Biosolids, Soils, Ground-Water, and Streambed-Sediment Data for a Biosolids-Application Area near Deer Trail, Colorado, 1999

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
acre	0.4047	hectare (ha)
centimeter (cm)	0.3937	inch
foot (ft)	0.3048	meter
gallon (gal)	3.785	liter
gram (g)	0.035	ounce
inch	2.54	centimeter
liter (L)	0.2642	gallon (gal)
micrometer (µm)	0.00003937	inch
mile (mi)	1.609	kilometer
milliliter (mL)	0.0610	cubic inch
millimeter (mm)	0.03937	inch
square mile (mi^2)	2.590	square kilometer

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

$$°F = (1.8 \times °C) + 32$$

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

$$°C = (°F - 32) / 1.8$$

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

ADDITIONAL ABBREVIATIONS

gal/min	gallons per minute
mg	milligrams
mg/g	milligrams per gram
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter at 25 degrees Celsius
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
pCi/L	picocuries per liter
pCi/g	picocuries per gram
ROE	residue on evaporation

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Abstract

In January 1999, the U.S. Geological Survey began an expanded monitoring program near Deer Trail, Colorado, in cooperation with the Metro Wastewater Reclamation District and the North Kiowa Bijou Groundwater Management District. Monitoring components were biosolids, soils, crops, ground water, and streambed sediments. The monitoring program addresses concerns from the public about chemical effects from applications of biosolids to farmland in the Deer Trail, Colorado, area. Constituents of primary concern to the public are arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity and are included for all monitoring components. This report presents chemical data from the first year of the monitoring program, January–December 1999, for biosolids, soils, alluvial and bedrock ground water, and streambed sediments. The ground-water section of this report also includes climate data, lithologic descriptions, well-completion diagrams, water levels, summary statistics for the water-quality data, and results of statistical testing of selected data for trends and for exceedance of Colorado regulatory standards. Data in this report provide a geochemical baseline for each monitoring component prior to the planned water transfer in 2000 from the Lowry Landfill Superfund site to Metro Wastewater Reclamation District treatment facilities.

INTRODUCTION

Since 1993, the Metro Wastewater Reclamation District (MWRD) has been applying biosolids resulting from municipal sewage treatment in Denver, Colo., to MWRD property near Deer Trail, Colo. The biosolids are trucked about 75 mi east from Denver to the MWRD property and are applied to nonirrigated farmland. From 1993 to 1999, the U.S. Geological Survey (USGS), in cooperation with the MWRD, monitored the quality of shallow ground water on the MWRD central property (1993–99 monitoring program), which consisted of about 15 mi^2 and was the first property the MWRD purchased near Deer Trail. In 1995, the MWRD traded some of the property and acquired additional property in the same area. The new property consisted of about 14.5 mi^2 known as the north property and about 50 mi^2 known as the south property. The three MWRD properties together are known as the METROGRO Farm and include land in Arapahoe and Elbert Counties. The three MWRD properties and surrounding private property are hereinafter referred to as the study area (fig. 1 in the Data Section at the back of the report).

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. The surficial 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). Multiple alluvial aquifers are present in the study area. These aquifers are associated with the surficial drainage network but contain water of variable quality, are of limited extent, and generally yield little water (U.S. Geological Survey, unpub. data, 1999). 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). 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 MWRD 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 was historically rangeland or cropland and pasture (U.S. Geological Survey, 1980). Some petroleum exploration was done in the area (Drew and others, 1979), but no oil or gas production took place within the study area during 1999. Land use in the study area during 1999 was rangeland or cropland. Cattle and sheep are the primary domesticated animals grazing the area, and wheat is the primary crop. Cropland is not irrigated. Land use on the MWRD properties during 1999 was primarily cropland (with biosolids applied as a fertilizer) and some rangeland.

Biosolids are applied to MWRD properties near Deer Trail according to agronomic loading rates. Land-applied biosolids must meet Colorado regulations for metals and radioactivity; otherwise, 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 or metals. Pesticides, herbicides, and fertilizers other than biosolids also may have been applied to the MWRD properties in the past, but less information is available about these applications.

Applications of pesticides, herbicides, and fertilizers (including biosolids) can affect soil quality, crops, water quality in alluvial and bedrock aquifers, and streambed-sediment chemistry. Water quality can be affected directly by contaminated recharge water or by infiltration of water through contaminated soils or sediments (remobilization). Water quality can be affected indirectly by plowing that mobilizes or mixes subsurface chemical constituents or by contributions to natural processes such as nitrification. Contaminated ground water or surface water could contaminate ground water in bedrock water-supply aquifers or alluvial aquifers, other surface-water bodies (ponds or streams), or streambed sediments.

Public concern about applications of biosolids to farmland increased after the MWRD agreed to accept treated ground water from the Lowry Landfill Superfund site near Denver. Because of this concern, a local stakeholder group formed about 1997 (including Arapahoe and Elbert Counties, North Kiowa Bijou Groundwater Management District, and area residents) requested additional monitoring in the area. The MWRD agreed to fund additional monitoring related to the biosolids-application program, and in spring 1998, the USGS was requested to work with the stakeholders and provide additional monitoring. USGS personnel met with the stakeholders to consider monitoring approaches and sites. In January 1999, the USGS began the new monitoring program in cooperation with the MWRD and the North Kiowa Bijou Groundwater Management District. The USGS refers to the new monitoring program (1999–2005) as the "expanded monitoring program."

The expanded monitoring program near Deer Trail is distinct from, but builds on, the 1993–99 monitoring program in which the USGS monitored the quality of shallow ground water on the MWRD central property (fig. 1). Relative to the 1993–99 program, the expanded program includes a larger study area (fig. 1) (all three MWRD properties and private-property locations), more monitoring components (biosolids, soils, crops, and streambed sediments in addition to ground water), a more comprehensive list of chemical constituents, expanded statistical analyses of data, and a later monitoring period (1999–2005). As with the 1993–99 monitoring program, the expanded monitoring program is designed, conducted, and interpreted independently by the USGS, and quality-assured USGS data and reports will be released to the public and the MWRD at the same time.

The expanded monitoring program near Deer Trail addresses concerns about biosolids applications and other farming-related effects on the environment and should increase 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, ground water in alluvial and bedrock aquifers, and streambed sediments by comparing chemical data to (a) Colorado 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 Colorado regulatory standards; and (3) characterize the hydrology of the study area. Each of the five monitoring components—biosolids, soils, crops, ground water, and streambed sediments—is a stand-alone study that includes radioactivity analyses because of public concerns about possible effects from the water transfer from the Lowry Landfill Superfund site. More detailed information about each monitoring component is included later in this report.

Purpose and Scope

The purpose of this report is to present information from the expanded monitoring program near Deer Trail for 1999 (January through December). This report presents data for four of the five monitoring components of the program: biosolids, soils, ground water (alluvial and bedrock), and streambed sediment. Collection of crop data will begin in 2000. Alluvial and bedrock ground water are separate components in the monitoring program but are combined in this report because the data were collected in the same way and the types of data included are the same. The ground-water sections include climate data, lithologic descriptions, well-completion diagrams, hydrologic data (depth to ground water), water-quality data (chemistry and field measurements), summary statistics for the water-quality data, and results of statistical testing of selected data for trends and exceedance of Colorado regulatory standards. This report does not include the hydrogeologic structure map that was prepared in 1999 as part of the ground-water monitoring component of the program. Plans are to include the structure map, along with a more detailed discussion of the hydrogeology of the region, in an interpretive USGS report. The structure map was used to select bedrock-aquifer monitoring locations for the expanded monitoring program.

This report is organized by monitoring component because each component (such as soils or ground water) is monitored as a separate study. For each monitoring component, the specific objectives, scope, approach, analytical results, quality-assurance information, and a discussion of data are included. All data in this report were collected by the USGS before water transfer began from the Lowry Landfill Superfund site to MWRD treatment facilities in 2000. The data provide geochemical baselines that will enable the USGS to recognize and quantify potential chemical changes in each monitoring component.

Acknowledgments

The USGS thanks all private landowners for allowing access to their properties for data collection. The USGS especially thanks the Price and Weisensee families and the MWRD for allowing USGS instrument or well installations on their property, and the Kalcevic family for timely runoff information after storms and for allowing streambed-sediment sampling on their property.

BIOSOLIDS

Biosolids are solid organic matter recovered from a sewage-treatment process that meet State and Federal regulatory criteria for beneficial use, such as for fertilizer. Land-applied biosolids must meet or exceed Grade II, Class B criteria (Colorado Department of Public Health and Environment, 1998). Grade I exceeds Grade II. The MWRD applies Grade I, Class B biosolids to its properties near Deer Trail. The biosolids-application areas, dates of application, and application rates provided by the MWRD for its properties near Deer Trail are listed in table 1 (located in the Data Section at the back of the report); application areas (called “Destination Codes”) are marked DC and are shown in figure 2 (in the Data Section at the back of the report).

Objectives of Monitoring Biosolids

The biosolids must meet regulatory standards for trace elements and radioactivity. Exceeding these standards could adversely affect the quality of soil on which the biosolids are applied and could alter MWRD plans for the application of biosolids in

Arapahoe and Elbert Counties. The composition of the biosolids was monitored to provide an independently determined data set against which the MWRD 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

In 1999, the USGS began monitoring MWRD biosolids for concentrations of arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, and plutonium, and gross alpha and beta activity. Radioactivity analyses were included in response to public concerns that biosolids radioactivity could increase from the planned transfer of water from the Lowry Landfill Superfund site.

Biosolids samples were collected directly from the MWRD facility in Denver rather than from individual trucks or fields near Deer Trail to enable the USGS to obtain a more representative sample. In 1999, one sample was collected for analysis each quarter. Samples were collected on March 26, June 15, September 1, and December 2. The concentrations in the samples were compared to applicable Colorado standards for biosolids (Colorado Department of Public Health and Environment, 1998). After the Lowry Landfill Superfund site water transfer begins, samples will be collected and analyzed once each month for 6 months (instead of quarterly) to evaluate any changes in the composition of biosolids.

Sampling Methods for Biosolids

Each biosolids sample is a 24-hour composite of 12 subsamples collected about every 2 hours by MWRD personnel at the MWRD facility. The subsamples were collected from the conveyor belt that transfers the biosolids into the transport trucks. Each sample was placed in two acid-washed, 1-gallon plastic bottles and delivered to the USGS.

Analytical Methods for Biosolids

The biosolids samples were processed and analyzed quarterly at the chemical laboratories of the USGS Mineral Resources Program in Denver for most analytes. Radioactivity analyses were done by Acculabs, a commercial laboratory near Denver, Colo. The biosolids material was air dried and then ground to less than 150 µm prior to chemical analysis. The methods used to analyze the biosolids samples for each constituent are listed in table 2 (located in the Data Section at the back of the report).

Quality Assurance for Biosolids

The purpose of the quality-assurance program developed for the biosolids monitoring component was to ensure that 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 sludge. This SRM was prepared by NIST from material collected at the MWRD 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 quarterly 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.

In 2002, the USGS became concerned about the gross alpha data for the biosolids samples. For the March 1999 through June 2000 samples, the gross alpha data from Acculabs for the NIST SRM 2781 (domestic sludge) ranged from 27–37 pCi/g. For the August 2000 through August 2001 samples, the values ranged from 37–60 pCi/g. This shift to higher values for the same SRM indicates possible increasing analytical bias that could be present in the gross alpha data for the biosolids samples collected from the MWRD. Additional information about these analyses is not available because Acculabs went out of business in early 2002. Therefore, the USGS submitted split samples from a subset of the biosolids samples and NIST SRM to a different laboratory in an attempt to reconcile this issue. A split of the September 1999 biosolids sample and three splits of the NIST SRM 2781 were analyzed for radioactivity in 2002 by Severn Trent Laboratory (formerly Quanterra

Analytical Services) in Richland, Wash., under a contract with the USGS National Water Quality Laboratory (NWQL).

Biosolids Data

The summaries of all the chemical analyses for trace-element concentrations for the biosolids samples collected in 1999 are listed in table 3 (in the Data Section at the back of the report), and radioactivity data (gross alpha activity, gross beta activity, and plutonium concentration) are listed in table 4 (in the Data section at the back of the report). The tables also list the maximum allowable concentrations for Grade I biosolids, if available. Radioactivity data for the same samples from two different laboratories are listed in table 5 (at the back of the report).

Discussion of Biosolids Data

All trace-element concentrations were less than the maximum allowable values established by Colorado for Grade I biosolids. Gross alpha activity also was less than the maximum allowable value for Grade I biosolids. No maximum allowable values have been established for gross beta, plutonium 238, or plutonium 239 and 240. The data from Severn Trent Laboratory (STL) compare with the Acculabs data from 1999. No significant analytical bias or variability likely is present in the 1999 biosolids data from Acculabs.

SOILS

Biosolids can contain large concentrations of certain trace constituents. Therefore, the application of biosolids to cropland has caused concern among the citizens of Arapahoe and Elbert Counties regarding the potential short-term and long-term effects on soil quality.

Objectives of Monitoring Soils

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

Approach for Monitoring Soils

In August 1999, the USGS began monitoring soils on two sites, one site on MWRD property in Arapahoe County and one site on MWRD property in Elbert County. Soils were monitored for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, gross alpha and beta activity, and plutonium. Soil samples were collected once during 1999, before the application of biosolids to the monitoring sites. Soil monitoring will continue through two cycles of biosolids application and crop harvest, and soil sampling will be done shortly after each harvest.

Fields that receive biosolids applications and fields that do not receive biosolids applications were monitored. The fields that do not receive biosolids applications were used as a reference for the comparison. Each of the two soil-monitoring sites consisted of three 20-acre (933-ft by 933-ft) fields separated by 100-ft buffer zones (figs. 3 and 4, in the Data Section at the back of the report). In 1999, the center 20-acre field at each site received a single biosolids application after the initial August soil sampling. The other two 20-acre fields at each site will not receive biosolids applications and will be used as “control” fields to determine the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site are farmed the same way as the rest of the MWRD property and have crops planted and harvested. Soils from each of the six fields were sampled before the application of biosolids to the two center fields and will be sampled again after harvest. 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 Soils

Sites were selected on MWRD properties where biosolids have never been applied. One site was selected on the MWRD’s north property in Arapahoe County, and one site was selected on the MWRD’s south property in Elbert County. 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).

Sampling Methods for Soils

The sampling protocol was designed to determine the average composition of the top 12 inches of soil in each of the six 20-acre fields. Soil samples were collected with a standard soil auger to a depth of 12 inches according to a systematic grid pattern. For each of the two fields to which biosolids will be applied, 36 subsamples were collected on approximately 133-ft centers. A similar grid was used to collect 36 subsamples from the southern “control” field on the Arapahoe County site. For the remaining three “control” fields, 30 subsamples were collected at approximately 155-ft centers.

Analytical Methods for Soils

Soil samples were processed and analyzed at the chemical laboratories of the USGS Mineral Resources Program in Denver for most analytes. Radioactivity analyses were done by Acculabs, a commercial laboratory near Denver, Colo. All soil subsamples were air dried at room temperature in the laboratories of the USGS Mineral Resources Program in Denver. Each of the 198 dried subsamples was disaggregated and sieved to less than 2 mm. This minus-2-mm material then was ground to less than 150 μm in size. Splits of each subsample were taken for archival storage, and the subsamples for each field were composited into one sample for chemical analysis. The six composite soil samples, each representing one 20-acre field, were analyzed by the methods listed in table 2. Four separate splits of each composited soil sample were analyzed independently and the results averaged to determine the concentration reported for a given constituent.

Quality Assurance for Soils

The accuracy of the soil analysis was ensured by the analysis of NIST SRM 2709, an agricultural soil. Five separate samples of this SRM were randomly placed among the Arapahoe and Elbert County soil samples and submitted to the laboratories. If the analytical results for the constituent of interest in the SRM were within an acceptable range, analytical results for the soil samples were accepted.

Soils Data

Soil samples were collected from the Arapahoe County site on August 25, 1999, and from the Elbert County site on August 26, 1999. The trace-element concentrations for the three composite soil samples from the Arapahoe County site are listed in table 6, and radioactivity data are listed in table 7. Data for the three composite soil samples from the Elbert County site are listed in tables 8 and 9. Tables 6–9 are in the Data Section at the back of the report.

Discussion of Soils Data

The analytical results listed in tables 6 through 9 represent the pre-biosolids-application geochemical baseline for each of the six fields sampled. These results indicate the soils sampled in Arapahoe County have somewhat different geochemical characteristics than those sampled in Elbert County. The Elbert County soils generally have higher trace-element concentrations than the Arapahoe County soils. These higher concentrations probably are related to the higher clay content, which is caused by a higher component of shale as parent material, in the Elbert County soils. Shales usually contain more trace elements than sandstones (Drever, 1988), which make up the other parent material for soils in Arapahoe and Elbert Counties (Sharps, 1980). The observed differences in soil chemistry between the Arapahoe and Elbert County soils and the observed differences among the three 20-acre fields in each county represent the natural variation of soil chemistry. All soil samples were collected before application of biosolids to the center 20-acre field in each county.

ALLUVIAL AND BEDROCK GROUND WATER

Applications of pesticides, herbicides, or fertilizers (including biosolids) to the land surface can affect the quality of shallow ground water. Discharge from contaminated alluvial ground water 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 and gravels 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 unconsolidated materials; the primary bedrock aquifer in the study area is the Laramie-Fox Hills aquifer (Robson and Banta, 1995). Alluvial and bedrock ground water are separate components in the monitoring program but are combined in this report because the data were collected in the same way and the types of data included are the same.

Objectives of Monitoring Ground Water

Ground water is 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, zinc, gross alpha and gross beta activity, and plutonium in the ground water are significantly greater than Colorado regulatory standards; and to determine if concentrations of these constituents are increasing with time in ground water at or near the MWRD properties. Bedrock core samples are analyzed to determine if bedrock is a possible source of nitrogen and trace constituents to ground water in the study area.

Approach for Monitoring Ground Water

A structure map of the base of the Laramie-Fox Hills aquifer was compiled for the study area by using existing information such as geophysical logs from oil and gas exploration and other data. Plans are to explain and publish the structure map in an interpretive USGS report.

Ground-water recharge is evaluated using multiple wells at two locations. Multiple wells at each location enable 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. Two bedrock-aquifer nested wells and two alluvial-aquifer wells constitute the recharge-evaluation sites. Nested wells mean each borehole has two separate casings, each screened at a separate zone. The interactions in the bedrock aquifer were monitored in two different zones (designated by “A” [shallow] or “B” [deep] at the end of the well name] so three aquifer zones (one alluvial, one shallow bedrock, and one deep bedrock) were monitored at each recharge-evaluation site. DTX7 and DTX8 (fig. 1) constitute one recharge-evaluation site, and DTX9 and DTX10 constitute the other recharge-evaluation site (fig. 1). In this report, information pertaining to the entire borehole is shown as DTX8 or DTX10, whereas information pertaining to a specific piezometer within the borehole is designated with “A” or “B” such as DTX8A or DTX8B.

Monitoring wells for the expanded monitoring program include selected wells installed as part of the 1993–99 monitoring program and new wells. Completion information for the wells is shown in figure 5 (in the Data Section at the back of the report). Of the 33 existing USGS ground-water monitoring wells on the MWRD’s central property, 9 are included in this study (all 9 wells are monitored for water levels, and 6 of these wells are sampled). “D”-numbered wells were drilled before 1999 as part of the previous monitoring program, and “DTX”-numbered wells were drilled in 1999 (fig. 1). The USGS installed 10 new monitoring wells in the study area in 1999; cores were collected from all wells during drilling to evaluate lithology. Sandstone or shale bedrock-core samples from wells DTX3 (shale), DTX8 (sandstone and shale), and DTX10 (sandstone and shale) were analyzed in June 1999 by the USGS for nitrite plus nitrate, total nitrogen, arsenic, cadmium, chromium, copper, mercury, lead, molybdenum, nickel, selenium, and zinc.

Water levels in the monitoring wells were measured monthly. Data-collection platforms (DCP’s) were installed during the summer of 1999 at three alluvial-aquifer wells (D25, DTX2, and DTX5) to continuously monitor ground-water levels, water temperature, precipitation, and air temperature. The data were transmitted to Denver by satellite and are available on the Internet (http://water.usgs.gov). The data provided information about the hydrology in the study area and the response of ground water to climate variables.

Water-quality samples were collected from 11 alluvial-aquifer wells on the MWRD properties (fig. 1), and the shallowest zones of the bedrock aquifer were sampled at three locations that are important to alluvial/bedrock ground-water interactions. The remaining USGS monitoring wells were used to provide hydrologic information only. Samples were collected and analyzed quarterly for physical properties, dissolved major ions and trace elements, and dissolved and total nutrients. Analyses were done by the USGS and included constituents of primary concern (nitrate, arsenic, cadmium, copper, chromium, lead, mercury, molybdenum, nickel, selenium, and zinc). Samples also were collected and analyzed annually for gross alpha and gross beta activity and dissolved plutonium. Water levels and field measurements such as pH and specific conductance were recorded with the collection of each ground-water sample to provide context for the chemical analyses. Blank and replicate samples were analyzed to evaluate bias and variability of the ground-water data. All water-quality data are maintained in the USGS National Water Information System (NWIS) data base, and selected data were published in the "USGS Expanded Monitoring Program Near Deer Trail" quarterly reports (http://co.water.usgs.gov/pubs/). Selected water-quality data will be statistically analyzed each year of the program and after about 5 years.

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 sites for alluvial-aquifer wells were selected by the USGS according to the following criteria: (1) locations in proximity to a stream channel that could carry runoff from MWRD biosolids-applied fields, (2) locations at the most downstream point of the drainage basin, (3) locations at MWRD property boundaries to represent the condition of ground water leaving the properties and to consider only those effects from activities on MWRD properties and not from other landowners, (4) locations where most of the upstream basin is on MWRD 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 drilling and sampling wells. Alluvial-aquifer wells were not installed upgradient from MWRD property boundaries 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 MWRD properties, and that part of the basin that receives biosolids is relatively small. Therefore, the USGS installed two alluvial-aquifer wells on the MWRD's north property and four on the MWRD's south property (fig. 1); all wells on the MWRD's central property used for this study (fig. 1) were installed before 1999 as part of the 1993–99 monitoring program.

Bedrock aquifers can be recharged by alluvial ground water or can be a source of water to alluvial aquifers. Therefore, the sites for bedrock-aquifer wells were selected by the USGS according to the following criteria: (1) locations where a particular Fox Hills sandstone sequence in the Laramie-Fox Hills aquifer is present at substantial areal extent and thickness, (2) locations on MWRD property where the bedrock aquifer is present without an alluvial aquifer, (3) locations 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 drilling and sampling wells. Locations where the sandstone sequence in the Laramie-Fox Hills aquifer is present with substantial areal extent and thickness were determined by the USGS on the basis of structure mapping of the top and base of the Laramie-Fox Hills aquifer using analysis of available geophysical logs, lithologic descriptions from core samples, and outcrops. For the expanded monitoring program, the unpublished USGS structure map was used to select locations for the two ground-water recharge-evaluation sites where the Laramie-Fox Hills aquifer is present beneath the Muddy Creek alluvial aquifer. The recharge-evaluation sites consist of two nested bedrock-aquifer wells and two new alluvial-aquifer wells installed along Muddy Creek downgradient from the MWRD property (fig. 1.) One USGS bedrock-aquifer monitoring well, D29 (fig. 1), was included in this monitoring program because the well is on MWRD property where the bedrock aquifer is present without an overlying alluvial aquifer, and prior sampling data exist.

DCP sites provided information about the variability in space and time of climate and hydrology in the study area as well as about the hydrologic responses to climate. This monitoring program includes three DCP sites installed during summer 1999, one on each of the MWRD's 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 being sampled, (2) locations near possible streambed-sediment sampling drainages (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 to indicate spatial variability in hydrology, (5) locations needing additional hydrologic information to explain chemical variability (well D25), and (6) locations accessible year round. Continuous-recording instrumentation associated with a recharge-evaluation site near DTX 9 and DTX10 was installed in 2000 and, therefore, is not discussed in this report.

Sampling Methods for Ground Water

Monthly water-level measurements were made using a vinyl-coated electric tape, which makes a sound when a sensor near the end of the tape contacts the water surface in the well. When the water surface was located, the gradations marked on the tape were read at the measuring point on the well casing. For monthly water-level measurements, the tape was washed with deionized (DI) water between sites. For ground-water sampling, the tape was washed with a nonphosphate detergent solution and rinsed thoroughly with DI water between wells to prevent cross contamination.

Water levels, water temperatures, air temperatures, and precipitation were recorded every hour at each of three DCP sites. The DCP data were transmitted every 4 hours, by satellite, to the USGS. The data then were made available to the public over the Internet (http://water.usgs.gov). Continuously recorded water levels (depth below land surface, in feet) were determined using a submersible pressure transducer calibrated in the field according to manufacturer’s specifications. Water temperatures were measured continuously by a thermistor submersed in the well, and air temperatures were measured by a thermistor mounted on a post above the ground at the DCP site; both thermistors provided data in degrees Celsius. Precipitation was measured at each DCP by a post-mounted tipping-bucket type rain gage. A plastic collection-container rain gage (also mounted on a post) provided a second, discrete measurement of rainfall, but these measurements were recorded manually during site visits. The status of the DCP instrumentation and the accuracy relative to manual field measurements were checked during site visits at least once each month; the accuracy relative to known standards (calibration) was checked in the field about every 6 months.

Samples were collected and analyzed quarterly for physical properties, major ions, dissolved and total nutrients, and dissolved trace elements. Samples also were collected once in July and analyzed for gross alpha and gross beta activity and for plutonium.

USGS clean-hands sampling procedures (Horowitz and others, 1994) were implemented to ensure consistent, reproducible results that are as free from contamination (high bias) as possible. Sample water and surfaces that may contact the sample water were kept clean and isolated from possible contaminant sources. The sample-collection and sample-processing equipment was cleaned to trace-element standards in the USGS preparatory laboratory (hereinafter “the lab”) according to procedures given in Horowitz and others (1994). According to these procedures, the equipment was washed with nonphosphate detergent and then rinsed with a 5-percent hydrochloric acid solution (HCl) and DI water. Processing equipment and supplies were packed in clean, sealed plastic bags inside clean plastic containers for transport to the sampling site. Sample bottles were rinsed in the lab with DI water and sent to the sampling site while retaining a small amount of DI water, which was poured out of the bottle inside the clean sampling chamber, just before rinsing and filling with sample water. Disposable 0.45-μm capsule filters used at the sampling sites were preconditioned with DI water in the lab to remove surfactants and then chilled until used. Silicone tubing dedicated to each well (which means used only at that well) was cleaned in the lab with HCl and DI water. The submersible pump (Grundfos Redi-Flo2™) and Teflon-lined polyethylene hose also were cleaned at the lab with nonphosphate detergent and DI water after each sampling trip and before each use at a well.

Wells were purged just before sample collection to remove ground water that had been in contact with air and well materials to ensure the sampled water was representative of aquifer water. The sampling pump was used to remove ground water until field parameters (such as pH and specific conductance) stabilized. At least three casing volumes were removed at each well. Specific conductance, pH, water temperature, and dissolved oxygen were monitored at the sampling sites during the purge process by using a multiprobe equipped with a flow cell; ground water was pumped from the well through the flow cell. This configuration enabled field-parameter measurements on the same aliquot of ground water, minimal contact of the ground water with air (which can affect parameter values), and continuous monitoring of the parameters throughout the purge process to determine when purging was completed. The multiprobe was calibrated at the beginning of each day to standards that were in the range of the environmental samples at approximately the same temperature as the ground water. Calibration was rechecked at the end of the day. Water was pumped from the well by a peristaltic or submersible pump. When a peristaltic pump was used, the dedicated silicone pump tubing was attached near the top of the well casing to a dedicated Teflon-lined polyethylene tube that was installed in each well. The end of the dedicated tubing was pulled out of the well by a length that resulted in the bottom of the tube being located at approximately the bottom of the screened interval in the well. During the purge process, the tubing from the well was attached to the multiprobe flow cell by the dedicated silicone pump tubing; the pumping rate was kept below 0.25 gal/min. Field parameters were monitored to ensure that stability was achieved by the end of the purge process and that representative aquifer water was flowing from the well. After the purge process was completed, the sampling pump was left on, but the silicone pump tubing was disconnected from the multiprobe flow cell and rinsed before being inserted into the processing chamber.

Samples were processed onsite in the back of a truck (covered by a nonmetal camper shell). The samples were processed using a clean chamber constructed by clipping a large, clean, clear-plastic bag to the inside of a frame constructed of plastic pipe. This method resulted in a disposable, nearly dust-free glove-box where sample bottles could be rinsed and filled while being protected from fumes and wind-blown particles and debris. Sampling personnel wore vinyl gloves and changed them frequently, such as after contact with dirty surfaces and between various phases of the processing procedure at each sampling site.

Sample water was pumped directly from the well through the dedicated silicone tubing that entered the processing chamber through a small hole in the top of the chamber bag. Multiple sample bottles were filled at each well site because different constituents require different processing and bottles. For dissolved constituents, the sample bottles were filled through silicone pump tubing attached from inside the processing chamber to a disposable 0.45-μm capsule filter. For whole-water (total) constituents, the filter was removed and the sample bottles were filled directly from the silicone pump tubing inside the processing chamber. Bottles for dissolved constituents were filled before bottles for whole-water constituents. The specific order for filling the filtered-sample bottles was: trace-element bottles, radiochemical bottles, nutrient bottles, and major-ion bottles.

Sample preservation was done inside a new chamber bag (the bag used for filtration was discarded). The samples for arsenic, mercury, and selenium analysis were preserved using a potassium-dichromate-nitric acid preservative. The samples for trace-element analysis and radioactivity analysis were preserved using concentrated ultrapure nitric acid. Nutrient samples were preserved using 4.5 Normal ultrapure sulfuric acid. All samples were chilled to approximately 4° C for transport to the laboratory.

All sampling equipment was used exclusively by the USGS and was used only in the study area to prevent cross contamination from other areas. All samples and sampling equipment were kept at all times in the custody of the USGS in locked, guarded facilities.

Analytical Methods for Ground Water

Ground-water samples were submitted to the USGS National Water Quality Laboratory (NWQL) in Denver. Most analyses were done by the NWQL, but plutonium analyses were done by Quanterra Analytical Services (now known [2000] as Severn Trent Laboratory) in Richland, Wash., under a contract with the USGS NWQL. The methods used to analyze the bedrock-core samples were the same as those listed in table 2 (in the Data Section at the back of the report) for soils. The methods used to analyze the ground-water samples are listed in table 10 with laboratory minimum reporting levels (MRL) for the elements of interest and minimum detectable concentrations (MDC) for the radiochemical samples.

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 and core-data collection, ground-water-sampling preparation, field-parameter measurements, ground-water sampling, and laboratory analysis.

Water levels in the wells were measured monthly. Water levels were measured twice and then remeasured if the first two measurements differed by more than 0.02 ft. Water levels also were remeasured if the first two measurements differed from those of the previous month by more than 1 ft. The two electric tapes used to measure water levels were checked periodically against each other and against a steel tape of known length.

Continuous-recorder DCP data were quality assured by discrete field measurements of water level, air temperature, water temperature, and time. Tipping-bucket rain-gage data were verified with collection-container rain-gage data from the same site. DCP instruments were calibrated approximately every 6 months.

Bedrock-core analyses were quality assured by including SRM’s and replicates as blind samples for analysis. Two replicate core samples were analyzed in 1999.

Sampling equipment and water-quality meters were checked regularly and calibrated onsite or in the office. The multiprobes used to measure field parameters also were checked for accuracy through the USGS National Field Quality Assurance (NFQA) program. The DI water used in cleaning and sample processing was monitored for purity according to procedures given in Horowitz and others (1994).

Laboratory and onsite cleaning procedures were rigorous and designed to prevent contamination of samples. Before sample collection, all sampling equipment and materials were cleaned according to standard procedures given in Horowitz and others (1994).

If analytical results for a particular constituent or property were questionable, the sample was reanalyzed at the NWQL. If results from the second analysis were more consistent with known characteristics of the site or the particular sample, the new results were used instead of the previous results. In some samples, the filtered concentrations of some constituents were reported to be higher than the total concentrations. These inconsistencies generally were within the precision of the methods used and were due, in part, to differences between particular aliquots of the sample.

Blank samples were collected by the USGS to quantify contamination, a type of high bias, contributed by field conditions, sampling equipment, and laboratory analysis. At least two field blanks were collected each quarter. The field blanks were prepared using certified inorganic blank water that was passed through all sampling equipment, processed, and preserved as a regular sample at the well. In addition, equipment blanks were prepared using a submersible pump and were analyzed periodically. The equipment blanks were prepared using certified inorganic blank water that was passed through all sampling equipment, processed, and preserved as a regular sample at the laboratory. The equipment blanks do not indicate bias contributed by field conditions near Deer Trail because the blanks were prepared at a laboratory in Denver. Blank samples were submitted to the NWQL and usually were analyzed with the same analytical equipment as regular samples. However, a special low-level trace-element analysis using “blanks only” analytical equipment was done at least once a year to quantify even very low levels of bias. Analytical bias contributed by the NWQL also was evaluated for higher concentrations through USGS blind sample programs and performance-evaluation studies (Pirkey and Glodt, 1998).

Replicate samples were collected by the USGS to quantify variability contributed by ground water, sampling and processing, field conditions, and laboratory conditions and analysis. A minimum of two field replicates were collected each quarter. The replicates were collected concurrently with the environmental samples, using the same equipment. Bottles of a particular type were filled in sequence. For example, after the regular-sample trace-elements bottle was filled, the replicate-sample trace-elements bottle was filled; after the regular-sample nutrients bottle was filled, the replicate-sample nutrients bottle was filled; and so forth. Variability contributed by the NWQL also was evaluated through NWQL method-performance programs (Pirkey and Glodt, 1998).

Quality assurance of the NWQL was done at many levels. Field quality-control samples indicate bias and variability of the NWQL as well as of field methods. The analytical quality-assurance practices and procedures of the NWQL are described in Friedman and Erdmann (1982). The NWQL has a three-tier quality-control process consisting of (1) method-performance evaluations (laboratory blanks, laboratory spikes, laboratory replicates, calibration standards, and calibration-check samples or standard reference materials); (2) data review and blind sample programs; and (3) internal and external performance-evaluation studies (Pirkey and Glodt, 1998).

Ground-Water Data

The ground-water part of the monitoring program during 1999 produced meteorology, hydrogeology, hydrology, and water-quality data. Meteorology data include precipitation and air temperature at three sites. Hydrogeology data include chemical data for the bedrock-core samples obtained during well drilling, lithologic descriptions of the cores, and well-completion diagrams. Hydrology data include monthly water levels at all wells and hourly water levels and water temperature at three DCP sites. Water-quality data include analytical results from quarterly sampling.

Meteorology Data

Precipitation and air temperature were recorded hourly for part of the year at wells D25, DTX2, and DTX5 (figures 6 through 8 at the back of the report). The maximum daily precipitation recorded during September through December at the three sites was 0.44 inch at well DTX5 on September 28, 1999. Precipitation data recorded during April–October probably were from thunderstorms and frontal storms. The precipitation data recorded during October through December could represent melted snow. Because air temperature was monitored only part of the year, complete seasonal characterizations are not possible. However, the data indicate air temperatures can fluctuate more than 20° C during the day.

Hydrogeology Data

Bedrock-core samples obtained when the new USGS monitoring wells were drilled in 1999 were analyzed for chemistry. The chemical data for these core samples are listed in table 11 (at the back of the report).

All wells were cored by the USGS during drilling in 1999 to provide information about ground water and geology at each new well location. Occasionally, cores could not be recovered from the borehole because the geologic units being drilled were not sufficiently consolidated to stay in the core barrel. However, some geologic information was obtained through the drill cuttings, which are the pieces of the rock formation that are removed from the borehole during drilling. The lithologic descriptions for the wells are listed in table 12 (at the back of the report).

The details of the construction of each well are given in the well-completion diagrams shown in figure 5 (at the back of the report). These details, which include the depth of well, screened interval, materials used, and stickup, provide a physical context for the other ground-water data, such as water levels and chemistry data, and should be considered when comparing data for different wells.

Hydrology Data

Monthly water-level data and continuous water-level and water-temperature data can be useful for describing the hydrology of the aquifers in the area near Deer Trail, can indicate seasonal effects, and can aid in the interpretation of chemical data. The monthly water-level data for the USGS monitoring wells used in this study are listed in table 13 (at the back of the report), and the continuous water-level and water-temperature data for the three DCP sites (D25, DTX2, and DTX5; fig. 1) are shown in figures 6–8.

Water-level data also can indicate ground-water recharge information. 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 occur 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). 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. 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 elevation) to areas of low hydraulic head (low water-level elevation). For the expanded monitoring program, such interactions were monitored at two recharge-evaluation sites, each of which included one alluvial-aquifer well and one bedrock-aquifer well. Water levels for the paired alluvial-aquifer and bedrock-aquifer wells at the two recharge-evaluation sites are shown in figures 9 and 10 (at the back of the report).

Water-Quality Data

Water-quality data for samples collected quarterly from 11 alluvial-aquifer and 3 bedrock-aquifer wells (fig. 1) in 1999 are listed in tables 14 and 15 (at the back of the report). Data are provided for physical properties, major ions, nutrients, trace elements, and radioactivity data. Quality-control water-quality data for the blank samples are listed in tables 16 and 17 (at the back of the report), and data for the replicate samples are listed in table 18 (at the back of the report).

Discussion of Ground-Water Data

Median values or concentrations for the blank samples (tables 16 and 17) indicated no substantial or systematic contamination bias during sample collection and processing. Although the median concentrations for specific conductance and acid-neutralizing capacity in blank samples were above the laboratory MRL's, most concentrations for the blank samples were much less than those for the ground-water samples. The data indicate that ground-water data for specific conductance and acid-neutralizing capacity are not affected by a high bias.

The relative percent differences (RPD) between the replicate and the regular samples were computed to summarize sample variability (table 18). Many of the larger RPD's are due to values or concentrations near the MRL where precision is expected to be poor. In these cases, concentrations may vary little but result in large RPD's. For example, a regular 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 regular-replicate sample pairs also are listed in table 18 to help the reader determine if large RPD's are the result of substantial differences between regular- and replicate-sample concentrations or just small differences between small concentrations. The replicate-sample data indicate generally reproducible analytical results.

The radioactivity data are reported in the uncensored form, as received from the laboratory, rather than censored by either the calculated minimum detectable concentration (MDC) or the contract-required 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 the plutonium and gross alpha and gross beta activity. The negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background counts were subtracted from the sample counts, and the resulting value was converted to activity-concentration units of picocuries per liter.

In general, the expanded monitoring program is too new for sufficient data to have been collected for meaningful interpretation of the ground-water data. However, 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. Data in this report provide baseline information that can be used to address concerns about possible contamination of the study area from the planned Lowry Landfill Superfund site water transfer; no water from the Lowry site was transferred to MWRD during 1999.

The USGS was asked to evaluate the ground-water data for water-quality effects each year of the study. Therefore, summary statistics were computed for the water-quality data for 1999, and results for selected constituents were tested to determine if statistical evidence indicated exceedance of regulatory limits or a monotonic trend in concentration with time.

Summary Statistics for Ground-Water-Quality Data

Summary statistics are computations that characterize the distribution of data. Statistics computed for the water-quality data include sample size, percentage of censored data, maximum, minimum, mean, median, and percentiles (95th, 75th, 25th, and 5th). Statistics for the data for the 11 alluvial-aquifer wells and 3 bedrock-aquifer wells are listed in table 19 (at the back of the report). For constituents with censored values (values reported as less than the laboratory MRL), a lognormal probability regression method was used to estimate the statistics (Helsel and Cohn, 1988).

Regulatory Standards

Regulatory standards that might be used as guidelines to evaluate the ground-water quality in the study area are the human health standards and agricultural standards enforced by the State of Colorado (Colorado Department of Public Health and Environment, 1997). For this report, a one-tailed Sign Test (Helsel and Hirsch, 1995) was used to indicate the level of statistical evidence that selected median constituent concentrations were significantly greater than regulatory standards. The hypotheses tested were as follows:

H_o = median concentration is less than or equal to the regulatory standard and

H_a = median concentration is greater than the regulatory standard.

A small p-value result from the Sign Test indicates H_o, the null hypothesis, should be rejected. The confidence level in rejecting H_o and, therefore, accepting H_a can be determined by subtracting the p-value from 1 and multiplying by 100. The confidence level also can be thought of as the probability (in percent) that the regulatory standard has been exceeded by the median concentration (table 20 at the back of the report). For example, if the Sign Test for a constituent results in a p-value of 0.10, there is a 90-percent confidence level or probability that the median concentration for that constituent is greater than the regulatory standard. The results of the statistical testing of the data for the 11 alluvial-aquifer wells and 3 bedrock-aquifer wells for exceedance of regulatory standards for 11 constituents of primary concern identified by the public are listed in table 20. The power of the statistical test (level of statistical evidence) is low because quarterly samples have been collected for only 1 year to date. As sampling continues, the power of the test will increase. Radioactivity data were not statistically tested because the single radiochemical sample collected at each well in 1999 is an insufficient number of samples for statistical testing. The distribution of concentrations at each well for selected constituents and the regulatory standards used to test the ground-water data are shown in figure 11 (at the back of the report).

