizing capacity, titration, field (mg/L as $CaCO_3$)	Water temperature (°C)	Water level before sampling, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Specific conductance, laboratory (µS/cm)	pH, laboratory (standard units)	Hardness, total (mg/L as $CaCO_3$)
D6	01/08/04	1325	16,400	7.2	--	11.4	10.01	0.6	E16,600	7.2	11,000
D6	04/07/04	1250	16900	7.0	--	11.4	10.18	.4	E16,900	7.7	11,000
D6	07/07/04	1500	17,700	6.9	--	13.0	10.20	.4	15,500	7.2	11,000
D6	10/19/04	1245	17,200	7.0	--	12.4	10.38	.7	E15,500	7.4	11,000
D6	01/11/05	1030	16,700	7.0	658	11.3	10.39	1.5	E15,500	7.1	12,000
D6	06/01/05	1245	17,600	7.0	--	13.3	9.95	--	E16,300	7.3	12,000
D6	07/06/05	1240	17,600	7.1	626	12.2	10.18	1.4	E16,300	7.2	12,000
D6	11/08/05	1010	17,100	7.1	670	12.6	10.59	.7	E17,300	7.2	12,000
D6	01/04/06	1025	16,800	7.0	642	11.1	10.68	.5	E17,800	7.5	12,000
D6	04/04/06	1155	17,100	7.1	630	11.8	10.63	1.2	E17,200	7.2	12,000
D6	06/28/06	1030	17,300	7.1	650	12.6	10.77	.8	E17,300	7.2	11,000
D6	11/15/06	1120	17,100	6.9	609	11.0	9.86	1.3	E17,500	7.2	11,000
D25	01/09/04	1130	4,100	--	--	11.9	12.48	.6	4,380	7.9	2,600
D25	04/08/04	1200	4,350	7.2	--	11.7	12.23	.6	4,250	7.4	2,800
D25	10/19/04	1430	4,430	7.1	--	13.8	13.25	.8	4,160	7.5	2,700
D25	02/25/05	1350	4,200	7.2	322	11.8	12.80	.8	4,230	7.3	3,100
D25	06/01/05	1525	4,500	7.0	339	13.0	12.45	.8	4,170	7.3	2,600
D25	07/05/05	1015	4,500	7.0	367	12.3	12.88	1.0	4,130	7.4	2,700
D25	11/09/05	1005	4,300	7.2	324	11.5	13.45	1.0	4,360	7.1	2,600
D25	01/04/06	1235	4,400	7.0	333	11.7	13.23	.9	4,390	7.5	2,600
D25	04/05/06	1025	4,400	7.0	330	12.2	13.01	.6	4,300	7.2	2,600
D25	06/27/06	1235	4,500	7.0	360	13.2	13.50	.7	4,360	7.3	2,700
D25	11/14/06	1550	4,460	7.0	--	11.0	10.71	.8	4,470	7.3	2,500
DTX8A	04/07/04	1045	1,860	7.4	--	14.6	9.18	1.6	1,860	7.9	550
DTX8A	07/08/04	1210	1,980	7.5	--	13.2	10.03	.6	1,860	E7.5	510
DTX8A	10/19/04	1100	1,920	7.5	--	12.0	10.79	.0	1,820	7.8	540
DTX8A	07/07/05	1015	1,870	7.5	240	16.7	9.97	1.9	1,740	7.8	540
DTX8A	06/27/06	1015	1,800	7.4	230	16.1	10.45	3.3	1,870	7.6	510
DTX2	01/09/04	0945	4,470	6.9	--	10.6	9.99	.6	4,680	7.2	2,100
DTX2	04/08/04	1405	4,830	7.1	--	9.8	9.67	.8	4,790	7.3	2,300
DTX2	10/21/04	1415	4,520	7.0	--	12.8	11.01	1.5	4,460	E7.1	2,400
DTX2	02/25/05	1120	4,700	7.1	409	10.1	10.64	1.4	4,680	7.2	2,400
DTX2	06/02/05	1205	5,000	7.0	430	10.6	10.38	1.7	4,680	7.2	2,200
DTX2	07/05/05	1240	4,710	6.8	389	10.6	11.36	.8	4,310	7.2	2,200
DTX2	11/08/05	1340	4,600	7.0	420	12.9	11.61	.4	4,580	7.1	2,200
DTX2	01/05/06	1000	4,600	7.0	420	10.4	11.46	.7	4,860	7.4	2,400
DTX2	04/05/06	1450	5,020	6.9	430	10.5	11.22	.8	4,880	7.2	2,100
DTX2	06/26/06	1320	4,800	6.9	480	10.6	12.16	.5	4,780	7.2	2,200
DTX2	11/14/06	1040	4,700	6.7	--	12.0	12.21	1.0	4,760	7.2	2,100

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sodium adsorption ratio	Sodium, dissolved (mg/L)	Acid neutralizing capacity, titration to pH4.5, laboratory (mg/L as $CaCO_3$)	Bromide, dissolved (mg/L)	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)
DTX3	01/08/04	1020	243	93.5	7.56	2	121	--	0.2	19.4	0.43
D17	06/02/05	0950	59.7	20.1	1.62	.5	17.5	[1]191	.06	2.03	1.39
D17	07/06/05	0940	58.8	20.0	1.56	.5	16.9	185	.06	2.26	1.40
D17	11/08/05	1205	60.0	19.6	1.71	.5	17.0	192	.06	2.16	1.45
D17	01/04/06	1355	63.1	19.6	1.80	.5	17.7	205	.08	2.32	1.45
D17	04/04/06	1410	61.3	18.7	1.57	.5	16.5	203	.06	2.29	1.47
D17	06/27/06	1400	59.2	18.3	1.61	.5	16.2	204	.06	2.24	1.39
D17	11/15/06	1455	58.7	17.9	1.73	.5	16.8	204	.06	2.28	1.41
DTX5	04/05/04	1415	377	59.9	4.13	1	114	109	.13	6.62	.34
DTX5	07/06/04	1350	437	67.2	4.47	1	124	172	.14	7.09	.35
DTX5	07/08/04	1350	433	66.6	4.42	1	123	--	--	--	--
DTX5	10/21/04	1050	384	58.5	4.50	1	103	[1]282	.11	4.89	.36
DTX5	11/07/05	1130	447	67.9	4.70	2	150	[1]262	.20	9.39	.36
DTX6	04/06/04	1345	493	251	13.0	3	372	218	.17	20.6	.59
DTX6	07/08/04	1420	482	266	13.9	3	358	244	.18	20.3	.56
DTX6	10/21/04	1235	503	268	13.2	3	344	246	.18	18.3	.59
DTX6	11/07/05	1415	444	257	12.5	3	322	244	.14	16.7	.57
D29	04/05/04	1040	616	367	13.1	1	172	271	.15	12.5	.58
D29	07/06/04	1130	593	369	12.1	1	162	299	.10	13.0	.61
D29	10/20/04	1215	559	338	12.0	1	148	295	.23	11.6	.62
DTX10A	01/07/04	1230	486	173	9.34	2	166	175	.41	19.2	.95
DTX10A	04/06/04	1050	498	173	9.15	2	178	219	.25	19.1	1.0
DTX10A	07/07/04	1320	463	171	9.01	2	164	220	.32	18.9	.96
DTX10A	10/22/04	1110	506	172	9.46	2	164	216	.32	17.9	.95
DTX10A	07/08/05	1100	402	162	9.04	2	152	[1]225	.26	18.3	.96
DTX10A	06/26/06	1120	451	168	9.35	2	157	224	.25	17.7	.96
DTX1	06/02/05	1355	496	206	3.29	3	364	[1]304	.77	50.9	.78
DTX1	07/05/05	1430	494	233	3.75	4	379	[1]304	.76	51.7	.79
DTX1	11/08/05	1500	481	206	3.91	3	358	298	.76	48.8	.77
DTX1	01/05/06	1145	516	216	4.18	3	369	315	.76	48.4	.79
DTX1	04/05/06	1325	461	195	3.39	3	334	306	.76	49.2	.77
DTX1	06/26/06	1435	483	199	3.52	3	343	304	.73	48.6	.70
DTX1	11/14/06	1330	474	184	3.58	3	340	301	.77	49.5	.63