Trends

Upward monotonic trends in concentration could indicate biosolids, other farm practices, grazing, or even natural processes such as geochemical dissolution are affecting ground-water quality. For this report, the Kendall's tau statistic (Helsel and Hirsch, 1995) was used as an indicator of monotonic correlation between concentration and time. Kendall's tau is a number between negative one and positive one where values approaching negative or positive one indicate increasing strength of the correlation and a number approaching zero indicates decreasing strength of the correlation. Positive values of Kendall's tau indicate upward trends, and negative values indicate downward trends. The results of the statistical testing of the data for monotonic trends in 11 constituents of primary concern identified by the public are listed in table 21 (at the back of the report). A p-value is listed to indicate the level of significance of the coefficient, the tau value. The p-value must be less than 0.10 for tau to be significant with at least 90-percent confidence. Radioactivity data were not statistically tested because the single radiochemical sample collected at each well in 1999 is an insufficient number of samples for statistical testing.

Because quarterly samples have been collected for only 1 year to date, the power of the trend test is low, and too few data are available to consider seasonal effects. As sampling continues, the power of the test will increase and the amount of data available will enable seasonal effects to be evaluated.

STREAMBED SEDIMENT

Applications of pesticides, herbicides, and fertilizers (including biosolids) to the land surface could affect surface-water quality directly through runoff. These applications also can affect surface-water quality indirectly by contaminating ground water that is inflow, base flow, or recharge to surface water or by contributing to natural processes such as nitrification. Contaminated surface water could contaminate downstream, previously uncontaminated ponds, streams, streambed sediment, alluvial aquifers, or bedrock water-supply aquifers in aquifer-recharge zones.

Surface-water contamination from biosolids applications is a public concern. However, because streams flow off the MWRD properties only after intense thunderstorms, surface-water sampling is impractical, and monitoring extreme surface-water events is difficult. Monitoring streambed-sediment chemistry is more practical and cost effective and offers greater opportunity to establish comparison or baseline sites than monitoring surface-water chemistry. For the expanded monitoring program, streambed sediment is defined as the fine-grained alluvium freshly deposited in the drainage bottoms by surface-water flow from runoff.

Sediment affected by the application of biosolids could be transported off MWRD property into streambeds when precipitation is intense enough to cause overland flow. Therefore, streambed-sediment chemistry is used as an indirect indicator of surface-water quality because of the close contact between surface flows and sediment during transport. Constituents in the streambed sediments could cause ground-water or surface-water contamination if the constituents are resuspended in water or leached from the bed sediment. Furthermore, concentrations of trace elements and plutonium and gross alpha and gross beta activity may be higher in the bed sediment than in the surface water.

Objectives of Monitoring Streambed Sediment

Streambed sediments are monitored for concentrations of nitrate, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, organic carbon, and plutonium and gross alpha and beta radioactivity. Results are used to determine if concentrations in sediment derived from (or transported through) biosolids-application areas are significantly higher than in sediment derived from nearby farmland that did not receive biosolids applications.

Approach for Monitoring Streambed Sediment

Two small drainage basins are monitored for comparison of streambed-sediment chemistry (fig. 1). The basins have similar physical characteristics, but one basin (known as the biosolids basin) receives biosolids applications and is part of the MWRD farming program, and the other basin (known as the control basin or nonbiosolids basin) receives no biosolids applications and is farmed privately.

Plans were to collect paired streambed-sediment samples when freshly deposited bed sediment was available from both the biosolids basin and the control basin at the same time (after the same storm caused runoff in both basins). The USGS was unable to collect paired samples during 1999 despite many attempts, but a single sample from the biosolids basin was collected in late August. Because paired samples are preferred, the sample was refrigerated at the laboratory and not submitted immediately for analysis in case a future runoff event enabled paired samples to be obtained. However, the summer monsoon season (July–August) ended without any additional large storms, so the single sample was analyzed by the USGS for trace elements, gross alpha and gross beta activity, and plutonium. The radioactivity analyses were included in response to public concerns that biosolids radioactivity concentrations could increase from the planned transfer of water from the Lowry Landfill Superfund site. The sample likely had been held too long to enable accurate analysis of nutrients or carbon, so these analyses were not done.

When sufficient storms occur, three to four paired samples per year are planned. When enough paired samples are collected, data can be statistically tested to determine if streambed-sediment chemistry is significantly different between the two basins.

Site Selection for Monitoring Streambed Sediment

Several pairs of similar small basins (one on MWRD property and one on nearby private property) were considered by the USGS for monitoring. Only small (less than 5-mi^2) basins were considered because (1) the large biosolids basins did not have a nearby corresponding control basin that had similar characteristics, (2) the storms likely to cause runoff were usually localized and were not likely to affect two large basins with the same duration and intensity, (3) sampling is more efficient in small basins because each streambed-sediment sample is a composite of sediment collected throughout the basin, and (4) the large basins in the study area are more variable with respect to geology, soil type, and land use. Sediment collected from the large basins is more likely to be affected by this variability and, therefore, may not indicate effects from biosolids. The criteria used to pair basins included distance between basins; proximity to a USGS ground-water-monitoring well that included DCP instrumentation; land use (farmed); likely accessibility even after severe storms; and similar bedrock geology, soil type, aspect, stream order, channel length, channel slope, relief, and ponding. From the three basin pairs identified as candidates for streambed-sediment monitoring (table 22 [at the back of the report] and fig. 12 [at the back of the report]), the basin pair on Badger Creek tributaries (on and near the MWRD's north property) was selected (fig. 1).

Sampling Methods for Streambed Sediment

DCP data from DTX2 transmitted by satellite to the USGS were monitored daily to determine the occurrence, intensity, and duration of rainfall in the study area. If sufficient rainfall in the area of the paired basins was indicated by the data, the sampling crew visited the sites to determine if the rainfall had produced sediment transport from the hillsides to the alluvial channel in both basins. If transport occurred, a streambed-sediment sample was collected from the newly transported sediment in the main stream channel of the basin.

Bed sediment was collected from the alluvial channel by using a plastic scoop. The upper 2 cm of fine-grained wet sediment that collects in depositional areas was removed and composited, placed in a plastic collection bowl, and transported to a central location for processing. For the trace-element sample, the sediment was washed into an acid-rinsed polypropylene sample jar through a nylon, 0.63-μm sieve using native water, if possible, or DI water. The sediment in the jar was allowed to settle, and then the clear water was removed from the top of the sample by using a plastic syringe. The procedure was repeated until sufficient sediment (about 35 g total) was sieved for the sample. The procedure was repeated using a 2-mm stainless-steel sieve to fill sample containers for analyses of inorganic and organic carbon (500 g in a 1-L, baked glass jar), nutrients (20 g in a polypropylene jar), gross alpha and gross beta (1 g in a polypropylene jar), and plutonium (150 g in a polypropylene jar).

Analytical Methods for Streambed Sediment

Trace-element samples were analyzed at the USGS NWQL. Gross alpha, gross beta, and plutonium analyses were done by Quanterra Analytical Services (now [2001] known as Severn Trent Laboratory) in Richland, Wash., under a contract with the USGS NWQL. The analytical methods used to analyze the streambed-sediment samples and the laboratory MRL's or MDC's are listed in table 23 (at the back of the report).

Quality Assurance for Streambed Sediment

Quality-assurance procedures were implemented during the course of the monitoring program to ensure the quality of the data. The DI water used in cleaning and sample processing was monitored for purity according to procedures given in Horowitz and others (1994). The analytical quality-assurance practices and procedures of the NWQL are described in Friedman and Erdmann (1982).

Field cleaning procedures were rigorous and designed to prevent contamination of samples. Prior to sample collection, all sampling equipment and materials were cleaned according to standard procedures given in Horowitz and others (1994), Radtke (1997), and Wilde and others (1998). Sampling equipment was field washed with phosphate-free detergent, rinsed three times with DI water, and wrapped in clean plastic bags for transport to the next site. Trace-element sampling equipment received an additional rinse with 5-percent trace-element-grade nitric acid solution and three more rinses with DI water. New sieve cloth was used at each site. The trace-element equipment was allowed to air dry and was stored in plastic bags until use. Stainless-steel equipment was allowed to air dry and was wrapped in aluminum foil and stored in sealed plastic containers.

Sufficient streambed sediment was not available from the site for a replicate sample. Quality-control samples for 1999 consist of a laboratory replicate, method blank, and spike analyzed only for plutonium and gross alpha and gross beta activity. The replicate was used to assess analytical precision. The blank was used to assess contamination bias at the laboratory. The spike was prepared by the laboratory using known concentrations of a constituent to assess recovery and analytical precision. The quality-control samples provide information about the bias and variability contributed by the laboratory but not the bias and variability contributed by field conditions or sampling equipment, or the natural variability of the sediment.

Streambed-Sediment Data

The USGS was unable to obtain paired samples during 1999. However, a single sample from the biosolids-applied basin was collected in August after storm runoff and analyzed for trace elements, gross alpha and gross beta activity, and plutonium (tables 24 and 25 at the back of the report).

Discussion of Streambed-Sediment Data

The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated 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 and gross alpha and gross beta activity. The negative activity concentration reported for one of the radiochemical samples 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.

No comparisons or statistical evaluations are possible with the limited data collected. The streambed-sediment data in this report should provide baseline information that can be used to address concerns about possible contamination of the study area from the planned Lowry Landfill Superfund site water transfer; no water from the Lowry site was transferred to MWRD during 1999.

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DATA SECTION

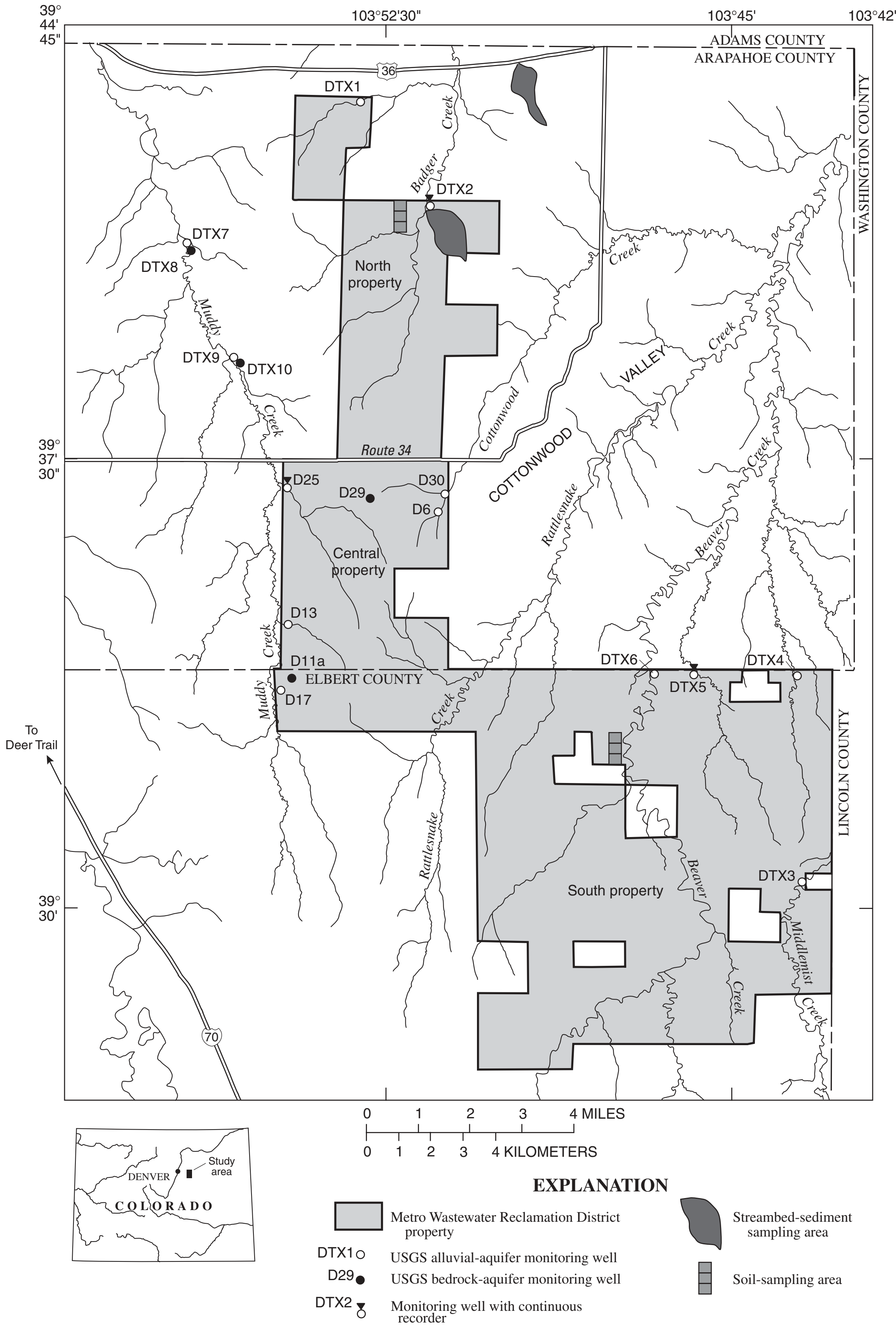


Figure 1. Location of study area and U.S. Geological Survey (USGS) monitoring sites near Deer Trail, Colorado, 1999.

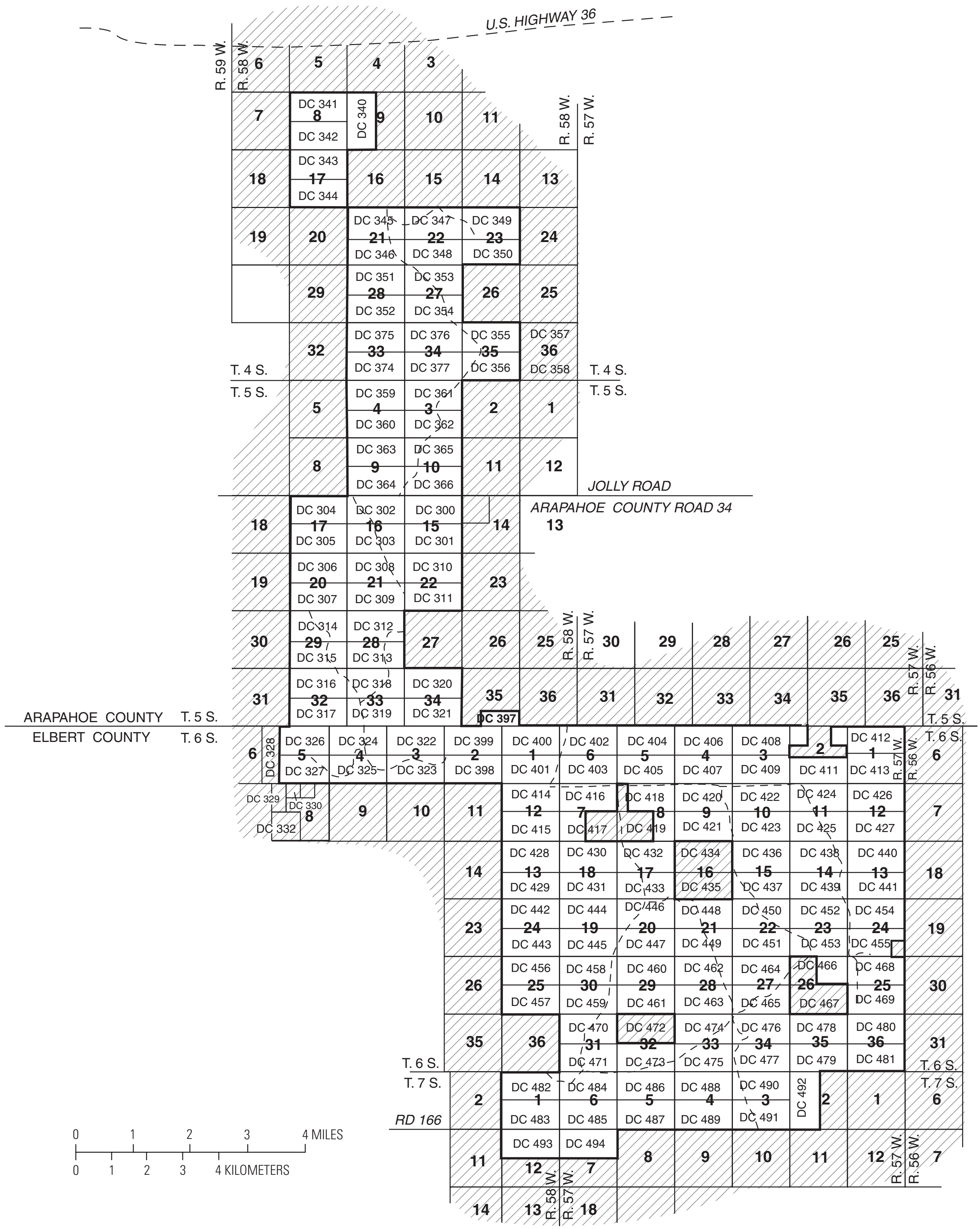


Figure 2. Metro Wastewater Reclamation District biosolids-application areas near Deer Trail, Colorado (modified from Metro Wastewater Reclamation District).

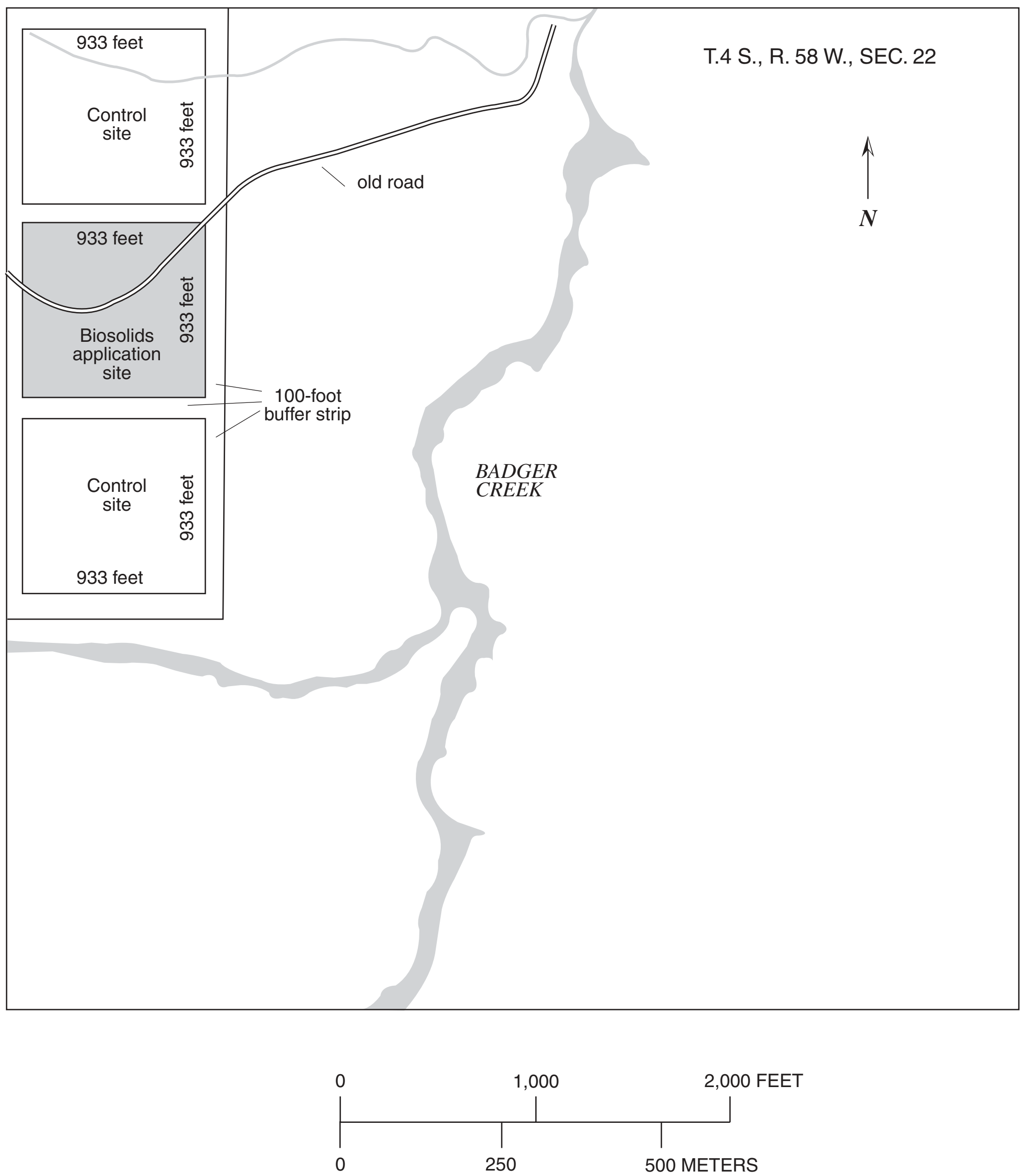


Figure 3. Arapahoe County, Colorado, soil-monitoring site: T. 4 S., R. 58 W., sec. 22 (modified from Metro Wastewater Reclamation District).

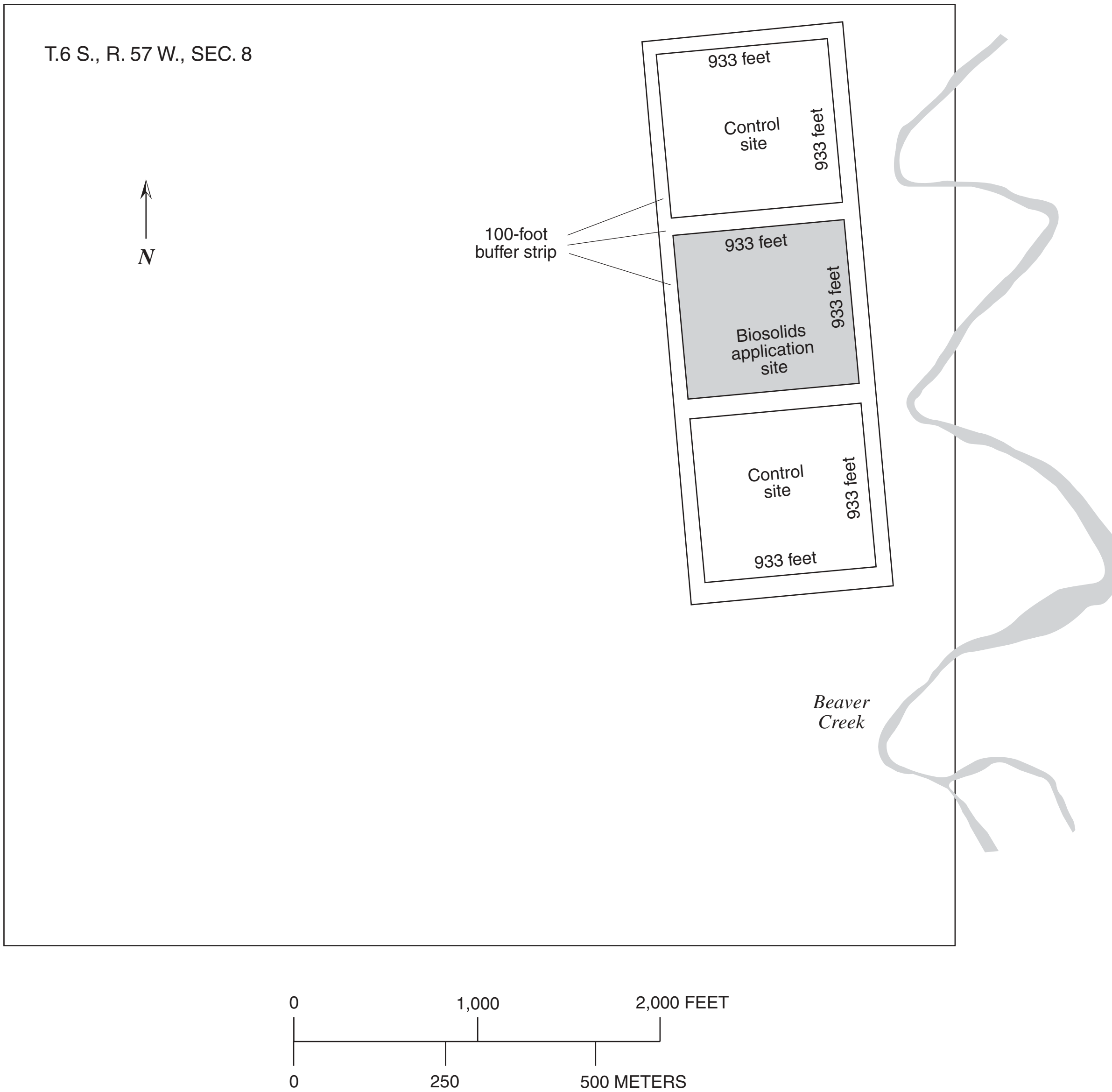
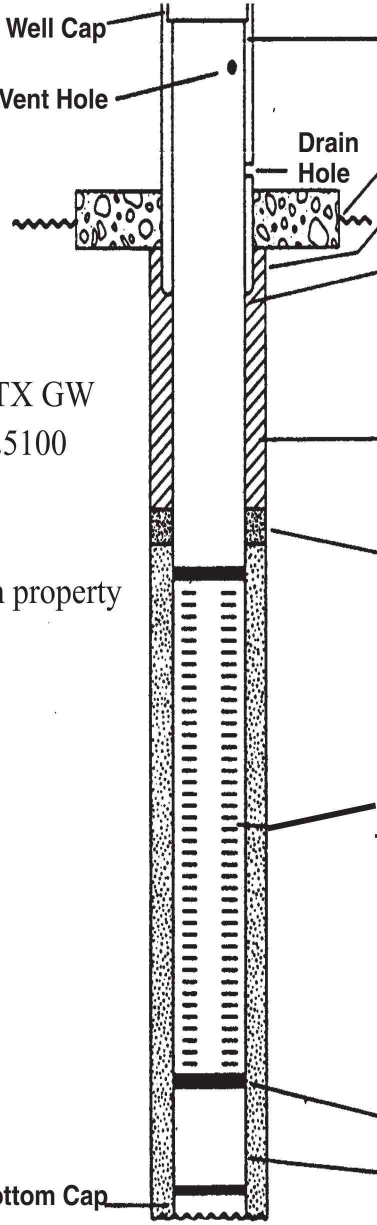


Figure 4. Elbert County, Colorado, soil-monitoring site: T. 6 S., R. 57 W., sec. 8 (modified from Metro Wastewater Reclamation District).



Stickup............................ 2.57 feet

Well Development..........

Traffic Pad .... 2' x 2' x 4" (concrete)

Borehole Diameter .... 8 5/8"

Casing Diameter .... 2"

Material .... PVC, SCH. 40

Length....................... 2.57' ALS to 18.02'; 20.59'

Grout: Material/Mixture . Bentonite chip+cement

Setting....................... 0-15.7' bls

Plug: Material .... Bentonite Tablets (1/4")

Setting....................... 15.7-16.4'bls

Sandpack: Material........ Silica sand

Gradation.................. 10/20

Setting....................... 16.4-25.0' bls

Screen: Material............ PVC, SCH. 40

Length....................... 1.6'

Type.......................... Slotted screen

Opening Size............ 0.010"

Setting....................... 18.02-19.62' bls

Coupling........................ Threaded

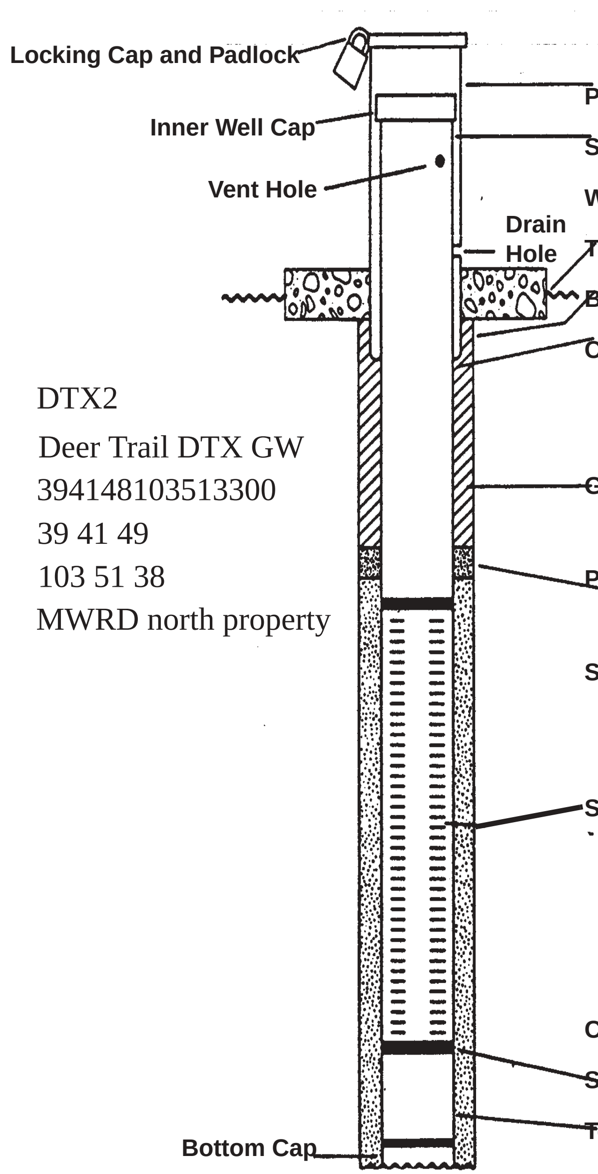
Sump Length .... 19.62-22.93' bls; 3.31'

Total Depth of Well .... 22.93' bls well; 25.0' bls borehole

Well Number:	DTX1
Project	Deer Trail DTX GW
U.S.G.S.	394333103525100
Latitude	39 43 33
Longitude	103 52 51
Local	MWRD north property

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; F
polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium).



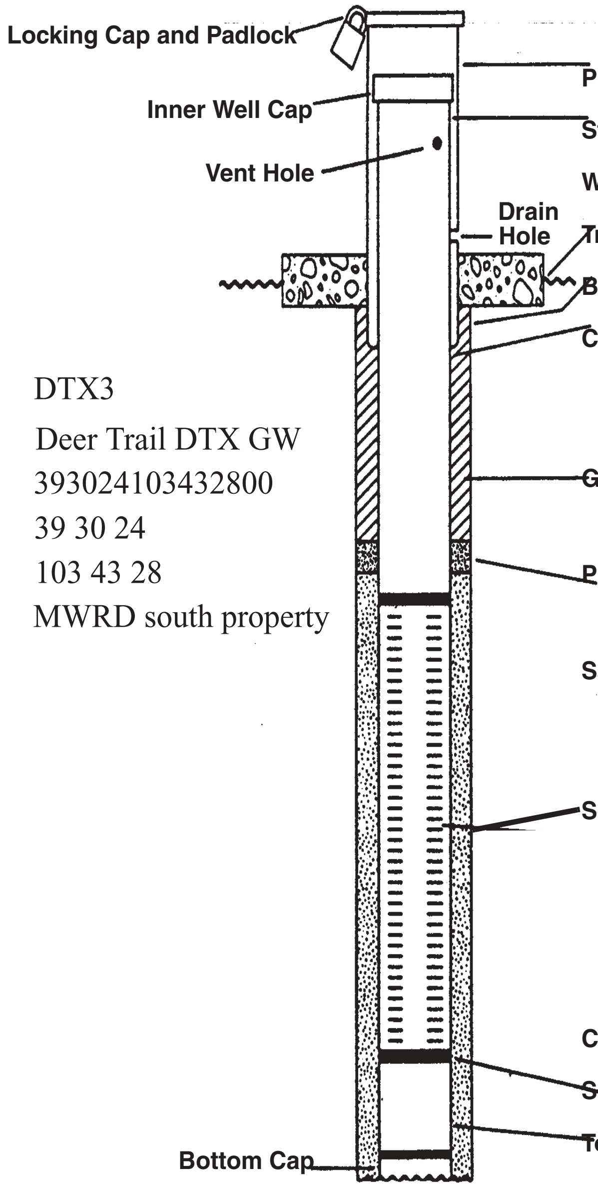
Well Number:	DTX2
Project	Deer Trail DTX GW
U.S.G.S.	394148103513300
Latitude	39 41 49
Longitude	103 51 38
Local	MWRD north property

Protective Casing	6” x 6” x 5’ steel cover
Stickup	3.22 feet
Well Development	
Traffic Pad	2’ x 2’ x 4” (concrete)
Borehole Diameter	8 5/8”
Casing Diameter	2”
Material	PVC, SCH. 40
Length	3.22’ ALS to 12.37’; 15.59’
Grout: Material/Mixture	Bentonite chip+cement
Setting	0-8.0’ bls
Plug: Material	Bentonite Tablets (1/4”)
Setting	8.0-9.5’bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	9.5-18.5’ bls
Screen: Material	PVC, SCH. 40
Length	1.6’
Type	Slotted screen
Opening Size	0.010”
Setting	12.37-13.97’ bls
Coupling	Threaded
Sump Length	13.97-17.28’ bls; 3.31’
Total Depth of Well	17.28’ bls well; 18.5’ bls borehole

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

Well Number:	DTX3
Project	Deer Trail DTX GW
U.S.G.S.	393024103432800
Latitude	39 30 24
Longitude	103 43 28
Local	MWRD south property



Protective Casing	6" x 6" x 5' steel cover
Stickup	3.12 feet
Well Development	
Traffic Pad	2' x 2' x 4" (concrete)
Borehole Diameter	8 5/8"
Casing Diameter	2"
Material	PVC, SCH. 40
Length	3.12' ALS to 11.1'; 14.22'
Grout: Material/Mixture	Bentonite chip+cement
Setting	0-6.5' bls
Plug: Material	Bentonite Tablets (1/4")
Setting	6.5-8.5'bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	8.5-16.0' bls
Screen: Material	PVC, SCH. 40
Length	1.6'
Type	Slotted screen
Opening Size	0.010"
Setting	11.1-12.7' bls
Coupling	Threaded
Sump Length	12.7-16.01' bls; 3.31'
Total Depth of Well	16.0' bls well

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

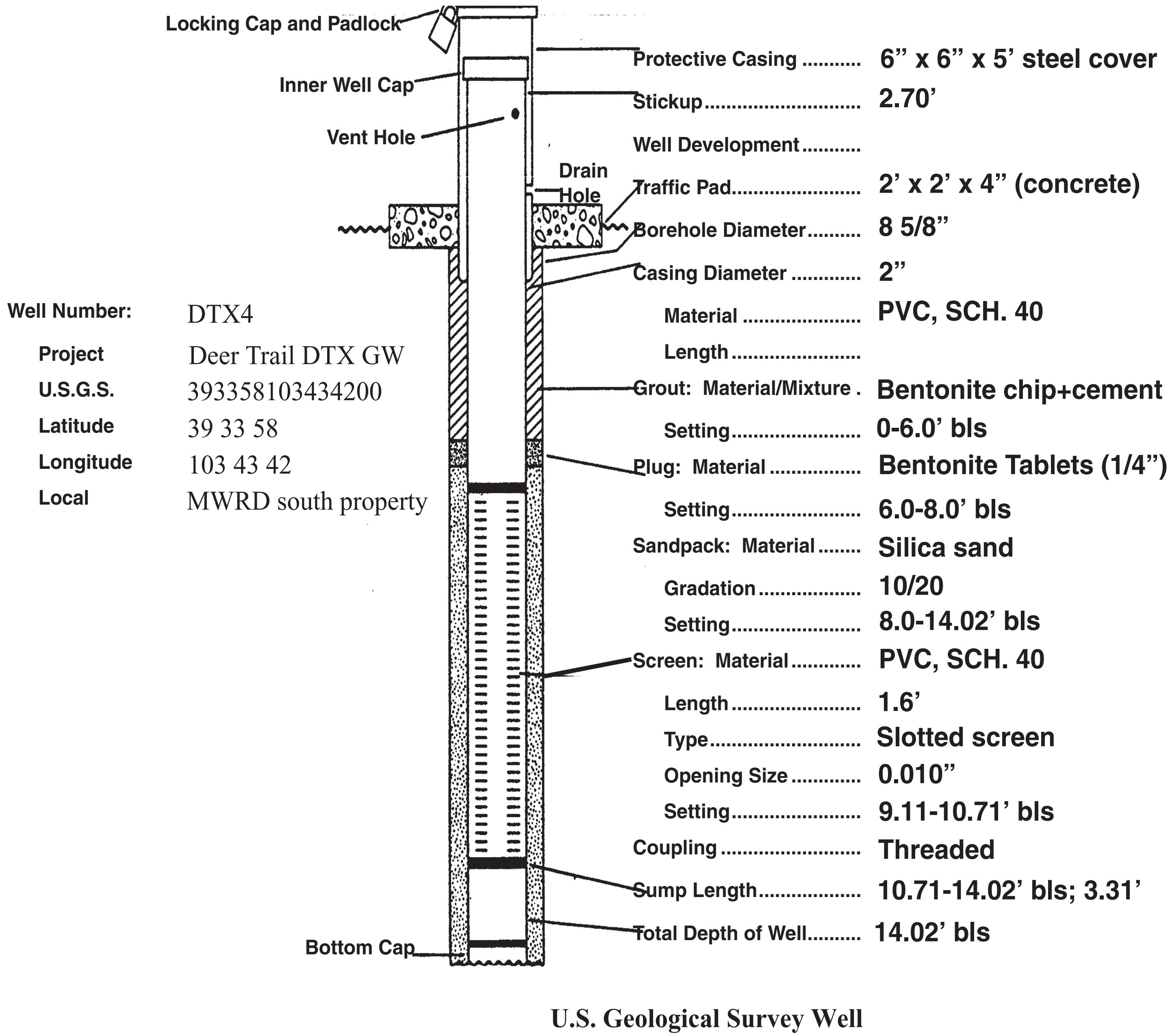


Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

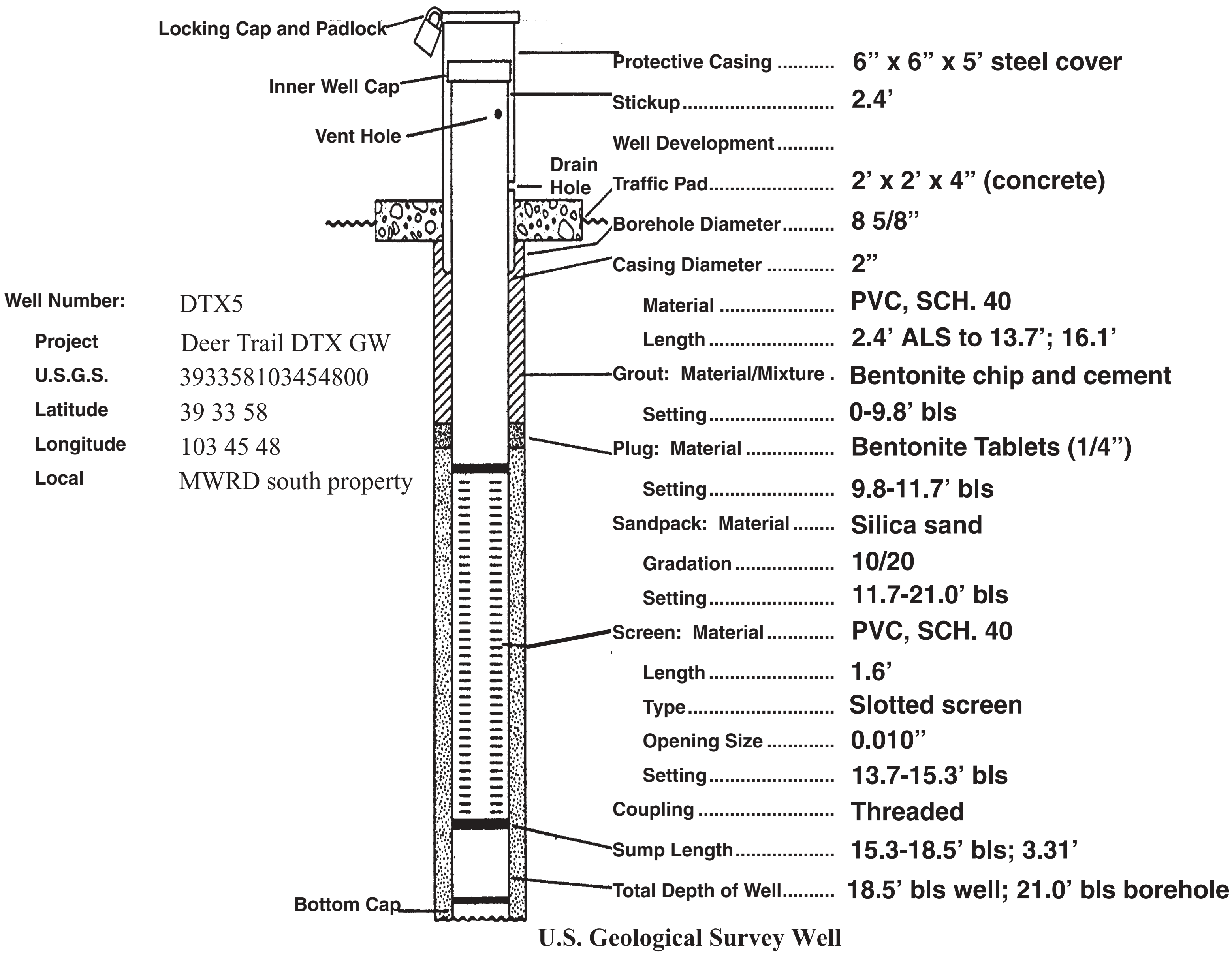
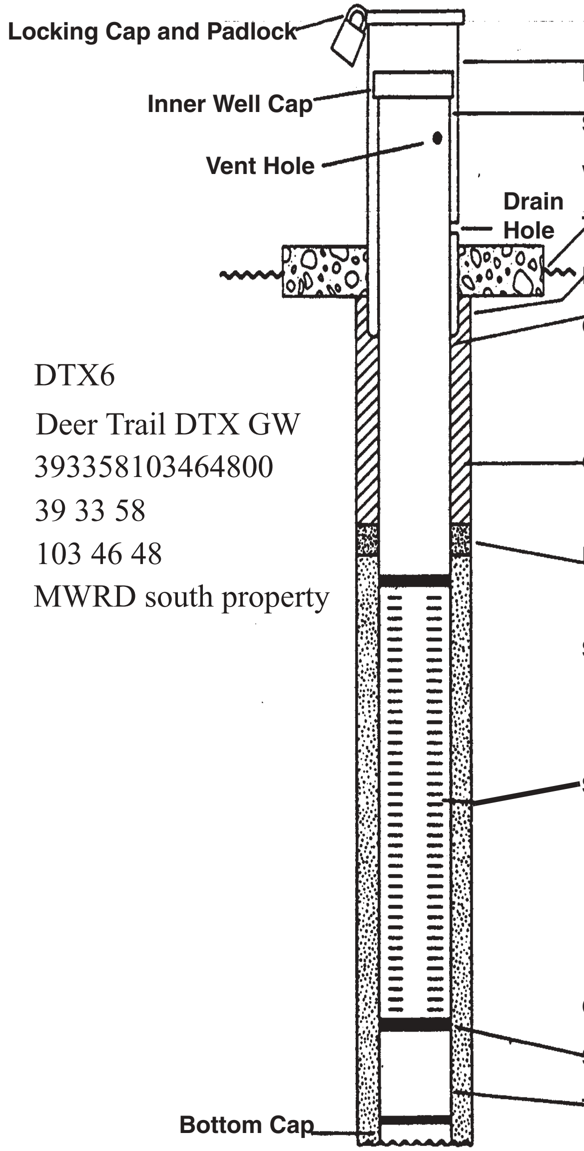


Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

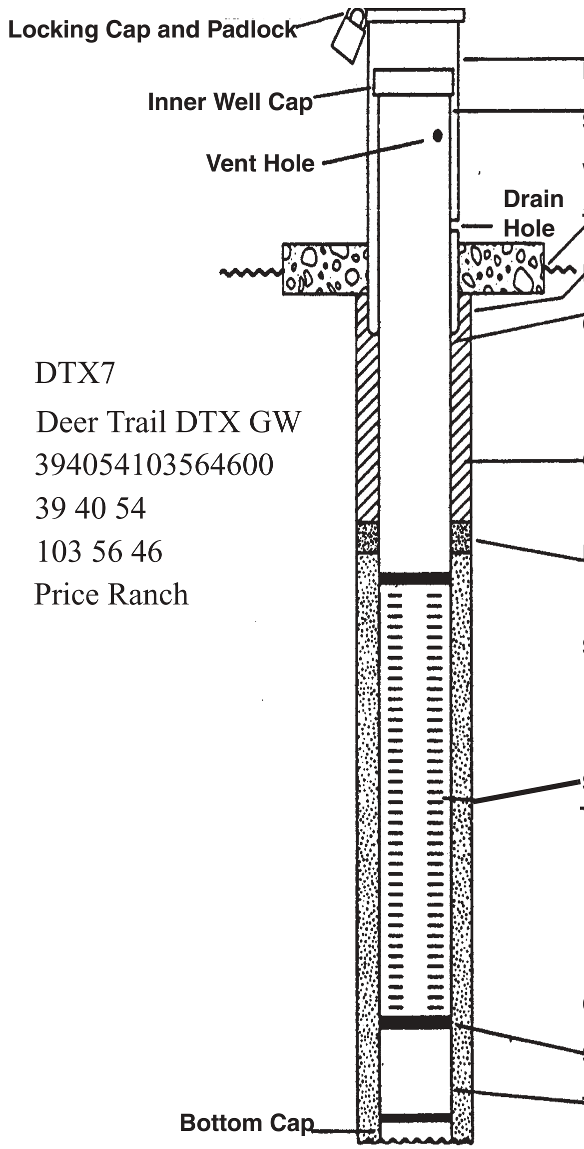
Well Number:	DTX6
Project	Deer Trail DTX GW
U.S.G.S.	393358103464800
Latitude	39 33 58
Longitude	103 46 48
Local	MWRD south property



Protective Casing	6" x 6" x 5' steel cover
Stickup	2.7'
Well Development	
Traffic Pad	2' x 2' x 4" (concrete)
Borehole Diameter	8 5/8"
Casing Diameter	2"
Material	PVC, SCH. 40
Length	2.7' ALS to 31.6'; 34.3'
Grout: Material/Mixture	Bentonite chip+cement
Setting	0-29.5' bls
Plug: Material	Bentonite Tablets (1/4")
Setting	29.5-30.0' bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	30.0-36.5' bls
Screen: Material	PVC, SCH. 40
Length	1.6'
Type	Slotted screen
Opening Size	0.010"
Setting	31.6-33.6' bls
Coupling	Threaded
Sump Length	33.6-36.5' bls; 3.31'
Total Depth of Well	36.5' bls well

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.



Well Number:	DTX7	
Project	Deer Trail DTX GW	
U.S.G.S.	394054103564600	
Latitude	39 40 54	
Longitude	103 56 46	
Local	Price Ranch	

Protective Casing	6” x 6” x 5’ steel cover
Stickup	2.77’
Well Development	
Traffic Pad	2’ x 2’ x 4” (concrete)
Borehole Diameter	8 5/8”
Casing Diameter	2”
Material	PVC, SCH. 40
Length	2.67’ ALS to 8.52’; 11.19’
Grout: Material/Mixture	Bentonite chip+cement
Setting	0-4.0’ bls
Plug: Material	Bentonite Tablets (1/4”)
Setting	4.0-7.0 bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	7.0-13.43’ bls
Screen: Material	PVC, SCH. 40
Length	1.6’
Type	Slotted screen
Opening Size	0.010”
Setting	8.52-10.12’ bls
Coupling	Threaded
Sump Length	10.12-13.43’ bls; 3.31’
Total Depth of Well	13.43’ bls

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

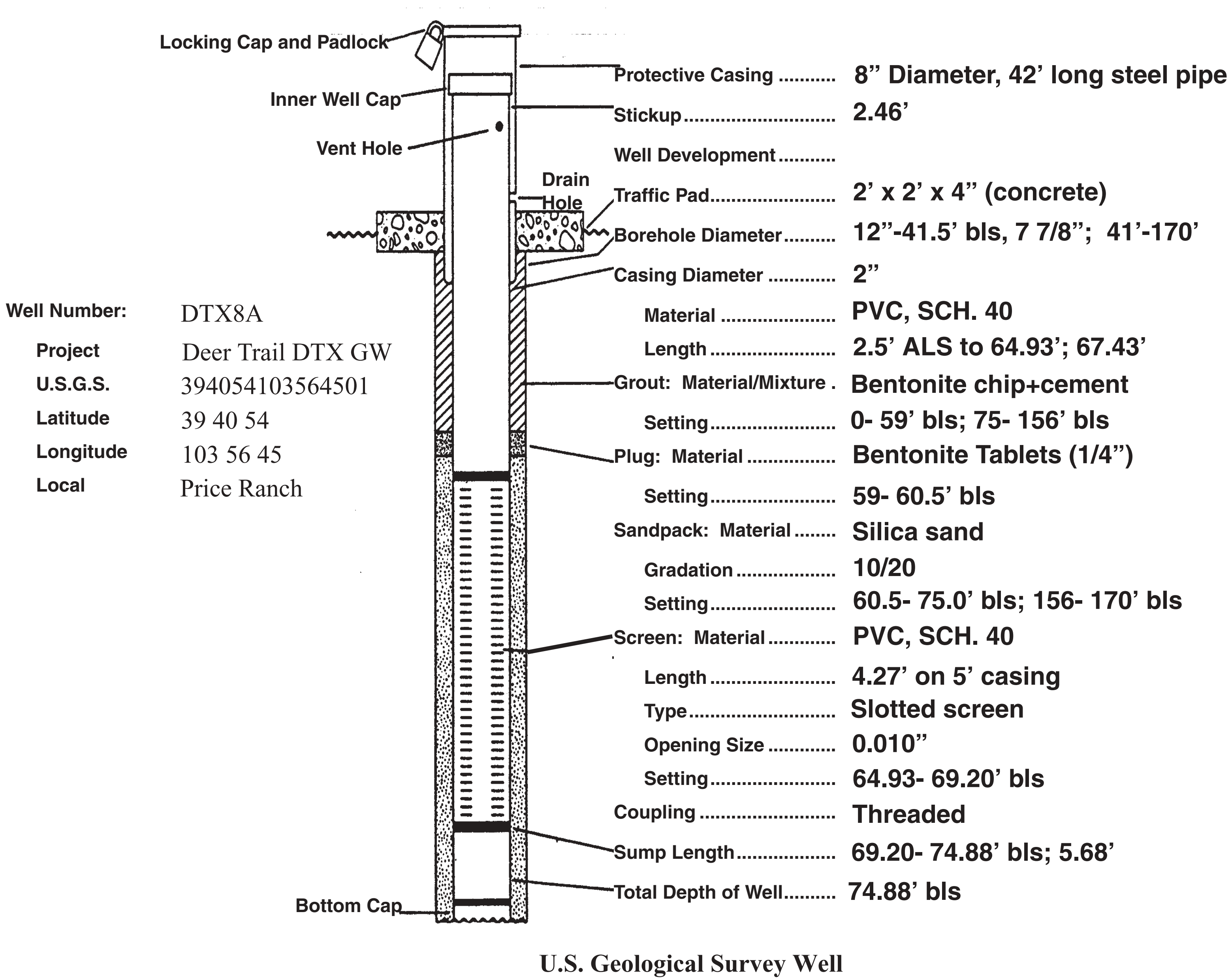
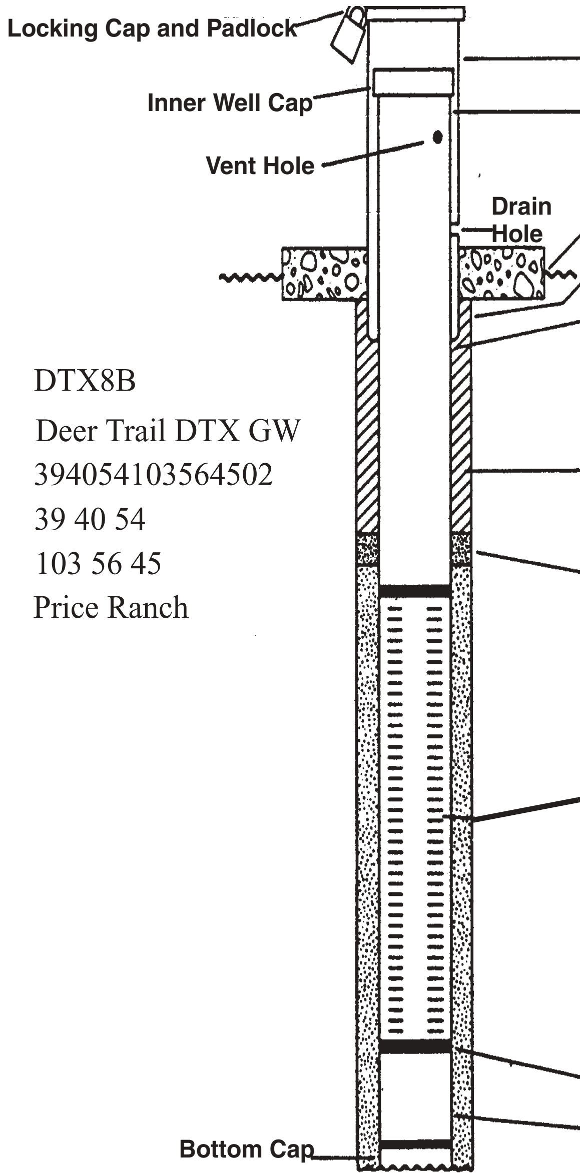


Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

Well Number:	DTX8B
Project	Deer Trail DTX GW
U.S.G.S.	394054103564502
Latitude	39 40 54
Longitude	103 56 45
Local	Price Ranch



Protective Casing	8” Diameter, 42’ long steel pipe
Stickup	2.49’
Well Development	
Traffic Pad	2’ x 2’ x 4” (concrete)
Borehole Diameter	12”-41.5’ bls, 7 7/8”; 41’-170’
Casing Diameter	2”
Material	PVC, SCH. 40
Length	2.5’ ALS to 159.97’; 162.47’
Grout: Material/Mixture	Bentonite chip+cement
Setting	0- 59’ bls; 75- 156’ bls
Plug: Material	Bentonite Tablets (1/4”)
Setting	59- 60.5’ bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	60.5- 75.0’ bls; 156- 170’ bls
Screen: Material	PVC, SCH. 40
Length	4.27’ on 5’ casing
Type	Slotted screen
Opening Size	0.010”
Setting	159.97- 164.24’ bls
Coupling	Threaded
Sump Length	164.24- 169.92’ bls; 5.68’
Total Depth of Well	170’ bls

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

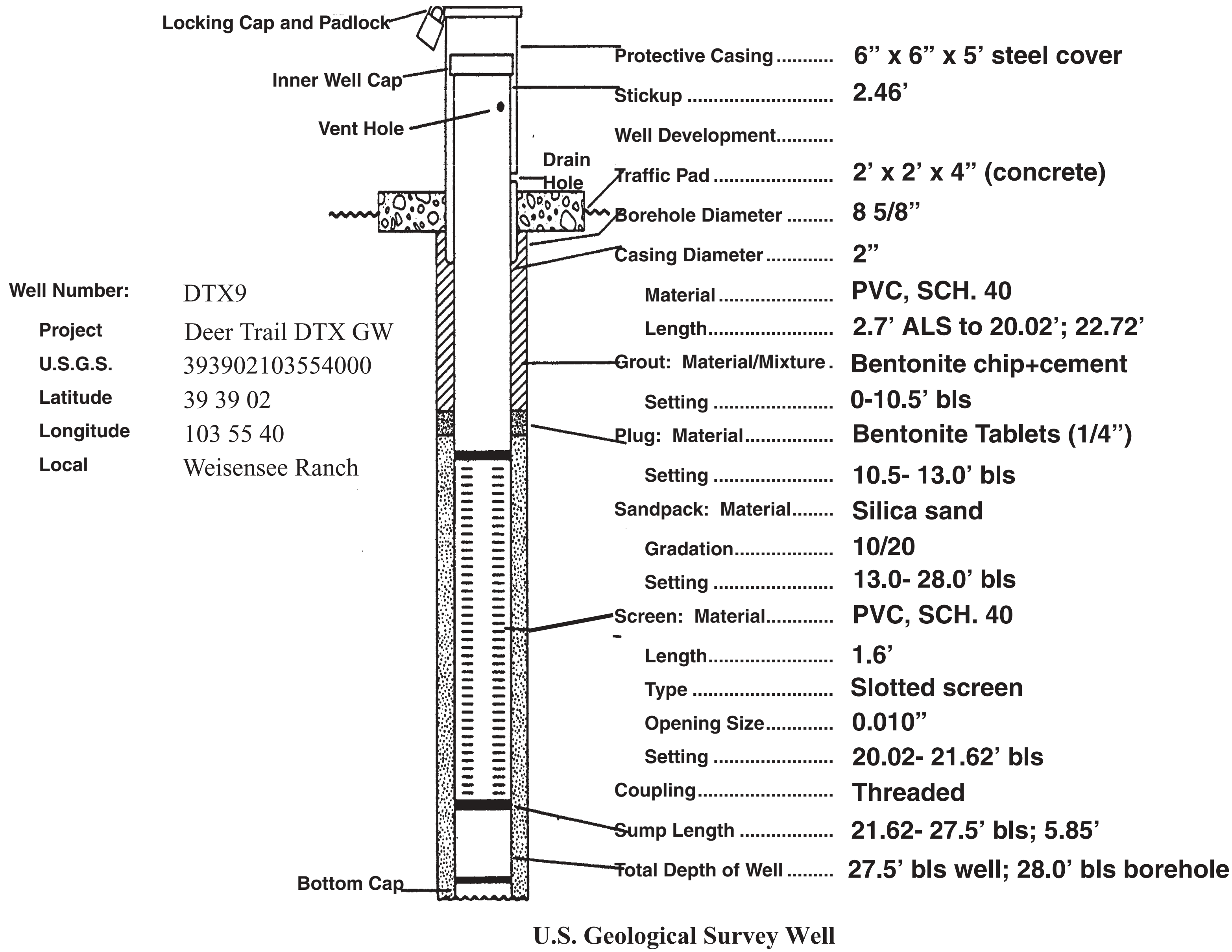
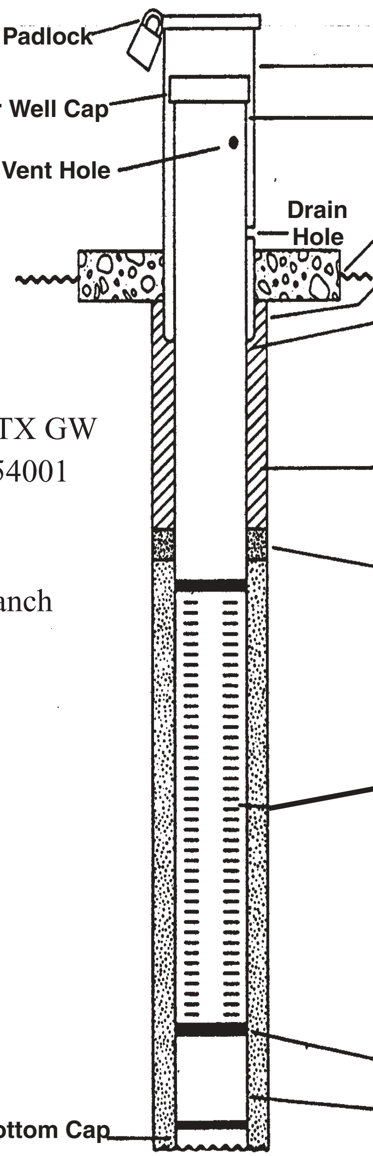


Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

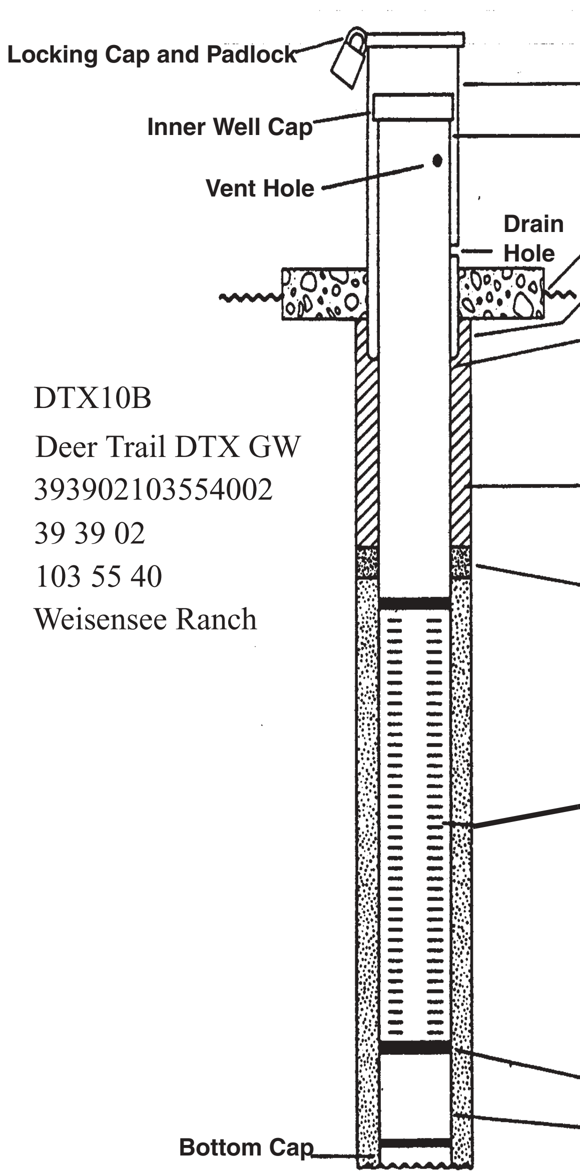


Well Number:	DTX10A
Project	Deer Trail DTX GW
U.S.G.S.	393902103554001
Latitude	39 39 02
Longitude	103 55 40
Local	Weisensee Ranch

Protective Casing	8” Diameter, 36’ long steel pipe
Stickup	2.03’
Well Development	
Traffic Pad	2’ x 2’ x 4” (concrete)
Borehole Diameter	12”- 35’ bls, 7 7/8”; 34.5’- 120’
Casing Diameter	2”
Material	PVC, SCH. 40
Length	2.5’ ALS to 50.71’; 53.21’
Grout: Material/Mixture	Bentonite chip+cement
Setting	0-39’ bls; 60- 97’ bls
Plug: Material	Bentonite Tablets (1/4”)
Setting	39- 43’ bls; 97- 104’ bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	43- 60’ bls; 104- 120’ bls
Screen: Material	PVC, SCH. 40
Length	4.27’ on 5’ casing
Type	Slotted screen
Opening Size	0.010”
Setting	50.71-54.98’bls
Coupling	Threaded
Sump Length	54.98- 60.66’ bls; 5.68’
Total Depth of Well	60.66’ bls

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

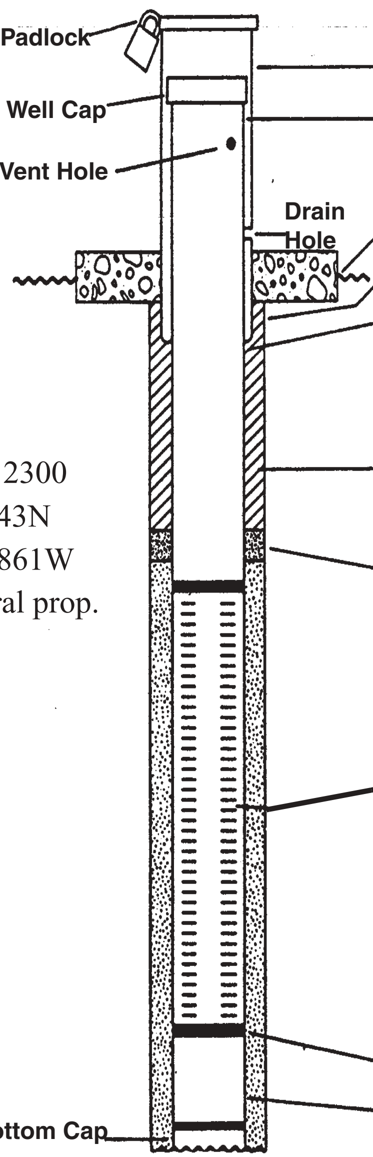


Well Number:	DTX10B
Project	Deer Trail DTX GW
U.S.G.S.	393902103554002
Latitude	39 39 02
Longitude	103 55 40
Local	Weisensee Ranch

Protective Casing	8” Diameter, 36’
Stickup	2.10’
Well Development	
Traffic Pad	2’ x 2’ x 4” (concrete)
Borehole Diameter	12”- 35’ bls, 7 7/8”; 34.5’- 120’
Casing Diameter	2”
Material	PVC, SCH. 40
Length	2.5’ ALS to 109.55’; 112.05’
Grout: Material/Mixture	Bentonite chip+cement
Setting	0-39’ bls; 60- 97’ bls
Plug: Material	Bentonite Tablets (1/4”)
Setting	39- 43’ bls; 97- 104’ bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	43- 60’ bls; 104- 120’ bls
Screen: Material	PVC, SCH. 40
Length	4.27’ on 5’ casing
Type	Slotted screen
Opening Size	0.010”
Setting	109.55- 113.82’ bls
Coupling	Threaded
Sump Length	113.82- 119.5’ bls; 5.68’
Total Depth of Well	120’ bls

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

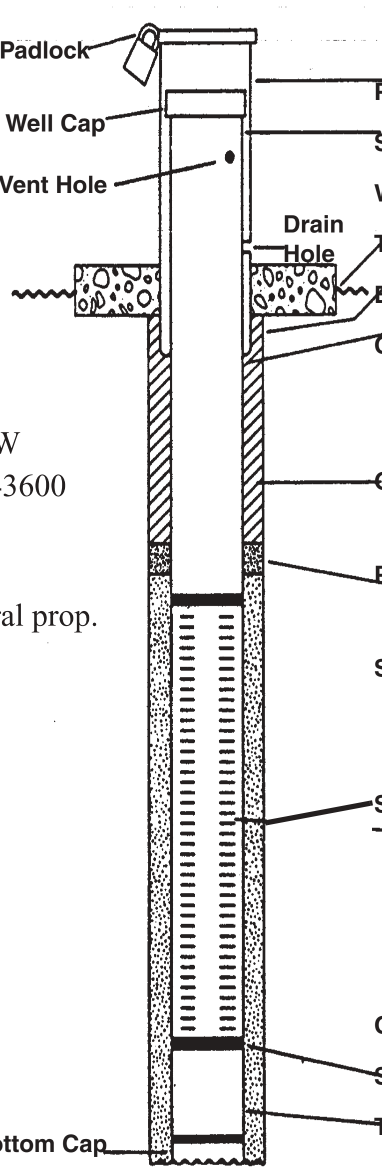


Well Number:	D6
Project	Deer Trail
U.S.G.S.	393633103512300
Latitude	39 36 32.92243N
Longitude	103 51 22.41861W
Local	MWRD central prop.

Protective Casing	6"X6"X5' (Aluminum)
Stickup	2.65'
Well Development	
Traffic Pad	2'X2'X4" (Concrete)
Borehole Diameter	5.50"
Casing Diameter	2.375"
Material	PVC, SCH.40
Length	13'
Grout: Material/Mixture	Pure Gold/Bentonite Slurry
Setting	0'-6'
Plug: Material	Bentonite Tablets (1/4")
Setting	6'-9'
Sandpack: Material	Silica Sand (4 50-pound bags)
Gradation	10/20
Setting	9'-23'
Screen: Material	PVC. SCH.40
Length	10'
Type	Slotted Screen
Opening Size	0.010"
Setting	13'-23'
Coupling	Threaded
Sump Length	4" PVC
Total Depth of Well	23'

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

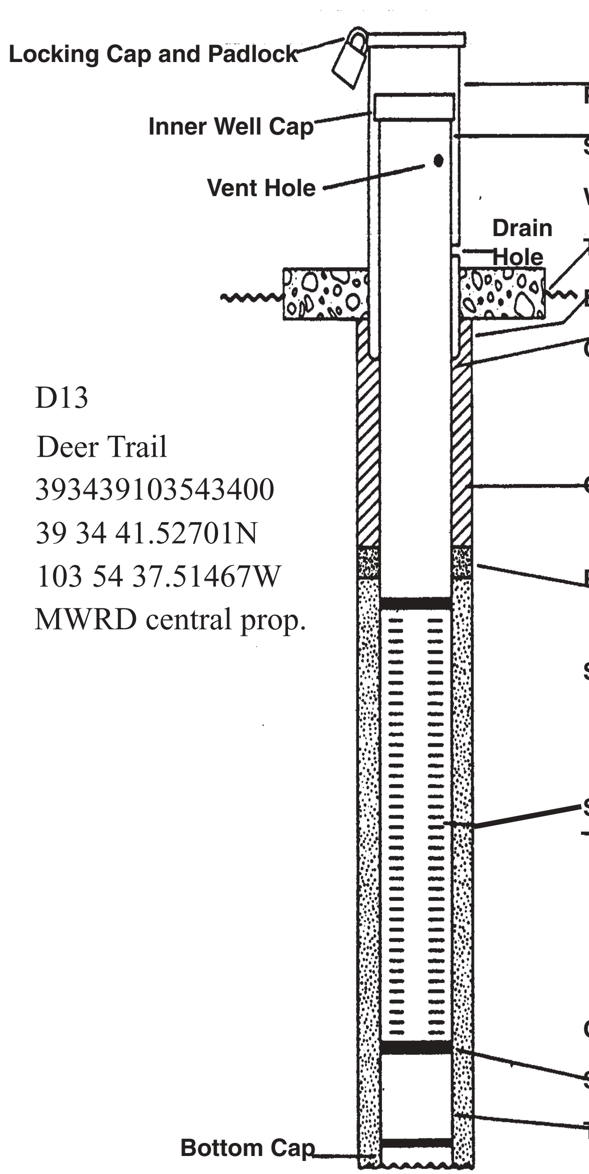


Well Number:	D11a
Project	Deer Trail GW
U.S.G.S.	393334103543600
Latitude	39 33 34
Longitude	103 54 36
Local	MWRD central prop.

Protective Casing	6” Diameter, 13’ steel pipe
Stickup	2.46’
Well Development	
Traffic Pad	2’ x 2’ x 4” (concrete)
Borehole Diameter	0-10’ bls=9 7/8”; 9-140’=5 7/8”
Casing Diameter	2”
Material	PVC, SCH. 40
Length	110.16’ (bls)
Grout: Material/Mixture	Pure Gold Grout, Na-Bentonite
Setting	0-90’ bls
Plug: Material	Bentonite Tablets (1/4”)
Setting	90-99.5’ bls
Sandpack: Material	Silica sand
Gradation	10/20
Setting	99.5-140.5’ bls
Screen: Material	PVC, SCH. 40
Length	10’
Type	Slotted screen
Opening Size	0.010”
Setting	110.16-120.16’ bls
Coupling	Threaded
Sump Length	20.38’ PVC
Total Depth of Well	140.54’ bls

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.



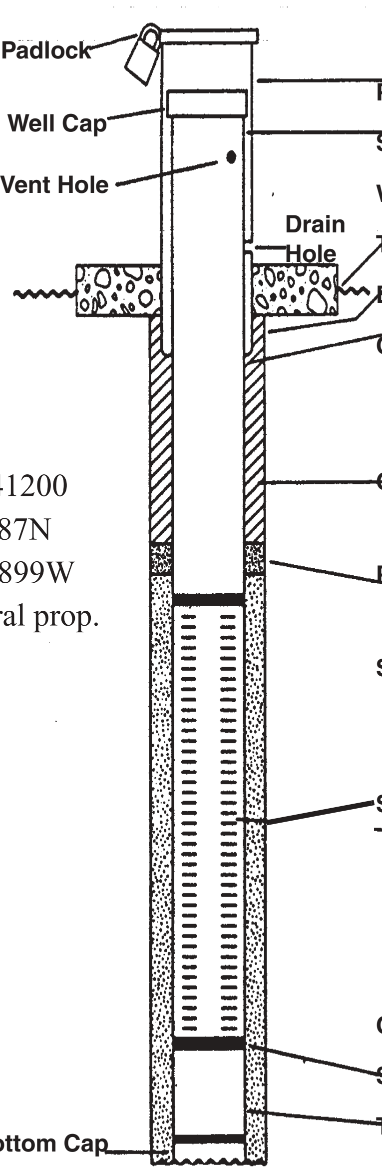
Well Number:	D13
Project	Deer Trail
U.S.G.S.	393439103543400
Latitude	39 34 41.52701N
Longitude	103 54 37.51467W
Local	MWRD central prop.

Protective Casing	6”X6”X5’ (Aluminum)
Stickup	1.81’
Well Development	
Traffic Pad	2’X2’X4” (Concrete)
Borehole Diameter	8.62”
Casing Diameter	2.375”
Material	PVC, SCH.40
Length	5’
Grout: Material/Mixture	Pure Gold
Setting	0’-0.5’
Plug: Material	Bentonite Tablets (1/4”)
Setting	0.5’-2.5’
Sandpack: Material	Silica Sand (9 50-pound bags)
Gradation	10/20: 16/40
Setting	4’-15’: 2.5’-4’
Screen: Material	PVC. SCH.40
Length	10’
Type	Slotted Screen
Opening Size	0.010”
Setting	5’-15’
Coupling	Threaded
Sump Length	4” PVC
Total Depth of Well	15’

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

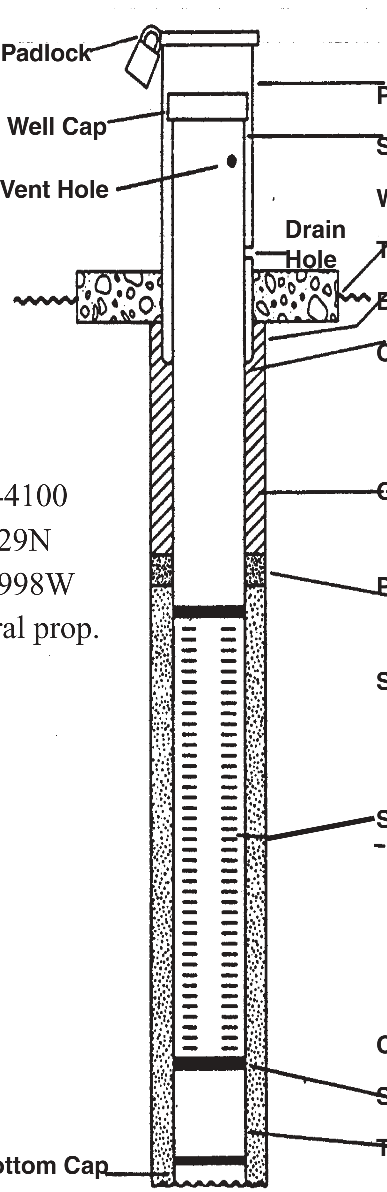
Well Number:	D17
Project	Deer Trail
U.S.G.S.	393327103541200
Latitude	39 33 34.44687N
Longitude	103 54 36.41899W
Local	MWRD central prop.



Protective Casing..........	6”X6”X5’ (Aluminum)
Stickup	1.90’
Well Development	
Traffic Pad	2’X2’X4” (Concrete)
Borehole Diameter	8.62”
Casing Diameter............	2.375”
Material	PVC, SCH.40
Length	10’
Grout: Material/Mixture.	Bentonite Grout
Setting	0’-3’
Plug: Material................	Bentonite Tablets (1/4”)
Setting	3’-6’
Sandpack: Material........	Silica Sand (9 50-pound bags)
Gradation	10/20: 16/40
Setting	7.5’-20’: 6’-7.5’
Screen: Material	PVC. SCH.40
Length	10’
Type	Slotted Screen
Opening Size............	0.010”
Setting	10’-20’
Coupling.........................	Threaded
Sump Length	4” PVC
Total Depth of Well	20’

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.



Well Number:	D25
Project	Deer Trail
U.S.G.S.	393702103544100
Latitude	39 37 02.36429N
Longitude	103 54 41.77998W
Local	MWRD central prop.

Protective Casing	6"X6"X5' (Aluminum)
Stickup	2.23'
Well Development	
Traffic Pad	2'X2'X4" (Concrete)
Borehole Diameter	8.62"
Casing Diameter	2.375"
Material	PVC, SCH.40
Length	16'
Grout: Material/Mixture	Pure Gold Bentonite Slurry
Setting	0'-10'
Plug: Material	Bentonite Tablets (1/4")
Setting	10'-12'
Sandpack: Material	Silica Sand
Gradation	10/20:16/40
Setting	13'-23':12'-13'
Screen: Material	PVC. SCH.40
Length	10'
Type	Slotted Screen
Opening Size	0.010"
Setting	13'-23'
Coupling	Threaded
Sump Length	4" PVC
Total Depth of Well	23'

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

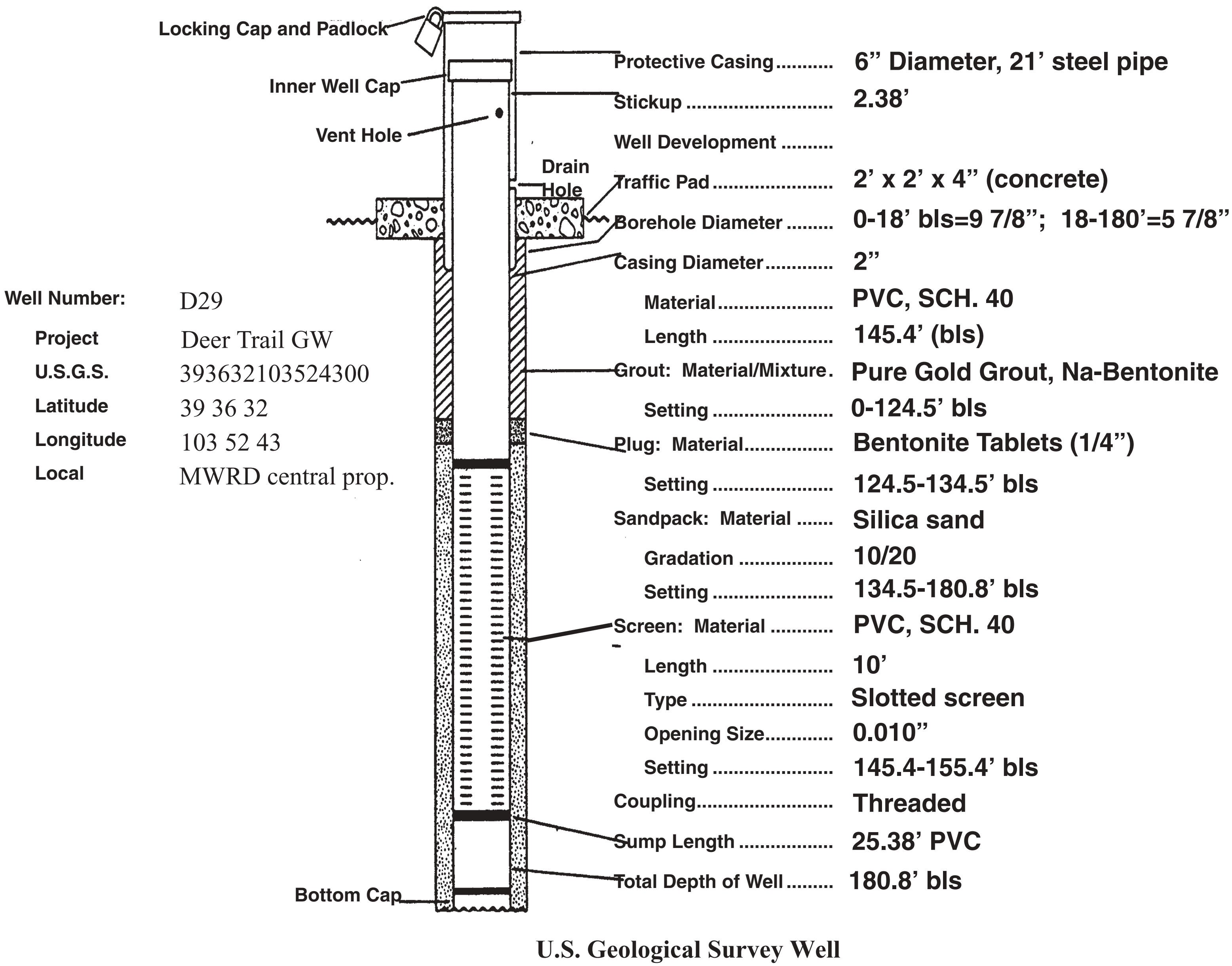
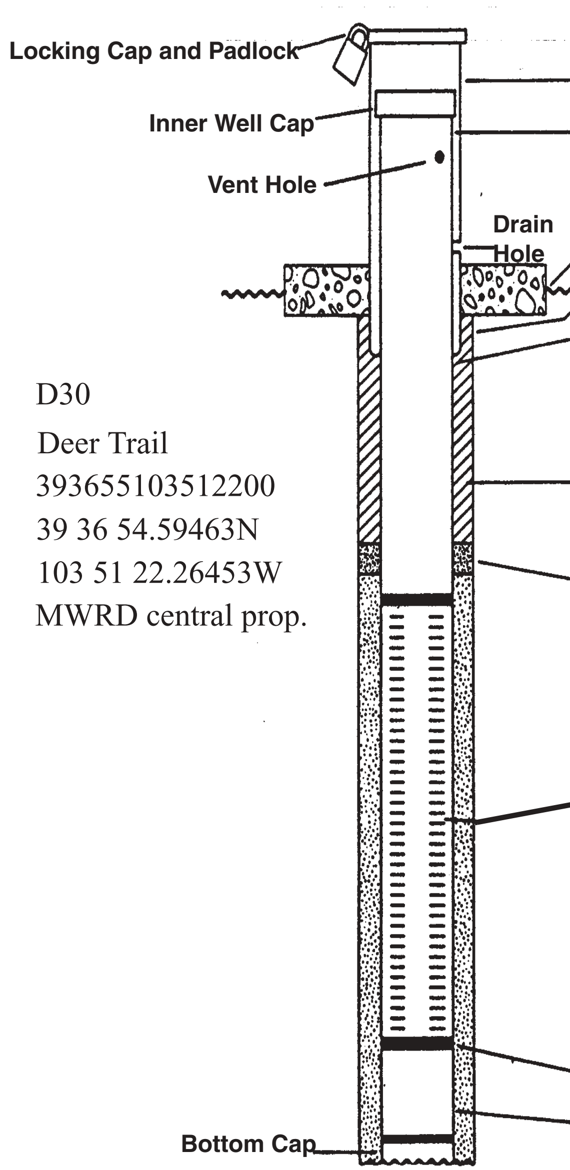


Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

Well Number:	D30
Project	Deer Trail
U.S.G.S.	393655103512200
Latitude	39 36 54.59463N
Longitude	103 51 22.26453W
Local	MWRD central prop.