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sodium adsorption ratio	Sodium, dissolved (mg/L)	Acid neutralizing capacity, titration to pH4.5, laboratory (mg/L as $CaCO_3$)	Bromide, dissolved (mg/L)	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)
D6	01/08/04	1325	453	2,420	14.2	9	2,230	645	4.01	412	1.24
D6	04/07/04	1250	441	2,300	13.1	9	2,210	--	4.41	423	1.28
D6	07/07/04	1500	434	2,430	13.4	9	2,170	644	4.56	409	1.24
D6	10/19/04	1245	431	2,420	15.9	9	2,280	645	4.25	394	1.24
D6	01/11/05	1030	434	2,620	15.6	9	2,370	647	4.27	401	1.21
D6	06/01/05	1245	428	2,700	15.4	9	2,310	646	4.42	390	1.30
D6	07/06/05	1240	436	2,700	15.4	9	2,330	647	4.42	394	1.25
D6	11/08/05	1010	439	2,520	15.1	9	2,310	[1]652	4.42	390	1.24
D6	01/04/06	1025	453	2,540	14.4	9	2,280	649	4.27	384	1.38
D6	04/04/06	1155	468	2,530	15.0	9	2,260	644	4.42	383	1.35
D6	06/28/06	1030	452	2,500	14.6	9	2,260	650	4.16	382	1.25
D6	11/15/06	1120	426	2,360	13.9	9	2,220	646	4.53	376	1.23
D25	01/09/04	1130	733	194	7.44	2	266	--	1.66	136	1.04
D25	04/08/04	1200	801	200	9.16	3	324	--	1.62	128	1.04
D25	10/19/04	1430	751	196	8.69	2	269	347	1.60	117	1.09
D25	02/25/05	1350	911	196	8.11	2	268	317	1.57	114	1.05
D25	06/01/05	1525	752	185	7.64	2	263	[1]351	1.63	113	1.09
D25	07/05/05	1015	703	238	7.74	2	292	[1]389	1.63	111	1.07
D25	11/09/05	1005	745	185	8.27	2	256	307	1.65	116	1.10
D25	01/04/06	1235	751	177	7.93	2	250	342	1.67	115	1.13
D25	04/05/06	1025	738	176	7.65	2	246	343	E1.65	117	1.13
D25	06/27/06	1235	781	179	7.81	2	256	358	1.63	115	1.06
D25	11/14/06	1550	718	173	7.95	2	265	383	1.76	115	1.06
DTX8A	04/07/04	1045	163	33.6	6.80	5	252	220	.29	27.5	.36
DTX8A	07/08/04	1210	149	32.5	6.68	5	243	187	.28	28.0	.36
DTX8A	10/19/04	1100	159	33.8	6.90	5	257	203	.36	26.8	.40
DTX8A	07/07/05	1015	159	33.7	7.11	4	238	[1]225	.29	27.2	.38
DTX8A	06/27/06	1015	150	31.8	6.58	5	235	223	.29	26.6	.37
DTX2	01/09/04	0945	509	208	8.89	5	515	305	.85	78.1	.6
DTX2	04/08/04	1405	532	223	10.4	6	609	313	.92	85.2	.59
DTX2	10/21/04	1415	567	235	9.62	4	488	[1]446	.85	60.2	.63
DTX2	02/25/05	1120	574	228	9.58	5	546	425	1.03	82.9	.60
DTX2	06/02/05	1205	513	215	9.44	5	565	[1]407	1.04	88.0	.58
DTX2	07/05/05	1240	489	232	9.00	5	508	388	.87	68.1	.61
DTX2	11/08/05	1340	511	221	8.96	4	460	400	.92	70.1	.62
DTX2	01/05/06	1000	560	239	10.5	5	543	428	1.04	83.8	.64
DTX2	04/05/06	1450	494	218	9.16	5	564	428	1.12	96.4	.63
DTX2	06/26/06	1320	514	217	9.42	5	526	426	.97	77.9	.60
DTX2	11/14/06	1040	506	205	9.12	4	470	433	1.01	79.3	.62

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L)	Phosphorus, total (mg/L)	Solids, residue on evaporation at 180°C, dissolved (mg/L)	Dissolved solids, sum of constituents (mg/L)
DTX3	01/08/04	1020	17.8	894	0.2	0.16	E,n0.020	3.41	<0.04	E,n0.02	1,640	--
D17	06/02/05	0950	20.2	43.4	E,n .07	E,n .06	<.040	.86	.09	.08	292	290
D17	07/06/05	0940	19.7	43.8	E,n .07	E,n .08	<.040	.89	.09	.09	280	276
D17	11/08/05	1205	20.4	48.5	E,n .09	E,n .09	<.040	.77	.06	.09	299	306
D17	01/04/06	1355	20.2	48.6	E,n .05	E,n .07	<.040	.80	.08	.09	294	298
D17	04/04/06	1410	18.8	49.2	E,n .07	<.10	<.040	.79	.09	.07	295	288
D17	06/27/06	1400	18.4	49.6	E,n .05	E,n .07	<.040	.79	.08	.08	295	303
D17	11/15/06	1455	18.6	52.0	E,n .06	E,n .07	E,n .025	.75	.08	.08	301	287
DTX5	04/05/04	1415	11.7	1,170	.20	.13	<.080	.64	<.04	<.04	1,980	1,820
DTX5	07/06/04	1350	11.8	1,310	.14	.10	E,n .022	1.26	<.04	<.04	2,300	2,070
DTX5	07/08/04	1350	11.8	--	--	--	--	--	--	--	--	--
DTX5	10/21/04	1050	12.4	1,050	.14	.16	E,n .022	1.59	<.04	<.04	1,890	1,790
DTX5	11/07/05	1130	11.8	1,350	E,n .08	E,n .07	E,n .024	.48	<.04	<.04	2,330	2,200
DTX6	04/06/04	1345	21.3	2,500	E,n .09	E,n .07	<.080	.29	<.04	<.04	4,190	3,810
DTX6	07/08/04	1420	11.5	2,570	E,n .09	.16	<.040	.25	<.04	<.04	4,270	3,880
DTX6	10/21/04	1235	12.3	2,510	.11	.12	E,n .028	.57	<.04	<.04	4,190	3,830
DTX6	11/07/05	1415	11.9	2,420	E,n .06	E,n .06	<.040	1.03	<.04	<.04	4,000	3,660
D29	04/05/04	1040	25.8	2,510	.33	.37	.289	.05	E,n .03	.26	4,060	3,890
D29	07/06/04	1130	24.5	2,750	.42	.48	.404	<.04	E,n .02	E,n .03	4,330	4,110
D29	10/20/04	1215	22.1	2,620	.35	.35	.339	.05	E,n .02	.19	4,310	3,890
DTX10A	01/07/04	1230	18.1	1,870	1.4	1.3	1.27	.04	<.04	<.04	3,070	2,860
DTX10A	04/06/04	1050	18.2	1,820	1.3	1.3	1.21	<.04	<.04	<.04	3,100	2,860
DTX10A	07/07/04	1320	18.3	1,830	1.4	1.3	1.24	<.04	<.04	<.04	3,130	2,820
DTX10A	10/22/04	1110	18.5	1,880	1.3	1.4	1.26	<.04	<.04	<.04	3,110	--
DTX10A	07/08/05	1100	17.8	1,890	1.3	1.3	1.28	<.04	E,n .02	<.04	3,130	2,790
DTX10A	06/26/06	1120	16.9	1,870	1.4	1.5	1.28	<.04	<.04	<.04	3,160	2,850
DTX1	06/02/05	1355	34.2	2,290	.19	.17	E,n .020	1.35	.09	.08	4,050	3,630
DTX1	07/05/05	1430	35.2	2,290	.21	.18	<.080	1.17	.08	.08	4,020	3,690
DTX1	11/08/05	1500	37.0	2,290	.14	.13	<.200	1.47	.08	.08	4,000	3,620
DTX1	01/05/06	1145	36.6	2,310	.19	.19	E,n .026	1.62	.08	.08	4,060	3,710
DTX1	04/05/06	1325	32.6	2,260	.19	.19	.046	2.24	.09	.07	3,990	3,520
DTX1	06/26/06	1435	34.5	2,260	.23	.24	.045	2.59	.07	.08	3,980	3,580
DTX1	11/14/06	1330	31.4	2,280	.25	.26	.071	2.84	.07	.07	3,920	3,550