Protective Casing	6"X6"X5' (Aluminum)
Stickup	1.98'
Well Development	
Traffic Pad	2'X2'X4" (Concrete)
Borehole Diameter	8.62"
Casing Diameter	2.375"
Material	PVC, SCH.40
Length	9.0'
Grout: Material/Mixture	Pure Gold Bentonite Slurry
Setting	0'-5.0'
Plug: Material	Bentonite Tablets (1/4")
Setting	5.0'- 7.0'
Sandpack: Material	Silica Sand
Gradation	10/20;16/40
Setting	9.0'-19'; 7.0'- 9.0'
Screen: Material	PVC. SCH. 40
Length	10'
Type	Slotted Screen
Opening Size	0.010"
Setting	9.0'- 19'
Coupling	Threaded
Sump Length	4" PVC
Total Depth of Well	19'

U.S. Geological Survey Well

Figure 5. Well-completion information for USGS monitoring wells near Deer Trail, Colorado, 1999 (latitude and longitude are in degrees minutes seconds; PVC, polyvinyl chloride; SCH., schedule; ALS, above land surface; bls, below land surface; prop., property; Na, sodium)—Continued.

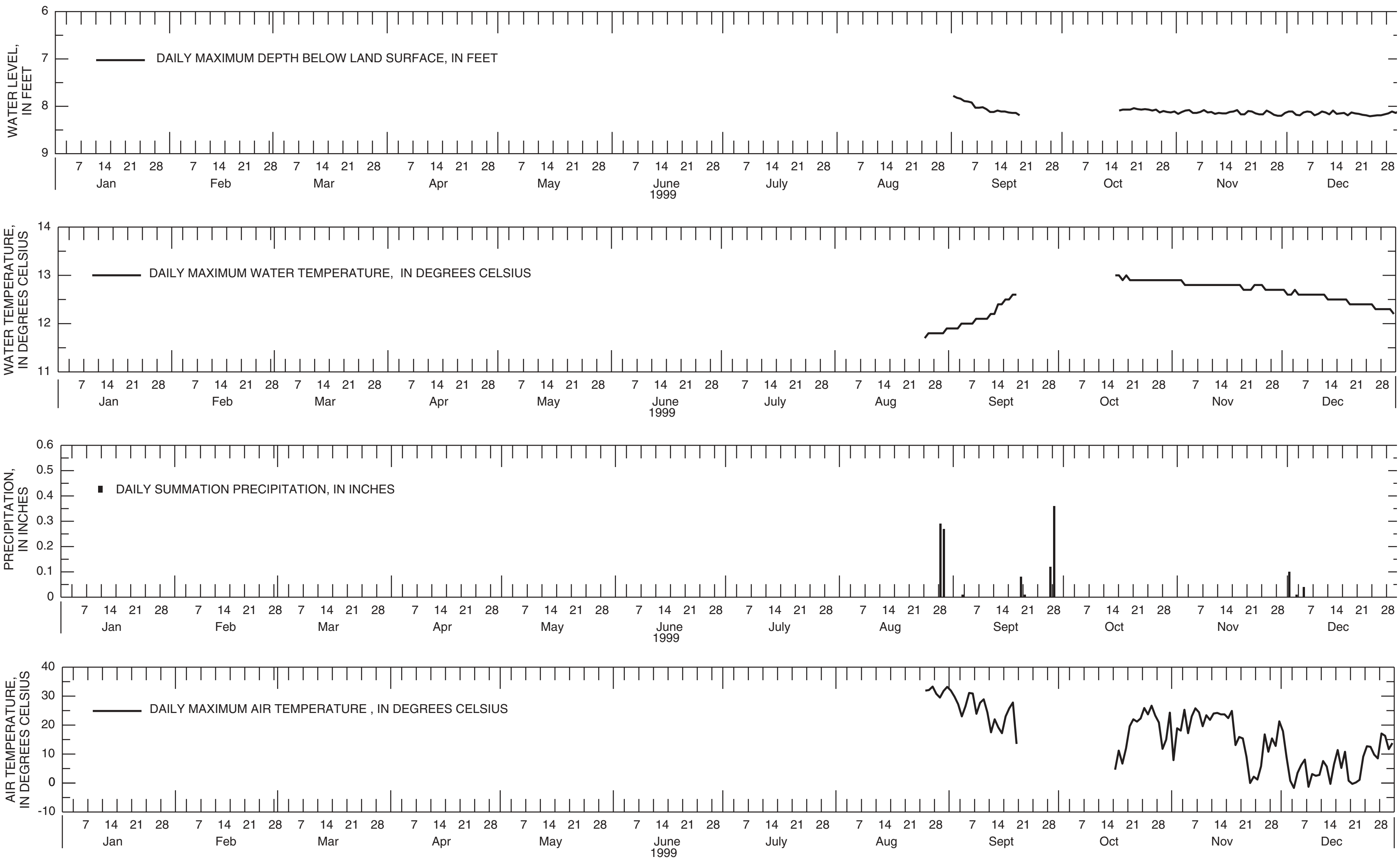


Figure 6. Continuous water-level, water-temperature, precipitation, and air-temperature data for well D25 near Deer Trail, Colorado, 1999. Data collection began in August.

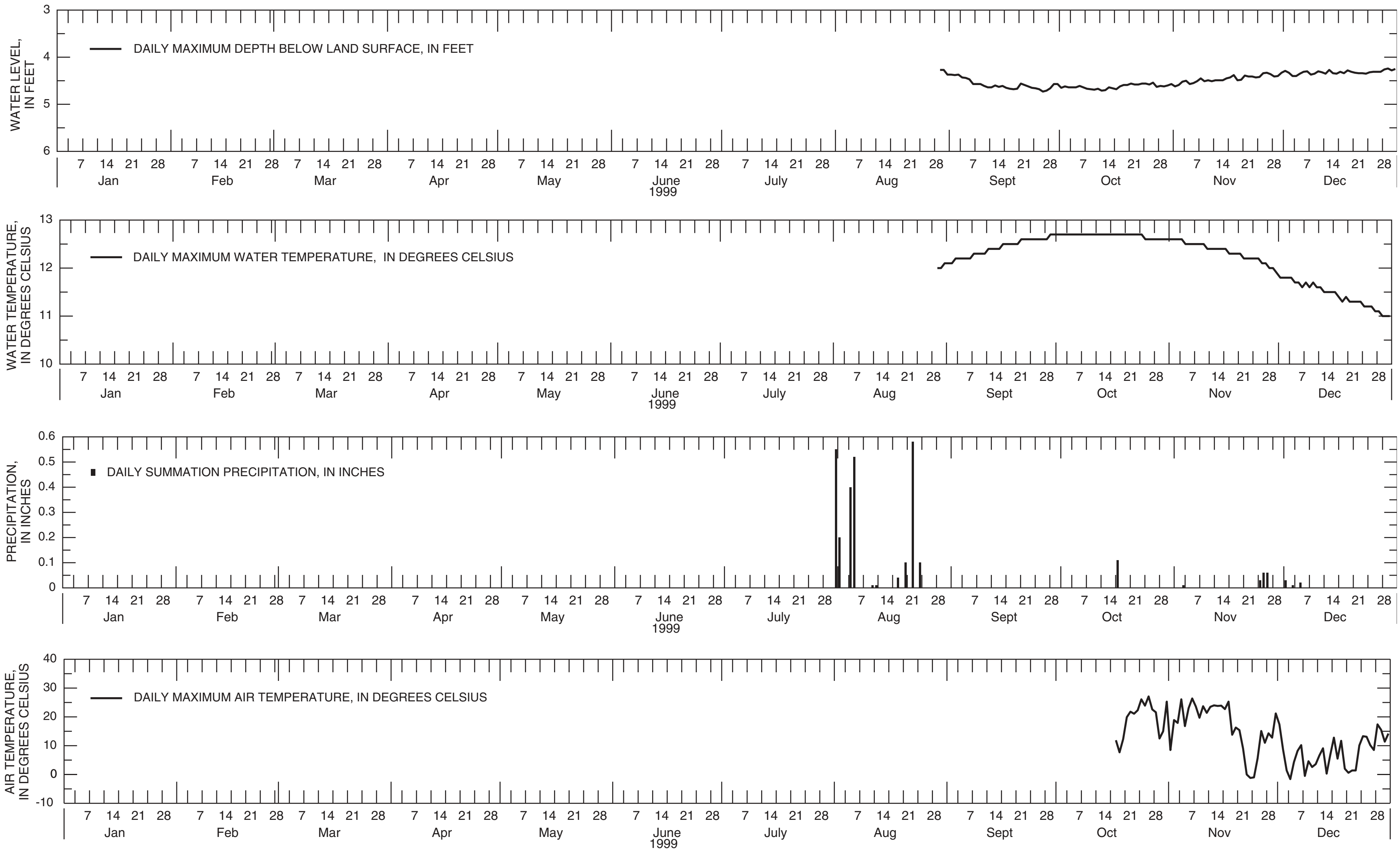


Figure 7. Continuous water-level, water-temperature, precipitation, and air-temperature data for well DTX2 near Deer Trail, Colorado, 1999. Data collection began August-October.

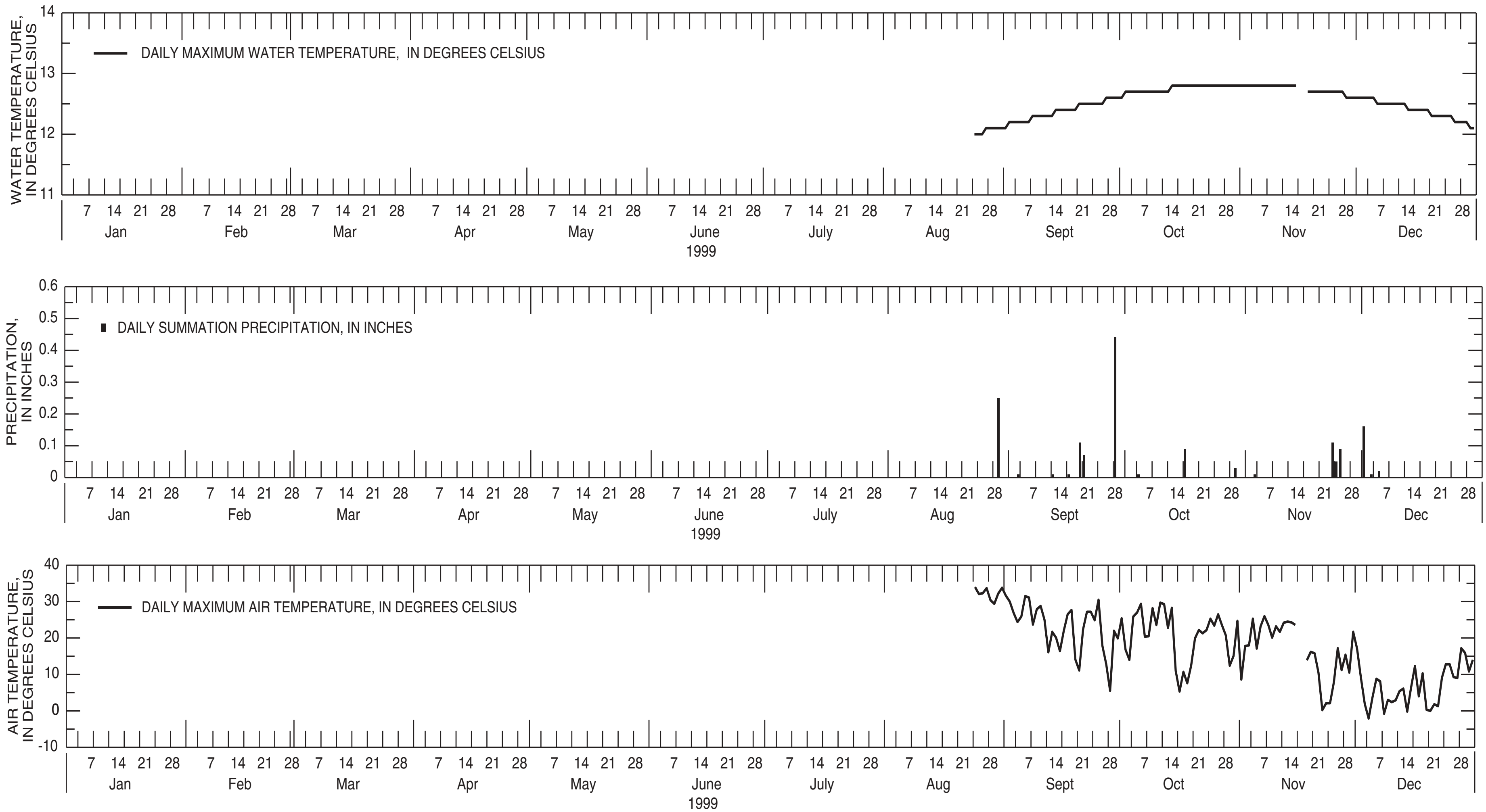


Figure 8. Continuous water-temperature, precipitation, and air-temperature data for well DTX5 near Deer Trail, Colorado, 1999. No water-level data are available. Data collection began in August.

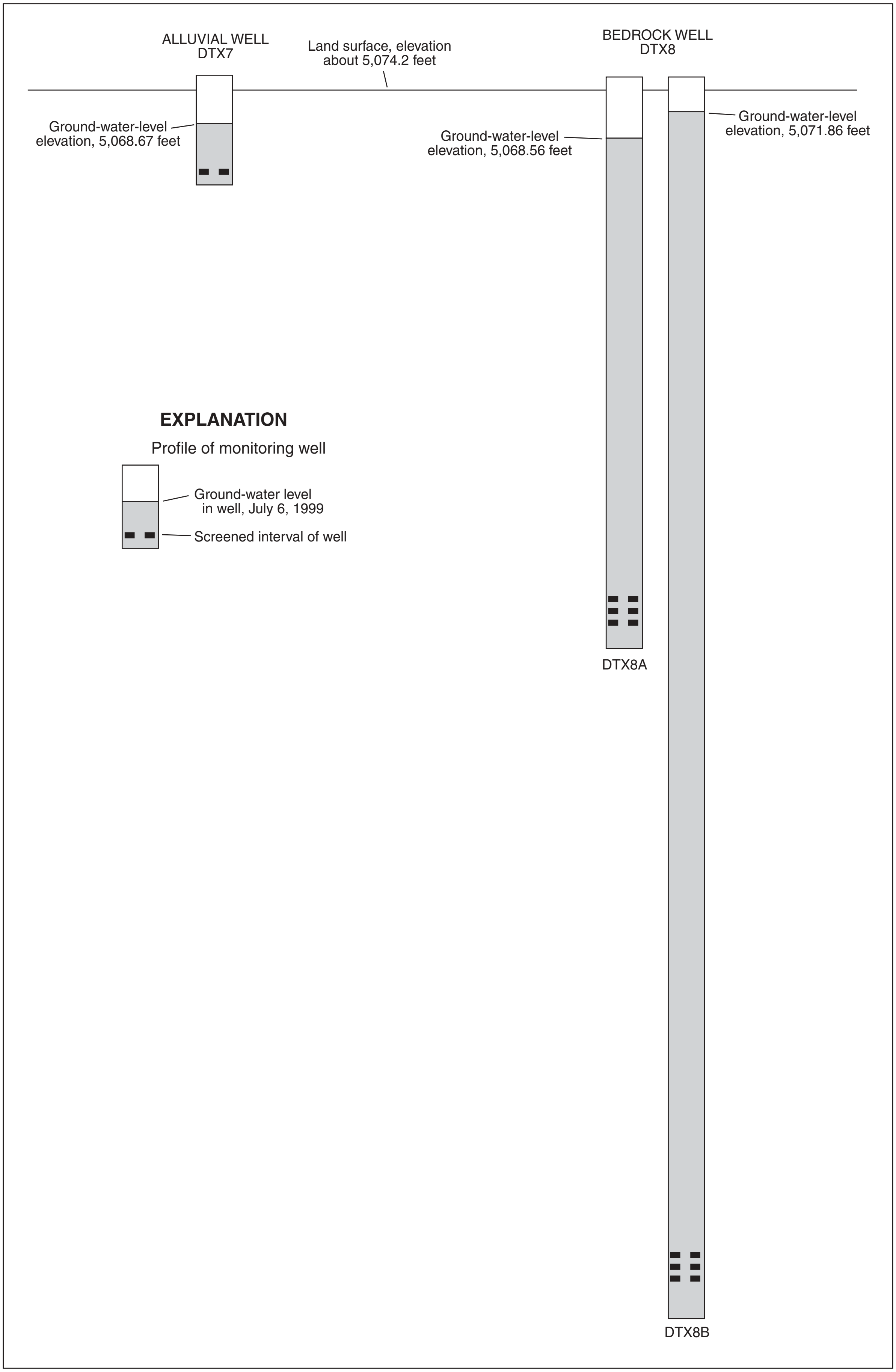


Figure 9. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 (includes DTX8A and DTX8B) near Deer Trail, Colorado, for July, August, and September 1999.

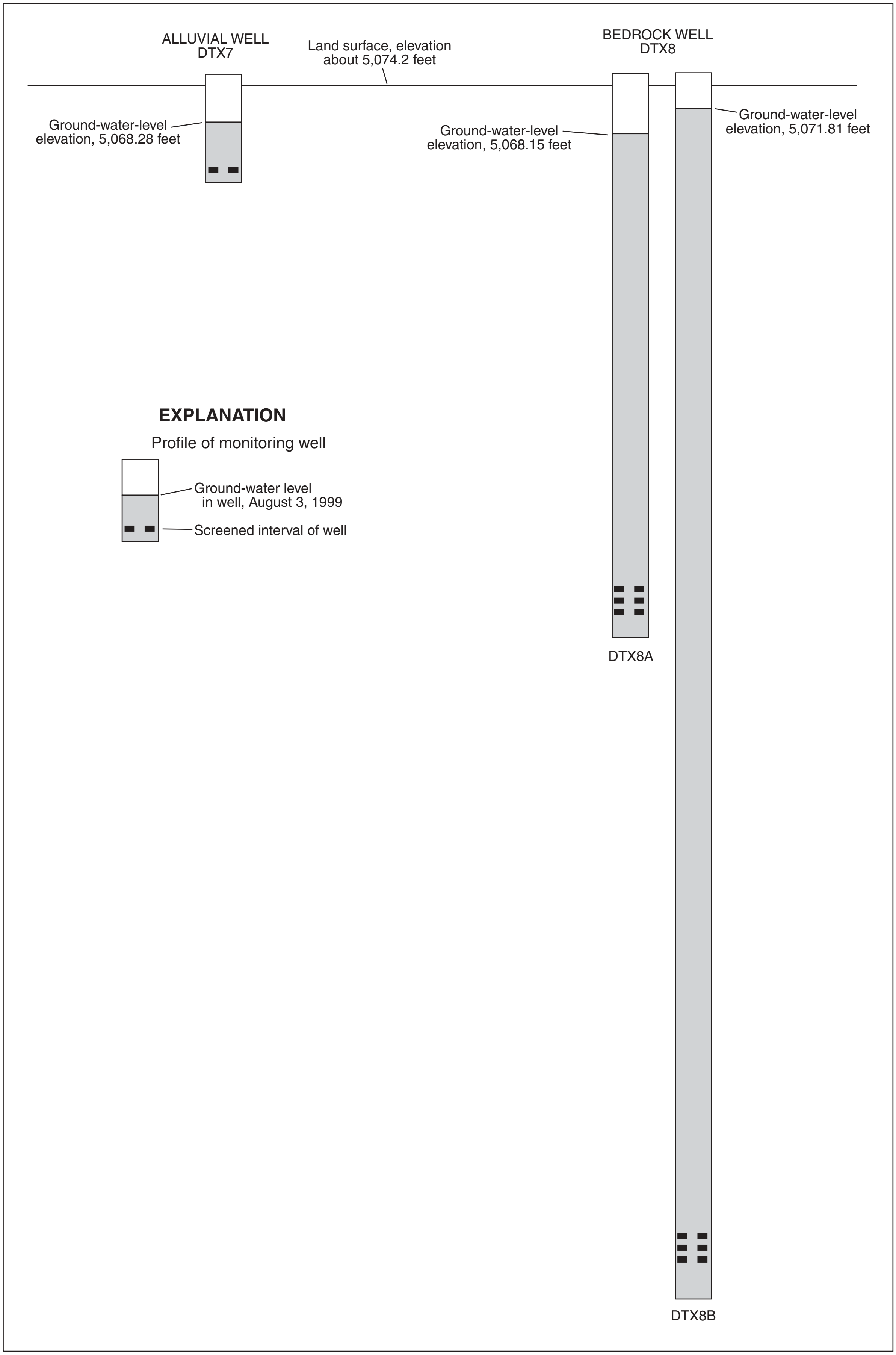


Figure 9. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 (includes DTX8A and DTX8B) near Deer Trail, Colorado, for July, August, and September 1999—Continued.

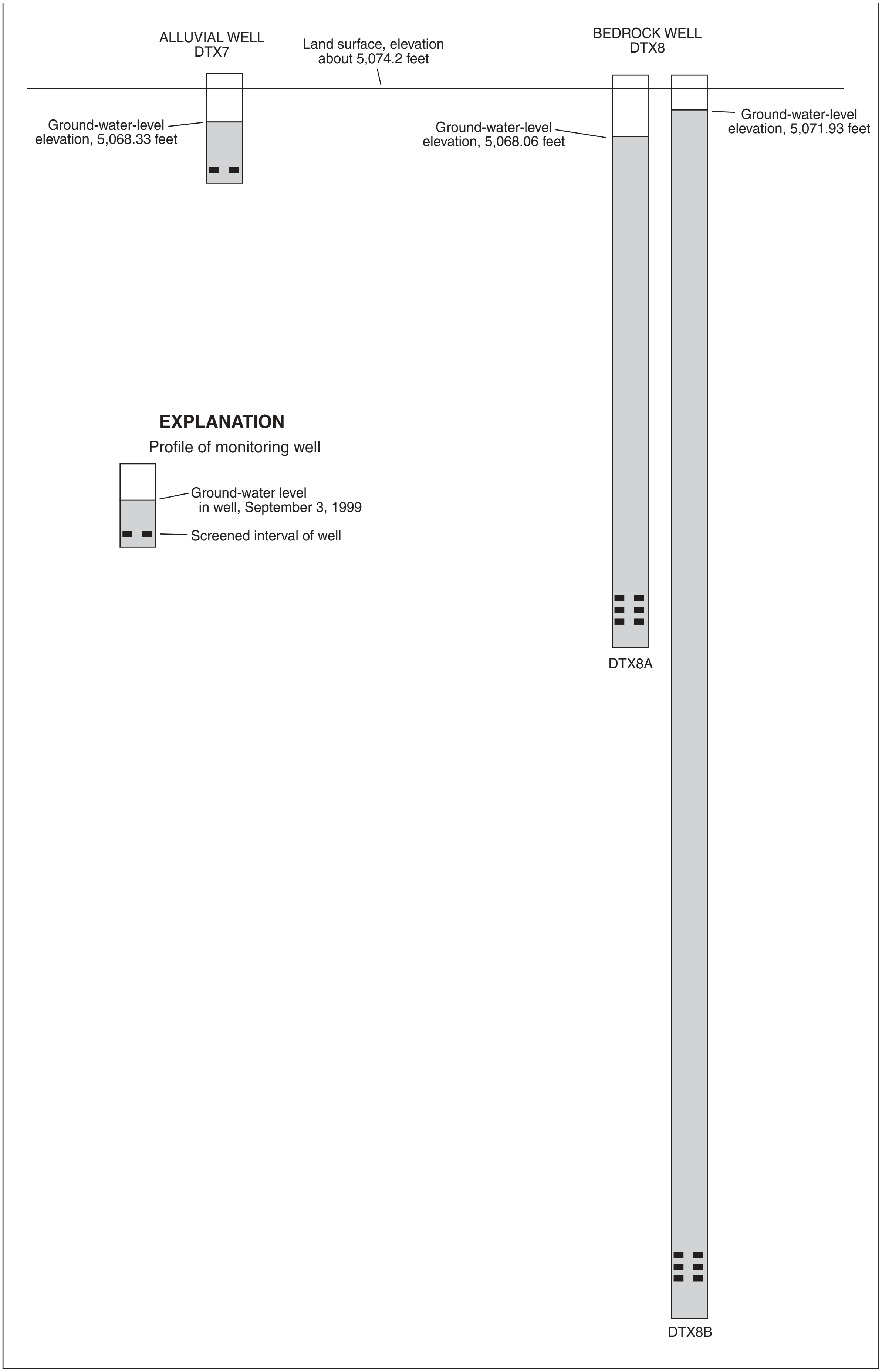


Figure 9. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 (includes DTX8A and DTX8B) near Deer Trail, Colorado, for July, August, and September 1999—Continued.

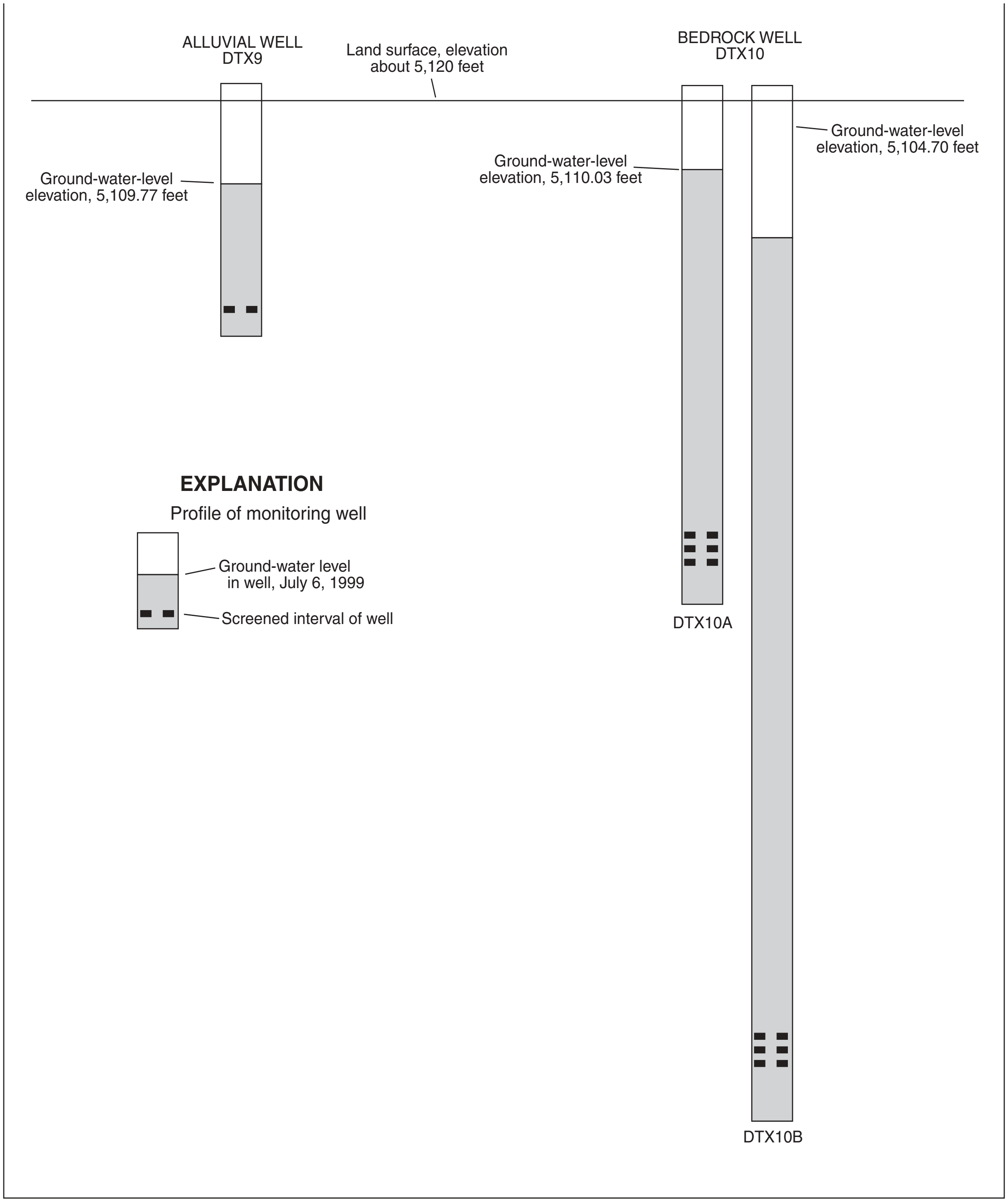


Figure 10. Water levels for the recharge-evaluation site containing well DTX9 and nested well DTX10 (includes DTX10A and DTX10B) near Deer Trail, Colorado, for July, August, and September 1999.

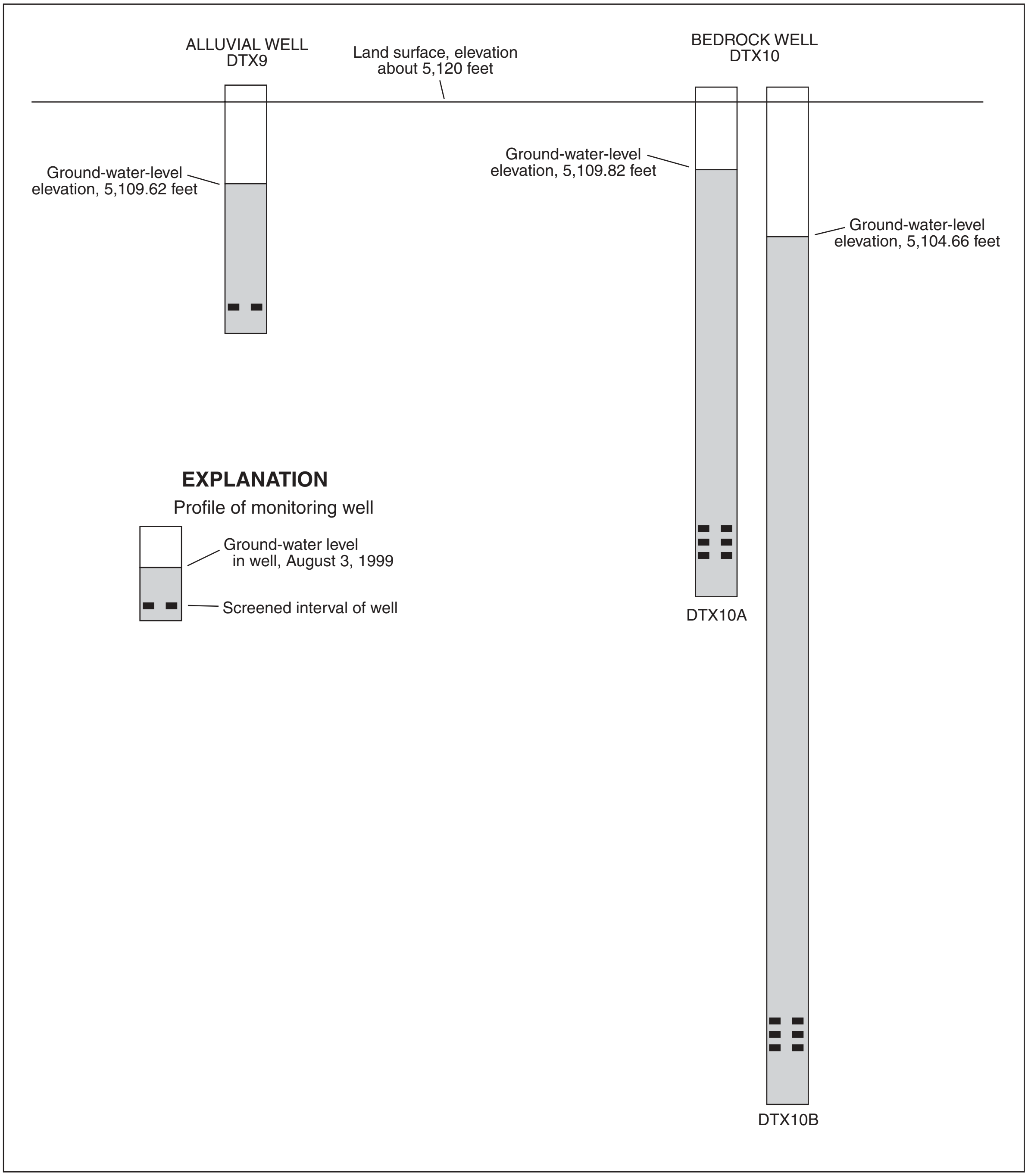


Figure 10. Water levels for the recharge-evaluation site containing well DTX9 and nested well DTX10 (includes DTX10A and DTX10B) near Deer Trail, Colorado, for July, August, and September 1999—Continued.

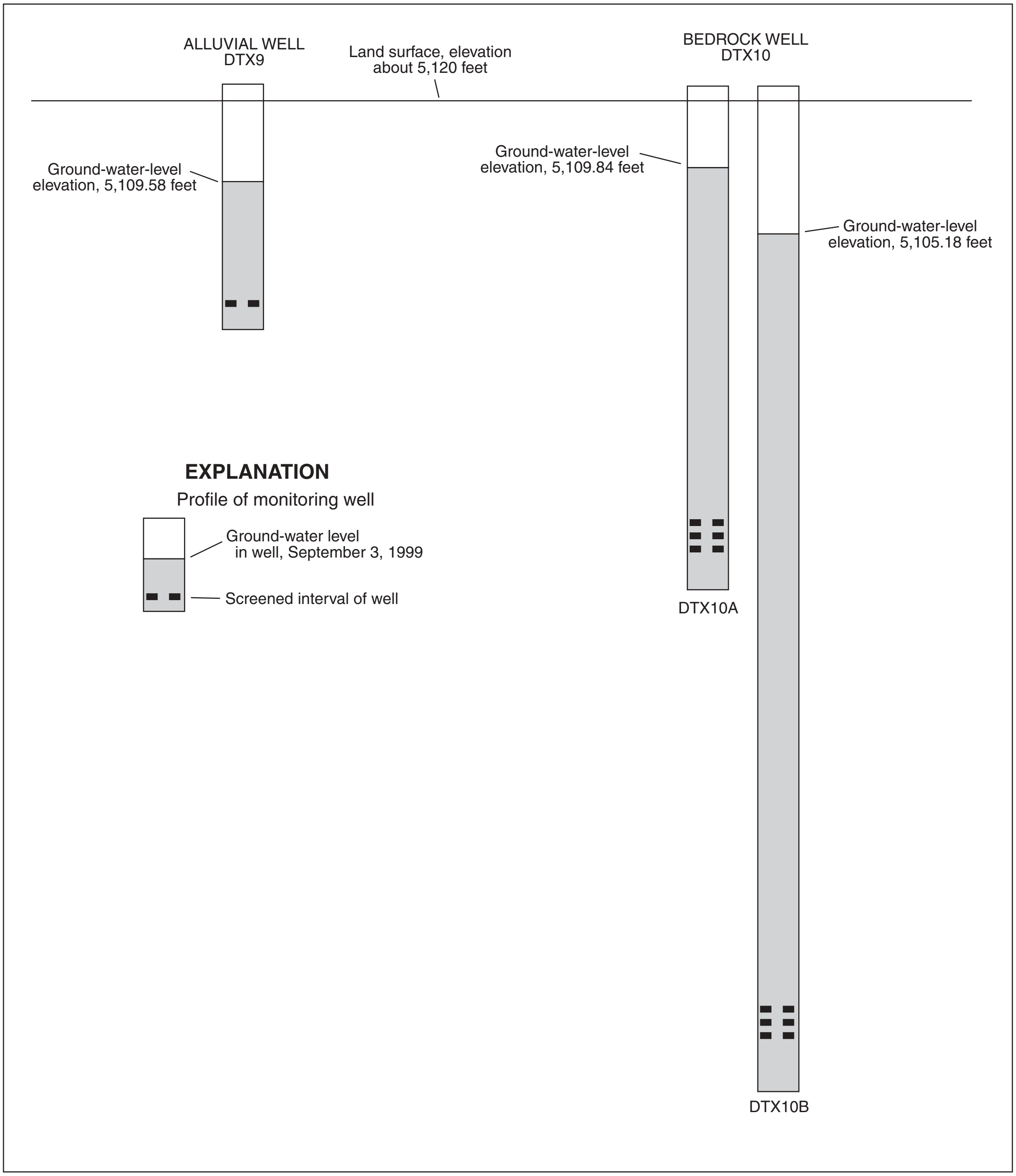


Figure 10. Water levels for the recharge-evaluation site containing well DTX9 and nested well DTX10 (includes DTX10A and DTX10B) near Deer Trail, Colorado, for July, August, and September 1999—Continued.

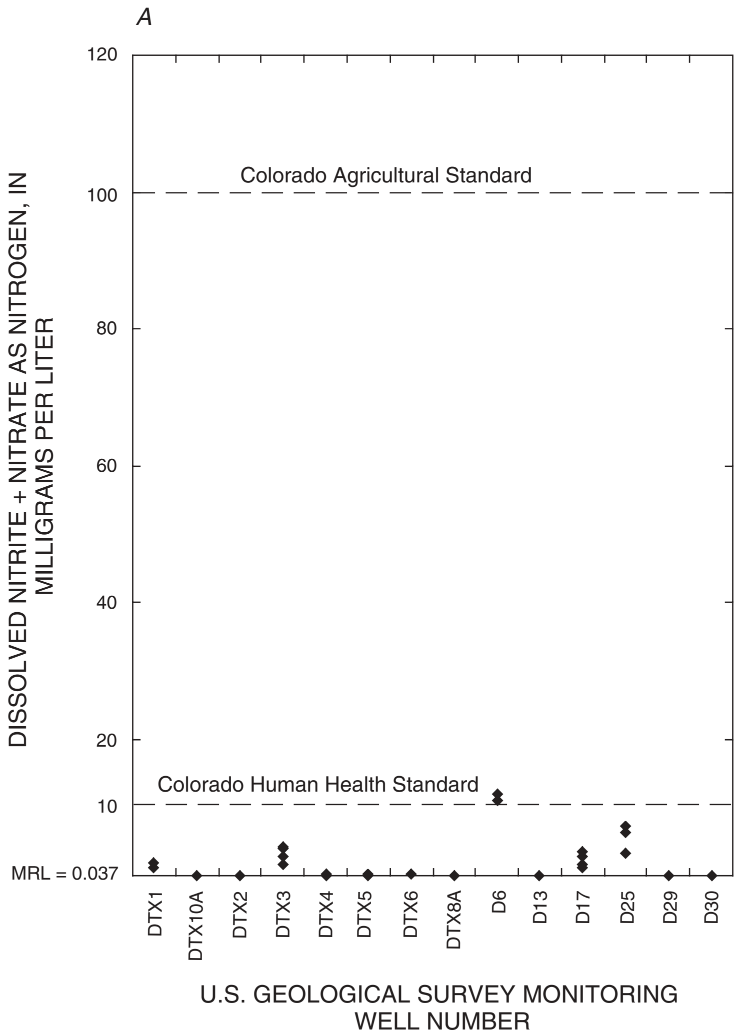


Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999.