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L)	Phosphorus, total (mg/L)	Solids, residue on evaporation at 180°C, dissolved (mg/L)	Dissolved solids, sum of constituents (mg/L)
D6	01/08/04	1325	23.1	13,200	1.7	0.91	0.082	21.7	E,n0.03	E,n0.03	21,800	19,300
D6	04/07/04	1250	22.3	13,100	1.5	1.6	<.400	22.9	E,n .04	E,n .03	21,400	--
D6	07/07/04	1500	23.0	13,100	1.5	1.6	.063	24.6	E,n .03	E,n .04	21,300	19,100
D6	10/19/04	1245	24.2	13,600	.68	1.4	.057	25.0	E,n .04	E,n .02	22,700	19,600
D6	01/11/05	1030	24.9	13,500	1.7	1.7	E,n .030	27	.04	E,n .03	21,400	19,900
D6	06/01/05	1245	24.5	13,300	E1.7	1.6	.052	E31	E,n .04	E,n .03	22,700	19,500
D6	07/06/05	1240	23.9	13,400	1.6	1.7	.062	31	.04	.04	22,200	19,900
D6	11/08/05	1010	22.5	13,500	1.5	1.6	.079	32	E,n .02	<.04	22,500	19,800
D6	01/04/06	1025	22.3	13,500	1.6	1.7	.078	32	E,n .03	E,n .04	22,400	19,700
D6	04/04/06	1155	22.2	13,600	1.6	1.6	.116	34	.04	E,n .03	21,900	19,800
D6	06/28/06	1030	22.9	13,500	1.6	1.7	.095	35	E,n .03	E,n .03	23,000	19,700
D6	11/15/06	1120	21.4	13,300	1.6	1.6	.141	38	E,n .03	.04	21,400	19,200
D25	01/09/04	1130	29.2	2,620	.58	.62	.068	.17	.10	.07	4,500	--
D25	04/08/04	1200	25.2	2,520	.50	.62	<.080	.26	.09	.09	4,540	--
D25	10/19/04	1430	30.0	2,520	.55	.5	.05	.12	.08	.09	4,500	4,120
D25	02/25/05	1350	28.7	2,540	.56	.55	.062	.13	.07	.07	4,480	4,270
D25	06/01/05	1525	26.6	2,550	.57	.56	.044	.52	.10	.08	4,550	4,110
D25	07/05/05	1015	29.7	2,520	.64	.61	<.080	1.48	.12	.12	4,550	4,130
D25	11/09/05	1005	26.9	2,520	.52	.53	.090	<.04	.06	.05	4,460	4,060
D25	01/04/06	1235	25.9	2,520	.54	.54	.076	<.04	.07	.08	4,510	4,060
D25	04/05/06	1025	23.1	2,500	.55	.54	E,n .043	E,n .02	.08	.07	4,510	4,020
D25	06/27/06	1235	23.9	2,510	.54	.60	.070	.33	.07	.08	4,550	4,100
D25	11/14/06	1550	24.3	2,520	.58	.58	.124	.66	.08	.08	4,470	4,060
DTX8A	04/07/04	1045	14.3	749	1.3	1.5	1.36	<.04	<.04	<.04	1,390	1,380
DTX8A	07/08/04	1210	14.6	757	1.5	1.6	1.38	<.04	<.04	<.04	1,410	1,350
DTX8A	10/19/04	1100	15.2	755	1.5	1.4	1.40	<.04	<.04	<.04	1,430	1,400
DTX8A	07/07/05	1015	14.1	762	1.4	1.5	1.43	<.04	<.04	<.04	1,400	1,390
DTX8A	06/27/06	1015	13.5	757	1.5	1.5	1.41	<.04	<.04	<.04	1,420	1,370
DTX2	01/09/04	0945	18.1	2,670	1.1	1.2	.819	<.04	<.04	<.04	4,640	4,200
DTX2	04/08/04	1405	17.3	2,770	.97	1.1	.665	E,n .03	<.04	E,n .02	4,770	4,450
DTX2	10/21/04	1415	19.3	2,510	1.0	1.1	.778	<.04	E,n .02	<.04	4,450	4,180
DTX2	02/25/05	1120	18.9	2,670	1.1	1.1	.809	<.04	<.04	<.04	4,740	--
DTX2	06/02/05	1205	16.6	2,700	1.1	1.1	.815	<.04	E,n .02	<.04	4,850	4,380
DTX2	07/05/05	1240	17.5	2,570	1.1	1.0	.784	<.04	<.04	<.04	4,570	4,140
DTX2	11/08/05	1340	18.2	2,530	.95	1.1	.826	<.04	<.04	<.04	4,500	4,080
DTX2	01/05/06	1000	17.8	2,650	1.1	1.2	.868	<.04	<.04	<.04	4,740	4,370
DTX2	04/05/06	1450	15.5	2,700	1.1	1.1	.821	E,n .03	<.04	<.04	4,810	4,370
DTX2	06/26/06	1320	15.2	2,600	1.1	1.1	.814	<.04	<.04	<.04	4,740	4,260
DTX2	11/14/06	1040	15.9	2,580	1.1	1.0	.914	<.04	<.04	E,n .02	4,500	4,120

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Aluminum, dissolved (µg/L)	Antimony, dissolved (µg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Cadmium, dissolved (µg/L)	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)	Lead, dissolved (µg/L)
DTX3	01/08/04	1020	<1.6	<0.20	1.6	15	<0.06	226	<0.04	<0.8	0.6	5.8	<6	<0.08
D17	06/02/05	0950	<1.6	<.20	2	60	<.06	60	<.04	<.8	.2	.5	<6	<.08
D17	07/06/05	0940	<1.6	<.20	2	60	<.06	58	E,n .02	<.8	.2	E,n .3	<6	<.08
D17	11/08/05	1205	E,n .8	<.20	2	60	<.06	60	E,n .02	<.04	.2	.7	<6	<.08
D17	01/04/06	1355	E,n .8	<.20	1	60	<.06	60	E,n .02	.1	.2	1	<6	<.08
D17	04/04/06	1410	<1.6	<.20	1	50	<.06	55	<.04	.1	.2	.6	<6	<.08
D17	06/27/06	1400	<1.6	<.20	1	60	<.06	53	<.04	E,n .02	.2	.7	<6	<.08
D17	11/15/06	1455	<1.6	.06	1	60	<.06	59	E,n .03	<.12	.1	<.40	<6	<.12
DTX5	04/05/04	1415	E,n .8	E,n .20	.3	14	<.06	359	.04	<.8	1.42	5.8	<19	.12
DTX5	07/06/04	1350	<1.6	.23	.2	13	<.06	372	E,n .04	<.8	1.02	8.4	<19	<.08
DTX5	07/08/04	1350	<3.2	<.40	<.4	14	<.12	385	<.08	<.8	1.58	7.6	<19	<.16
DTX5	10/21/04	1050	E,n1.0	1.90	.3	13	<.06	381	.05	<.8	.982	6.6	<18	<.08
DTX5	11/07/05	1130	<3.2	.81	.1	10	<.12	386	E,n .04	E,n .02	1.2	5	<18	<.16
DTX6	04/06/04	1345	<3.2	<.40	.6	9	<.12	386	<.08	<.8	1.65	12.6	<19	<.16
DTX6	07/08/04	1420	<3.2	<.40	E,n .3	8	<.12	335	<.08	<.8	1.34	13.2	<19	<.16
DTX6	10/21/04	1235	<3.2	<.40	1.1	8	.14	384	<.08	<.8	.790	13.8	<18	<.16
DTX6	11/07/05	1415	<3.2	<.40	.2	8	<.12	381	<.08	E,n .03	.7	10	<18	<.16
D29	04/05/04	1040	<3.2	<.40	.5	9	<.12	181	<.08	<.8	2.14	10.9	3,290	<.16
D29	07/06/04	1130	<3.2	<.40	E,n .2	8	<.12	209	<.08	.8	1.26	15.6	7,830	<.16
D29	10/20/04	1215	<3.2	<.40	.7	12	E,n .06	220	.08	<.8	1.44	14.7	4,010	<.16
DTX10A	01/07/04	1230	E,n1.0	<.20	.5	12	<.06	249	<.04	1.0	1.18	5.6	4,540	<.16
DTX10A	04/06/04	1050	13.6	<.40	.4	11	<.12	258	<.08	<.8	1.73	8.6	4,630	<.16
DTX10A	07/07/04	1320	<3.2	<.40	E,n .3	11	<.12	261	<.08	<.8	.990	12.7	4,550	<.16
DTX10A	10/22/04	1110	E,n1.9	<.40	.5	11	<.12	254	<.08	<.8	.870	9.7	4,330	<.16
DTX10A	07/08/05	1100	<3.2	<.40	.5	10	<.12	262	<.08	<.8	.8	5	4,470	<.16
DTX10A	06/26/06	1120	<3.2	<.40	E,n .07	10	<.12	222	<.08	.3	1.7	<.80	4,230	<.16
DTX1	06/02/05	1355	<3.2	<.40	3	8	<.12	478	.10	.8	1.2	6	<18	<.16
DTX1	07/05/05	1430	<3.2	<.40	2	9	<.12	464	.14	1	.74	6	<18	<.16
DTX1	11/08/05	1500	<3.2	<.40	2	8	<.12	495	.14	.1	1	10	<18	<.16
DTX1	01/05/06	1145	<3.2	<.40	2	8	<.12	479	.15	.07	1.1	7	<18	<.16
DTX1	04/05/06	1325	<3.2	<.40	2	7	<.12	413	.16	.3	1.2	6	<18	<.16
DTX1	06/26/06	1435	<3.2	<.40	2	8	<.06	402	.17	.04	1.7	.7	<18	E,n .04
DTX1	11/14/06	1330	<3.2	.14	1	9	<.12	410	.20	<.24	.2	E,n .6	<18	<.24