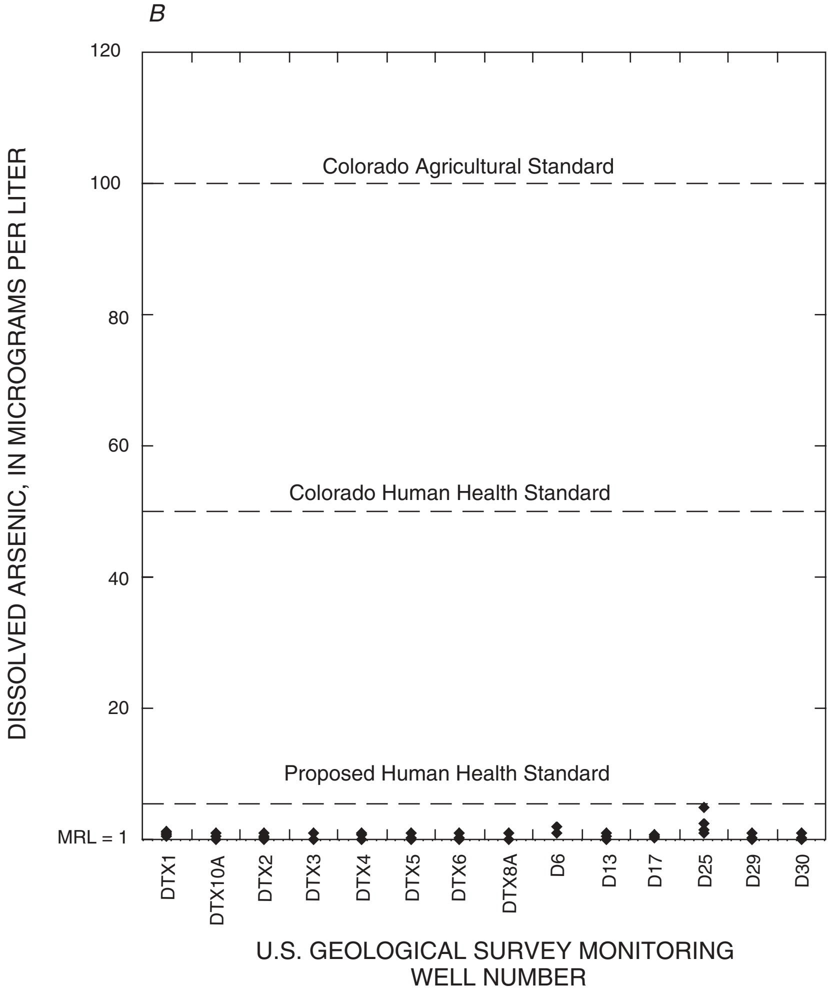


Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

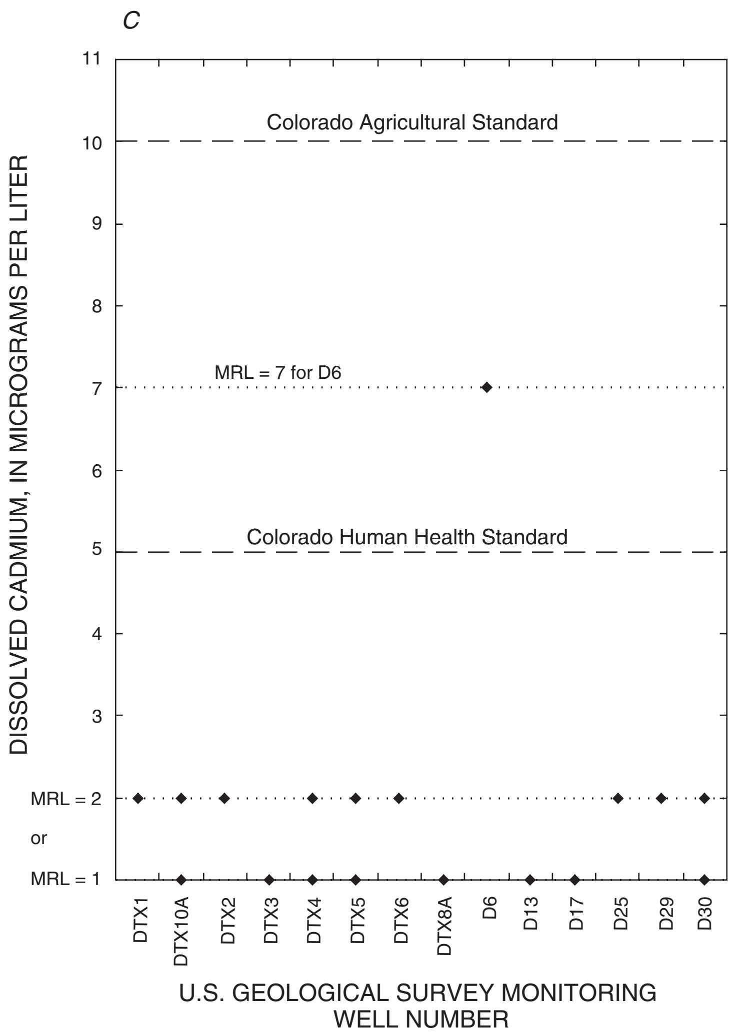


Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

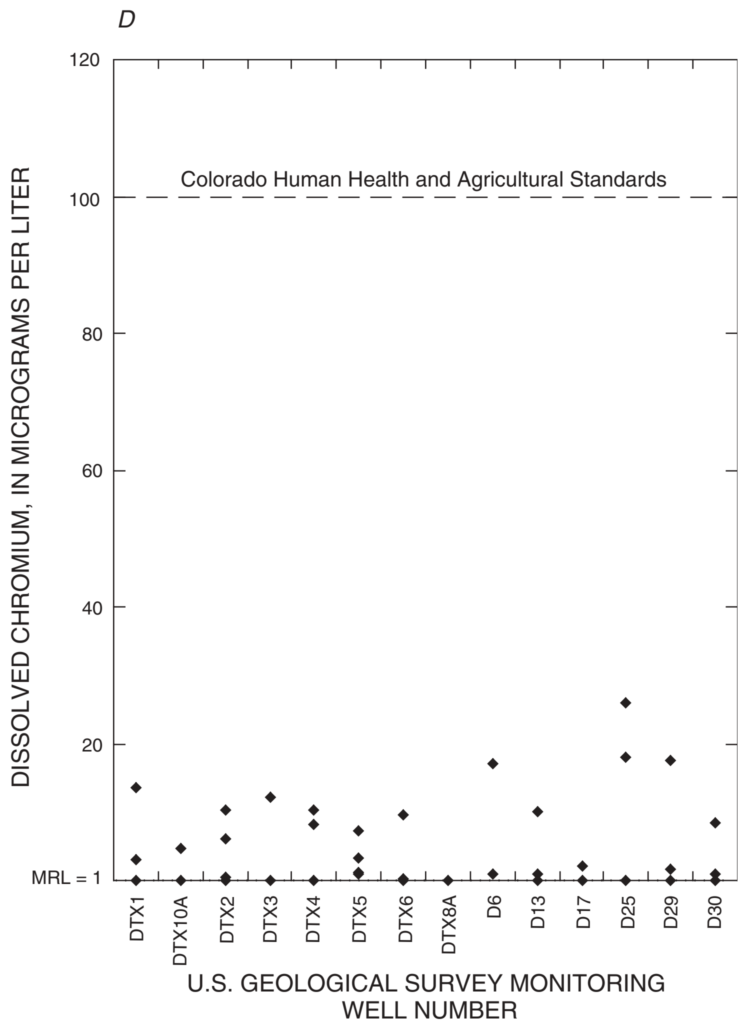


Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

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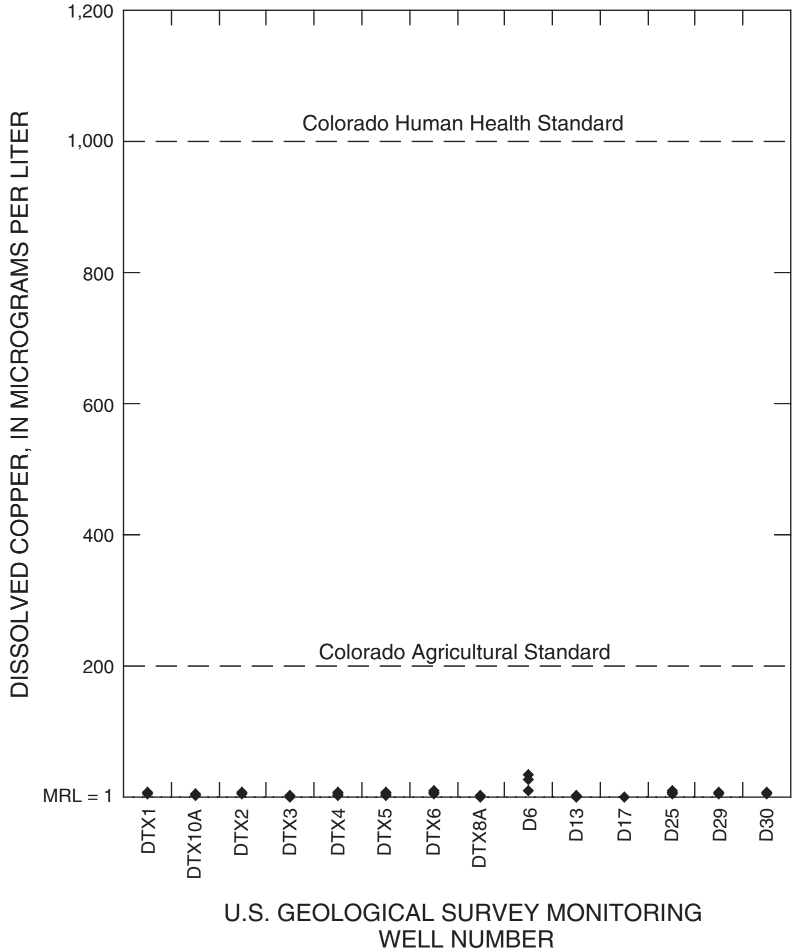

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

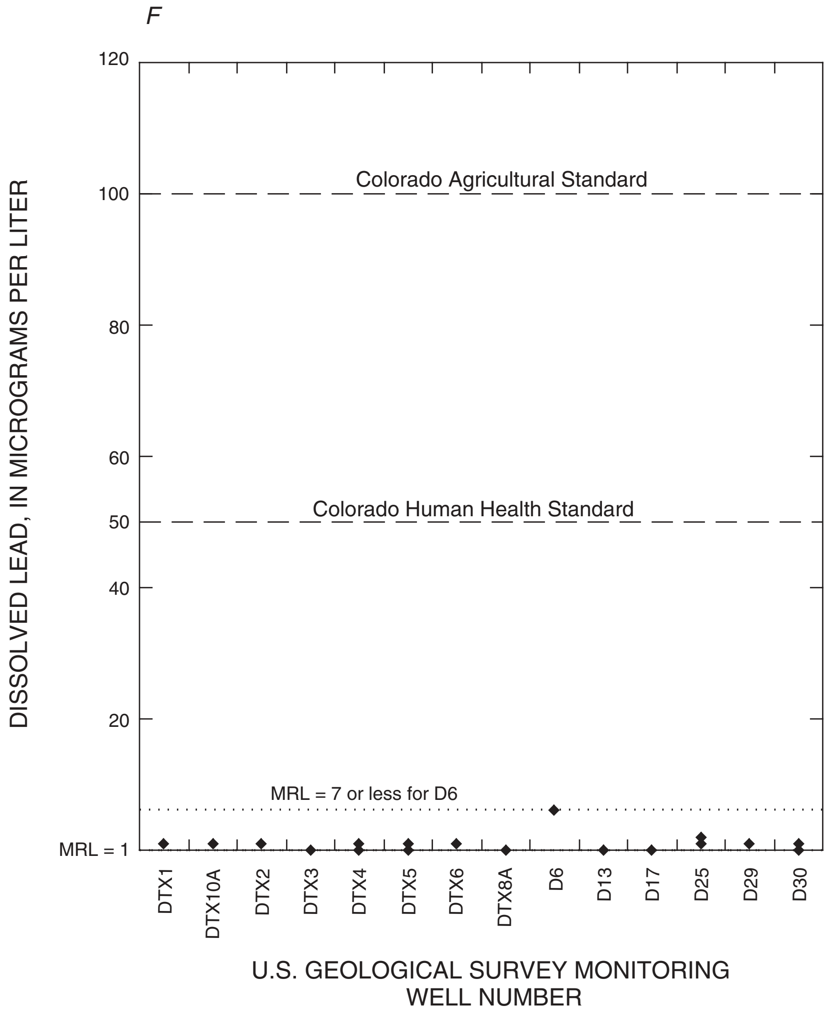

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

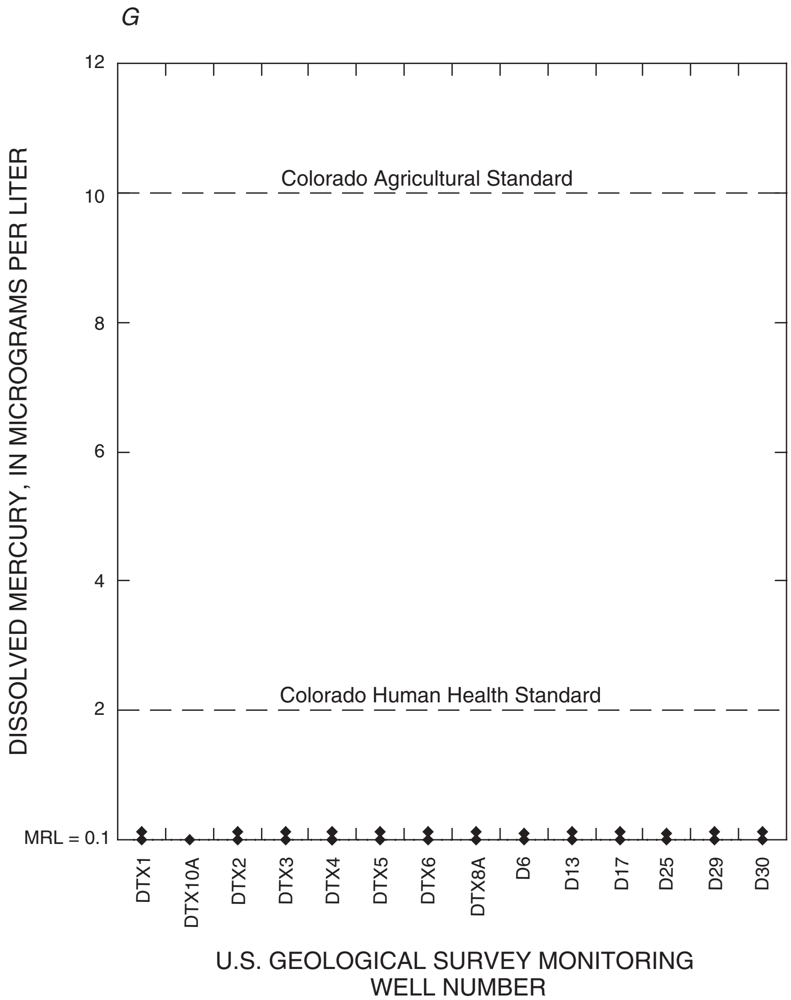

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

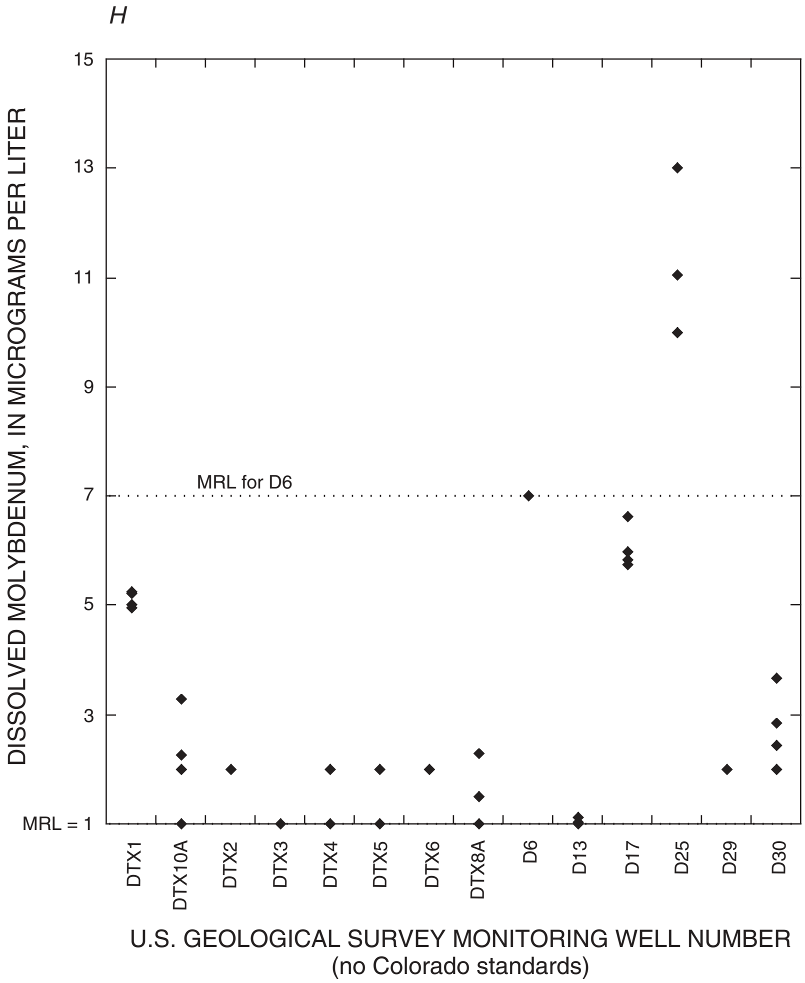

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

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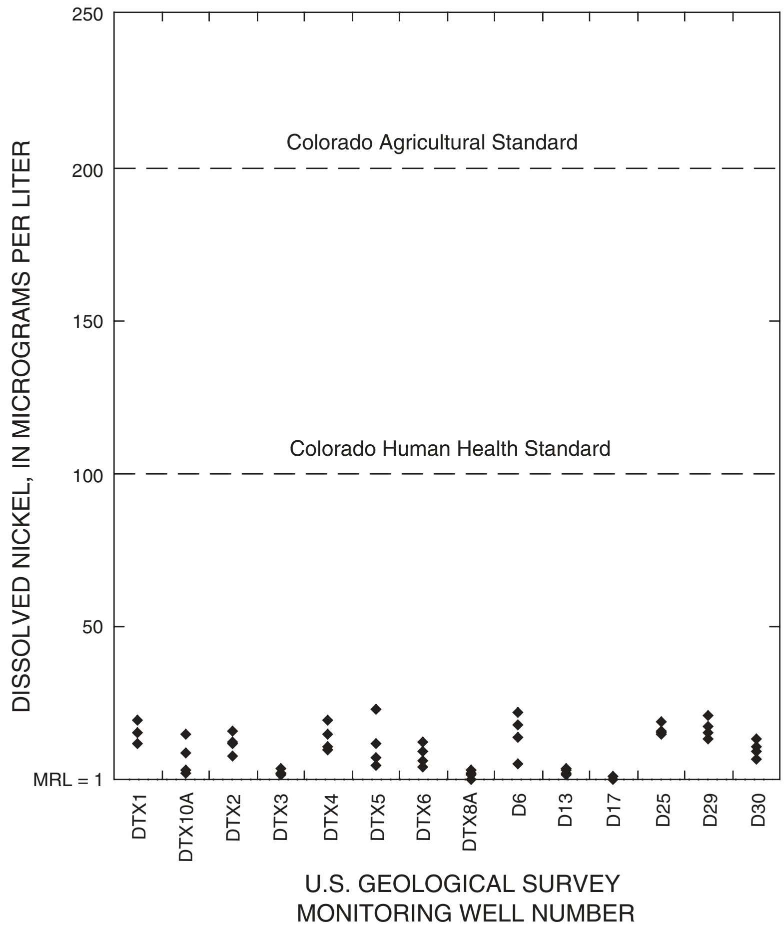

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

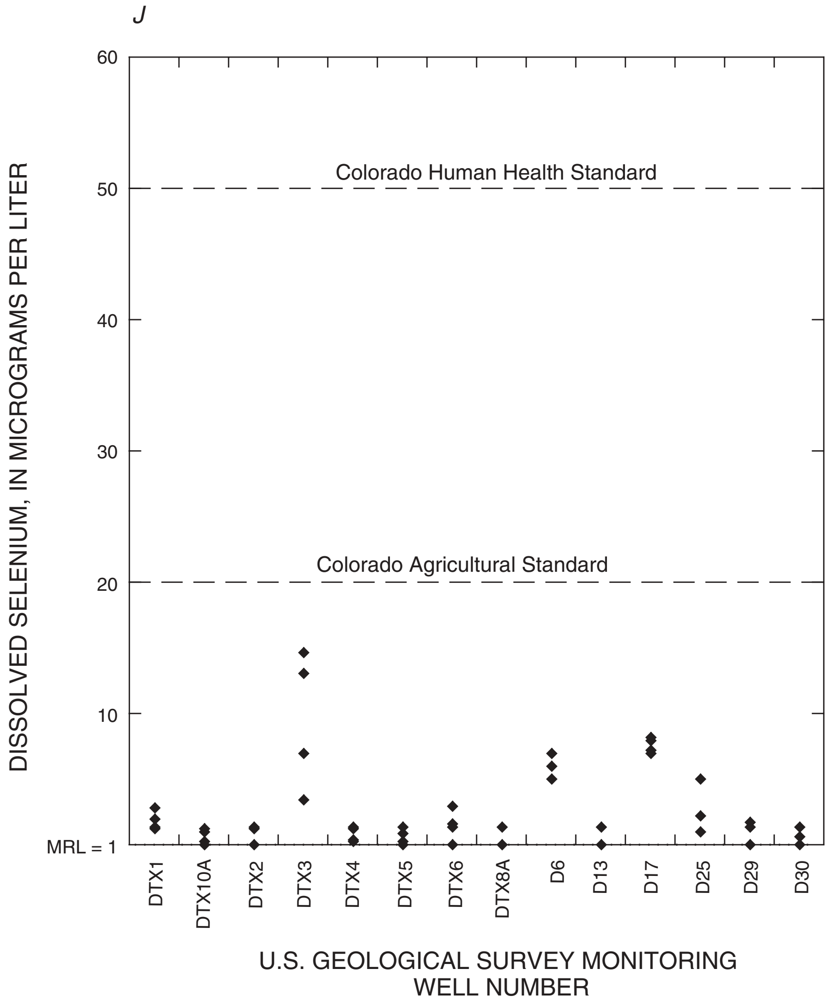

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

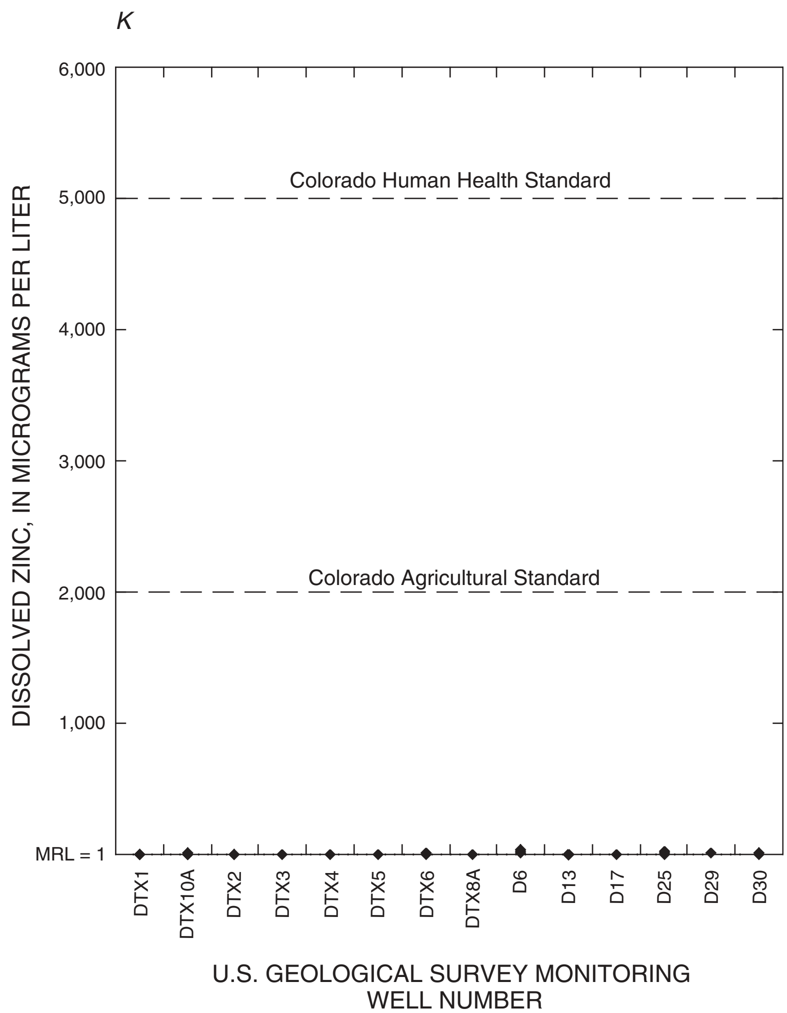

Figure 11. Distribution of ground-water data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 1999—Continued.

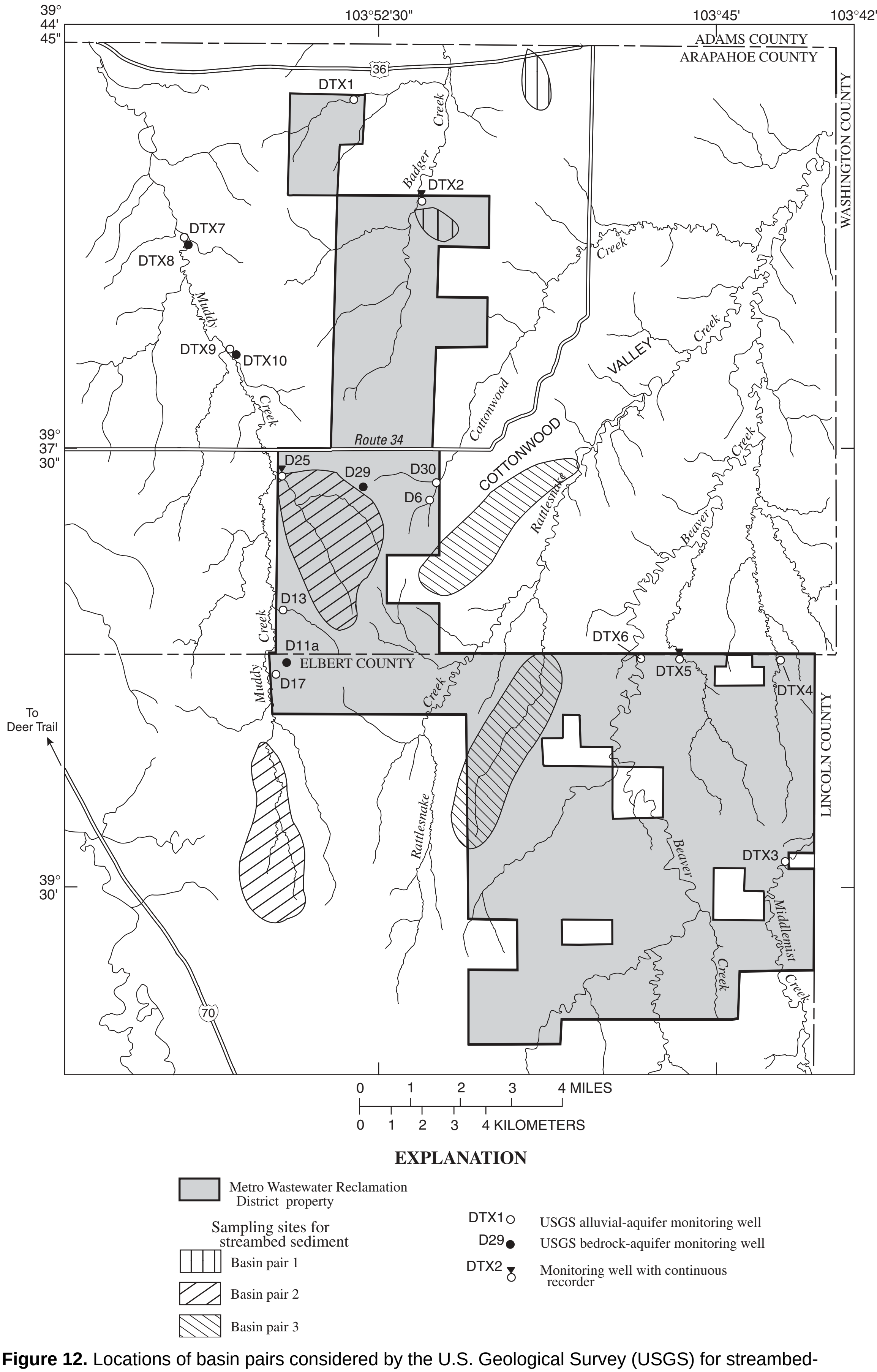

Figure 12. Locations of basin pairs considered by the U.S. Geological Survey (USGS) for streambed-sediment monitoring near Deer Trail, Colorado, 1999.

TERMS AND ABBREVIATIONS

The following terms and abbreviations are used in tables 1-25:

bls	below land surface
bmp	below the measuring point of the well casing
mi	mile
ft	feet
hhmm	24-hour time
mm/dd/yy	numerical date format for two-digit month/two-digit day/ and the last two digits of the year
C	Celsius
cm	centimeter
°	degree
in. or "	inch
µS/cm	microsiemens per centimeter at 25° Celsius
pH units	are the negative base-10 log of the hydrogen-ion activity in moles per liter
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter
dissolved	refers to that fraction of material in a water sample that passes through a 0.45-µm membrane filter
>	greater than
<	less than
g/kg	grams per kilogram
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
µg/g	micrograms per gram

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
300	N 1/2 SEC 15 T5S R58W	286.2	115.8	ARAPAHOE	CAKE	06/12/94	06/24/94	206	4708	827	750.25	2.89	6.48	75.00	84.08	WHEAT	
300	N 1/2 SEC 15 T5S R58W	286.2	115.8	ARAPAHOE	CAKE	02/04/98	02/09/98	108	2432	386	350.18	1.35	3.03	38.00	42.60	WHEAT	
301	S 1/2 SEC 15 T5S R58W	286.2	115.8	ARAPAHOE	CAKE	12/08/93	06/08/94	208	4586	787	713.97	2.75	6.17	74.00	82.96	WHEAT	
301	S 1/2 SEC 15 T5S R58W	286.2	115.8	ARAPAHOE	CAKE	01/29/98	02/04/98	111	2501	410	371.95	1.43	3.21	39.00	43.72	WHEAT	
302	N 1/2 SEC 16 T5S R58W	301.6	122.1	ARAPAHOE	CAKE	12/08/93	07/18/94	242	5329	886	803.78	2.94	6.59	75.00	84.08	WHEAT	
302	N 1/2 SEC 16 T5S R58W	301.6	122.1	ARAPAHOE	CAKE	10/13/97	01/29/98	116	2550	416	377.40	1.38	3.09	34.00	38.12	WHEAT	
303	S 1/2 SEC 16 T5S R58W	301.6	122.1	ARAPAHOE	CAKE	12/08/93	08/02/94	207	4615	796	722.13	2.64	5.92	70.00	78.48	WHEAT	
303	S 1/2 SEC 16 T5S R58W	301.6	122.1	ARAPAHOE	CAKE	09/17/97	09/20/97	78	1752	298	270.35	0.99	2.22	25.00	28.03	WHEAT	
304	N 1/2 SEC 17 T5S R58W	267.4	108.2	ARAPAHOE	CAKE	07/03/94	07/18/94	172	3814	650	589.68	2.43	5.45	64.00	71.75	WHEAT	
304	N 1/2 SEC 17 T5S R58W	267.4	108.2	ARAPAHOE	CAKE	10/06/97	10/11/97	112	2447	405	367.42	1.51	3.39	41.00	45.97	WHEAT	
305	S 1/2 SEC 17 T5S R58W	225.7	91.3	ARAPAHOE	CAKE	07/19/94	07/27/94	168	3746	627	568.81	2.78	6.23	62.00	69.51	WHEAT	
305	S 1/2 SEC 17 T5S R58W	270	109.3	ARAPAHOE	CAKE	10/05/97	02/14/98	105	2283	370	335.66	1.37	3.07	39.00	43.72	WHEAT	
306	N 1/2 SEC 20 T5S R58W	180.0	72.8	ARAPAHOE	CAKE	08/06/94	08/13/94	114	2527	423	383.75	2.35	5.27	53.00	59.42	WHEAT	
306	N 1/2 SEC 20 T5S R58W	232	93.9	ARAPAHOE	CAKE	08/06/94	05/10/95	153	3390	572	518.92	2.47	5.54	57.00	63.90	WHEAT	
306	N 1/2 SEC 20 T5S R58W	232	93.9	ARAPAHOE	CAKE	04/24/97	07/31/97	153	3501	612	555.21	2.64	5.92	58.00	65.02	WHEAT	
307	S 1/2 SEC 20 T5S R58W	60.0	24.3	ARAPAHOE	CAKE	08/12/94	08/13/94	32	707	122	110.68	2.03	4.55	46.00	51.57	WHEAT	
307	S 1/2 SEC 20 T5S R58W	250	101.2	ARAPAHOE	CAKE	08/12/94	05/31/95	134	3041	527	478.09	2.11	4.73	53.00	59.42	WHEAT	
307	S 1/2 SEC 20 T5S R58W	250	101.2	ARAPAHOE	CAKE	06/10/97	07/30/97	135	3127	533	483.54	2.13	4.78	48.00	53.81	WHEAT	
308	N 1/2 SEC 21 T5S R58W	314.0	127.1	ARAPAHOE	CAKE	05/07/94	05/27/94	240	5438	953	864.56	3.04	6.82	73.00	81.84	WHEAT	
308	N 1/2 SEC 21 T5S R58W	314	127.1	ARAPAHOE	CAKE	08/24/97	09/07/97	212	4817	827	750.25	2.63	5.90	70.00	78.48	WHEAT	
309	S 1/2 SEC 21 T5S R58W	320.0	129.5	ARAPAHOE	CAKE	03/04/94	03/14/94	202	4503	782	709.43	2.44	5.47	66.00	73.99	WHEAT	
309	S 1/2 SEC 21 T5S R58W	320	129.5	ARAPAHOE	CAKE	08/09/97	01/29/98	123	2779	476	431.83	1.49	3.34	38.00	42.60	WHEAT	
310	N 1/2 SEC 22 T5S R58W	299.1	121.0	ARAPAHOE	CAKE	04/20/94	05/07/94	221	4880	854	774.75	2.86	6.41	69.00	77.36	WHEAT	
310	N 1/2 SEC 22 T5S R58W	299.1	121.0	ARAPAHOE	CAKE	09/07/97	10/05/97	177	4039	681	617.80	2.28	5.11	68.00	76.23	WHEAT	
311	S 1/2 SEC 22 T5S R58W	320.0	129.5	ARAPAHOE	CAKE	03/15/94	04/19/94	170	3783	651	590.59	2.03	4.55	48.00	53.81	WHEAT	

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99—Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
311	S 1/2 SEC 22 T5S R58W	320	129.5	ARAPAHOE	CAKE	09/13/97	10/01/97	157	3600	599	543.41	1.87	4.19	50.00	56.06	WHEAT	
312	N 1/2 SEC 28 T5S R58W	305	123.4	ARAPAHOE	CAKE	08/14/94	04/08/95	180	3995	650	589.68	2.13	4.78	55.00	61.66	WHEAT	
312	N 1/2 SEC 28 T5S R58W	185.3	75.0	ARAPAHOE	CAKE	07/01/97	07/17/97	134	3061	524	475.37	2.83	6.35	69.00	77.36	WHEAT	
313	S 1/2 SEC 28 T5S R58W	280	113.3	ARAPAHOE	CAKE	11/04/94	04/06/95	232	5113	807	732.11	2.88	6.46	77.00	86.32	WHEAT	
313	S 1/2 SEC 28 T5S R58W	179	72.4	ARAPAHOE	CAKE	07/07/97	07/17/97	128	2878	482	437.27	2.69	6.03	61.00	68.39	WHEAT	
314	N 1/2 SEC 29 T5S R58W	95	38.4	ARAPAHOE	CAKE	05/27/95	05/30/95	69	1583	265	240.41	2.79	6.26	72.00	80.72	WHEAT	
314	N 1/2 SEC 29 T5S R58W	92	37.2	ARAPAHOE	CAKE	06/17/97	07/01/97	67	1532	263	238.59	2.86	6.41	63.00	70.63	WHEAT	
315	S 1/2 SEC 29 T5S R58W	95	38.4	ARAPAHOE	CAKE	05/23/95	05/26/95	75	1504	261	236.78	2.75	6.17	64.00	71.75	WHEAT	
315	S 1/2 SEC 29 T5S R58W	19	7.7	ARAPAHOE	CAKE	07/18/97	07/18/97	7	159	28	25.40	1.47	3.30	30.00	33.63	WHEAT	
316	N 1/2 SEC 32 T5S R58W	153	61.9	ARAPAHOE	CAKE/MAC	4/27/99	6/9/99	207	4573	799	724.85	5.22	11.70	133	149.11	O/GR	Y
316	N 1/2 SEC 32 T5S R58W	135	54.6	ARAPAHOE	CAKE	05/31/95	06/05/95	100	2308	391	354.72	2.90	6.50	72.00	80.72	WHEAT	
316	N 1/2 SEC 32 T5S R58W	95	38.4	ARAPAHOE	CAKE	07/11/97	07/13/97	66	1513	241	218.64	2.54	5.69	52.00	58.30	WHEAT	
317	S 1/2 SEC 32 T5S R58W	70	28.3	ARAPAHOE	CAKE	06/08/95	06/12/95	50	1149	203	184.16	2.90	6.50	68.00	76.23	WHEAT	
317	S 1/2 SEC 32 T5S R58W	155	62.7	ARAPAHOE	CAKE	07/13/97	07/22/97	113	2616	433	392.82	2.79	6.26	67.00	75.11	WHEAT	
318	N 1/2 SEC 33 T5S R58W	44.3	17.9	ARAPAHOE	CAKE/MAC	4/16/99	6/30/99	98	2148	370	335.66	7.18	16.10	209	234.31	O/GR	Y
318	N 1/2 SEC 33 T5S R58W	300	121.4	ARAPAHOE	CAKE	04/08/95	06/29/95	246	5478	887	804.69	2.96	6.64	82.00	91.93	WHEAT	
318	N 1/2 SEC 33 T5S R58W	124	50.2	ARAPAHOE	CAKE	07/24/97	07/27/97	67	1432	242	219.54	1.95	4.37	49.00	54.93	WHEAT	
319	S 1/2 SEC 33 T5S R58W	94.3	38.2	ARAPAHOE	CAKE/MAC	7/9/99	12/16/99	115	2600	441	400.08	4.37	9.80	106	118.84	O/GR	Y
319	S 1/2 SEC 33 T5S R58W	180	72.8	ARAPAHOE	CAKE	04/14/95	04/30/95	135	3044	495	449.06	2.75	6.17	79.00	88.57	WHEAT	
319	S 1/2 SEC 33 T5S R58W	66	26.7	ARAPAHOE	CAKE	07/22/97	07/23/97	41	917	154	139.71	2.33	5.22	64.00	71.75	WHEAT	
322	N 1/2 SEC 3 T6S R58W	245.0	99.2	ELBERT	CAKE	10/10/94	10/22/94	159	3565	594	538.88	2.42	5.43	58.00	65.02	WHEAT	
323	S 1/2 SEC 3 T6S R58W	140.0	56.7	ELBERT	CAKE	10/04/94	10/09/94	110	2444	404	366.51	2.89	6.48	72.00	80.72	WHEAT	
324	N 1/2 SEC 4 T6S R58W	77.3	31.3	ELBERT	CAKE/MAC	11/7/99	12/25/99	311	6962	1069	969.80	13.45	30.16	364	408.08	O/GR	Y
324	N 1/2 SEC 4 T6S R58W	135	54.6	ELBERT	CAKE	05/01/95	05/06/95	108	2459	393	356.53	2.91	6.52	76.00	85.20	WHEAT	
325	S 1/2 SEC 4 T6S R58W	74	29.9	ELBERT	CAKE/MAC	10/31/99	12/9/99	284	6266	959	870.00	12.53	28.09	355	397.99	O/GR	Y