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Aluminum, dissolved (µg/L)	Antimony, dissolved (µg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Cadmium, dissolved (µg/L)	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)	Lead, dissolved (µg/L)
D6	01/08/04	1325	<11	<1.40	8.8	6	<0.42	794	<0.28	<1.6	7.90	34.9	<64	E,n0.34
D6	04/07/04	1250	E,n6.5	<1.40	6.5	5	<.42	904	<.28	<1.6	7.06	49.1	<64	<.56
D6	07/07/04	1500	<9.6	<1.2	2.2	5	<.36	886	<.24	<1.6	7.48	29.8	<64	<.48
D6	10/19/04	1245	<1.6	<.20	10.3	5	<.06	835	.10	<1.6	6.68	33.9	<60	<.08
D6	01/11/05	1030	<11.2	<1.40	10	5	<.42	859	<.28	<1.6	7.7	47	<60	<.56
D6	06/01/05	1245	<11.2	<2.80	10	5	<.42	900	<.56	<1.6	8	42	<60	<1.12
D6	07/06/05	1240	<11.2	<1.40	1	5	<.42	880	<.28	<1.6	7.5	45	<90	<.56
D6	11/08/05	1010	<11.2	<1.40	1	5	<.42	812	<.28	<.12	8	49	<60	<.56
D6	01/04/06	1025	<12.8	<1.60	1	5	<.48	798	<.32	.2	7.5	35	<90	<.64
D6	04/04/06	1155	<11.2	<1.40	E,n1	5	<.42	788	E,n .14	<.4	6.9	38	<120	<.56
D6	06/28/06	1030	<11.2	<1.40	.2	5	<.42	804	<.28	<.04	7.7	.41	<120	<.56
D6	11/15/06	1120	<12.8	E,n .40	1	5	<.48	789	E,n .16	<.96	7	E,n3	<90	<.96
D25	01/09/04	1130	<3.2	E,n .28	3.5	18	<.12	232	.21	<.8	4.01	15.2	<19	<.16
D25	04/08/04	1200	<3.2	<.40	1.6	17	<.12	233	.17	<.8	4.42	12.8	<19	<.16
D25	10/19/04	1430	<3.2	E .2	2.4	19	<.12	191	.19	<.8	4.54	10.5	<18	<.16
D25	02/25/05	1350	<6.4	<.40	2	20	<.12	182	.18	<.8	4.4	8	<18	<.16
D25	06/01/05	1525	<3.2	<.40	3	20	<.12	210	.16	<8.0	2.6	10	<18	<.16
D25	07/05/05	1015	<3.2	<.40	3	20	<.12	326	.21	.2	3.3	7	<18	<.16
D25	11/09/05	1005	<3.2	<.40	1	20	<.12	158	.17	E,n .02	4.0	11	E,n15	<.16
D25	01/04/06	1235	<3.2	<.40	2	20	E,n .07	144	.20	.09	4.0	12	<18	<.16
D25	04/05/06	1025	<3.2	<.40	1	20	<.12	134	.18	.3	3.4	8	<18	<.16
D25	06/27/06	1235	E,n2.8	<.40	1	20	<.06	151	<.08	.06	3	.7	<6	<.08
D25	11/14/06	1550	<3.2	E,n .08	2	20	<.12	208	<.08	<.24	2	E,n .5	<18	<.24
DTX8A	04/07/04	1045	E,n1.5	<.20	.3	12	<.06	284	<.04	<.8	.918	3.5	688	<.08
DTX8A	07/08/04	1210	1.7	<.20	.2	12	<.06	282	<.04	<.8	.780	3.6	600	<.08
DTX8A	10/19/04	1100	<1.6	<.20	.3	12	<.06	266	<.04	<.8	.617	2.8	705	<.08
DTX8A	07/07/05	1015	E,n1.6	<.20	.2	10	<.06	292	<.04	<.8	.56	2	718	E,n .07
DTX8A	06/27/06	1015	E,n1.4	<.20	E,n .1	10	<.06	243	<.04	.2	.66	4	669	<.08
DTX2	01/09/04	0945	<1.6	<.20	1.0	13	<.06	292	<.04	<.8	5.18	8.9	560	<.08
DTX2	04/08/04	1405	<3.2	<.40	1.1	13	<.12	282	E,n .05	<.8	5.40	10.3	436	<.16
DTX2	10/21/04	1415	<3.2	<.40	1.1	14	E,n .06	355	E,n .04	<.8	5.68	11.8	717	<.16
DTX2	02/25/05	1120	<6.4	<.40	1	10	<.12	323	E,n .04	<.8	5.9	7	562	<.16
DTX2	06/02/05	1205	<3.2	<1.20	2	10	<.12	276	<.24	<8.0	5.8	7	388	E,n .26
DTX2	07/05/05	1240	<3.2	<.40	1	20	<.12	298	.08	.05	5.4	6	449	<.16
DTX2	11/08/05	1340	<3.2	<.40	1	10	<.12	345	E,n .04	E,n .02	5.7	10	684	<.16
DTX2	01/05/06	1000	<3.2	<.40	1	10	E,n .09	304	E,n .05	.1	5.8	12	754	<.16
DTX2	04/05/06	1450	<3.2	<.40	1	10	<.12	260	E,n .04	.3	4.8	7	516	<.16
DTX2	06/26/06	1320	<3.2	<.40	.3	10	<.12	261	E,n .05	E,n .02	5.6	<.40	456	<.16
DTX2	11/14/06	1040	E,n2.9	.14	.5	10	<.12	311	E,n .04	<.24	5	.9	653	E,n .14

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Manganese, dissolved (µg/L)	Mercury, dissolved (µg/L)	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Selenium, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Tungsten, dissolved (µg/L)	Zinc, dissolved (µg/L)	Uranium, dissolved (µg/L)
DTX3	01/08/04	1020	0.4	<0.020	0.7	5.08	22.1	<0.2	2,820	--	1.8	23.9
D17	06/02/05	0950	290	<.010	6	3	7	<.2	304	<.5	E,n .5	3.9
D17	07/06/05	0940	320	<.010	6	2	8	<.2	295	<.5	E,n .3	4.5
D17	11/08/05	1205	360	<.010	6	4	7	<.2	312	<.06	<.6	4
D17	01/04/06	1355	230	<.010	6	2	6	<.2	325	<.06	E,n .4	4
D17	04/04/06	1410	220	<.010	6	3	6	<.2	297	<.06	<.6	4
D17	06/27/06	1400	290	<.010	6	2	7	<.2	316	<.06	E,n .3	4.2
D17	11/15/06	1455	320	<.010	6	.6	7	<.1	296	<.06	<.6	4.2
DTX5	04/05/04	1415	85.4	<.020	1.9	11	.7	<.2	3,620	--	2.9	27.2
DTX5	07/06/04	1350	74.5	<.020	1.1	6.8	.7	<.2	4,030	<1.0	4.1	30.6
DTX5	07/08/04	1350	102	--	1.0	7.1	<.8	<.4	3,990	<1.0	3.2	31.2
DTX5	10/21/04	1050	77.7	<.010	1.0	3.6	.7	<.2	3,610	<.5	4.1	28.0
DTX5	11/07/05	1130	86	<.010	1	36	.2	<.4	3,920	<.06	4	28
DTX6	04/06/04	1345	<.4	<.020	E,n .8	19.6	4.5	<.4	5,590	--	5.7	30.7
DTX6	07/08/04	1420	<.4	<.020	E,n .8	4.19	3.4	<.4	6,020	<1.0	6.4	33.1
DTX6	10/21/04	1235	E,n .2	<.010	E,n .7	2.46	5.9	<.4	5,570	<1.0	10.2	32.6
DTX6	11/07/05	1415	<.4	<.010	E,n .8	14	4	<.4	5,190	0.16	5	32
D29	04/05/04	1040	682	<.020	2.4	21.3	1.5	<.4	6,960	--	16.6	.12
D29	07/06/04	1130	861	<.020	1.1	11.7	E,n .4	<.4	6,620	<1.0	9.7	.09
D29	10/20/04	1215	893	<.010	.8	6.69	2.0	<.4	6,200	<1.0	180	.16
DTX10A	01/07/04	1230	324	<.020	1.6	11.5	1.6	<.2	5,590	--	4.3	.19
DTX10A	04/06/04	1050	287	<.020	1.3	3.9	1.4	<.4	5,690	--	4.0	.15
DTX10A	07/07/04	1320	246	<.020	1.3	7.10	.9	<.4	5,600	<1.0	10.2	.19
DTX10A	10/22/04	1110	259	<.010	1.2	2.14	1.4	<.4	5,660	<1.0	7.3	.17
DTX10A	07/08/05	1100	260	<.010	1	20	2	<.4	5,380	<1.0	3	.1
DTX10A	06/26/06	1120	270	<.010	1	.9	<.16	<.4	5,660	<.06	7	.1
DTX1	06/02/05	1355	140	<.010	6	21	16	<.4	5,440	<1.0	4	40
DTX1	07/05/05	1430	150	<.010	6	27	15	<.4	5,700	<1.0	5	47
DTX1	11/08/05	1500	260	<.010	6	31	5	<.4	5,470	E,n .03	6	37
DTX1	01/05/06	1145	240	<.010	6	28	3	<.4	5,790	E,n .03	6	38
DTX1	04/05/06	1325	180	<.010	5	42	2	<.4	5,920	<.12	4	33
DTX1	06/26/06	1435	220	<.010	5	48	4	<.2	5,880	<.06	8	36
DTX1	11/14/06	1330	260	<.010	5	18	2	<.2	5,440	<.12	<1.2	35

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2004 through 2006.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; --, no data available; E, value estimated by laboratory; n, value is less than the minimum reporting level; <, less than]

Site name	Sample date (mm/dd/yy)	Sample time (hhmm)	Manganese, dissolved (µg/L)	Mercury, dissolved (µg/L)	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Selenium, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Tungsten, dissolved (µg/L)	Zinc, dissolved (µg/L)	Uranium, dissolved (µg/L)
D6	01/08/04	1325	3,750	<0.020	4.1	20.7	33.4	<1.4	17,300	--	32.8	181
D6	04/07/04	1250	3,740	<.020	3.3	27.0	48.5	<1.4	17,200	--	27.5	159
D6	07/07/04	1500	4,220	<.020	3.4	14.9	41.9	<1.2	18,100	<1.0	29.2	173
D6	10/19/04	1245	4,200	<.010	3.9	16.4	67.0	<.2	17,200	<3.5	20.3	183
D6	01/11/05	1030	4,200	<.010	4	23	65	<1.4	18,000	<3.5	34	170
D6	06/01/05	1245	4,600	<.010	4	17	21	<1.4	16,700	<7.0	36	160
D6	07/06/05	1240	4,500	<.010	4	18	57	<1.4	16,900	<3.5	32	160
D6	11/08/05	1010	4,200	<.010	4	25	52	<1.4	16,700	E,n .15	35	160
D6	01/04/06	1025	3,800	<.010	4	23	43	<1.6	17,300	<.2	35	170
D6	04/04/06	1155	4,400	<.010	4	8	49	<1.4	17,300	<.4	29	180
D6	06/28/06	1030	4,100	<.010	4	42	45	<1.4	18,300	<.06	<6	190
D6	11/15/06	1120	3,800	<.010	3	7	50	<.8	16,300	<.48	<4.8	160
D25	01/09/04	1130	3,260	<.020	7.3	9.88	2.9	<.4	3,590	--	6.4	30.6
D25	04/08/04	1200	2,830	<.020	8.2	15.0	1.1	<.4	3,620	--	6.8	29.7
D25	10/19/04	1430	3,300	<.010	8.2	8.76	3.5	<.4	3,530	<1.0	5.3	31.2
D25	02/25/05	1350	2,900	<.010	8	15	2	<.4	3,490	<2.0	6	30
D25	06/01/05	1525	2,900	<.010	8	11	20	<.4	3,290	<1.0	8	28
D25	07/05/05	1015	2,800	<.010	9	19	6	<.4	3,450	<1.0	6	37
D25	11/09/05	1005	3,100	<.010	7	28	.2	<.4	3,310	E,n .03	6	27
D25	01/04/06	1235	3,200	<.010	7	22	.2	<.4	3,430	<.06	6	29
D25	04/05/06	1025	2,600	<.010	7	36	.2	<.4	3,470	<.12	4	26
D25	06/27/06	1235	3,400	<.010	7	4	.7	<.2	3,570	<.06	1	30
D25	11/14/06	1550	3,300	<.010	8	4	2	<.2	3,310	<.12	1	40
DTX8A	04/07/04	1045	113	<.020	.6	7.32	.9	<.2	2,660	--	1.7	.17
DTX8A	07/08/04	1210	117	<.020	.6	1.36	<.4	<.2	2,520	<.5	2.4	.19
DTX8A	10/19/04	1100	98.0	<.010	.6	.80	.8	<.2	2,640	<.5	1.7	.18
DTX8A	07/07/05	1015	97	<.010	.6	4	.4	<.2	2,590	<.5	3	.2
DTX8A	06/27/06	1015	100	<.010	.7	6	<.08	<.2	2,630	E,n .04	3	.1
DTX2	01/09/04	0945	4,560	<.020	1.5	7.32	2.9	<.2	5,440	--	6.5	35.4
DTX2	04/08/04	1405	3,990	<.020	1.6	11.1	1.6	<.4	5,670	--	6.9	32.2
DTX2	10/21/04	1415	4,600	<.010	1.6	6.44	1.5	<.4	5,650	<1.0	9.2	33.1
DTX2	02/25/05	1120	2,400	<.010	2	11	2	<.4	5,440	<2.0	6	32
DTX2	06/02/05	1205	5,200	<.010	2	14	4	<.4	5,130	<3.0	5	33
DTX2	07/05/05	1240	4,800	<.010	2	14	.1	<.4	5,090	<1.0	7	31
DTX2	11/08/05	1340	4,800	<.010	2	36	.1	<.4	5,320	<.06	5	30
DTX2	01/05/06	1000	5,000	<.010	2	17	.1	<.4	5,590	E,n .04	7	32
DTX2	04/05/06	1450	4,100	<.010	2	31	E,n .1	<.4	5,340	<.12	5	30
DTX2	06/26/06	1320	4,400	<.010	2	33	.1	<.4	5,590	<.06	8	32
DTX2	11/14/06	1040	4,900	<.010	2	5	E,n .1	<.2	5,360	<.12	<1.8	29

[1]Incremental titration in laboratory (U.S. Geological Survey, variously dated).

Table 11. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 2004 through 2006.

[Site name refers to site where sample was processed or, for equipment blank, site where equipment was last used; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; F, field blank; E, value estimated by laboratory; <, less than; n, value is less than the minimum reporting level; Q, equipment blank; S, source-water blank; --, no sample submitted]

Blank type	Sample date	Sample time (hhmm)	Site name	Specific conductance, laboratory (µS/cm)	pH, laboratory (standard units)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Acid neutralizing capacity, titration to pH4.5, laboratory (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L)
F	01/09/04	0915	DTX2	E3	6.8	<0.01	<0.008	<0.16	E,n 0.07	<2	<0.20
F	04/06/04	1300	DTX6	3	6.6	<.01	<.008	<.16	<.10	<2	E,n .12
F	07/08/04	1340	DTX6	<3	E5.8	<.01	<.008	<.16	<.10	<2	<.20
Q	10/15/04	1000	DTX8A	E5	6.8	.04	E,n .004	<.16	<.20	<2	<.20
F	10/21/04	1150	DTX6	E4	5.6	<.02	<.008	<.16	<.20	<2	<.20
S	12/15/04	1615	DTX8A	E4	7.8	--	--	--	--	--	--
F	01/11/05	1410	D29	6	E6.7	<.02	<.008	<.16	<.20	<2	<.20
F	06/01/05	1215	D6	<3	E5.6	E,n .01	<.008	<.16	<.20	<2	<.20
F	07/06/05	1130	D6	7	6.7	.04	<.008	<.16	<.20	<5	<.20
Q	07/07/05	1430	DTX8A	<3	E5.8	.04	<.008	<.16	E,n .12	<5	<.20
F	11/07/05	1110	DTX5	5	8.9	<.02	<.008	<.16	<.20	<5	<.20
F	01/05/06	1110	DTX1	3	8.9	<.02	<.008	<.16	<.20	<5	<.20
F	04/05/06	1240	DTX1	<3	8.5	E,n .01	E,n .005	<.16	<.20	<5	<.20
F	06/28/06	0940	D6	5	7.7	<.02	<.008	<.16	<.20	<5	<.20
Q	06/28/06	1430	DTX8A	4	7.9	.13	.193	<.16	<.20	<5	<.20
F	11/15/06	1410	D17	4	8.1	<.02	<.014	<.04	<.20	<5	<.12

Table 11. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 2004 through 2006.—Continued

[Site name refers to site where sample was processed or, for equipment blank, site where equipment was last used; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; F, field blank; E, value estimated by laboratory; <, less than; n, value is less than the minimum reporting level; Q, equipment blank; S, source-water blank; --, no sample submitted]