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99—Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
325	S 1/2 SEC 4 T6S R58W	180	72.8	ELBERT	CAKE	05/06/95	05/20/95	132	3026	526	477.19	2.92	6.55	84.00	94.17	WHEAT	
326	N 1/2 SEC 5 T6S R58W	145.1	58.7	ELBERT	CAKE/MAC	6/29/99	11/27/99	600	12393	2211	2005.82	14.63	32.80	375	420.41	O/GR	Y
326	N 1/2 SEC 5 T6S R58W	235	95.1	ELBERT	CAKE	06/10/95	06/27/95	168	3773	671	608.73	2.86	6.41	71.00	79.60	WHEAT	
327	S 1/2 SEC 5 T6S R58W	125.5	50.8	ELBERT	CAKE/MAC	7/30/99	10/26/99	496	11073	1773	1608.47	14.00	31.39	371	415.93	O/GR	Y
327	S 1/2 SEC 5 T6S R58W	195	78.9	ELBERT	CAKE	06/07/95	07/03/95	134	3039	547	496.24	2.81	6.30	69.00	77.36	WHEAT	
328	E l/2 SEC 6 T6S R58W	309.1	125.1	ELBERT	CAKE	07/20/95	08/13/95	455	10010	1762	1598.49	5.70	12.78	140.00	156.95	WHEAT	
329	W 1/2 NW l/4 SEC 8 T6S R58W	50	20.2	ELBERT	CAKE	07/02/95	07/13/95	58	1330	241	218.64	4.82	10.81	110.00	123.32	WHEAT	
330	NE l/4 NW l/4 SEC 8 T6S R58W	25	10.1	ELBERT	CAKE	06/28/95	07/03/95	33	735	134	121.56	5.36	12.02	130.00	145.74	WHEAT	
332	SW l/4 SEC 8 T6S R58W	160	64.8	ELBERT	CAKE	07/03/95	07/19/95	229	5184	940	852.77	5.88	13.18	137.00	153.59	WHEAT	
340	W 1/2 SEC 9 T4S R58W	20	8.1	ARAPAHOE	CAKE	09/09/95	09/10/95	14	325	55	49.90	2.75	6.17	70.00	78.48	WHEAT	
340	W 1/2 SEC 9 T4S R58W	289.4	117.1	ARAPAHOE	CAKE	06/15/96	09/13/96	153	3477	578	524.36	2.00	4.48	46.00	51.57	WHEAT	
340	W 1/2 SEC 9 T4S R58W	258.4	104.6	ARAPAHOE	CAKE	03/17/98	03/31/98	143	3201	512	464.49	1.98	4.44	55	61.66	CORN	
341	N 1/2 SEC 8 T4S R58W	296	119.8	ARAPAHOE	CAKE/MAC	1/13/99	4/6/99	205	4418	721	654.09	2.44	5.47	63	70.63	WHEAT	
341	N 1/2 SEC 8 T4S R58W	120.2	48.6	ARAPAHOE	CAKE	09/06/95	09/10/95	61	1375	237	215.01	1.97	4.42	50.00	56.06	WHEAT	
341	N 1/2 SEC 8 T4S R58W	175.8	71.1	ARAPAHOE	CAKE	05/25/96	06/04/96	124	2704	463	420.03	2.63	5.90	54.00	60.54	WHEAT	
341	N 1/2 SEC 8 T4S R58W	175.8	71.1	ARAPAHOE	CAKE	04/17/98	04/22/98	112	2451	383	347.46	2.18	4.89	56	62.78	CORN	
342	S 1/2 SEC 8 T4S R58W	223.4	90.4	ARAPAHOE	CAKE	08/29/95	09/06/95	150	3364	577	523.45	2.58	5.78	70.00	78.48	WHEAT	
342	S 1/2 SEC 8 T4S R58W	87.9	35.6	ARAPAHOE	CAKE	05/30/96	06/01/96	64	1389	239	216.82	2.72	6.10	56.00	62.78	WHEAT	
342	S 1/2 SEC 8 T4S R58W	87.9	35.6	ARAPAHOE	CAKE	04/14/98	04/17/98	55	1209	194	176.00	2.21	4.96	57	63.90	CORN	
342	S 1/2 SEC 8 T4S R58W	311.3	126.0	ARAPAHOE	CAKE	10/29/98	11/12/98	119	2585	412	373.77	1.32	2.96	35	39.24	WHEAT	
343	N 1/2 SEC 17 T4S R58W	327.4	132.5	ARAPAHOE	CAKE/MAC	8/10/99	8/27/99	275	6254	1072	972.52	3.15	7.06	80	89.69	WHEAT	N
343	N 1/2 SEC 17 T4S R58W	320	129.5	ARAPAHOE	CAKE	05/14/96	06/06/96	235	5346	935	848.23	2.92	6.55	70.00	78.48	WHEAT	
343	N 1/2 SEC 17 T4S R58W	327.4	132.5	ARAPAHOE	CAKE	03/31/98	04/14/98	79	1767	286	259.46	0.87	1.95	24	26.91	CORN	
344	S 1/2 SEC 17 T4S R57W	279.2	113.0	ARAPAHOE	CAKE	09/10/95	09/20/95	178	4039	687	623.25	2.46	5.52	59.00	66.14	WHEAT	
344	S 1/2 SEC 17 T4S R58W	279.2	113.0	ARAPAHOE	CAKE/MAC	1/11/99	1/26/99	192	4364	725	657.72	2.60	5.83	65	72.87	WHEAT	
345	N 1/2 SEC 21 T4S R58W	310	125.5	ARAPAHOE	CAKE	09/20/95	10/02/95	217	4942	823	746.63	2.65	5.94	66.00	73.99	WHEAT	
346	S 1/2 SEC 21 T4S R58W	142.6	57.7	ARAPAHOE	CAKE	08/01/97	08/04/97	90	1904	329	298.47	2.31	5.18	53.00	59.42	WHEAT	
347	N 1/2 SEC 22 T4S R58W	140	56.7	ARAPAHOE	CAKE/MAC	8/17/99	9/26/99	88	1928	299	271.25	2.04	4.57	50	56.06	WHEAT	N

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99—Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
347	N 1/2 SEC 22 T4S R58W	140	56.7	ARAPAHOE	CAKE	10/03/95	10/26/95	75	1607	268	243.13	1.91	4.28	46.00	51.57	WHEAT	
348	S 1/2 SEC 22 T4S R58W	160	64.8	ARAPAHOE	CAKE/MAC	9/10/99	9/15/99	132	2842	471	427.29	2.74	6.14	71	79.60	WHEAT	N
348	S 1/2 SEC 22 T4S R58W	160	64.8	ARAPAHOE	CAKE	10/17/95	10/22/95	86	1929	329	298.47	2.06	4.62	53.00	59.42	WHEAT	
349	N 1/2 SEC 23 T4S R58W	310	125.5	ARAPAHOE	CAKE/MAC	8/27/99	9/23/99	246	5323	840	762.05	2.62	5.87	63	70.63	WHEAT	N
349	N 1/2 SEC 23 T4S R58W	310	125.5	ARAPAHOE	CAKE	10/09/95	10/17/95	176	3900	656	595.12	2.12	4.75	52.00	58.30	WHEAT	
350	S 1/2 SEC 23 T4S R58W	256	103.6	ARAPAHOE	CAKE	8/28/99	9/18/99	201	4351	686	622.34	2.68	6.01	67	75.11	WHEAT	N
350	S 1/2 SEC 23 T4S R58W	256	103.6	ARAPAHOE	CAKE	10/04/95	10/09/95	100	2203	356	322.96	1.39	3.12	32.00	35.88	WHEAT	
351	N 1/2 SEC 28 T4S R58W	290	117.4	ARAPAHOE	CAKE	11/27/95	12/08/95	197	4397	741	672.24	2.56	5.74	66.00	73.99	WHEAT	
351	N 1/2 SEC 28 T4S R58W	290	117.4	ARAPAHOE	CAKE	04/22/98	05/05/98	134	2954	485	439.99	1.67	3.74	41	45.97	CORN	
352	S 1/2 SEC 28 T4S R58W	299	121.0	ARAPAHOE	CAKE	11/17/95	11/27/95	216	4819	812	736.65	2.72	6.10	76.00	85.20	WHEAT	
352	S 1/2 SEC 28 T4S R58W	299	121.0	ARAPAHOE	CAKE	04/22/98	05/05/98	142	3166	525	476.28	1.76	3.95	43	48.21	CORN	
353	(E 1/2) N 1/2 SEC 27 T4S R58W	170.2	68.9	ARAPAHOE	CAKE	03/22/98	03/25/98	67	1457	231	209.56	1.36	3.05	35	39.24	WHEAT	
353	(W 1/2) N 1/2 SEC 27 T4S R58W	120	48.6	ARAPAHOE	CAKE	05/05/98	05/11/98	54	1168	195	176.90	1.63	3.65	40	44.84	CORN	
353	N 1/2 SEC 27 T4S R57W	280	113.3	ARAPAHOE	CAKE/MAC	9/27/99	10/6/99	167	3599	619	561.56	1.87	4.19	55	61.66	WHEAT	N
353	N 1/2 SEC 27 T4S R58W	279.9	113.3	ARAPAHOE	CAKE	06/11/96	06/15/96	67	1500	263	238.59	0.94	2.11	21.00	23.54	WHEAT	
354	(E 1/2) S 1/2 SEC 27 T4S R58W	170.2	68.9	ARAPAHOE	CAKE	03/20/98	03/22/98	66	1432	226	205.03	1.33	2.98	34	38.12	WHEAT	
354	(W 1/2) S 1/2 SEC 27 T4S R58W	130	52.6	ARAPAHOE	CAKE	05/06/98	05/11/98	78	1703	284	257.64	2.18	4.89	54	60.54	CORN	
354	S 1/2 SEC 27 T4S R58W	280	113.3	ARAPAHOE	CAKE/MAC	9/26/99	10/14/99	152	3324	555	503.50	1.81	4.06	47	52.69	WHEAT	N
354	S 1/2 SEC 27 T4S R58W	279.8	113.2	ARAPAHOE	CAKE	06/06/96	06/11/96	108	2407	440	399.17	1.57	3.52	36.00	40.36	WHEAT	
355	N 1/2 SEC 35 T4S R58W	300	121.4	ARAPAHOE	CAKE/MAC	10/14/99	11/15/99	82	1810	275	249.48	0.86	1.93	25	28.03	WHEAT	N
355	N 1/2 SEC 35 T4S R58W	300	121.4	ARAPAHOE	CAKE	10/26/95	11/07/95	218	4757	788	714.87	2.63	5.90	60.00	67.27	WHEAT	
355	N 1/2 SEC 35 T4S R58W	300	121.4	ARAPAHOE	CAKE	05/15/98	05/20/98	120	2667	437	396.45	1.46	3.27	45	50.45	WHEAT	
356	S 1/2 SEC 35 T4S R58W	300	121.4	ARAPAHOE	CAKE	11/06/95	11/17/95	203	4454	747	677.68	2.49	5.58	56.00	62.78	WHEAT	

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99—Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
356	S 1/2 SEC 35 T4S R58W	300	121.4	ARAPAHOE	CAKE	04/05/98	06/25/98	115	2589	418	379.21	1.39	3.12	38	42.60	WHEAT	
359	N 1/2 SEC 4 T5S R58W	30	12.1	ARAPAHOE	CAKE	12/23/98	12/23/98	9	191	30	27.22	1.00	2.24	27	30.27	WHEAT	
359	N 1/2 SEC 4 T5S R58W	290	117.4	ARAPAHOE	CAKE/MAC	10/5/98	1/19/99	190	4066	677	614.17	2.33	5.22	60	67.27	WHEAT	
359	N 1/2 SEC 4 T5S R58W	290	117.4	ARAPAHOE	CAKE	08/14/95	08/25/95	216	4770	815	739.37	2.81	6.30	62.00	69.51	WHEAT	
360	S 1/2 SEC 4 T5S R58W	57.8	23.4	ARAPAHOE	CAKE/MAC	12/23/98	1/7/99	43	904	150	136.08	2.60	5.83	66	73.99	WHEAT	
360	S 1/2 SEC 4 T5S R58W	57.8	23.4	ARAPAHOE	CAKE	08/25/95	08/27/95	42	924	158	143.34	2.73	6.12	77.00	86.32	WHEAT	
360	S 1/2 SEC 4 T5S R58W	89.1	36.1	ARAPAHOE	CAKE	03/04/98	03/06/98	34	755	125	113.40	1.40	3.14	37	41.48	WHEAT	
361	N 1/2 SEC 3 T5S R58W	250	101.2	ARAPAHOE	CAKE	02/16/98	02/21/98	97	2053	344	312.08	1.38	3.09	39.00	43.72	WHEAT	
362	S 1/2 SEC 3 T5S R58W	307.1	124.3	ARAPAHOE	CAKE	10/31/97	02/16/98	119	2577	427	387.37	1.39	3.12	33.00	37.00	WHEAT	
363	N 1/2 SEC 9 T5S R58W	29.3	11.9	ARAPAHOE	CAKE	08/28/95	08/29/95	21	466	82	74.39	2.80	6.28	79.00	88.57	WHEAT	
363	N 1/2 SEC 9 T5S R58W	200	80.9	ARAPAHOE	CAKE	06/17/96	06/25/96	144	3307	590	535.25	2.95	6.61	76.00	85.20	WHEAT	
363	N 1/2 SEC 9 T5S R58W	200	80.9	ARAPAHOE	CAKE	03/06/98	03/12/98	78	1751	274	248.57	1.37	3.07	36	40.36	WHEAT	
363	N 1/2 SEC 9 T5S R58W	29.3	11.9	ARAPAHOE	CAKE	9/21/98	9/22/98	20	443	72	65.32	2.46	5.52	62	69.51	WHEAT	
364	S 1/2 SEC 9 T5S R58W	30	12.1	ARAPAHOE	CAKE/MAC	9/22/98	12/24/98	23	493	89	80.74	2.53	5.67	71	79.60	WHEAT	N
364	S 1/2 SEC 9 T5S R58W	30	12.1	ARAPAHOE	CAKE	08/26/95	08/28/95	24	546	98	88.91	3.27	7.33	80.00	89.69	WHEAT	
364	S 1/2 SEC 9 T5S R58W	283.7	114.8	ARAPAHOE	CAKE	06/26/96	07/07/96	205	4747	819	743.00	2.89	6.48	73.00	81.84	WHEAT	
364	S 1/2 SEC 9 T5S R58W	283.7	114.8	ARAPAHOE	CAKE	03/12/98	03/17/98	113	2541	407	369.23	1.43	3.21	38	42.60	WHEAT	
365	N 1/2 SEC 10 T5S R58W	300	121.4	ARAPAHOE	CAKE	07/18/96	08/31/96	202	4568	775	703.08	2.58	5.78	62.00	69.51	WHEAT	
365	N 1/2 SEC 10 T5S R58W	300	121.4	ARAPAHOE	CAKE	02/22/98	03/08/98	115	2463	409	371.04	1.36	3.05	39	43.72	WHEAT	
366	S 1/2 SEC 10 T5S R58W	318.2	128.8	ARAPAHOE	CAKE	07/08/96	08/30/96	230	5218	895	811.94	2.81	6.30	67.00	75.11	WHEAT	
366	S 1/2 SEC 10 T5S R58W	318.2	128.8	ARAPAHOE	CAKE	02/27/98	03/09/98	124	2643	431	391.00	1.35	3.03	38	42.60	WHEAT	
401	S 1/2 SEC 1 T6S R58W	300	121.4	ELBERT	CAKE	10/05/96	10/30/96	161	3477	599	543.41	2.00	4.48	48.00	53.81	WHEAT	
402	N 1/2 SEC 6 T6S R57W	338	136.8	ELBERT	CAKE/MAC	10/1/98	1/10/99	212	4539	725	657.72	2.15	4.82	53	59.42	CORN	
402	N 1/2 SEC 6 T6S R57W	337.8	136.7	ELBERT	CAKE	12/19/96	12/31/96	229	5098	868	787.45	2.57	5.76	75.00	84.08	WHEAT	
403	S 1/2 SEC 6 T6S R57W	338	136.8	ELBERT	CAKE/MAC	10/13/98	12/1/98	223	4729	794	720.32	2.35	5.27	56	62.78	CORN	

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99—Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
404	N 1/2 SEC 5 T6S R57W	350	141.6	ELBERT	CAKE/MAC	10/23/98	11/28/98	222	4874	808	733.02	2.31	5.18	63	70.63	CORN	
405	S 1/2 SEC 5 T6S R57W	350	141.6	ELBERT	CAKE	11/26/98	12/10/98	232	5019	795	721.22	2.27	5.09	64	71.75	CORN	
406	N 1/2 SEC 4 T6S R57W	133.1	53.9	ELBERT	CAKE	11/15/98	11/26/98	81	1798	284	257.64	2.13	4.78	59	66.14	WHEAT	N
406	N 1/2 SEC 4 T6S R57W	300	121.4	ELBERT	CAKE	11/13/96	11/25/96	217	4817	843	764.77	2.81	6.30	71.00	79.60	WHEAT	
407	S 1/2 SEC 4 T6S R57W	100	40.5	ELBERT	CAKE	11/27/98	12/10/98	62	1366	217	196.86	2.17	4.87	61	68.39	CORN	
407	S 1/2 SEC 4 T6S R57W	290	117.4	ELBERT	CAKE	09/04/96	10/06/96	116	2648	463	420.03	1.60	3.59	38.00	42.60	WHEAT	
408	N 1/2 SEC 3 T6S R57W	325	131.5	ELBERT	CAKE	11/25/96	12/04/96	171	3848	658	596.94	2.02	4.53	56.00	62.78	WHEAT	
409	S 1/2 SEC 3 T6S R57W	325	131.5	ELBERT	CAKE	08/24/96	09/04/96	172	3982	670	607.82	2.06	4.62	46.00	51.57	WHEAT	
411	S 1/2 SEC 2 T6S R57W	333.2	134.8	ELBERT	CAKE	12/04/96	12/15/96	224	4954	857	777.47	2.57	5.76	77.00	86.32	WHEAT	
412	N 1/2 SEC 1 T6S R57W	343	138.8	ELBERT	CAKE	12/15/96	05/17/97	231	5174	899	815.57	2.62	5.87	74.00	82.96	WHEAT	
413	S 1/2 SEC 1 T6S R57W	343	138.8	ELBERT	CAKE	05/17/97	06/04/97	248	5642	941	853.68	2.74	6.14	70.00	78.48	WHEAT	
418	N 1/2 SEC 8 T6S R57W	20	8.1	ARAPAHOE	CAKE	9/3/99	9/3/99	16	337	56	50.80	2.80	6.28	52	58.30	WHEAT	N
420	N 1/2 SEC 9 T6S R57W	101	40.9	ELBERT	CAKE	09/13/96	09/22/96	60	1376	233	211.38	2.31	5.18	56.00	62.78	WHEAT	
422	N 1/2 SEC 10 T6S R57W	290	117.4	ELBERT	CAKE	9/1/98	9/9/98	196	4313	731	663.16	2.52	5.65	63	70.63	WHEAT	
423	S 1/2 SEC 10 T6S R57W	300	121.4	ELBERT	CAKE	9/10/98	9/17/98	159	3519	582	527.99	1.94	4.35	51	57.18	WHEAT	
426	N 1/2 SEC 12 T6S R57W	286.1	115.8	ELBERT	CAKE	06/13/97	06/26/97	186	4293	737	668.61	2.58	5.78	59.00	66.14	WHEAT	
427	S 1/2 SEC 12 T6S R57W	236	95.5	ELBERT	CAKE	06/04/97	06/28/97	159	3593	592	537.06	2.51	5.63	57.00	63.90	WHEAT	
436	N 1/2 SEC 15 T6S R57W	286.1	115.8	ELBERT	CAKE	9/17/98	9/30/98	211	4659	746	676.77	2.61	5.85	65	72.87	WHEAT	
438	N 1/2 SEC 14 T6S R57W	312.2	126.3	ELBERT	CAKE/MAC	11/14/99	12/1/99	251	5501	870	789.26	2.58	5.78	76	85.20	WHEAT	N
439	S 1/2 SEC 14 T6S R57W	312.2	126.3	ELBERT	CAKE/MAC	11/27/99	12/26/99	253	5524	872	791.08	2.55	5.72	71	79.60	WHEAT	N
440	N 1/2 SEC 13 T6S R57W	263.3	106.6	ELBERT	CAKE	8/27/98	8/31/98	114	2477	418	379.21	1.59	3.56	37	41.48	WHEAT	
441	S 1/2 SEC 13 T6S R57W	300	121.4	ELBERT	CAKE	8/22/98	8/27/98	114	2495	421	381.93	1.40	3.14	33	37.00	WHEAT	
444	N 1/2 SEC 19 T6S R57W	170	68.8	ELBERT	CAKE	8/7/98	9/24/98	124	2621	448	406.43	2.64	5.92	61	68.39	WHEAT	
445	S 1/2 SEC 19 T6S R57W	85	34.4	ELBERT	CAKE	8/8/98	8/10/98	62	1334	236	214.10	2.78	6.23	60	67.27	WHEAT	
446	N 1/2 SEC 20 T6S R57W	145	58.7	ELBERT	CAKE/MAC	8/5/98	1/5/99	105	2257	371	336.57	2.56	5.74	51	57.18	WHEAT	
449	S 1/2 SEC 21 T6S R57W	123.7	50.1	ELBERT	CAKE	10/23/96	11/02/96	60	1338	229	207.75	1.85	4.15	45.00	50.45	WHEAT	
450	N 1/2 SEC 22 T6S R57W	109	44.1	ELBERT	CAKE	10/11/96	10/13/96	52	1198	210	190.51	1.93	4.33	44.00	49.33	WHEAT	

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, 1993–99—Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; ha, hectares; CAKE, Grade I Class B biosolids; MAC, biosolids ammended with wood fiber; dT, dry tons; dMT, dry metric tons; lb/acre, pounds per acre; kg/ha, kilograms per hectare; Y, yes; N, no; O/GR, oats and grass]

DC	Legal description	Area applied to		County	Biosolids product applied	Start date	Stop date	Total loads	Total wet tons	Total dry tons		Loading rate, tons per acre		Nitrogen loading rate		Crop	Recla-mation project
		acre	ha							dT	dMT	Cake dT	Cake dMT	lb/acre	kg/ha		
451	S 1/2 SEC 22 T6S R57W	219	88.6	ELBERT	CAKE	10/14/96	10/20/96	107	2415	416	377.40	1.90	4.26	45.00	50.45	WHEAT	
453	S 1/2 SEC 23 T6S R57W	30	12.1	ELBERT	CAKE	10/20/96	10/21/96	15	338	57	51.71	1.90	4.26	46.00	51.57	WHEAT	
454	N 1/2 SEC 24 T6S R57W	300	121.4	ELBERT	CAKE	8/14/98	8/22/98	115	2547	429	389.19	1.43	3.21	34	38.12	WHEAT	
455	S 1/2 SEC 24 T6S R57W	225.5	91.3	ELBERT	CAKE	7/17/98	8/14/98	87	1896	304	275.79	1.35	3.03	34	38.12	WHEAT	
458	N 1/2 SEC 30 T6S R57W	106.2	43.0	ELBERT	CAKE/MAC	1/4/99	1/15/99	77	1724	281	254.92	2.65	5.94	60	67.27	WHEAT	
459	S 1/2 SEC 30 T6S R57W	104	42.1	ELBERT	CAKE/MAC	1/4/99	1/9/99	77	1682	283	256.74	2.72	6.10	61	68.39	WHEAT	
460	N 1/2 SEC 29 T6S R57W	20	8.1	ELBERT	CAKE	1/11/99	1/11/99	5	112	18	16.33	0.90	2.02	21	23.54	WHEAT	
462	N 1/2 SEC 28 T6S R57W	100	40.5	ELBERT	CAKE	11/05/96	11/06/96	37	848	148	134.27	1.48	3.32	35.00	39.24	WHEAT	
463	S 1/2 SEC 28 T6S R57W	61	24.7	ELBERT	CAKE	11/09/96	11/11/96	29	649	125	113.40	2.05	4.60	51.00	57.18	WHEAT	
464	N 1/2 SEC 27 T6S R57W	204.3	82.7	ELBERT	CAKE	10/21/96	11/04/96	95	2139	372	337.48	1.82	4.08	44.00	49.33	WHEAT	
465	S 1/2 SEC 27 T6S R57W	172.5	69.8	ELBERT	CAKE	11/07/96	11/13/96	84	1884	349	316.61	2.02	4.53	49.00	54.93	WHEAT	
468	N 1/2 SEC 25 T6S R57W	230	93.1	ELBERT	CAKE	07/11/98	07/17/98	89	1931	310	281.23	1.35	3.03	37	41.48	WHEAT	
469	S 1/2 SEC 25 T6S R57W	261	105.6	ELBERT	CAKE	07/06/98	07/16/98	100	2206	348	315.71	1.33	2.98	35	39.24	WHEAT	
476	N 1/2 SEC 34 T6S R57W	27.9	11.3	ELBERT	CAKE	11/11/96	11/12/96	14	324	57	51.71	2.04	4.57	51.00	57.18	WHEAT	
477	S 1/2 SEC 34 T6S R57W	103.5	41.9	ELBERT	CAKE/MAC	12/28/98	1/1/99	76	1693	275	249.48	2.66	5.96	63	70.63	WHEAT	
480	N 1/2 SEC 36 T6S R57W	301	121.8	ELBERT	CAKE	7/2/98	8/22/98	116	2616	420	381.02	1.4	3.14	36	40.36	WHEAT	
481	S 1/2 SEC 36 T6S R57W	300	121.4	ELBERT	CAKE	06/28/98	07/16/98	115	2564	415	376.49	1.38	3.09	36	40.36	WHEAT	
488	N 1/2 SEC 4 T7S R57W	45	18.2	ELBERT	CAKE	12/11/98	12/18/98	25	545	86	78.02	1.91	4.28	53	59.42	WHEAT	
489	S 1/2 SEC 4 T7S R57W	50	20.2	ELBERT	CAKE	12/11/98	12/18/98	29	620	98	88.91	1.96	4.39	54	60.54	WHEAT	
490	N 1/2 SEC 3 T7S R57W	137	55.4	ELBERT	CAKE/MAC	12/8/98	12/28/98	79	1754	285	258.55	2.08	4.66	51	57.18	WHEAT	
491	S 1/2 SEC 3 T7S R57W	112.6	45.6	ELBERT	CAKE	12/12/98	12/27/98	91	2009	316	286.68	2.81	6.30	71	79.60	WHEAT	

Table 2. Methods used to analyze biosolids and soil samples collected near Deer Trail, Colorado, 1999

Constituent or property	Medium	Analytical method	Reference
Arsenic	Soils and biosolids	HG-AAS[1]	Hageman and Welsch (1996)
Cadmium	Biosolids	ICP-MS[2]	Briggs and Meier (1999)
Cadmium	Soils	ICP-AES[3]	Motooka (1996)
Copper	Biosolids	ICP-MS[2]	Briggs and Meier (1999)
Copper	Soils	ICP-AES[3]	Briggs (1996)
Lead	Biosolids	ICP-MS[2]	Briggs and Meier (1999)
Lead	Soils	ICP-AES[3]	Briggs (1996)
Mercury	Soils and biosolids	CV-AAS[4]	O'Leary and others (1996)
Molybdenum	Biosolids	ICP-MS[2]	Briggs and Meier (1999)
Molybdenum	Soils	ICP-AES[3]	Motooka (1996)
Nickel	Biosolids	ICP-MS[2]	Briggs and Meier (1999)
Nickel	Soils	ICP-AES[3]	Briggs (1996)
Selenium	Soils and biosolids	HG-AAS[1]	Hageman and Welsch (1996)
Zinc	Biosolids	ICP-MS[2]	Briggs and Meier (1999)
Zinc	Soils	ICP-AES[3]	Briggs (1996)
Gross alpha, total	Soils and biosolids	Radiological method	Greenberg (1992)
Gross beta, total	Soils and biosolids	Radiological method	Greenberg (1992)
Plutonium 238, total	Soils and biosolids	Radiological method	Whittaker and Grothaus (1979); Lyon (1980)
Plutonium 239+240, total	Soils and biosolids	Radiological method	Whittaker and Grothaus (1979); Lyon (1980)

[1]Hydride generation-atomic absorption spectrometry.
[2]Inductively coupled plasma-mass spectrometry.
[3]Inductively coupled plasma-atomic emission spectrometry.
[4]Continuous flow-cold vapor-atomic absorption spectrometry.

Table 3. Trace-element concentrations in biosolids samples collected at the Metro Wastewater Reclamation District during 1999

[Concentrations in milligrams per kilogram, dry weight basis; maximum allowable values from Colorado Department of Public Health and Environment, 1998]

Constituent	March	June	September	December	Maximum allowable for Grade I
Arsenic	1.9	2.6	2.9	6.6	41
Cadmium	4.0	3.3	3.1	2.6	39
Copper	630	570	580	470	1,500
Lead	77	120	120	56	300
Mercury	2.2	1.8	1.8	1.7	17
Molybdenum	31	24	23	20	[1]75
Nickel	30	40	30	36	420
Selenium	7.7	13	15	13	100
Zinc	630	700	710	480	2,800

[1]For Grade II biosolids only; no standard set for Grade I.

Table 4. Radioactivity data for biosolids samples collected at the Metro Wastewater Reclamation District during 1999

[Concentrations in picocuries per gram; maximum allowable for Grade I, concentrations for Grade I biosolids from Colorado Department of Public Health and Environment, 1998; ±, plus or minus]

Constituent or property	March	June	September	December	Maximum allowable for Grade I
Gross alpha	19 ±7	37 ±11	32 ±22	27 ±12	40
Gross beta	24 ±7	39 ±7	24 ±6	21 ±6	No standard set
Plutonium 238	–0.01 ±0.01	0 ±0.04	0 ±0 .01	0.01 ±0.02	No standard set
Plutonium 239+240	0 ±0.01	0.02 ±0.03	0 ±0 .01	0 ±0.02	No standard set

Table 5. Comparison of radioactivity data from two laboratories for biosolids samples

[Samples were run at two different laboratories for quality-assurance purposes; concentrations in picocuries per gram]

Constituent or property	Data from Acculabs received in 2000 (reported in table 4)	Data from Severn Trent Laboratory received in 2002
September 1999 biosolids sample		
Gross alpha	32 ± 22	48 ± 13
Gross beta	24 ± 6	31 ± 5
Plutonium 238	0 ± 0.01	0 ± 0.02
Plutonium 239+240	0 ± 0.01	0 ± 0.02
NIST Standard Reference Material 2781		
Gross alpha	33 ± 10, 37 ± 11, 27 ± 11, 29 ± 13	34 ± 9, 39 ± 10, 45 ± 11
Gross beta	28 ± 7, 39 ± 7, 30 ± 6, 29 ± 5	21 ± 4, 23 ± 4, 23 ± 4
Plutonium 238	0 ± 0.03, 0 ± 0.04, 0 ± 0.02, 0.01 ± 0.03	-0.001 ± 0.002, 0 ± 0.025, 0 ± 0.024
Plutonium 239+240	0 ± 0.02, 0.02 ± 0.03, 0 ± 0.01, 0.01 ± 0.02	-0.001 ± 0.002, 0 ± 0.027, 0.01 ± 0.02

Table 6. Trace-element concentrations in soil samples collected on August 25, 1999, Arapahoe County site

[Concentrations in milligrams per kilogram; <, less than]

Constituent	North (control) field	Middle (biosolids-application) field	South (control) field
Arsenic	7.0	6.6	6.4
Cadmium	0.18	0.28	0.20
Copper	19	17	15
Lead	17	21	19
Mercury	<0.02	<0.02	<0.02
Molybdenum	0.6	0.6	0.6
Nickel	13	15	11
Selenium	0.4	0.4	0.3
Zinc	60	63	58

Table 7. Radioactivity data for soil samples collected on August 25, 1999, Arapahoe County site

[Concentrations in picocuries per gram; ±, plus or minus]

Constituent or property	North (control) field	Middle (biosolids-application) field	South (control) field
Gross alpha	16 ±12	15 ±16	13 ±9
Gross beta	28 ±8	27 ±8	22 ±7
Plutonium 238	0.00 ±0.01	0.00 ±0.01	0.01 ±0.02
Plutonium 239+240	0.02 ±0.02	0.00 ±0.01	0.00 ±0.01

Table 8. Trace-element concentrations in soil samples collected on August 26, 1999, Elbert County site

[Concentrations in milligrams per kilogram]

Constituent	North (control) field	Middle (biosolids-application) field	South (control) field
Arsenic	11.2	14.1	13.9
Cadmium	0.21	0.21	0.24
Copper	22	21	18
Lead	26	36	24
Mercury	0.03	0.04	0.03
Molybdenum	1.2	1.4	1.2
Nickel	22	21	18
Selenium	0.9	1.0	0.8
Zinc	90	90	78

Table 9. Radioactivity data for soil samples collected on August 26, 1999, Elbert County site

[Concentrations in picocuries per gram; ±, plus or minus]

Constituent or property	North (control) field	Middle (biosolids-application) field	South (control) field
Gross alpha	13 ±11	17 ±12	14 ±14
Gross beta	31 ±9	28 ±7	24 ±7
Plutonium 238	0.01 ±0.02	0.01 ±0.03	0.01 ±0.02
Plutonium 239+240	0.00 ±0.01	0.00 ±0.01	0.00 ±0.01

Table 10. Methods used to analyze ground-water samples collected near Deer Trail, Colorado, 1999

[MRL, minimum reporting level; MDC, minimum detectable concentration (radiochemical samples); ICP, inductively coupled plasma; AA, atomic absorption spectrometry; MS, mass spectroscopy; ASF, automated segmented-flow spectrophotometery; IC, ion chromatography; dilutions for samples having high specific conductance may result in higher MRL's for some samples; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter]

Property or constituent	Units	Analytical method	MRL or MDC
Major ions and mineral characteristics			
Specific conductance, laboratory	µS/cm	Wheatstone bridge	2.6
pH, laboratory	units	Electrometric electrode	0.1
Calcium, dissolved	mg/L	ICP	0.02
Magnesium, dissolved	mg/L	ICP	0.014
Sodium, dissolved	mg/L	ICP	0.09
Potassium, dissolved	mg/L	AA	0.24
Acid-neutralizing capacity, laboratory as $CaCO_3$	mg/L	Electrometric titration	1
Sulfate, dissolved	mg/L	IC	0.31
Chloride, dissolved	mg/L	IC	0.29
Fluoride, dissolved	mg/L	Colorimetry, ASF, ion-selective electrode	0.1
Bromide, dissolved	mg/L	Colorimetry, ASF, fluorescein	0.01
Silica, dissolved	mg/L	Colorimetry, ASF, molybdate blue	0.09
Dissolved solids, residue at 180° C	mg/L	Gravimetric	10
Nutrients			
Nitrite plus nitrate, dissolved as N	mg/L	Colorimetry, ASF, cadmium reduction, diazotization	0.037
Nitrogen, ammonia, dissolved as N	mg/L	Colorimetry, ASF, salicylate-hypochlorite	0.029
Nitrogen, ammonia plus organic, total as N	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.1
Nitrogen, ammonia plus organic, dissolved as N	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.1
Phosphorus, total as P	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.05
Phosphorus, dissolved as P	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.05
Phosphorus, ortho, dissolved as P	mg/L	Colorimetry, ASF, phosphomolybdate	0.001
Trace elements			
Aluminum, dissolved as Al	µg/L	ICP-MS	1
Antimony, dissolved as Sb	µg/L	ICP-MS	1
Arsenic, dissolved as As	µg/L	Hydride generation	1
Barium, dissolved as Ba	µg/L	ICP-MS	1
Beryllium, dissolved as Be	µg/L	ICP-MS	1
Boron, dissolved as B	µg/L	ICP-MS	1
Cadmium, dissolved as Cd	µg/L	ICP-MS	1
Chromium, dissolved as Cr	µg/L	ICP-MS	1
Cobalt, dissolved as Co	µg/L	ICP-MS	1
Copper, dissolved as Cu	µg/L	ICP-MS	1
Iron, dissolved as Fe	µg/L	ICP	3
Lead, dissolved as Pb	µg/L	ICP-MS	1
Manganese, dissolved as Mn	µg/L	ICP-MS	1
Mercury, dissolved as Hg	µg/L	Hydride generation	0.1
Molybdenum, dissolved as Mo	µg/L	ICP-MS	1
Nickel, dissolved as Ni	µg/L	ICP-MS	1
Selenium, dissolved as Se	µg/L	Hydride generation	1
Silver, dissolved as Ag	µg/L	ICP-MS	1
Strontium, dissolved as Sr	µg/L	ICP-MS	1
Zinc, dissolved as Zn	µg/L	ICP-MS	1
Radioactivity			
Uranium, natural dissolved	µg/L	ICP-MS	1
Gross alpha, dissolved	pCi/L	Residue procedure, thorium-230	3
Gross beta, dissolved	pCi/L	Residue procedure, cesium-137	4
Plutonium 238, dissolved	pCi/L	Alpha spectrometry	0.1*
Plutonium 239+240, dissolved	pCi/L	Alpha spectrometry	0.1*

*Contractual MDC; reported value may be lower depending upon the sample.

Table 11. Chemical data for bedrock-core samples from U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 1999

[ft, feet; bls, below land surface; N, nitrogen; ppm, parts per million; <, less than; Rep, replicate sample]

Well number	Core description	Interval sampled, ft bls	Date core collected	Date sample collected	Date of sample analysis	Nitrate plus nitrite as N, ppm	Total N, ppm	Arsenic, ppm	Cad-mium, ppm	Chro-mium, ppm	Copper, ppm	Mercury, ppm	Lead, ppm	Molyb-denum, ppm	Nickel, ppm	Sele-nium, ppm	Zinc, ppm
DTX3	Black shale	14.20–14.86	02/12/99	04/01/99	06/29/99	<1	850	32	0.26	80	25	0.05	23	6	34	3.1	108
DTX3 Rep	Black shale	14.20–14.86	02/12/99	04/01/99	06/29/99	<1	840	35	0.21	56	22	0.05	22	5	34	3.2	109
DTX8	Gray sand and silt with shale	163.33–163.92	03/02/99	04/01/99	06/29/99	<1	360	11	<0.05	73	8	0.02	14	<2	13	0.2	57
DTX8	Gray sand and silt with shale	160.60–161.19	03/02/99	04/01/99	06/29/99	<1	370	7.8	0.07	52	9	0.04	16	3	16	0.5	62
DTX8	Hard black shale with sand, silt	138.52–139.10	03/02/99	04/01/99	06/29/99	<1	750	9.3	0.13	53	19	0.05	21	3	27	0.7	97
DTX10	Hard black clay with shale, sand, silt	109.92–110.75	02/24/99	04/01/99	06/29/99	1	470	11	0.1	30	12	0.03	15	2	18	0.6	72
DTX10	Black shale with sand, silt, fossil fragments	102.54–103.14	02/24/99	04/01/99	06/29/99	<1	400	18	0.07	31	13	0.04	16	4	18	0.4	70
DTX10	Gray sand and silt with shale	85.6–86.4	02/24/99	04/01/99	06/29/99	<1	450	15	0.11	42	16	0.04	18	3	20	0.4	78
DTX10	Shale, clay, sand, silt	82.14–82.75	02/24/99	04/01/99	06/29/99	<1	500	8.6	0.08	42	12	0.03	16	3	18	0.2	77
DTX10 Rep	Shale, clay, sand, silt	82.14–82.75	02/24/99	04/01/99	06/29/99	<1	490	24	0.1	45	13	0.03	16	3	18	0.2	77

Table 12. Lithologic descriptions for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 1999

Depth below land surface, in feet	Source	Description of material
		Well DTX1, description from geologist's notes
0–18.4 feet	Core	Dark-brown clayey loam and silt with a few pebbles (less than 2 centimeters in length) at 3.7 feet; sandier at 6.1 feet. Wet below about 4.5 feet.
18.4–19.9 feet	Core	Orange-brown coarse sand in wet silt. Sandstone fragments (less than or equal to 5 centimeters in length) with arkosic sands and gravels.
19.9–23.6 feet	Core	Wet, orange-brown loamy silt with a few thin beds of coarse sand containing sandstone fragments (less than or equal to 4 centimeters in length).
23.6–25 feet	Core	Hard, dry, dark-gray shale.
		Well DTX2, description from geologist's notes
0–6.5 feet	Core	Brown loam and silt; wet below 4 feet.
6.5–7.5 feet	Core	Coarse dark-brown sand with a few coal fragments.
7.5–12.9 feet	Core	Gray-brown sandy silt to loamy silt; drier below 11 feet.
12.9–13.5 feet	Core	Orange-brown sand and loam with a few pebbles (less than or equal to 0.7 centimeter) of quartz and iron-rich sandstone; dry or damp.
13.5–16.4 feet	Core	Wet, gray-brown and orange-brown silty loam and sandy loam; some thin clay bands and a few pebbles (less than or equal to 0.3 centimeter).
16.4–18.5 feet	Core	Dry dark-gray and black shale and clays, interbedded with a little coal; distinct sulfide odor.
		Well DTX3, description from geologist's notes
0–0.6 feet	Core	Brown clayey loam.
0.6–8.3 feet	Core	Interbedded quartz and arkosic sands in brown silt; gravels (less than or equal to 0.5 centimeter) throughout the silt and clayey silt; wet below 5 feet.
8.3–8.8 feet	Core	Wet, sandy, brown silt and clay.
8.8–14.2 feet	Core	Interbedded quartz and arkosic sands; gravels (less than or equal to 2 centimeters) in silt, clayey silt and silty clay; very wet.
14.2–16.0 feet	Core	Hard, dry, black shale with a few horizontal bands of brown clay near the 14- to 15-foot-depth interval.
		Well DTX4, description from geologist's notes
0–10.1 feet	Core	Brown, dry silt and silty clay with a few rounded pebbles (less than or equal to 6 centimeters).
10.1–10.7 feet	Core	Wet, arkosic sand and gravel (less than or equal to 2 centimeters) throughout brown clay.
10.7–14.3	Core	Interbedded brown clay with dry gray and black shale.
		Well DTX5, description from geologist's notes
0 –14.6 feet	Core	Brown, dry clay and clay loam.
14.6–14.9 feet	Core	Brown sand in wet clay and silt.
14.9–15.5 feet	Core	Moist, brown clay with a few pebbles (less than or equal to 2 centimeters).
15.5–21.0 feet	Core	Interbedded black shale and dark brown clay; dry below about 18 feet.

Table 12. Lithologic descriptions for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 1999—Continued

Depth below land surface, in feet	Source	Description of material
		Well DTX6, description from geologist's notes
0–14.0 feet	Core	Very fine-grained sand and brown silt; dry.
14.0–16.0 feet	Core	Brown clay grades into coarse pebbles and gravel (less than or equal to 8 centimeters); dry.
16.0–19.0 feet	Core	Dark-brown clay and silt; dry.
19.0–23.5 feet	Core	Sand and coarse-grained arkosic gravel (less than or equal to 8 centimeters) throughout silt; wet below 20 feet.
23.5–29.0 feet	Core	Brown clay and silt with some coarse quartz and arkosic sands; wet.
29.0–35.5 feet	Core	Interbedded brown clayey sand and quartz-arkose gravels; very wet.
35.5–36.5 feet	Core	Gray shale.
		Well DTX7, description from geologist's notes
0–5.2 feet	Core	Brown clayey loam and loamy clay, silt; dense, thin clay layer at 4.75 to 5.25 feet.
5.2–5.8 feet	Core	Gray and buff clayey loam and fine sand; wet.
5.8–13.4 feet	Core	Brown loamy silt, clay and fine sand (wet); semilithified dry clay from 13 to 13.4 feet.
		Well DTX8, description from geologist's notes
0–5.2 feet	Core	Brown clayey loam and loamy clay with silt. Dense, thin clay layer at 4.75 to 5.25 fee.
5.2–5.8 feet	Core	Gray and buff clayey loam and fine sand; wet.
5.8–13.4 feet	Core	Brown loamy silt, clay, and fine sand (wet); semilithified dry clay from 13 to 13.4 feet
13.4–22.0 feet	Mud-rotary cuttings	Dry, gray clay grades into wet, brown silt.
22.0–24.5 feet	Mud-rotary cuttings	Pebbles (equal to about 0.5 centimeter) made of granite, shale, and quartz in gray and brown silt; very wet.
24.5–35.0 feet	Mud-rotary cuttings	Light-brown and gray sandy silt with clay.
35.0–75.0 feet	Mud-rotary cuttings to 41.5 feet; air rotary cuttings 41.5 to 75 feet	Green-gray and buff-colored silt and very fine-grained sand with a few thin layers of gray shale; wet from 41 to 75 feet
75.0–170 feet	Air rotary cuttings to 121 feet; core from 121 to 165 feet.	Interbedded black or gray shale (beds less than 5 centimeters thick) and gray silt with very fine-grained sand; sandier at 105 feet and 163 feet; variably saturated from 75 to 170 feet.

Table 12. Lithologic descriptions for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 1999—Continued

Depth below land surface, in feet	Source	Description of material
		Well DTX9, description from geologist's notes
0–17 feet	Core	Dark-brown clayey silt interbedded with hard silty clay.
17–23.2 feet	Core	Wet, brown clayey silt; a few sandstone pebbles (less than or equal to 2 centimeters) at 18 feet and 23 feet.
23.2–23.8 feet	Core	Drier; semilithified gray clay.
23.8–28.0 feet	Core	Dry, semilithified light-gray silt and fine-grained sand with 2 thin beds (less than 0.5 foot thick) of coarse-grained orange sand.
		Well DTX10, description from geologist's notes
0–17.0 feet	Core	Dark-brown clayey silt interbedded with tight silty clay.
17.0–23.2 feet	Core	Wet, brown clayey silt; a few sandstone pebbles (less than or equal to 2 centimeters) at 18 feet and 23 feet.
23.2–23.8 feet	Core	Drier, semilithified gray clay.
23.8–32.0 feet	Core	Dry, semilithified light gray silt and fine-grained sand with 2 thin beds (less than 0.5 foot thick) of coarse-grained orange sand.
32.0–35.0 feet	Core	Pebbles (less than or equal to 5 centimeters) of granite, quartzite, and shale in gray silt and sand; very wet.
35.0–70 feet	Drilling returns, with core from 56 to 70 feet	Green-gray silt and very fine-grained sand interbedded with thin beds of clayey black shale; wet from 35 to 57.5 feet.
70.0 to 120.0 feet	Drilling returns, with core from 70 to 86.5 feet and 101 to 112 feet	Interbedded black shale (beds less than 5 centimeters) and gray silt with very fine-grained sand; wet from 86.5 to about 120 feet.
		Well D6, description from driller's notes
0–3 feet	Surficial drilling returns	Dry, silty, powdery, light-brown clay.
3–8 feet	Surficial drilling returns	Silty clay; moist at 7 feet.
8–13 feet	Surficial drilling returns	Water at 10 to 11 feet; wet silty clay.
13–23 feet	Surficial drilling returns	Saturated, silty, sandy clay.

Table 12. Lithologic descriptions for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 1999—Continued

Depth below land surface, in feet	Source	Description of material
		Well D11a, description from geologist's notes
0–35 feet	Air rotary cuttings	Fine-grained, beige, friable, calcareous quartz sandstone with few small (less than l/4 inch) iron concretions; calcareous bioturbation.
35–75 feet	Air rotary cuttings	Fine-grained sandstone (same as above) with 20–80 percent clay in drilling returns; brown.
75–100 feet	Air rotary cuttings	Fine-grained, soft, friable, beige sandstone and silt.
100–120 feet	Air rotary cuttings	Beige to orange, soft, friable sandstone; water near 120 feet.
120–140 feet	Air rotary cuttings	Gray to dark-gray shale with some tiny anhedral pyrite crystals near 125 feet; denser shale at 134–140 feet.
		Well D13, description from driller's notes
0–3 feet	Surficial drilling returns	Silty, powdery clay; moist at 1.5 feet with black and dark-brown fine sand; light-gray fine sand at 3 feet.
3–8 feet	Surficial drilling returns	Saturated, fine-grained sand; water at 4.5 to 5 feet.
8–15 feet	Surficial drilling returns	Same material as above.
		Well D17, description from driller's notes
0–3 feet	Surficial drilling returns	Black silty sand; more clay at 1.5 feet grading into light-brown fine sand at 2 feet.
3–8 feet	Surficial drilling returns	Trace of gravel at 6.5 feet; moist, fine sand from 7 to 7.5 feet.
8–13 feet	Surficial drilling returns	Water at 10 feet; saturated fine sand.
13–20 feet	Surficial drilling returns	Same material as above.
		Well D25, description from driller's notes
0–3.5 feet	Surficial drilling returns	Sandy silt.
3.5–23 feet	Surficial drilling returns	Clayey sand; water at 15 feet.

Table 12. Lithologic descriptions for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 1999—Continued

Depth below land surface in feet	Source	Description of material
		Well D29, description from geologist's notes
0–5 feet	Air rotary cuttings	Uniform brown sandy loam.
5–15 feet	Air rotary cuttings	Brown, fine-grained loamy sand with soft chunks of friable beige sandstone.
15–25 feet	Air rotary cuttings	Beige, fine-grained friable sandstone; calcareous with chunks of bioturbated sandstone near 15 feet and brownish-orange lithified sandstone near 20 feet.
25–30 feet	Air rotary cuttings	Hard, dark, gray-brown shale.
30–75 feet	Air rotary cuttings	Interbedded beige, soft, friable sandstone with orange-brown and harder red-brown sandstone; friable dark brown shale from 35 to 38 feet.
75–85 feet	Air rotary cuttings	Black friable shale and gray clay.
85–125 feet	Air rotary cuttings	Interbedded beige friable sandstone and gray clay with shale fragments.
125–153 feet	Air rotary cuttings	Interbedded, soft, orange, silty sandstone with gray clay and gray-black shale; formation has water somewhere in this zone.
153–180 feet	Air rotary cuttings	Gray-black shale.
		Well D30, description from driller's notes
0–1 feet	Surficial drilling returns	Sandy silt.
1–9 feet	Surficial drilling returns	Clayey sand; wet at 8 feet.
9–19 feet	Surficial drilling returns	Sandy clay.

Table 13. Monthly water-level data for U.S.Geological Survey monitoring wells near Deer Trail, Colorado, 1999

[All measurements made with electric tape; BMP, feet below measuring point]

Well number	Date	Time	Water level, BMP	Well number	Date	Time	Water level, BMP
DTX1	3/24/99	1525	8.84	DTX4	3/19/99	1235	8.39
DTX1	4/1/99	1509	8.83	DTX4	4/1/99	1034	8.46
DTX1	5/7/99	0906	8.93	DTX4	5/18/99	0901	5.09
DTX1	6/7/99	0850	7.93	DTX4	6/7/99	1242	5.13
DTX1	7/6/99	0832	8.55	DTX4	7/6/99	1200	6.23
DTX1	8/3/99	1230	6.90	DTX4	8/18/99	1257	5.42
DTX1	9/3/99	0745	6.97	DTX4	9/3/99	1112	6.25
DTX1	10/4/99	0810	7.58	DTX4	10/4/99	1050	7.08
DTX1	11/3/99	0920	7.79	DTX4	11/3/99	1305	7.50
DTX1	12/1/99	0852	7.81	DTX4	12/1/99	1010	7.64
DTX2	3/25/99	1235	7.63	DTX5	3/18/99	1615	10.17
DTX2	4/1/99	1459	7.74	DTX5	4/1/99	1058	10.09
DTX2	5/7/99	0842	7.07	DTX5	5/7/99	1316	6.93
DTX2	6/7/99	0823	7.31	DTX5	6/7/99	1304	7.18
DTX2	7/6/99	0855	7.77	DTX5	7/6/99	1114	8.37
DTX2	8/11/99	0940	7.33	DTX5	8/3/99	1020	8.09
DTX2	9/3/99	0803	7.31	DTX5	9/13/99	1148	8.70
DTX2	10/4/99	0830	7.56	DTX5	10/4/99	1150	9.29
DTX2	11/3/99	0940	7.51	DTX5	11/3/99	1240	9.44
DTX2	12/1/99	0806	7.28	DTX5	12/1/99	1145	9.49
DTX3	3/19/99	0920	11.45	DTX6	3/18/99	1210	21.85
DTX3	4/1/99	1019	11.48	DTX6	4/1/99	1052	21.84
DTX3	5/18/99	0938	7.39	DTX6	5/7/99	1325	20.86
DTX3	6/7/99	1218	8.31	DTX6	6/7/99	1312	20.69
DTX3	7/6/99	1228	7.96	DTX6	7/6/99	1129	20.95
DTX3	8/18/99	1350	7.96	DTX6	8/3/99	1120	21.11
DTX3	9/3/99	1042	8.20	DTX6	9/3/99	1131	21.05
DTX3	10/4/99	1115	8.46	DTX6	10/4/99	1140	21.31
DTX3	11/3/99	1330	8.57	DTX6	11/3/99	1130	21.47
DTX3	12/1/99	1031	8.67	DTX6	12/1/99	1050	21.54

Table 13. Monthly water-level data for U.S.Geological Survey monitoring wells near Deer Trail, Colorado, 1999

[All measurements made with electric tape; BMP, feet below measuring point]

Well number	Date	Time	Water level, BMP
DTX7	3/24/99	1055	not measured
DTX7	4/1/99	1437	7.27
DTX7	5/7/99	1453	6.19
DTX7	6/7/99	0910	6.62
DTX7	7/6/99	1633	7.51
DTX7	8/3/99	1317	7.90
DTX7	9/3/99	0845	7.85
DTX7	10/4/99	0906	8.00
DTX7	11/3/99	1004	7.84
DTX7	12/1/99	0910	7.69
DTX8A	3/24/99	1055	7.55
DTX8A	4/1/99	1439	7.50
DTX8A	5/7/99	0926	6.16
DTX8A	6/7/99	0907	7.05
DTX8A	7/6/99	1630	8.10
DTX8A	8/3/99	1316	8.51
DTX8A	9/3/99	0842	8.60
DTX8A	10/4/99	0900	8.93
DTX8A	11/3/99	1007	8.77
DTX8A	12/1/99	0907	8.25
DTX8B	3/24/99	1055	not measured
DTX8B	4/1/99	1440	5.25
DTX8B	5/7/99	0929	4.69
DTX8B	6/7/99	0908	4.68
DTX8B	7/6/99	1632	4.85
DTX8B	8/3/99	1315	4.90
DTX8B	9/3/99	0840	4.78
DTX8B	10/4/99	0902	4.88
DTX8B	11/3/99	1009	4.89
DTX8B	12/1/99	0908	4.84
DTX9	3/25/99	0930	not measured
DTX9	4/1/99	1424	12.84
DTX9	5/7/99	0947	12.48
DTX9	6/7/99	0923	12.32
DTX9	7/6/99	1616	12.45
DTX9	8/3/99	1330	12.60
DTX9	9/3/99	0946	12.64
DTX9	10/4/99	0925	12.67
DTX9	11/3/99	1037	12.69
DTX9	12/1/99	0923	12.69
DTX10A	3/25/99	0930	13.05
DTX10A	4/1/99	1427	13.01
DTX10A	5/7/99	0942	12.40
DTX10A	6/7/99	0924	12.33
DTX10A	7/6/99	1610	12.67
DTX10A	8/3/99	1334	12.88
DTX10A	9/3/99	0943	12.86
DTX10A	10/4/99	0920	12.92
DTX10A	11/3/99	1039	12.92
DTX10A	12/1/99	0921	12.92
DTX10B	3/25/99	0930	not measured
DTX10B	4/1/99	1428	18.37
DTX10B	5/7/99	0945	17.83
DTX10B	6/7/99	0926	17.91
DTX10B	7/6/99	1612	18.09
DTX10B	8/3/99	1333	18.13
DTX10B	9/3/99	0941	17.61
DTX10B	10/4/99	0921	18.71
DTX10B	11/3/99	1041	18.75
DTX10B	12/1/99	0922	18.71

Table 13. Monthly water-level data for U.S.Geological Survey monitoring wells near Deer Trail, Colorado, 1999

[All measurements made with electric tape; BMP, feet below measuring point]

Well number	Date	Time	Water level, BMP	Well number	Date	Time	Water level, BMP
D6	3/4/99	1045	8.89	D17	8/3/99	1430	10.44
D6	4/1/99	0904	9.01	D17	9/3/99	1335	10.73
D6	5/7/99	1235	7.25	D17	10/4/99	1255	10.92
D6	6/7/99	1440	7.14	D17	11/3/99	1436	10.97
D6	7/6/99	1030	7.82	D17	12/1/99	1303	10.97
D6	8/3/99	1517	8.35				
D6	9/3/99	1246	8.71	D25	3/4/99	0930	9.29
D6	10/4/99	1005	9.05	D25	4/1/99	1217	9.35
D6	11/3/99	1200	9.21	D25	5/7/99	1400	8.50
D6	12/1/99	1221	9.30	D25	6/7/99	0938	8.32
				D25	7/6/99	1355	8.67
D11a	3/4/99	0953	112.94	D25	8/3/99	1630	9.42
D11a	4/1/99	1145	113.07	D25	9/3/99	1406	9.98
D11a	5/7/99	1037	113.10	D25	10/4/99	1400	10.20
D11a	6/7/99	1059	113.16	D25	11/3/99	1505	10.28
D11a	7/6/99	1447	113.20	D25	12/1/99	1354	10.28
D11a	8/3/99	1415	113.80				
D11a	9/3/99	1325	113.04	D29	3/4/99	1100	154.14
D11a	10/4/99	1305	113.07	D29	4/1/99	1208	154.01
D11a	11/3/99	1440	112.99	D29	5/7/99	1007	154.39
D11a	12/1/99	1310	112.79	D29	6/7/99	1124	154.43
				D29	7/6/99	0945	154.70
D13	3/4/99	0900	7.56	D29	8/3/99	1545	154.53
D13	4/1/99	1311	7.48	D29	9/3/99	1300	154.19
D13	5/7/99	1421	5.90	D29	10/4/99	1220	154.42
D13	6/7/99	0956	6.80	D29	11/3/99	1407	154.30
D13	7/7/99	1414	7.60	D29	12/1/99	1242	154.09
D13	8/3/99	1615	7.95				
D13	9/3/99	1353	8.29	D30	3/4/99	1040	4.86
D13	10/4/99	1335	8.41	D30	4/1/99	0951	5.00
D13	11/3/99	1452	8.16	D30	5/7/99	1240	4.35
D13	12/1/99	1326	7.84	D30	6/7/99	1450	4.73
				D30	7/6/99	1016	5.22
D17	3/4/99	1006	11.10	D30	8/3/99	1510	5.63
D17	4/1/99	1150	11.09	D30	9/3/99	1240	5.78
D17	5/7/99	1028	10.12	D30	10/4/99	0950	5.75
D17	6/7/99	1106	9.81	D30	11/3/99	1155	5.62
D17	7/6/99	1430	9.99	D30	12/1/99	1227	5.39

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado, 1999

[mm/dd/yy, month/dayyear; hhmm, hours and minutes in military time; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Specific conductance, lab (µS/cm at 25° C)	pH, lab (standard units)	Specific conductance, field (µS/cm at 25° C)	pH, field (standard units)	Water temperature (degrees Celsius)	Water level, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)
D6	03/19/99	1600	15,800	7.3	16,100	7.0	11	8.95	0.6	10,000	440	2,200
D6	04/12/99	1000	15,900	7.2	16,200	6.9	11	9.08	0.4	10,000	440	2,200
D6	07/06/99	1800	15,800	7.2	16,600	6.9	13	7.75	0.6	10,000	430	2,200
D6	11/12/99	1030	14,700	7.2	16,200	6.9	12	9.27	0.4	11,000	450	2,300
D13	03/22/99	1500	1,530	7.5	1,500	7.1	8.5	7.49	1.3	780	210	60
D13	04/20/99	1445	1,520	7.4	1,600	7.3	9.1	7.41	0.8	810	220	61
D13	07/07/99	1445	1,530	7.4	1,700	7.0	14	7.6	0.9	780	210	59
D13	11/17/99	1340	1,470	7.4	1,500	7.1	13	8.01	1	780	210	61
D17	03/22/99	1250	487	8.0	450	7.6	12	11.11	0.9	220	58	19
D17	04/20/99	1315	494	7.8	480	7.5	12	11.09	0.9	220	60	18
D17	07/06/99	1530	526	7.7	520	7.5	14	9.7	1.5	240	58	22
D17	11/09/99	1040	507	7.8	500	7.3	14	10.99	1.2	230	59	20
D25	03/18/99	1000	4,600	7.4	4,500	7.1	10	9.38	--	2,600	650	230
D25	04/16/99	0945	4,540	7.4	4,400	5.8	8.6	9.42	0.6	2,700	700	230
D25	07/07/99	1310	5,180	7.4	5,500	7.0	15	8.69	0.6	3,100	700	320
D25	11/08/99	1430	4,600	7.4	4,600	7.0	15	10.29	0.9	2,700	690	240
D30	03/22/99	1015	4,970	7.4	4,700	7.0	9.6	4.93	0.6	2,900	460	420
D30	04/12/99	1130	5,010	7.2	5,100	6.8	10	4.98	0.6	2,900	440	420
D30	07/12/99	1320	5,000	7.2	5,100	6.8	12	5.46	0.9	2,900	460	420
D30	11/12/99	1230	4,320	7.2	4,900	6.9	14	5.55	0.7	2,700	440	400
DTX1	03/24/99	1655	4,210	7.5	4,200	7.0	11	8.84	1	2,100	480	210
DTX1	04/20/99	1630	4,200	7.3	4,200	7.2	11	8.84	0.6	2,200	500	220

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado, 1999—Continued

[mm/dd/yy, month/dayyear; hhmm, hours and minutes in military time; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Specific conductance, lab (µS/cm at 25° C)	pH, lab (standard units)	Specific conductance, field (µS/cm at 25° C)	pH, field (standard units)	Water temperature (degrees Celsius)	Water level, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)
DTX1	07/07/99	1015	4,150	7.4	4,400	6.9	12	8.59	0.9	2,100	480	210
DTX1	11/08/99	1215	4,140	7.4	4,200	7.1	13	7.77	0.5	2,000	470	210
DTX2	03/25/99	1320	4,230	7.3	4,200	7.1	11	7.63	1.2	2,200	510	220
DTX2	04/19/99	1700	4,230	7.1	4,300	6.7	11	7.68	0.7	2,200	510	220
DTX2	07/12/99	1015	4,290	7.1	4,500	6.7	12	7.93	0.7	2,100	490	210
DTX2	11/08/99	1010	4,280	7.2	4,300	6.8	13	7.45	0.7	2,100	500	210
DTX3	03/19/99	1040	2,040	7.4	2,000	7.3	9.3	11.45	5.2	1,100	260	98
DTX3	04/20/99	1000	2,080	7.3	2,100	6.8	10	11.52	5.6	1,100	280	110
DTX3	07/09/99	1530	1,200	7.6	1,270	7.1	13	8.07	6.4	520	130	47
DTX3	11/17/99	1200	992	7.5	1,000	7.2	13	8.61	3.4	450	110	42
DTX4	03/19/99	1330	3,110	7.1	3,000	6.6	9.3	8.39	0.9	1,900	590	90
DTX4	04/13/99	1500	3,120	6.9	3,100	6.7	9.8	8.39	0.9	1,900	600	93
DTX4	07/09/99	1315	2,990	7.0	3,200	6.5	13	6.36	0.7	1,800	560	86
DTX4	11/16/99	1040	2,870	7.0	2,900	6.7	13	7.7	1	1,600	520	81
DTX5	03/18/99	1730	3,180	7.3	3,200	6.9	8.8	10.17	--	2,200	710	99
DTX5	04/13/99	1300	3,120	7.1	3,200	6.8	9.7	10.09	0.6	2,100	690	97
DTX5	07/08/99	1500	2,350	7.2	2,500	6.8	13	8.41	0.7	1,500	500	74
DTX5	11/16/99	1320	2,720	7.2	2,700	7.0	14	9.5	0.9	1,700	550	83
DTX6	03/18/99	1400	4,080	7.4	4,000	7.0	12	21.85	--	2,200	470	250
DTX6	04/13/99	1110	4,120	7.2	4,100	7.0	14	21.81	0.6	2,300	500	250
DTX6	07/08/99	1230	4,190	7.3	4,500	6.9	14	20.94	1.6	2,300	500	270
DTX6	11/17/99	0950	4,140	7.3	4,200	7.0	13	21.52	1.1	2,300	480	250

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Sodium, dissolved (mg/L as Na)	Sodium adsorption ratio	Sodium, (percent)	Potassium, dissolved (mg/L as K)	Acid-neutralizing capacity, titration to 4.5, lab (mg/L as $CaCO_3$)	Sulfate, dissolved, (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide, dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)
D6	03/19/99	1600	2,000	9	30	15	629	13,000	410	0.8	4.2	21
D6	04/12/99	1000	2,100	9	31	12	628	13,000	420	0.8	4.2	27
D6	07/06/99	1800	2,000	9	30	12	636	13,000	400	1.5	3.8	21
D6	11/12/99	1030	2,000	8	29	18	639	13,000	410	0.9	4.1	22
D13	03/22/99	1500	63	1	15	2.5	236	650	3.6	1.3	0.17	12
D13	04/20/99	1445	63	1	14	2.3	238	630	3.9	1.2	0.18	13
D13	07/07/99	1445	64	1	15	2.9	248	650	3.7	1.3	0.17	14
D13	11/17/99	1340	65	1	15	2.6	247	620	3.5	1.4	0.17	15
D17	03/22/99	1250	17	0.5	14	1.6	206	44	2.4	1.5	0.07	18
D17	04/20/99	1315	17	0.5	14	1.4	208	42	3.3	1.5	0.08	18
D17	07/06/99	1530	16	0.5	13	1.7	219	43	3.8	1.8	0.09	20
D17	11/09/99	1040	17	0.5	13	1.7	206	45	2.8	1.7	0.08	20
D25	03/18/99	1000	320	3	21	[1]0.3	538	2,500	98	1	1.1	28
D25	04/16/99	0945	320	3	21	7	519	2,500	92	1	1.3	29
D25	07/07/99	1310	460	4	24	6.9	740	2,800	84	1.1	1.1	35
D25	11/08/99	1430	300	2	19	6.7	520	2,600	94	1.2	1.4	31
D30	03/22/99	1015	380	3	22	3.9	382	3,100	54	0.8	0.54	23
D30	04/12/99	1130	390	3	23	4	390	3,100	52	0.8	0.65	21
D30	07/12/99	1320	390	3	23	4.6	435	3,000	54	0.8	0.62	23
D30	11/12/99	1230	350	3	22	4.2	352	3,000	50	0.9	0.71	23
DTX1	03/24/99	1655	350	3	27	3.4	319	2,500	53	0.8	0.66	31

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Sodium, dissolved (mg/L as Na)	Sodium adsorption ratio	Sodium, (percent)	Potassium, dissolved (mg/L as K)	Acid-neutralizing capacity, titration to 4.5, lab (mg/L as $CaCO_3$)	Sulfate, dissolved, (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide, dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)
DTX1	04/20/99	1630	370	4	27	3.3	314	2,400	52	0.7	0.67	32
DTX1	07/07/99	1015	360	3	28	3.6	309	2,400	52	0.8	0.66	33
DTX1	11/08/99	1215	340	3	27	3.4	308	2,400	50	0.9	0.76	33
DTX2	03/25/99	1320	380	4	27	7.9	390	2,400	39	0.5	0.44	17
DTX2	04/19/99	1700	380	4	28	7.5	393	2,400	37	0.5	0.38	17
DTX2	07/12/99	1015	380	4	28	8.4	403	2,400	37	0.5	0.42	17
DTX2	11/08/99	1010	380	4	28	8.4	405	2,400	46	0.6	0.59	18
DTX3	03/19/99	1040	99	1	17	7.3	271	920	33	0.3	0.24	16
DTX3	04/20/99	1000	110	1	17	6.8	270	920	31	0.3	0.24	17
DTX3	07/09/99	1530	63	1	21	5.4	240	410	11	0.5	[1]0.09	14
DTX3	11/17/99	1200	47	1	18	5	268	270	9.5	0.5	0.13	15
DTX4	03/19/99	1330	140	1	14	7.6	413	1,600	18	0.2	0.22	12
DTX4	04/13/99	1500	150	2	15	7.8	407	1,600	[1]78	0.2	0.24	12
DTX4	07/09/99	1315	140	1	14	7.6	409	1,600	19	0.2	0.19	12
DTX4	11/16/99	1040	150	2	16	7.4	385	1,500	17	0.3	0.18	13
DTX5	03/18/99	1730	95	0.9	9	4.9	268	2,000	9.7	0.3	0.18	12
DTX5	04/13/99	1300	91	0.9	9	5.1	267	1,800	[1]38	0.3	0.18	12
DTX5	07/08/99	1500	46	0.5	6	4.2	268	1,300	5.4	0.3	0.1	12
DTX5	11/16/99	1320	73	0.8	8	4.3	275	1,600	7.9	0.3	0.16	13
DTX6	03/18/99	1400	310	3	23	13	260	2,500	21	0.5	0.15	12
DTX6	04/13/99	1110	300	3	22	13	261	2,500	[1]89	0.5	0.16	12
DTX6	07/08/99	1230	320	3	23	12	261	2,600	20	0.5	0.15	11
DTX6	11/17/99	0950	310	3	23	12	269	2,600	20	0.5	0.15	12

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Solids, residue on evaporation at 180° C, dissolved (mg/L)	Dissolved solids, sum of constituents (mg/L)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Phosphorus, total (mg/L as P)	Phosphorus, dissolved (mg/L as P)	Phosphorus, ortho, dissolved (mg/L as P)
D6	03/19/99	1600	20,000	18,500	0.01	11	<.02	1.4	1.4	E.04	E.04	0.04
D6	04/12/99	1000	20,000	18,400	0.01	11	0.07	1.4	1.4	<.05	<.05	0.04
D6	07/06/99	1800	21,200	18,400	--	12	0.07	0.9	1.4	<.05	E.04	--
D6	11/12/99	1030	20,600	18,600	--	12	0.09	1.3	0.3	E.04	<.05	--
D13	03/22/99	1500	1,220	1,150	<.01	<.05	0.04	0.2	0.1	<.05	<.05	<.01
D13	04/20/99	1445	1,220	1,140	<.01	<.05	0.03	0.1	0.1	<.05	<.05	0.02
D13	07/07/99	1445	1,220	1,160	--	ND	ND	0.2	ND	<.05	ND	--
D13	11/17/99	1340	1,160	1,130	--	<.037	<.03	0.2	E.10	<.05	<.05	--
D17	03/22/99	1250	302	292	<.01	1.2	<.02	0.1	<.1	0.08	0.08	0.07
D17	04/20/99	1315	300	293	<.01	1.6	<.02	E.08	E.08	E.04	E.05	0.08
D17	07/06/99	1530	332	314	--	3.5	<.02	0.2	0.2	0.07	0.08	--
D17	11/09/99	1040	305	305	--	2.9	<.03	<.1	0.1	0.08	0.09	--
D25	03/18/99	1000	4,640	4,230	<.01	7.4	<.02	0.9	0.8	0.14	0.14	0.13
D25	04/16/99	0945	2,280	4,210	0.01	6.3	0.07	0.9	1.0	0.11	0.12	0.16
D25	07/07/99	1310	5,130	4,850	--	ND	ND	1.4	ND	0.22	ND	--
D25	11/08/99	1430	4,710	4,300	--	3.4	E.02	1	0.9	0.17	0.19	--
D30	03/22/99	1015	5,110	4,640	<.01	0.06	0.06	0.3	0.2	0.07	E.05	0.04
D30	04/12/99	1130	5,190	4,660	<.01	<.05	0.08	0.3	0.3	E.05	<.05	0.06
D30	07/12/99	1320	5,130	4,650	--	<.05	0.08	0.3	0.3	E.05	<.05	--
D30	11/12/99	1230	5,030	4,530	--	<.037	0.06	0.4	0.2	0.06	<.05	--

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Solids, residue on evaporation at 180° C, dissolved (mg/L)	Dissolved solids, sum of constituents (mg/L)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Phosphorus, total (mg/L as P)	Phosphorus, dissolved (mg/L as P)	Phosphorus, ortho, dissolved (mg/L as P)
DTX1	03/24/99	1655	4,220	3,790	<.01	1.2	0.03	0.2	0.2	0.06	0.07	0.07
DTX1	04/20/99	1630	4,180	3,800	<.01	1.1	0.05	0.2	0.2	E.04	0.07	0.07
DTX1	07/07/99	1015	4,170	3,730	--	ND	ND	0.2	ND	0.06	ND	--
DTX1	11/08/99	1215	4,150	3,720	--	1.9	<.03	0.2	0.2	0.06	0.1	--
DTX2	03/25/99	1320	4,250	3,850	<.01	<.05	0.53	0.8	0.8	<.05	<.05	<.01
DTX2	04/19/99	1700	4,190	3,830	<.01	<.05	0.58	0.9	0.9	<.05	<.05	0.02
DTX2	07/12/99	1015	4,150	3,800	--	<.05	0.55	0.9	0.9	<.05	<.05	--
DTX2	11/08/99	1010	4,220	3,830	--	<.037	0.61	1	1.0	<.05	<.05	--
DTX3	03/19/99	1040	1,730	1,620	<.01	4.1	<.02	0.2	0.1	<.05	<.05	<.01
DTX3	04/20/99	1000	1,770	1,660	<.01	4.3	0.02	0.2	0.2	<.05	<.05	0.01
DTX3	07/09/99	1530	870	836	--	2.8	<.02	0.1	1.4	<.05	<.05	--
DTX3	11/17/99	1200	704	671	--	1.6	<.03	0.2	0.1	<.05	<.05	--
DTX4	03/19/99	1330	2,950	2,770	<.01	0.08	0.11	0.3	0.2	<.05	<.05	<.01
DTX4	04/13/99	1500	2,940	2,790	<.01	0.36	0.11	0.3	0.3	<.05	<.05	0.02
DTX4	07/09/99	1315	2,790	2,670	--	0.13	0.08	0.3	0.3	<.05	<.05	--
DTX4	11/16/99	1040	2,700	2,550	--	<.037	0.08	0.3	0.3	<.05	<.05	--
DTX5	03/18/99	1730	3,260	3,050	<.01	<.05	0.06	0.2	0.1	<.05	<.05	<.01
DTX5	04/13/99	1300	3,180	2,910	<.01	<.05	0.08	0.2	0.2	<.05	<.05	0.02
DTX5	07/08/99	1500	2,180	2,080	--	0.10	0.06	0.1	0.1	<.05	<.05	--
DTX5	11/16/99	1320	2,660	2,490	--	<.037	0.03	0.2	0.1	<.05	<.05	--
DTX6	03/18/99	1400	4,120	3,750	<.01	0.24	0.04	0.1	E.07	<.05	<.05	<.01
DTX6	04/13/99	1110	4,140	3,790	<.01	0.22	0.02	0.1	0.1	<.05	<.05	0.02
DTX6	07/08/99	1230	4,270	3,900	--	0.32	0.02	0.1	E.10	<.05	<.05	--
DTX6	11/17/99	0950	4,160	3,900	--	0.28	<.03	0.1	<.1	<.05	<.05	--

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Aluminum, dissolved (µg/L as Al)	Antimony, dissolved (µg/L as Sb)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Boron, dissolved (µg/L as B)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)
D6	03/19/99	1600	<7	<7	3	<7	<7	843	<7	2	7	29
D6	04/12/99	1000	<2	<2	2	<2	<2	946	<2	<2	<2	11
D6	07/06/99	1800	9	<7	<2	<7	<7	803	<7	<1.0	<7	34
D6	11/12/99	1030	<6	<6	E1	<6	<6	1,030	<6	<4	6	27
D13	03/22/99	1500	2	<1	<1	20	<1	88.6	<1	<1	<1	2
D13	04/20/99	1445	2	<1	<1	20	<1	84.6	<1	<1.0	<1	4
D13	07/07/99	1445	2	<1	1	21	<1	98.8	<1	2	<1	2
D13	11/17/99	1340	1	<1	<2	22	<1	101	<1	<.8	<1	3
D17	03/22/99	1250	2	<1	2	58	<1	67.2	<1	<1	<1	<1
D17	04/20/99	1315	<1	<1	2	58	<1	55.1	<1	<1.0	<1	<1
D17	07/06/99	1530	1	<1	2	57	<1	71.5	<1	<1.0	<1	<1
D17	11/09/99	1040	1	<1	E1	61	<1	69.2	<1	<.8	<1	<1
D25	03/18/99	1000	6	<2	3	19	<2	396	<2	<1.0	3	8
D25	04/16/99	0945	<2	<2	2	17	<2	395	<2	[1]27	3	7
D25	07/07/99	1310	8	<3	6	19	<3	700	<3	[1]19	<3	11
D25	11/08/99	1430	2	<2	2	19	<2	445	<2	<1.0	3	7
D30	03/22/99	1015	3	<2	1	10	<2	468	<2	<2	2	9
D30	04/12/99	1130	5	<2	<1	>11	<2	512	<2	<2	<2	8
D30	07/12/99	1320	<2	<2	<1	11	<2	521	<2	[1]9.5	<2	8
D30	11/12/99	1230	1	<1	<2	11	<1	459	<1	<1.0	2	7
DTX1	03/24/99	1655	<2	<2	2	9	<2	523	<2	<1.0	<2	7
DTX1	04/20/99	1630	<2	<2	1	9	<2	574	<2	<1.0	<2	9
DTX1	07/07/99	1015	4	<2	2	8	<2	559	<2	[1]14	<2	7
DTX1	11/08/99	1215	2	<2	<2	8	<2	618	<2	<1.0	<2	6

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Aluminum, dissolved (µg/L as Al)	Antimony, dissolved (µg/L as Sb)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Boron, dissolved (µg/L as B)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)
DTX2	03/25/99	1320	2	<2	2	21	<2	346	<2	<1	6	6
DTX2	04/19/99	1700	<2	<2	1	19	<2	350	<2	<1.0	6	8
DTX2	07/12/99	1015	<2	<2	<1	17	<2	348	<2	[1]11	5	6
DTX2	11/08/99	1010	<2	<2	<2	16	<2	342	<2	1.5	5	5
DTX3	03/19/99	1040	<1	<1	<1	15	<1	228	<1	<1.0	<1	3
DTX3	04/20/99	1000	1	<1	<1	14	<1	265	<1	<1.0	<1	4
DTX3	07/09/99	1530	2	<1	<1	12	<1	192	<1	<1.0	<1	2
DTX3	11/17/99	1200	2	<1	<2	19	<1	208	<1	<.8	<1	2
DTX4	03/19/99	1330	2	<2	1	17	<2	244	<2	<1.0	<2	6
DTX4	04/13/99	1500	3	<2	<1	16	<2	260	<2	<1.0	<2	8
DTX4	07/09/99	1315	3	<2	2	14	<2	276	<2	[1]11	<2	6
DTX4	11/16/99	1040	2	<1	<2	15	<1	289	<1	1	1	4
DTX5	03/18/99	1730	3	<2	<1	20	<2	373	<2	<1	2	7
DTX5	04/13/99	1300	3	<2	<1	18	<2	374	<2	<2	<2	8
DTX5	07/08/99	1500	3	<1	1	16	<1	334	<1	[1]8.2	2	5
DTX5	11/16/99	1320	1	<1	<2	17	<1	408	<1	2.1	2	4
DTX6	03/18/99	1400	<2	<2	<1	11	<2	367	<2	1.2	6	7
DTX6	04/13/99	1110	6	<2	<1	10	<2	366	<2	1	<2	11
DTX6	07/08/99	1230	3	<2	1	9	<2	368	<2	[1]11	<2	8
DTX6	11/17/99	0950	2	<2	<2	9	<2	354	<2	<1.0	<2	6

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)
D6	03/19/99	1600	<250	<7	3,590	<.1	<7	23	8	<7	17,000	31
D6	04/12/99	1000	<200	<2	3,930	<.1	<2	6	7	<2	17,000	9
D6	07/06/99	1800	<200	<7	3,600	<.1	<7	15	8	<7	17,000	33
D6	11/12/99	1030	<250	<6	3,740	<.2	<6	19	6	<6	17,000	29
D13	03/22/99	1500	<10	<1	120	<.1	<1	3	<1	<1	1,200	1
D13	04/20/99	1445	17	<1	115	<.1	<1	3	<1	<1	1,100	3
D13	07/07/99	1445	20	<1	156	<.1	1	4	<1	<1	1,100	1
D13	11/17/99	1340	17	<1	92	<.2	1	5	<2	<1	1,100	2
D17	03/22/99	1250	<10	<1	236	<.1	6	1	9	<1	310	<1
D17	04/20/99	1315	<10	<1	255	<.1	6	1	8	<1	300	<1
D17	07/06/99	1530	<10	<1	271	<.1	7	<1	8	<1	330	<1
D17	11/09/99	1040	<10	<1	347	<.2	6	2	9	<1	320	<1
D25	03/18/99	1000	<30	<2	2,260	<.1	11	20	3	<2	3,400	25
D25	04/16/99	0945	<30	<2	2,230	<.1	11	16	2	<2	3,500	5
D25	07/07/99	1310	<50	<3	2,190	<.1	13	17	6	<3	3,900	10
D25	11/08/99	1430	<30	<2	2,640	<.2	10	16	<2	<2	3,300	6
D30	03/22/99	1015	92	<2	266	<.1	3	14	2	<2	6,200	10
D30	04/12/99	1130	65	<2	323	<.1	<2	14	<1	<2	6,200	10
D30	07/12/99	1320	120	<2	281	<.1	4	8	<1	<2	6,200	7
D30	11/12/99	1230	120	<1	251	<.2	2	10	<2	<1	5,800	6
DTX1	03/24/99	1655	<30	<2	69	<.1	5	21	2	<2	5,600	6
DTX1	04/20/99	1630	E17	<2	60	<.1	5	13	3	<2	5,800	6
DTX1	07/07/99	1015	45	<2	78	<.1	5	13	4	<2	5,700	5
DTX1	11/08/99	1215	<30	<2	88	<.2	5	16	<2	<2	5,600	6

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Molybde-num, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)
DTX2	03/25/99	1320	140	<2	3,440	<.1	<2	17	1	<2	5,700	6
DTX2	04/19/99	1700	190	<2	3,470	<.1	<2	13	2	<2	5,600	6
DTX2	07/12/99	1015	270	<2	3,470	<.1	<2	9	<1	<2	5,400	6
DTX2	11/08/99	1010	400	<2	3,830	<.2	<2	13	<2	<2	5,300	7
DTX3	03/19/99	1040	<30	<1	6	<.1	<1	5	14	<1	2,900	2
DTX3	04/20/99	1000	<30	<1	2	<.1	<1	2	16	<1	3,200	2
DTX3	07/09/99	1530	<10	<1	<1	<.1	<1	3	8	<1	1,400	1
DTX3	11/17/99	1200	<10	<1	<1	<.2	<1	3	4	<1	1,200	1
DTX4	03/19/99	1330	<30	<2	60	<.1	<2	20	1	<2	4,600	4
DTX4	04/13/99	1500	<30	<2	67	<.1	<2	16	1	<2	4,700	6
DTX4	07/09/99	1315	<30	<2	51	<.1	<2	11	2	<2	3,700	4
DTX4	11/16/99	1040	E26	<1	66	<.2	<1	12	<2	<1	4,100	3
DTX5	03/18/99	1730	<30	<2	104	<.1	<2	24	2	<2	6,000	5
DTX5	04/13/99	1300	<30	<2	122	<.1	<2	13	<1	<2	5,900	5
DTX5	07/08/99	1500	E21	<1	173	<.1	<1	8	1	<1	4,500	3
DTX5	11/16/99	1320	250	<1	253	<.2	1	6	<2	<1	5,100	3
DTX6	03/18/99	1400	<30	<2	11	<.1	<2	7	3	<2	5,500	6
DTX6	04/13/99	1110	<30	<2	5	<.1	<2	13	<1	<2	5,600	7
DTX6	07/08/99	1230	<40	<2	<2	<.1	<2	5	4	<2	5,800	6
DTX6	11/17/99	0950	<10	<2	<2	<.2	<2	10	<2	<2	5,400	6

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999--Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available from laboratory; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Uranium natural, dissolved (µg/L as U)	Alpha radio-activity, dissolved (pCi/L)	Alpha radio-activity, 2-sigma precision estimate (pCi/L)	Beta radio-activity, dissolved (pCi/L)	Beta radio-activity, 2-sigma precision estimate (pCi/L)	Plutonium 238, dissolved (pCi/L)	Plutonium 238, 2-sigma precision estimate (pCi/L)	Plutonium 239+240, dissolved (pCi/L)	Plutonium 239+240, 2-sigma precision estimate (pCi/L)
D6	03/19/99	1600	156	--	--	--	--	--	--	--	--
D6	04/12/99	1000	48	--	--	--	--	--	--	--	--
D6	07/06/99	1800	152	110	74	52	68	ND	ND	ND	ND
D6	11/12/99	1030	156	--	--	--	--	--	--	--	--
D13	03/22/99	1500	7	--	--	--	--	--	--	--	--
D13	04/20/99	1445	7	--	--	--	--	--	--	--	--
D13	07/07/99	1445	7	11	5.3	11	4.6	-0.001	0.002	0	0.006
D13	11/17/99	1340	7	--	--	--	--	--	--	--	--
D17	03/22/99	1250	5	--	--	--	--	--	--	--	--
D17	04/20/99	1315	5	--	--	--	--	--	--	--	--
D17	07/06/99	1530	7	5.6	3.5	<4.0	2.1	-0.002	0.007	0.002	0.006
D17	11/09/99	1040	5	--	--	--	--	--	--	--	--
D25	03/18/99	1000	48	--	--	--	--	--	--	--	--
D25	04/16/99	0945	52	--	--	--	--	--	--	--	--
D25	07/07/99	1310	73	81	38	71	21	0.001	0.016	-0.011	0.011
D25	11/08/99	1430	47	--	--	--	--	--	--	--	--
D30	03/22/99	1015	38	--	--	--	--	--	--	--	--
D30	04/12/99	1130	40	--	--	--	--	--	--	--	--
D30	07/12/99	1320	37	22	19	42	19	-0.016	0.016	0.006	0.021
D30	11/12/99	1230	36	--	--	--	--	--	--	--	--
DTX1	03/24/99	1655	55	--	--	--	--	--	--	--	--
DTX1	04/20/99	1630	52	--	--	--	--	--	--	--	--
DTX1	07/07/99	1015	51	55	19	46	15	-0.001	0.014	0.006	0.012
DTX1	11/08/99	1215	50	--	--	--	--	--	--	--	--

Table 14. Water-quality data for alluvial-aquifer wells near Deer Trail, Colorado,1999--Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available from laboratory; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Uranium natural, dissolved (µg/L as U)	Alpha radio-activity, dissolved (pCi/L)	Alpha radio-activity, 2-sigma precision estimate (pCi/L)	Beta radio-activity, dissolved (pCi/L)	Beta radio-activity, 2-sigma precision estimate (pCi/L)	Plutonium 238, dissolved (pCi/L)	Plutonium 238, 2-sigma precision estimate (pCi/L)	Plutonium 239+240, dissolved (pCi/L)	Plutonium 239+240, 2-sigma precision estimate (pCi/L)
DTX2	03/25/99	1320	37	--	--	--	--	--	--	--	--
DTX2	04/19/99	1700	36	--	--	--	--	--	--	--	--
DTX2	07/12/99	1015	37	31	16	47	15	ND	ND	ND	ND
DTX2	11/08/99	1010	35	--	--	--	--	--	--	--	--
DTX3	03/19/99	1040	25	--	--	--	--	--	--	--	--
DTX3	04/20/99	1000	24	--	--	--	--	--	--	--	--
DTX3	07/09/99	1530	13	7.7	4.0	18	4.0	0	0.007	-0.001	0.002
DTX3	11/17/99	1200	13	--	--	--	--	--	--	--	--
DTX4	03/19/99	1330	35	--	--	--	--	--	--	--	--
DTX4	04/13/99	1500	36	--	--	--	--	--	--	--	--
DTX4	07/09/99	1315	33	18	9.4	34	11	-0.002	0.004	0.001	0.011
DTX4	11/16/99	1040	29	--	--	--	--	--	--	--	--
DTX5	03/18/99	1730	41	--	--	--	--	--	--	--	--
DTX5	04/13/99	1300	43	--	--	--	--	--	--	--	--
DTX5	07/08/99	1500	34	27	12	24	8.4	ND	ND	ND	ND
DTX5	11/16/99	1320	37	--	--	--	--	--	--	--	--
DTX6	03/18/99	1400	39	--	--	--	--	--	--	--	--
DTX6	04/13/99	1110	39	--	--	--	--	--	--	--	--
DTX6	07/08/99	1230	37	37	19	36	15	ND	ND	ND	ND
DTX6	11/17/99	0950	36	--	--	--	--	--	--	--	--

[1]Value is significantly different from historic or subsequent data at the same site, and analytical bias is suspected. However, insufficient evidence from laboratory to reject or change value.