Blank type	Sample date	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phos-phorus, dissolved (mg/L)	Phos-phorus, total (mg/L)	Solids, residue on evaporation at 180°C, dissolved (mg/L)	Aluminum, dissolved (µg/L)
F	01/09/04	<0.17	<0.04	<0.18	<0.10	<0.10	<0.04	<0.04	<0.04	<0.04	<10	<1.6
F	04/06/04	<.17	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
F	07/08/04	<.17	E,n .02	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
Q	10/15/04	<.10	<.04	<.18	<.10	<.1	<.04	<.04	<.04	<.04	<10	<1.6
F	10/21/04	<.10	<.04	<.18	<.10	<.1	<.04	<.04	<.04	<.04	<10	<1.6
S	12/15/04	--	--	--	--	--	--	--	--	--	--	<1.6
F	01/11/05	E,n .09	E.04	E,n .12	<.10	<.1	<.04	<.04	<.04	<.04	<10	<1.6
F	06/01/05	<.10	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
F	07/06/05	E,n .06	<.36	E,n .17	<.10	E,n .07	<.04	<.04	<.04	<.04	<10	3.1
Q	07/07/05	<.10	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
F	11/07/05	<.10	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
F	01/05/06	<.10	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
F	04/05/06	<.10	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
F	06/28/06	<.10	<.04	<.18	<.10	<.10	<.04	<.04	<.04	<.04	<10	<1.6
Q	06/28/06	<.10	<.04	<.18	<.10	E,n .06	E,n .03	<.04	<.04	<.04	<10	<1.6
F	11/15/06	<.10	E,n .01	<.18	<.10	E,n .06	E,n .02	<.04	<.04	<.04	<10	<1.6

Table 11. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 2004 through 2006.—Continued

[Site name refers to site where sample was processed or, for equipment blank, site where equipment was last used; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; F, field blank; E, value estimated by laboratory; <, less than; n, value is less than the minimum reporting level; Q, equipment blank; S, source-water blank; --, no sample submitted]

Blank type	Sample date	Antimony, dissolved (µg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Bromide, dissolved (µg/L)	Cadmium, dissolved (µg/L)	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)
F	01/09/04	<0.2	<0.2	<0.2	<0.06	<7	<0.02	<0.04	<0.8	<0.01	<0.4	<6
F	04/06/04	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	<.01	<.4	<6
F	07/08/04	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	<.01	<.4	<6
Q	10/15/04	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	E.01	E,n .2	<6
F	10/21/04	<.2	<.2	<.2	<.06	<7	E,n .01	<.04	<.8	<.01	E,n .2	<6
S	12/15/04	<.2	<.2	<.2	<.06	--	--	<.04	<.8	<.01	<.4	--
F	01/11/05	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	<.01	E,n .2	<6
F	06/01/05	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	<.01	<.4	<6
F	07/06/05	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	<.01	<.4	<6
Q	07/07/05	<.2	<.2	<.2	<.06	<7	<.02	<.04	<.8	<.01	<.4	E,n 4
F	11/07/05	<.2	<.1	<.2	<.06	<7	<.02	<.04	<.04	<.04	<.4	<6
F	01/05/06	<.2	<.1	<.2	<.06	<7	<.02	<.04	.09	<.04	E,n .3	<6
F	04/05/06	<.2	<.1	<.2	<.06	<7	<.02	<.04	E,n .03	<.04	<.4	<6
F	06/28/06	<.2	<.1	E,n .1	<.06	<7	<.02	<.04	E,n .02	<.04	.6	<6
Q	06/28/06	<.2	<.1	E.2	<.06	<7	<.02	<.04	E,n .03	<.04	1.3	<6
F	11/15/06	<.1	<.1	<.1	<.06	<2	<.02	<.04	<.12	<.04	<.4	<6

Table 11. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 2004 through 2006.—Continued

[Site name refers to site where sample was processed or, for equipment blank, site where equipment was last used; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; F, field blank; E, value estimated by laboratory; <, less than; n, value is less than the minimum reporting level; Q, equipment blank; S, source-water blank; --, no sample submitted]

Blank type	Sample date	Lead, dissolved (µg/L)	Manganese, dissolved (µg/L)	Mercury, dissolved (µg/L)	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Selenium, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Tungsten, dissolved (µg/L)	Zinc, dissolved (µg/L)	Uranium, dissolved (µg/L)
F	01/09/04	<0.08	<0.2	<0.02	<0.4	<0.06	<0.4	<0.20	<1.4	--	<0.6	<0.04
F	04/06/04	<.08	<.2	<.02	<.4	<.06	<.4	<.20	<1.4	--	<.6	<.04
F	07/08/04	<.08	<.2	<.02	<.4	<.06	<.4	<.20	<1.4	<.5	<.6	E,n .02
Q	10/15/04	<.08	E,n .1	<.01	<.4	<.12	<.4	<.20	<1.0	<.5	.7	<.04
F	10/21/04	<.08	<.2	<.01	<.4	<.06	E,n .2	<.20	<1.0	<.5	<.6	<.04
S	12/15/04	<.08	<.2	<.01	<.4	<.06	<.4	<.20	--	<.5	<.6	<.04
F	01/11/05	<.08	<.2	<.01	<.4	<.06	<.4	<.20	<1.0	<.5	E,n .4	<.04
F	06/01/05	<.08	<.2	<.01	<.4	<.06	<.4	<.20	<1.0	<.5	E,n .3	<.04
F	07/06/05	<.08	<.2	<.01	<.4	E,n .03	<.4	<.20	<1.0	<.5	<.6	<.04
Q	07/07/05	<.08	<.2	<.01	<.4	.10	<.4	<.20	<1.0	<.5	.8	<.04
F	11/07/05	<.08	<.2	<.01	<.4	<.06	<.1	<.20	<1.0	<.06	<.6	<.04
F	01/05/06	<.08	<.2	<.01	<.4	<.06	<.1	<.20	<1.0	<.06	E,n .4	<.04
F	04/05/06	<.08	<.2	<.01	<.4	<.06	<.1	<.20	<1.0	<.06	<.6	<.04
F	06/28/06	<.08	<.2	<.01	<.4	<.06	<.1	<.20	<1.0	<.06	<.6	E,n .02
Q	06/28/06	<.08	.3	<.01	<.4	E,n .05	<.1	<.20	E,n .8	<.06	1.5	<.04
F	11/15/06	<.12	<.2	<.01	<.1	<.06	<.1	<.10	<0.6	<.06	<.6	<.04

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2004 through 2006.

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] × 100; µS/cm, microsiemens per centimeter: °C, degrees Celsius; mg/L, milligrams per liter; E, value estimated by laboratory; <, less than; ND, not determined because data were less than the minimum reporting level; n, value less than the minimum reporting level; µg/L, micrograms per liter; --, not analyzed]

Site name / Sample date	D6 01/08/04			DTX10A 04/06/04			D6 07/07/04			D25 10/19/04		
Property or constituent	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
pH, laboratory (standard units)	7.2	7.2	0	7.2	7.3	-1	7.2	7.2	0	7.5	7.4	1
Specific conductance, lab (S/cm at 25°C)	E 16,600	E 16,600	0	3,120	3,120	0	15,500	15,400	1	4,160	4,140	0
Calcium, dissolved (mg/L)	453	444	2	498	498	0	434	445	-2	751	768	-2
Magnesium, dissolved (mg/L)	2,420	2,400	1	173	175	-1	2,430	2,410	1	196	200	-2
Potassium, dissolved (mg/L)	14.2	14.7	-3	9.15	9.34	-2	13.4	13.2	2	8.69	8.92	-3
Sodium, dissolved (mg/L)	2,230	2,200	1	178	159	12	2,170	2,240	-3	269	275	-2
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	645	648	0	219	65.5	108	644	644	0	347	346	0
Bromide, dissolved (mg/L)	4.01	4.13	-3	0.25	0.24	4	4.56	4.42	3	1.60	1.63	-2
Chloride, dissolved (mg/L)	412	411	0	19.1	19.3	-1	409	419	-3	117	124	-6
Fluoride, dissolved (mg/L)	1.24	1.25	-1	1.0	1.0	0	1.24	1.24	0	1.09	1.07	2
Silica, dissolved (mg/L as SiO_2)	23.1	23.4	-1	18.2	18.2	0	23.0	24.0	-4	30.0	30.4	-1
Sulfate, dissolved (mg/L)	13,200	13,280	-1	1,820	1,840	-1	13,100	13,200	-1	2,520	2,500	1
Solids, residue on evaporation at 180°C, dissolved (mg/L)	21,800	21,700	0	3,100	3,100	0	21,300	21,300	0	4,500	4,500	0
Nitrogen, ammonia plus organic, dissolved (mg/L as N)	1.7	1.7	0	1.3	1.3	0	1.51	1.49	1	0.55	0.53	4
Nitrogen, ammonia plus organic, total (mg/L as N)	0.91	1.0	-9	1.3	1.4	-7	1.6	1.5	6	0.5	0.5	0
Nitrogen, ammonia, dissolved (mg/L as N)	0.082	0.097	-17	1.21	1.22	-1	0.063	0.063	0	0.05	0.05	0
Nitrite plus nitrate, dissolved (mg/L as N)	21.7	21.7	0	< 0.04	< 0.04	ND	24.6	24.6	0	0.12	0.12	0
Phosphorus, dissolved (mg/L)	E,n 0.03	E,n 0.02	ND	< 0.04	< 0.04	ND	E,n 0.03	E,n 0.03	ND	0.08	0.09	-12
Phosphorus, total (mg/L)	E,n 0.03	< 0.04	ND	< 0.04	< 0.04	ND	E,n 0.04	E,n 0.04	ND	0.09	0.09	0
Aluminum, dissolved (µg/L)	< 11	2.8	ND	13.6	13.0	4	< 9.6	< 11.2	ND	< 3.2	< 3.2	ND
Antimony, dissolved (µg/L)	< 1.4	0.27	ND	< 0.40	< 0.40	ND	< 1.2	< 1.4	ND	E 0.2	E 0.2	0
Arsenic, dissolved (µg/L)	8.8	8.3	6	0.4	E 0.4	0	2.2	2.1	5	2.4	2.6	-8
Barium, dissolved (µg/L)	6	6	0	11	12	-9	5	5	0	19	19	0
Beryllium, dissolved (µg/L)	< 0.42	0.14	ND	< 0.12	< 0.12	ND	< 0.36	< 0.42	ND	< 0.12	< 0.12	ND
Boron, dissolved (µg/L)	794	787	1	258	301	-15	886	866	2	191	190	1
Cadmium, dissolved (µg/L)	< 0.28	0.10	ND	< 0.08	< 0.08	ND	< 0.24	< 0.28	ND	0.19	0.17	11
Chromium, dissolved (µg/L)	< 1.6	< 1.6	ND	< 0.8	< 0.8	ND	< 1.6	< 1.6	ND	< 0.8	< 0.8	ND
Cobalt, dissolved (µg/L)	7.90	8.08	-2	1.73	1.70	2	7.48	7.47	0	4.54	4.47	2
Copper, dissolved (µg/L)	34.9	35.1	-1	8.6	8.7	-1	29.8	28.4	5	10.5	10.6	-1
Iron, dissolved (µg/L)	< 64	< 64	ND	4,630	4,690	-1	< 64	< 64	ND	< 18	< 18	ND
Lead, dissolved (µg/L)	E,n 0.34	E,n 0.29	ND	< 0.16	< 0.16	ND	< 0.48	< 0.56	ND	< 0.16	< 0.16	ND
Manganese, dissolved (µg/L)	3,750	3,570	5	287	283	1	4,220	4,260	-1	3,300	3,130	5
Mercury, dissolved (µg/L)	< 0.020	< 0.020	ND	< 0.020	< 0.020	ND	< 0.020	< 0.020	ND	< 0.010	< 0.010	ND
Molybdenum, dissolved (µg/L)	4.1	4.0	2	1.3	1.4	-7	3.4	3.2	6	8.2	8.0	2
Nickel, dissolved (µg/L)	20.7	20.2	2	3.9	5.1	-25	14.9	14.8	1	8.76	10.3	-16
Selenium, dissolved (µg/L)	33.4	60.8	-58	1.4	1.3	8	41.9	40.4	4	3.5	4.0	-13
Silver, dissolved (µg/L)	< 1.4	< 0.2	ND	< 0.4	< 0.4	ND	< 1.2	< 1.4	ND	< 0.4	< 0.4	ND
Strontium, dissolved (µg/L)	17,300	17,200	1	5,690	5,630	1	18,100	18,000	1	3,530	3,600	-2
Tungsten, dissolved (µg/L)	--	--		--	--		< 1.0	< 1.0	ND	< 1.0	< 1.0	ND
Zinc, dissolved (µg/L)	32.8	33.4	-2	4.0	4.2	-5	29.2	28.5	2	5.3	5.2	2
Uranium, natural, dissolved (µg/L)	181	186	-3	0.15	0.20	-29	173	174	0	31.2	30.9	1

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2004 through 2006.—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] × 100; µS/cm, microsiemens per centimeter: °C, degrees Celsius; mg/L, milligrams per liter; E, value estimated by laboratory; <, less than; ND, not determined because data were less than the minimum reporting level; n, value less than the minimum reporting level; µg/L, micrograms per liter; --, not analyzed]

Site name / Sample date	D6 01/11/05			D6 06/01/05			D6 07/06/05			D6 11/08/05		
Property or constituent	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
pH, laboratory (standard units)	7.1	7.2	-1	7.3	7.3	0	7.2	7.2	0	7.2	7.2	0
Specific conductance, lab (S/cm at 25°C)	E 15,500	E 15,600	-1	E 16,300	E 16,700	-2	E 16,300	E 16,400	-1	17,300	17,400	-1
Calcium, dissolved (mg/L)	434	437	-1	428	432	-1	436	428	2	439	444	-1
Magnesium, dissolved (mg/L)	2,620	2,590	1	2,700	2,610	3	2,700	2,660	1	2,520	2,740	-8
Potassium, dissolved (mg/L)	15.6	15.7	-1	15.4	15.2	1	15.4	13.7	12	15.1	14.8	2
Sodium, dissolved (mg/L)	2,370	2,440	-3	2,310	2,330	-1	2,330	2,280	2	2,310	2,360	-2
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	647	648	0	646	646.0	0	647	646	0	--	607	--
Bromide, dissolved (mg/L)	4.27	4.03	6	4.42	4.36	1	4.42	4.56	-3	4.42	4.40	0
Chloride, dissolved (mg/L)	401	398	1	390	394	-1	394	389	1	390	390	0
Fluoride, dissolved (mg/L)	1.21	1.24	-2	1.30	1.28	2	1.25	1.26	-1	1.24	1.24	0
Silica, dissolved (mg/L as SiO_2)	24.9	24.8	0	24.5	24.6	0	23.9	23.4	2	22.5	23.2	-3
Sulfate, dissolved (mg/L)	13,500	13,300	1	13,300	13,500	-1	13,400	13,400	0	13,500	13,500	0
Solids, residue on evaporation at 180°C, dissolved (mg/L)	21,400	21,700	-1	22,700	22,500	1	22,200	22,900	-3	22,500	22,600	0
Nitrogen, ammonia plus organic, dissolved (mg/L as N)	1.7	1.6	6	E,n 1.7	E,n 1.7	0	1.6	1.6	0	1.5	1.6	-6
Nitrogen, ammonia plus organic, total (mg/L as N)	1.7	1.7	0	1.6	1.7	-6	1.7	1.6	6	1.6	1.4	13
Nitrogen, ammonia, dissolved (mg/L as N)	E,n 0.03	E,n 0.03	0	0.052	0.094	-58	0.062	0.061	2	0.079	0.096	-19
Nitrite plus nitrate, dissolved (mg/L as N)	27	27	0	E 31	E 31	0	31	32	-3	32	33	-3
Phosphorus, dissolved (mg/L)	0.04	0.04	0	E,n 0.04	0.04	0	0.04	E,n 0.04	0	E,n 0.02	E,n 0.02	0
Phosphorus, total (mg/L)	E,n 0.03	E,n 0.02	40	E,n 0.03	E,n 0.03	0	0.04	0.04	0	< 0.04	< 0.04	ND
Aluminum, dissolved (µg/L)	< 11.2	< 11.2	ND	< 11.2	< 11.2	ND	< 11.2	< 11.2	ND	< 11.2	< 11.2	ND
Antimony, dissolved (µg/L)	< 1.40	< 1.40	ND	< 2.80	< 1.40	ND	< 1.40	< 1.40	ND	< 1.40	< 1.40	ND
Arsenic, dissolved (µg/L)	10	10	0	10	10	0	1	1	0	1	1	0
Barium, dissolved (µg/L)	5	5	0	5	5	0	5	5	0	5	5	0
Beryllium, dissolved (µg/L)	< 0.42	< 0.42	ND	< 0.42	< 0.42	ND	< 0.42	< 0.42	ND	< 0.42	< 0.42	ND
Boron, dissolved (µg/L)	859	874	-2	900	905	-1	880	843	4	812	823	-1
Cadmium, dissolved (µg/L)	< 0.28	< 0.28	ND	< 0.56	< 0.28	ND	< 0.28	< 0.28	ND	< 0.28	< 0.28	ND
Chromium, dissolved (µg/L)	< 1.6	< 1.6	ND	< 1.6	< 1.6	ND	< 1.6	< 1.6	ND	< 0.12	E 0.06	ND
Cobalt, dissolved (µg/L)	7.7	7.6	1	8	8	0	7.5	6.8	10	8	8	0
Copper, dissolved (µg/L)	47	46	2	42	48	-13	45	48	-6	49	48	2
Iron, dissolved (µg/L)	< 60	< 60	ND	< 60	< 60	ND	< 90	< 90	ND	< 60	< 60	ND
Lead, dissolved (µg/L)	< 0.56	< 0.56	ND	< 1.12	< 0.56	ND	< 0.56	< 0.56	ND	< 0.56	< 0.56	ND
Manganese, dissolved (µg/L)	4,200	4,100	2	4,600	4,800	-4	4,500	4,500	0	4,200	4,300	-2
Mercury, dissolved (µg/L)	< 0.010	< 0.010	ND	< 0.010	< 0.010	ND	< 0.010	< 0.010	ND	< 0.010	< 0.010	ND
Molybdenum, dissolved (µg/L)	4	4	0	4	3	29	4	4	0	4	4	0
Nickel, dissolved (µg/L)	23	23	0	17	19	-11	18	18	0	25	25	0
Selenium, dissolved (µg/L)	65	66	-2	21	71	-109	57	63	-10	52	50	4
Silver, dissolved (µg/L)	< 1.4	< 1.4	ND	< 1.4	< 1.4	ND	< 1.4	< 1.4	ND	< 1.4	< 1.4	ND
Strontium, dissolved (µg/L)	18,000	18,500	-3	16,700	16,900	-1	16,900	16,600	2	16,700	17,000	-2
Tungsten, dissolved (µg/L)	< 3.5	< 3.5	ND	< 7.0	< 3.5	ND	< 3.5	< 3.5	ND	E,n 0.15	< 0.18	ND
Zinc, dissolved (µg/L)	34	33	3	36	36	0	32	33	-3	35	36	-3
Uranium, natural, dissolved (µg/L)	170	170	0	160	160	0	160	160	0	160	170	-6

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2004 through 2006.—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] × 100; µS/cm, microsiemens per centimeter: °C, degrees Celsius; mg/L, milligrams per liter; E, value estimated by laboratory; <, less than; ND, not determined because data were less than the minimum reporting level; n, value less than the minimum reporting level; µg/L, micrograms per liter; --, not analyzed]

Site name / Sample date	D6 01/04/06			D6 04/04/06			D6 06/28/06			D6 11/15/06		
Property or constituent	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
pH, laboratory (standard units)	7.5	7.5	0	7.2	7.2	0	7.2	7.2	0	7.2	7.2	0
Specific conductance, lab (µS/cm at 25°C)	E 17,800	E 17,400	2	E 17,200	E 17,000	1	E 17,300	E 17,600	-2	E 17,500	E 17,500	0
Calcium, dissolved (mg/L)	453	457	-1	468	464	1	452	440	3	426	438	-3
Magnesium, dissolved (mg/L)	2,540	2,540	0	2,530	2,520	0	2,500	2,440	2	2,360	2,350	0
Potassium, dissolved (mg/L)	14.4	14.4	0	15.0	14.8	1	14.6	14.0	4	13.9	14.5	-4
Sodium, dissolved (mg/L)	2,280	2,270	0	2,260	2,240	1	2,260	2,200	3	2,220	2,220	0
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	649	649	0	644	644	0	640	650	-2	646	646	0
Bromide, dissolved (mg/L)	4.27	4.27	0	4.42	4.25	4	4.16	4.39	-5	4.53	4.47	1
Chloride, dissolved (mg/L)	384	384	0	383	383	0	382	377	1	376	376	0
Fluoride, dissolved (mg/L)	1.38	1.39	-1	1.35	1.32	2	1.25	1.22	2	1.23	1.24	-1
Silica, dissolved (mg/L as SiO_2)	22.3	23.8	-7	22.2	23.0	-4	22.9	22.3	3	21.4	21.6	-1
Sulfate, dissolved (mg/L)	13,500	13,600	-1	13,600	13,800	-1	13,500	13,800	-2	13,300	13,300	0
Solids, residue on evaporation at 180°C, dissolved (mg/L)	22,400	22,500	0	21,900	21,900	0	23,000	22,900	0	21,400	21,400	0
Nitrogen, ammonia plus organic, dissolved (mg/L as N)	1.6	1.6	0	1.6	1.6	0	1.6	1.6	0	1.6	1.6	0
Nitrogen, ammonia plus organic, total (mg/L as N)	1.7	1.7	0	1.6	1.6	0	1.7	1.6	6	1.6	1.6	0
Nitrogen, ammonia, dissolved (mg/L as N)	0.078	0.077	1	0.116	0.111	4	0.095	0.098	-3	0.141	0.145	-3
Nitrite plus nitrate, dissolved (mg/L as N)	32	33	-3	34	33	3	35	36	-3	38	39	-3
Phosphorus, dissolved (mg/L)	E,n 0.03	E,n 0.03	0	0.04	E,n 0.04	0	E,n 0.03	E,n 0.03	0	E,n 0.03	E,n 0.04	-29
Phosphorus, total (mg/L)	E,n 0.04	E,n 0.03	29	E,n 0.03	E,n 0.02	40	E,n 0.03	E,n 0.04	-29	0.04	0.04	0
Aluminum, dissolved (µg/L)	< 12.8	< 11.2	ND	< 11.2	< 11.2	ND	< 11.2	< 12.8	ND	< 12.8	< 12.8	ND
Antimony, dissolved (µg/L)	< 1.60	< 1.40	ND	< 1.40	< 1.40	ND	< 1.40	< 1.60	ND	E,n 0.40	E,n 0.32	22
Arsenic, dissolved (µg/L)	1	2	-67	E,n 1	E,n 1	0	0.2	1	-133	1	1	0
Barium, dissolved (µg/L)	5	5	0	5	5	0	5	6	-18	5	6	-18
Beryllium, dissolved (µg/L)	< 0.48	0.43	ND	< 0.42	< 0.42	ND	< 0.42	< 0.48	ND	< 0.48	< 0.48	ND
Boron, dissolved (µg/L)	798	846	-6	788	799	-1	804	778	3	789	827	-5
Cadmium, dissolved (µg/L)	< 0.32	< 0.28	ND	E,n 0.14	E,n 0.22	-44	< 0.28	< 0.32	ND	E,n 0.16	< 0.32	ND
Chromium, dissolved (µg/L)	0.2	2	-164	< 0.4	E,n 0.2	ND	< 0.04	< 0.04	ND	< 0.96	< 0.96	ND
Cobalt, dissolved (µg/L)	7.5	7.7	-3	6.9	7.2	-4	7.7	7.8	-1	7	7	0
Copper, dissolved (µg/L)	35	34	3	38	37	3	E,n 0.4	E,n 3	-153	E,n 3	E,n 2	40
Iron, dissolved (µg/L)	< 90	< 90	ND	< 120	< 120	ND	< 120	< 120	ND	< 90	< 90	ND
Lead, dissolved (µg/L)	< 0.64	< 0.56	ND	< 0.56	< 0.56	ND	< 0.56	< 0.64	ND	< 0.96	< 0.96	ND
Manganese, dissolved (µg/L)	3,800	3,900	-3	4,400	4,700	-7	4,100	4,200	-2	3,800	3,900	-3
Mercury, dissolved (µg/L)	< 0.010	< 0.010	ND	< 0.010	< 0.010	ND	< 0.010	< 0.010	ND	< 0.010	< 0.010	ND
Molybdenum, dissolved (µg/L)	4	4	0	4	4	0	4	3	29	3	3	0
Nickel, dissolved (µg/L)	23	22	4	8	10	-22	42	44	-5	7	8	-13
Selenium, dissolved (µg/L)	43	41	5	49	44	11	45	47	-4	50	52	-4
Silver, dissolved (µg/L)	< 1.6	< 1.4	ND	< 1.4	E,n 1.0	ND	< 1.4	< 1.6	ND	< 0.8	< 0.8	ND
Strontium, dissolved (µg/L)	17,300	17,600	-2	17,300	17,150	1	18,300	17,790	3	16,300	16,890	-4
Tungsten, dissolved (µg/L)	< 0.2	< 0.2	ND	< 0.4	< 0.4	ND	< 0.06	< 0.06	ND	< 0.48	< 0.48	ND
Zinc, dissolved (µg/L)	35	35	0	29	29	0	< 6	< 4.8	ND	< 4.8	< 4.8	ND
Uranium, natural, dissolved (µg/L)	170	180	-6	180	180	0	190	190	0	160	160	0

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