Table 15. Water-quality data for bedrock-aquifer wells near Deer Trail, Colorado, 1999

[mm/dd/yr, month/day/year; hh/mm, hours, minutes; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hh/mm)	Specific conductance, laboratory (µS/cm at 25° C)	pH, laboratory (standard units)	Specific conductance, field (µS/cm at 25° C)	pH, field (standard units)	Water temperature (degrees Celsius)	Water level, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)
D29	03/23/99	1635	4,080	6.9	4,000	6.8	19	154.37	2.6	2,800	580	340
D29	04/16/99	1330	4,060	6.9	4,000	6.0	14	154.64	3.2	2,800	580	320
D29	07/06/99	1230	4,040	7.0	4,200	6.7	20	154.7	5.6	2,700	550	330
D29	11/09/99	1500	4,030	6.9	4,000	6.6	20	154.22	2.8	2,700	550	330
DTX10A	03/25/99	1100	3,150	7.3	3,100	7.1	15	13.05	0.2	1,900	470	170
DTX10A	04/19/99	1400	3,160	7.2	3,200	6.9	16	13.03	0.3	2,000	490	180
DTX10A	07/12/99	1545	3,180	7.2	3,300	7.0	18	12.68	0.7	1,800	460	170
DTX10A	11/16/99	1650	3,140	7.2	3,200	7.2	13	12.94	0.7	1,900	470	170
DTX8A	03/24/99	1215	1,890	7.8	1,900	7.5	16	7.55	0.3	480	140	32
DTX8A	04/19/99	1045	1,920	7.7	1,900	7.3	15	7.46	0.3	530	160	33
DTX8A	07/08/99	1000	1,920	7.7	1,600	7.2	14	8.17	--	500	150	32
DTX8A	11/12/99	1430	1,890	7.6	1,900	7.4	15	8.71	0.6	480	140	31

Well number (fig. 1)	Date (mm/dd/yy)	Time (hh/mm)	Sodium, dissolved (mg/L as Na)	Sodium adsorption ratio	Sodium, (percent)	Potassium, dissolved (mg/L as K)	Acid-neutralizing capacity, titration to 4.5, laboratory (mg/L as $CaCO_3$)	Sulfate, dissolved, (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide, dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)
D29	03/23/99	1635	140	1	10	12	284	2,700	14	0.5	0.17	22
D29	04/16/99	1330	140	1	10	[1]2.3	284	2,700	13	0.5	0.17	21
D29	07/06/99	1230	140	1	10	12	283	2,600	12	0.5	0.18	22
D29	11/09/99	1500	140	1	10	11	282	2,700	--	0.5	0.19	22
DTX10A	03/25/99	1100	150	2	15	9	223	1,900	18	0.9	0.24	17
DTX10A	04/19/99	1400	150	1	14	8.3	225	1,900	19	0.8	0.20	18
DTX10A	07/12/99	1545	150	2	15	9.1	227	1,900	18	0.9	0.25	17
DTX10A	11/16/99	1650	150	1	15	9	227	1,900	18	0.9	0.24	17
DTX8A	03/24/99	1215	240	5	51	6.7	229	760	29	0.4	0.29	12
DTX8A	04/19/99	1045	250	5	50	6.1	226	760	27	0.4	0.24	13
DTX8A	07/08/99	1000	250	5	52	6.5	225	760	28	0.4	0.25	13
DTX8A	11/12/99	1430	230	5	51	5.8	226	750	29	0.4	0.26	13

Table 15. Water-quality data for bedrock-aquifer wells near Deer Trail, Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hh/mm)	Solids, residue on evaporation at 180°C, dissolved (mg/L)	Dissolved solids, sum of constituents (mg/L)	Nitrite, dissolved (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Phosphorus, total (mg/L as P)	Phosphorus, dissolved (mg/L as P)	Phosphorus, ortho, dissolved (mg/L as P)
D29	03/23/99	1635	4,330	3,990	<.01	<.05	0.38	0.4	0.4	0.06	E.03	<.01
D29	04/16/99	1330	2,170	3,950	<.01	<.05	0.45	0.5	0.5	E.04	<.05	0.02
D29	07/06/99	1230	4,360	3,890	--	<.05	0.41	0.5	0.4	0.14	<.05	--
D29	11/09/99	1500	4,230	--	--	<.037	0.39	0.4	0.4	0.05	<.05	--
DTX10A	03/25/99	1100	3,080	2,850	<.01	<.05	1.1	1.3	1.2	<.05	<.05	<.01
DTX10A	04/19/99	1400	3,060	2,870	<.01	<.05	1.2	1.3	1.3	<.05	<.05	<.01
DTX10A	07/12/99	1545	3,080	2,820	--	<.05	1.2	1.4	1.7	<.05	0.19	--
DTX10A	11/16/99	1650	3,080	2,890	--	<.037	1.2	1.3	1.3	<.05	<.05	--
DTX8A	03/24/99	1215	1,390	1,350	0.02	0.06	1.3	1.4	1.4	<.05	<.05	<.01
DTX8A	04/19/99	1045	1,430	1,380	0.01	0.06	1.4	1.5	1.5	<.05	<.05	0.01
DTX8A	07/08/99	1000	1,410	1,370	--	<.05	1.4	1.4	1.8	<.05	<.05	--
DTX8A	11/12/99	1430	1,400	1,340	--	<.037	1.4	1.6	1.5	<.05	<.05	--

Well number (fig. 1)	Date (mm/dd/yy)	Time (hh/mm)	Aluminum, dissolved (µg/L as Al)	Antimony, dissolved (µg/L as Sb)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Boron, dissolved (mg/L as B)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)
D29	03/23/99	1635	<2	<2	1	9	<2	184	<2	<1.0	<2	8
D29	04/16/99	1330	<2	<2	<1	9	<2	192	<2	[1]18	<2	7
D29	07/06/99	1230	<2	<2	2	9	<2	162	<2	<1.0	<2	8
D29	11/09/99	1500	<2	<2	<2	9	<2	174	<2	2.7	<2	6
DTX10A	03/25/99	1100	6	<2	<1	25	<2	263	<2	<1.0	2	6
DTX10A	04/19/99	1400	<2	<2	1	20	<2	264	<2	<1.0	<2	6
DTX10A	07/12/99	1545	<2	<2	<1	15	<2	233	<2	5.7	<2	5
DTX10A	11/16/99	1650	1	<1	<2	13	<1	245	<1	1.0	<1	4
DTX8A	03/24/99	1215	2	<1	<1	74	<1	250	<1	<1.0	<1	2
DTX8A	04/19/99	1045	3	<1	<1	54	<1	260	<1	<1.0	<1	3
DTX8A	07/08/99	1000	5	<1	<1	35	<1	272	<1	<1.0	<1	2
DTX8A	11/12/99	1430	4	<1	<2	24	<1	250	<1	<.8	<1	2

Table 15. Water-quality data for bedrock-aquifer wells near Deer Trail,Colorado,1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; ND, no data available; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hh/mm)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)
D29	03/23/99	1635	7,200	<2	867	<.1	<2	22	3	<2	6,300	14
D29	04/16/99	1330	7,700	<2	872	.1	<2	18	<1	<2	6,000	8
D29	07/06/99	1230	7,100	<2	905	<.1	<2	14	<1	<2	6,000	9
D29	11/09/99	1500	6,800	<2	810	<.2	<2	16	<2	<2	6,000	13
DTX10A	03/25/99	1100	2,700	<2	652	<.1	3	16	1	<2	5,500	10
DTX10A	04/19/99	1400	3,300	<2	555	<.1	2	10	2	<2	5,700	5
DTX10A	07/12/99	1545	3,700	<2	356	<.1	<2	4	<1	<2	5,400	5
DTX10A	11/16/99	1650	4,000	<1	331	<.2	1	3	<2	<1	5,400	3
DTX8A	03/24/99	1215	<10	<1	204	<.1	2	4	<1	<1	2,300	2
DTX8A	04/19/99	1045	<10	<1	218	<.1	1	1	<1	<1	2,500	2
DTX8A	07/08/99	1000	13	<1	211	<.1	<1	3	<1	<1	2,400	2
DTX8A	11/12/99	1430	67	<1	186	<.2	<1	3	<2	<1	2,300	2

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Uranium-natural, dissolved (mg/L as U)	Alpha radio-activity, dissolved (pCi/L)	Alpha radio-activity, 2-sigma precision estimate (pCi/L)	Beta radio-activity, dissolved (pCi/L)	Beta radio-activity, 2-sigma precision estimate (pCi/L)	Plutonium 238, dissolved (pCi/L)	Plutonium 238, 2-sigma precision estimate (pCi/L)	Plutonium-239+240, dissolved (pCi/L)	Plutonium-239+240, 2-sigma precision estimate (pCi/L)
D29	03/23/99	1635	<2	--	--	--	--	--	--	--	--
D29	04/16/99	1330	<2	--	--	--	--	--	--	--	--
D29	07/06/99	1230	<2	<3.0	8.9	26	16	0	0.018	0.012	0.022
D29	11/09/99	1500	<2	--	--	--	--	--	--	--	--
DTX10A	03/25/99	1100	<2	--	--	--	--	--	--	--	--
DTX10A	04/19/99	1400	<2	--	--	--	--	--	--	--	--
DTX10A	07/12/99	1545	<2	5.6	9.4	21	11	-0.008	0.011	0.000	0.024
DTX10A	11/16/99	1650	<1	--	--	--	--	--	--	--	--
DTX8A	03/24/99	1215	2	--	--	--	--	--	--	--	--
DTX8A	04/19/99	1045	<1	--	--	--	--	--	--	--	--
DTX8A	07/08/99	1000	<1	8.8	5.9	7.2	6.1	0.001	0.004	-0.002	0.002
DTX8A	11/12/99	1430	<1	--	--	--	--	--	--	--	--

[1]Value is significantly different from historic or subsequent data at the same site, and analytical bias is suspected. However, insufficient evidence from laboratory to reject or change value.

Table 16. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 1999

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; R, sample ruined at laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Specific conductance, laboratory (µS/cm at 25° C)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Acid-neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide, dissolved (mg/L as Br)
DTX1	03/24/99	1600	2	<.02	E.003	<.06	<.1	2.1	<.1	<.1	<.1	<.01
DTX5	03/18/99	1645	16	<.02	0.004	<.06	<.1	2.4	<.1	<.1	<.1	<.01
DTX10A	03/26/99	0830	2	0.619	0.14	0.3	<.1	1.9	0.2	<.1	<.1	<.01
DTX3	04/20/99	0940	3	<.02	<.004	<.06	<.1	1.7	0.3	<.1	<.1	<.01
D17	04/20/99	1230	5	<.02	<.004	<.06	<.1	2	<.1	<.1	<.1	<.01
DTX6	07/08/99	1200	2	<.02	<.004	0.2	<.1	1.5	<.1	<.1	<.1	<.01
DTX4	07/09/99	1245	3	<.02	<.004	0.2	<.1	1.6	<.1	<.1	<.1	<.01
D17	11/09/99	1030	E2	E.01	<.01	<.09	<.2	2.4	<.3	<.3	<.1	<.01
DTX4	11/16/99	1045	E1	<.02	<.004	E.05	<.2	2.4	<.3	<.3	<.1	<.01
DTX10A	11/23/99	1430	E2	E.01	<.01	<.09	<.2	2	<.3	<.3	<.1	<.01

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Silica, dissolved (mg/L as SiO_2)	Solids, residue on evaporation at 180° C, dissolved (mg/L)	Nitrite plus nitrate (mg/L as N)	Nitrogen, ammonia dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Phosphorus, total (mg/L as P)	Phosphorus, dissolved (mg/L as P)	Aluminum, dissolved (µg/L as Al)	Antimony, dissolved (µg/L as Sb)
DTX1	03/24/99	1600	E.04	<10	<.05	<.02	<.1	<.1	<.05	<.05	<1	<1
DTX5	03/18/99	1645	<.05	<10	<.05	<.02	<.1	<.1	<.05	<.05	<1	<1
DTX10A	03/26/99	0830	0.12	<10	<.05	<.02	E.06	<.1	<.05	<.05	<1	<1
DTX3	04/20/99	0940	<.05	<10	<.05	<.02	<.1	<.1	<.05	<.05	<1	<1
D17	04/20/99	1230	<.05	<10	<.05	<.02	E.06	<.1	<.05	<.05	<1	<1
DTX6	07/08/99	1200	<.05	<10	<.050	<.02	E.08	<.1	<.05	<.05	<1	<1
DTX4	07/09/99	1245	<.05	<10	<.050	<.02	<.1	R	<.05	<.05	<1	<1
D17	11/09/99	1030	<.09	<10	<.037	<.03	<.1	<.1	<.05	<.05	<1	<1
DTX4	11/16/99	1045	<.05	<10	<.037	<.03	<.1	<.1	<.05	<.05	<1	<1
DTX10A	11/23/99	1430	<.09	<10	<.037	<.03	<.1	<.1	<.05	<.05	<1	<1

Table 16. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; R, sample ruined at laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Boron, dissolved (µg/L as B)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)
DTX1	03/24/99	1600	<1	<1	<1	<16	<1	<1	<1	<1	<10	<1
DTX5	03/18/99	1645	<1	<1	<1	<16	<1	<1	<1	<1	<10	<1
DTX10a	03/26/99	0830	<1	<1	<1	<16	<1	<1	<1	1	E6	<1
DTX3	04/20/99	0940	<1	<1	<1	<16	<1	<1	<1	<1	<10	<1
D17	04/20/99	1230	<1	<1	<1	<16	<1	<1	<1	<1	<10	<1
DTX6	07/08/99	1200	<1	<1	<1	<16	<1	<1.0	<1	<1	<10	<1
DTX4	07/09/99	1245	<1	<1	<1	<16	<1	<1.0	<1	<1	<10	<1
D17	11/09/99	1030	<2	<1	<1	<16	<1	<.8	<1	<1	<10	<1
DTX4	11/16/99	1045	<2	<1	<1	<16	<1	<.8	<1	<1	<10	<1
DTX10a	11/23/99	1430	<2	<1	<1	<16	<1	<.8	<1	3	E6	<1

Well number (fig. 1)	Date (mm/dd/yy)	Time (hhmm)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)	Uranium natural, dissolved (µg/L as U)
DTX1	03/24/99	1600	<1	<.1	<1	<1	<1	<1	<1	<1	<1
DTX5	03/18/99	1645	<1	<.1	<1	<1	<1	<1	<1	<1	<1
DTX10a	03/26/99	0830	<1	<.1	<1	<1	<1	<1	5	<1	<1
DTX3	04/20/99	0940	<1	<.1	<1	<1	<1	<1	<1	<1	<1
D17	04/20/99	1230	<1	<.1	<1	<1	<1	<1	<1	<1	<1
DTX6	07/08/99	1200	<1	<.1	<1	<1	<1	<1	<1	<1	<1
DTX4	07/09/99	1245	<1	<.1	<1	<1	<1	<1	8	<1	<1
D17	11/09/99	1030	<1	<.2	<1	<1	<2	<1	<1	<1	<1
DTX4	11/16/99	1045	<1	<.2	<1	<1	<2	<1	<1	<1	<1
DTX10a	11/23/99	1430	<1	<.2	<1	<1	<2	<1	E.6	<1	<1

Table 16. Quality-control data for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 1999—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, no sample submitted; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number (fig. 1)	Date (mm/dd/yy)	Time (hh/mm)	Alpha radio-activity, dissolved (pCi/L)	Alpha radio-activity, 2-sigma precision estimate (pCi/L)	Beta radio-activity, dissolved (pCi/L)	Beta radio-activity, 2-sigma precision estimate (pCi/L)	Plutonium 238, dissolved (pCi/L)	Plutonium 238, 2-sigma precision estimate (pCi/L)	Plutonium 239+240, dissolved (pCi/L)	Plutonium 239+240, 2-sigma precision estimate (pCi/L)
DTX1	03/24/99	1600	--	--	--	--	--	--	--	--
DTX5	03/18/99	1645	--	--	--	--	--	--	--	--
DTX10A	03/26/99	0830	--	--	--	--	--	--	--	--
DTX3	04/20/99	0940	--	--	--	--	--	--	--	--
D17	04/20/99	1230	--	--	--	--	--	--	--	--
DTX6	07/08/99	1200	<3.0	0.39	<4.0	0.78	-0.001	0.002	0	0.005
DTX4	07/09/99	1245	<3.0	0.51	<4.0	0.77	0	0.006	-0.001	0.002
D17	11/09/99	1030	--	--	--	--	--	--	--	--
DTX4	11/16/99	1045	--	--	--	--	--	--	--	--
DTX10A	11/23/99	1430	--	--	--	--	--	--	--	--

Table 17. Summary statistics for blank samples associated with ground-water samples collected near Deer Trail, Colorado, 1999

[--, value not determined because all data less than the minimum reporting limit; some median values estimated by using a log-probability regression to predict the values of data less than the minimum reporting limit; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; available; E, value estimated by laboratory; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Property or constituent	Units	Sample size	Percent censored	Maximum	Minimum	Median
Specific conductance, lab	µS/cm	10	0	16	1	2
Calcium, dissolved	mg/L	10	70	0.62	E.01	<.02
Magnesium, dissolved	mg/L	10	70	.14	.003	<.004
Sodium, dissolved	mg/L	10	60	.3	E.05	<.08
Potassium, dissolved	mg/L	10	100	<.2	--	--
Acid-neutralizing capacity, lab as $CaCO_3$	mg/L	10	0	2.4	1.5	2
Sulfate, dissolved	mg/L	10	80	.3	<.1	<.1
Chloride, dissolved	mg/L	10	100	<.3	--	--
Fluoride, dissolved	mg/L	10	100	<.1	--	--
Bromide, dissolved	mg/L	10	100	<.01	--	--
Silica, dissolved	mg/L	10	100	<.12	--	--
Dissolved solids, residue at 180^{o}C	mg/L	10	100	<10	--	--
Nitrite plus nitrate, dissolved as N	mg/L	10	100	<.05	--	--
Nitrogen, ammonia, dissolved as N	mg/L	10	100	<.03	--	--
Nitrogen, ammonia plus organic, total as N	mg/L	10	70	<.1	E.06	<.1
Nitrogen, ammonia plus organic, dissolved as N	mg/L	9	100	<.1	<.1	<.1
Phosphorus, total as P	mg/L	10	100	<.05	--	--
Phosphorus, dissolved as P	mg/L	10	100	<.05	--	--
Aluminum, dissolved as Al	µg/L	10	100	<1	--	--
Antimony, dissolved as Sb	µg/L	10	100	<1	--	--
Arsenic, dissolved as As	µg/L	10	100	<2	--	--
Barium, dissolved as Ba	µg/L	10	100	<1	--	--
Beryllium, dissolved as Be	µg/L	10	100	<1	--	--
Boron, dissolved as B	µg/L	10	100	<16	--	--
Cadmium, dissolved as Cd	µg/L	10	100	<1	--	--
Chromium, dissolved as Cr	µg/L	10	100	<1	--	--
Cobalt, dissolved as Co	µg/L	10	100	<1	--	--
Copper, dissolved as Cu	µg/L	10	80	3	<1	<1
Iron, dissolved as Fe	µg/L	10	80	<10	E6	<10
Lead, dissolved as Pb	µg/L	10	100	<1	--	--
Manganese, dissolved as Mn	µg/L	10	100	<1	--	--
Mercury, dissolved as Hg	µg/L	10	100	<.2	--	--
Molybdenum, dissolved as Mo	µg/L	10	100	<1	--	--
Nickel, dissolved as Ni	µg/L	10	100	<1	--	--
Selenium, dissolved as Se	µg/L	10	100	<2	--	--
Silver, dissolved as Ag	µg/L	10	100	<1	--	--
Strontium, dissolved as Sr	µg/L	10	70	8	E.6	<1
Zinc, dissolved as Zn	µg/L	10	100	<1	--	--
Uranium, natural dissolved	µg/L	10	100	<1	--	--
Gross alpha, dissolved	pCi/L	2	100	<3.0	--	--
Gross alpha, 2-sigma precision estimate	pCi/L	2	0	.51	.39	--
Gross beta, dissolved	pCi/L	2	100	<4.0	--	--
Gross beta, 2-sigma precision estimate	pCi/L	2	0	.78	.77	--
Plutonium 238, dissolved	pCi/L	2	0	0.000	-.001	--
Plutonium 238, 2-sigma precision estimate	pCi/L	2	0	.006	.002	--
Plutonium 239+240, dissolved	pCi/L	2	0	.000	-.001	--
Plutonium 239+240, 2-sigma precision estimate	pCi/L	2	0	.005	.002	--

Table 18. Comparison of water-quality data for replicate and regular ground-water samples collected near Deer Trail, Colorado, 1999

[RPD, relative percent difference, which is defined as [(sample value–replicate value)/[(sample value + replicate value)/2]] × 100; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; <, less than; E, value estimated by laboratory; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number	DTX1			DTX3			DTX1			D6		
Date	07/07/99			07/09/99			11/08/99			11/12/99		
Time	1015	1030		1530	1545		1215	1230		1030	1035	
Property or constituent	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD
Specific conductance, lab, µS/cm	4,150	4,150	0.0	1,200	1,220	1.7	4,140	4,150	0.2	14,700	16,000	8.5
pH, lab, units	7.4	7.4	0.0	7.6	7.5	1.3	7.4	7.4	0.0	7.2	7.2	0.0
Hardness as $CaCO_3$	2,100	2,100	0.0	520	530	1.9	2000	2100	4.9	11,000	11,000	0.0
Calcium, dissolved, mg/L	480	490	2.1	130	130	0.0	470	480	2.1	450	450	0.0
Magnesium, dissolved, mg/L	210	220	4.7	47	48	2.1	210	210	0.0	2,300	2,300	0.0
Sodium, dissolved, mg/L	360	370	2.7	63	63	0.0	340	350	2.9	2,000	2,000	0.0
Potassium, dissolved, mg/L	3.6	3.3	8.7	5.4	5.3	1.9	3.4	3.5	2.9	18	13	32.3
Acid-neutralizing capacity, lab as $CaCO_3$, mg/L	309	310	0.3	240	240	0.0	308	307	0.3	639	640	0.2
Sulfate, dissolved, mg/L	2,400	2,400	0.0	410	410	0.0	2,400	2,400	0.0	13,000	13,000	0.0
Chloride, dissolved, mg/L	52	51	1.9	11	10	9.5	50	49	2.0	410	420	2.4
Fluoride, dissolved, mg/L	0.8	0.8	0.0	0.5	0.5	0.0	0.9	0.9	0.0	0.9	0.9	0.0
Bromide, dissolved, mg/L	0.66	0.65	1.5	0.09	0.1	10.5	0.76	0.75	1.3	4.1	4.1	0.0
Silica, dissolved, mg/L	33	34	3.0	14	14	0.0	33	34	3.0	22	22	0.0
Dissolved solids, residue at 180° C, mg/L	4,170	4,140	0.7	870	866	0.5	4,150	4,100	1.2	20,600	20,800	1.0
Dissolved solids, sum of constituents	3,730	3,770	1.1	836	842	0.7	3,720	3,750	0.8	18,600	18,400	1.1
Nitrite plus nitrate, dissolved as N, mg/L	--	--	--	2.8	2.8	0.0	1.9	1.8	5.4	12	12	0.0
Nitrogen, ammonia, dissolved as N, mg/L	--	--	--	<.02	<.02	ND	<.03	<.03	ND	0.09	0.06	40.0
Nitrogen, ammonia plus organic, total as N, mg/L	0.2	0.2	0.0	0.1	0.1	0.0	0.2	0.1	66.7	1.3	1.4	7.4
Nitrogen, ammonia plus organic, dissolved as N, mg/L	--	--	--	1.4	1.6	13.3	0.2	0.19	5.1	0.3	0.54	57.1
Phosphorus, total as P, mg/L	0.06	0.06	0.0	<.05	<.05	ND	0.06	0.07	15.4	E0.04	E0.05	22.2
Phosphorus, dissolved as P, mg/L	--	--	--	<.05	<.05	ND	0.1	0.08	22.2	<.05	<.05	ND
Aluminum, dissolved as Al, µg/L	4	3	28.6	2	2	0.0	2	<2	ND	<6	<10	ND
Antimony, dissolved as Sb, µg/L	<2	<2	ND	<1	<1	ND	<2	<2	ND	<6	<10	ND
Arsenic, dissolved as As, µg/L	2	3	40.0	<1	<1	ND	<2	<2	ND	E1	<2	ND
Barium, dissolved as Ba, µg/L	8	8	0.0	12	12	0.0	8	8	0.0	<6	<10	ND
Beryllium, dissolved as Be, µg/L	<2	<2	ND	<1	<1	ND	<2	<2	ND	<6	<10	ND
Boron, dissolved as B, µg/L	559	601	7.2	192	194	1.0	618	638	3.2	1,030	840	20.3
Cadmium, dissolved as Cd, µg/L	<2	<2	ND	<1	<1	ND	<2	<2	ND	<6	<10	ND

Table 18. Comparison of water-quality data for replicate and regular ground-water samples collected near Deer Trail, Colorado, 1999—Continued

[RPD, relative percent difference, which is defined as [(sample value–replicate value)/[(sample value + replicate value)/2]] × 100; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; <, less than; E, value estimated by laboratory; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Well number	DTX1			DTX3			DTX1			D6		
Date	07/07/99			07/09/99			11/08/99			11/12/99		
Time	1015	1030		1530	1545		1215	1230		1030	1035	
Property or constituent	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD
Chromium, dissolved as Cr, μg/L	14	14	0.0	<1.0	<1.0	ND	<1.0	<.8	ND	<4	<4	ND
Cobalt, dissolved as Co, μg/L	<2	<2	ND	<1	<1	ND	<2	<2	ND	6	<10	ND
Copper, dissolved as Cu, μg/L	7	8	13.3	2	2	0.0	6	6	0.0	27	29	7.1
Iron, dissolved as Fe, μg/L	45	<30	ND	<10	<10	ND	<30	<30	ND	<250	<250	ND
Lead, dissolved as Pb, μg/L	<2	<2	ND	<1	<1	ND	<2	<2	ND	<6	<10	ND
Manganese, dissolved as Mn, μg/L	78	75	3.9	<1	<1	ND	88	86	2.3	3,740	3,830	2.4
Mercury, dissolved as Hg, μg/L	<.1	<.1	ND	<.1	<.1	ND	<.2	<.2	ND	<.2	<.2	ND
Molybdenum, dissolved as Mo, μg/L	5	5	0.0	<1	<1	ND	5	5	0.0	<6	<10	ND
Nickel, dissolved as Ni, μg/L	13	<2	ND	3	3	0.0	16	15	6.5	19	21	10.0
Selenium, dissolved as Se, μg/L	4	5	22.2	8	8	0.0	<2	<2	ND	6	5	18.2
Silver, dissolved as Ag, μg/L	<2	<2	ND	<1	<1	ND	<2	<2	ND	<6	<10	ND
Strontium, dissolved as Sr, μg/L	5,700	5,800	1.7	1,400	1,600	13.3	5,600	5,700	1.8	17,000	17,000	0.0
Zinc, dissolved as Zn, μg/L	5	6	18.2	1	1	0.0	6	5	18.2	29	33	12.9
Uranium, natural dissolved, μg/L	51	52	1.9	13	13	0.0	50	50	0.0	156	154	1.3
Gross alpha, dissolved	55	61	10.3	7.7	5.8	28.1	--	--	--	--	--	--
Gross alpha, 2-sigma precision estimate,	19	20	5.1	4.0	3.7	7.8	--	--	--	--	--	--
Gross beta, dissolved, pCi/L	46	51	10.3	18	18	0.0	--	--	--	--	--	--
Gross beta, 2-sigma precision estimate, pCi/L	15	16	6.5	4.0	4.0	0.0	--	--	--	--	--	--
Plutonium 238, dissolved, pCi/L	-0.001	0.000	--	0.000	-0.003	--	--	--	--	--	--	--
Plutonium 238, 2-sigma precision estimate	0.014	0.017	19.4	0.007	0.004	54.5	--	--	--	--	--	--
Plutonium 239+240, dissolved	0.006	0.008	28.6	-0.001	0.003	--	--	--	--	--	--	--
Plutonium 239+240, 2-sigma precision estimate	0.012	0.021	54.5	0.002	0.007	111.1	--	--	--	--	--	--

Table 18. Comparison of water-quality data for replicate and regular ground-water samples collected near Deer Trail, Colorado, 1999—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; E, estimated by laboratory; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Site	DTX6			D6			D30			DTX5		
Date	3/18/99			03/19/99			04/12/99			04/13/99		
Time	1400	1425		1600	1620		1130	1200		1300	1330	
Property or constituent	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD
Specific conductance, lab, µS/cm	4,080	4,070	0.2	15,800	15,800	0.0	5,010	4,990	0.4	3,120	3,140	0.6
pH, lab, units	7.4	7.4	0.0	7.3	7.3	0.0	7.2	7.2	0.0	7.1	7.1	0.0
Hardness as $CaCO_3$	2,200	2,200	0.0	10,000	11,000	9.5	2,900	2,800	3.5	2,100	2,100	0.0
Calcium, dissolved, mg/L	470	470	0.0	440	470	6.6	440	450	2.2	690	680	1.5
Magnesium, dissolved, mg/L	250	260	3.9	2,200	2,300	4.4	420	420	0.0	97	95	2.1
Sodium, dissolved, mg/L	310	310	0.0	2,000	2,000	0.0	390	380	2.6	91	90	1.1
Potassium, dissolved,	13	12	8.0	15	12	22.2	4	4.2	4.9	5.1	5.2	1.9
Acid-neutralizing capacity, lab as $CaCO_3$, mg/L	260	260	0.0	629	628	0.2	390	386	1.0	267	267	0.0
Sulfate, dissolved, mg/L	2,500	2,500	0.0	13,000	13,000	0.0	3,100	3,200	3.2	1,800	1,800	0.0
Chloride, dissolved, mg/L	21	20	4.9	410	410	0.0	52	48	8.0	38	38	0.0
Fluoride, dissolved, mg/L	0.5	0.5	0.0	0.8	0.8	0.0	0.8	0.8	0.0	0.3	0.3	0.0
Bromide, dissolved, mg/L	0.15	0.15	0.0	4.2	4	4.9	0.65	0.66	1.5	0.18	0.18	0.0
Silica, dissolved, mg/L	12	12	0.0	21	24	13.3	21	22	4.7	12	12	0.0
Dissolved solids, residue at 180° C, mg/L	4,120	4,100	0.5	20,000	20,100	0.5	5,190	5,170	0.4	3,180	3,200	0.6
Dissolved solids, sum of constituents	3,750	3,770	0.5	18,500	18,700	1.1	4,660	4,720	1.3	2,910	2,910	0.0
Nitrite plus nitrate, dissolved as N, mg/L	0.24	0.23	4.3	11	11	0.0	<.05	<.05	ND	<.05	<.05	ND
Nitrogen, ammonia, dissolved as N, mg/L	0.04	0.03	28.6	<.02	<.02	ND	0.08	0.07	13.3	0.08	0.07	13.3
Nitrogen, ammonia plus organic, total as N, mg/L	0.1	0.1	0.0	1.4	1.4	0.0	0.3	0.3	0.0	0.2	0.2	0.0
Nitrogen, ammonia plus organic, dissolved as N, mg/L	E.07	E.07	0.0	1.4	1.4	0.0	0.3	0.3	0.0	0.2	0.2	0.0
Phosphorus, total as P, mg/L	<.05	<.05	ND	E.04	E.03	28.6	E0.05	E0.04	22.2	<.05	<.05	ND
Phosphorus, dissolved as P, mg/L	<.05	<.05	ND	E.04	E.03	28.6	<.05	E0.032	ND	<.05	<.05	ND
Aluminum, dissolved as Al, µg/L	<2	3	ND	<7	<7	ND	5	10	66.7	3	7	80.0
Antimony, dissolved as Sb, µg/L	<2	<2	ND	<7	<7	ND	<2	<2	ND	<2	<2	ND
Arsenic, dissolved as As, µg/L	<1	<1	ND	3	3	0.0	<1	<1	ND	<1	<1	ND
Barium, dissolved as Ba, µg/L	11	11	0.0	<7	<7	ND	>11	10	ND	18	19	5.4
Beryllium, dissolved as Be, µg/L	<2	<2	ND	<7	<7	ND	<2	<2	ND	<2	<2	ND
Boron, dissolved as B, µg/L	367	376	2.4	843	872	3.4	512	475	7.5	374	374	0.0

Table 18. Comparison of water-quality data for replicate and regular ground-water samples collected near Deer Trail, Colorado, 1999—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; E, estimated by laboratory; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Site	DTX6			D6			D30			DTX5		
Date	3/18/99			03/19/99			04/12/99			04/13/99		
Time	1400	1425		1600	1620		1130	1200		1300	1330	
Property or constituent	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD	Sample	Replicate	RPD
Cadmium, dissolved as Cd, µg/L	<2	<2	ND	<7	<7	ND	<2	<2	ND	<2	<2	ND
Chromium, dissolved as Cr, µg/L	1.2	1.3	8.0	2	<7	ND	<2	<2	ND	<2	<2	ND
Cobalt, dissolved as Co, µg/L	6	7	15.4	7	<7	ND	<2	3	ND	<2	<2	ND
Copper, dissolved as Cu, µg/L	7	8	13.3	29	30	3.4	8	8	0.0	8	9	11.8
Iron, dissolved as Fe, µg/L	<30	<30	ND	<250	<250	ND	65	39	50.0	<30	<30	ND
Lead, dissolved as Pb, µg/L	<2	<2	ND	<7	<7	ND	<2	<2	ND	<2	<2	ND
Manganese, dissolved as Mn, µg/L	11	12	8.7	3,590	3,600	0.3	323	313	3.1	122	117	4.2
Mercury, dissolved as Hg, µg/L	<.1	<.1	ND	<.1	<.1	ND	<.1	<.1	ND	<.1	<.1	ND
Molybdenum, dissolved as Mo, µg/L	<2	<2	ND	<7	<7	ND	<2	3	ND	<2	<2	ND
Nickel, dissolved as Ni, µg/L	7	11	44.4	23	22	4.4	14	13	7.4	13	15	14.3
Selenium, dissolved as Se, µg/L	3	3	0.0	8	7	13.3	<1	<1	ND	<1	<1	ND
Silver, dissolved as Ag, µg/L	<2	<2	ND	<7	<7	ND	<2	<2	ND	<2	<2	ND
Strontium, dissolved as Sr, µg/L	5,500	5,700	3.6	17,000	17,000	0.0	6,200	6,100	1.6	5,900	5,800	1.7
Zinc, dissolved as Zn, µg/L	6	12	66.7	31	37	17.6	10	12	18.2	5	6	18.2
Uranium, natural dissolved, µg/L	39	39	0.0	156	158	1.3	40	39	2.5	43	42	2.4
Gross alpha, dissolved, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Gross alpha, 2-sigma precision estimate, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Gross beta, dissolved, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Gross beta, 2-sigma precision estimate, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Plutonium 238, dissolved, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Plutonium 238, 2-sigma precision estimate, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Plutonium 239+240, dissolved, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--
Plutonium 239+240, 2-sigma precision estimate, pCi/L	--	--	--	--	--	--	--	--	--	--	--	--

Table 19. Summary statistics for data from all ground-water samples collected near Deer Trail, Colorado, 1999

[censored, less than the minimum reporting level; --, statistics not calculated because all data were less than the minimum reporting limit; *, lognormal probability regression method (Helsel and Cohn, 1988) was used to estimate summary statistics; <, less than; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty; NA, not applicable]

Property or constituent	Sample size	Percent censored	Maximum	Minimum	Mean	95th percentile	75th percentile	Median	25th percentile	5th percentile
Specific conductance, field	56	0	16,600	450	4,100	16,200	4,400	3,650	1,925	497
Specific conductance, lab, µS/cm	56	0	15,900	487	4,020	15,800	4,270	3,605	1,950	505
pH, field	55	0	7.6	5.8	--	7.5	7.1	7.0	6.8	6.4
pH, laboratory, units	56	0	8.0	6.9	--	7.8	7.4	7.3	7.2	6.9
Water temperature	56	0	20.0	8.5	12.8	19.2	14.0	13.0	11.0	8.8
Oxygen, dissolved	52	0	6.4	0.2	1.3	5.6	1.2	0.8	0.6	0.3
Hardness as $CaCO_3$	56	0	11,000	220	2,400	10,000	2,700	2,100	882	228
Calcium, dissolved, mg/L	56	0	710	58	420	699	541	471	233	59
Magnesium, dissolved, mg/L	56	0	2,300	18	316	2180	262	192	64	20
Sodium, dissolved, mg/L	56	0	2,100	16	335	1970	360	193	96	17
Potassium, dissolved, mg/L	56	0	18	0.3	6.7	13.1	8.8	6.7	3.7	1.6
Acid-neutralizing capacity, lab as $CaCO_3$, mg/L	56	0	740	206	336	636	400	278	238	208
Sulfate, dissolved, mg/L	56	0	13,000	42	2,560	13,000	2,600	2,200	800	44
Chloride, dissolved, mg/L	56	2	420	2.4	59.4	410	52	28.2	12.0	3.2
Fluoride, dissolved, mg/L	56	0	1.8	0.2	0.7	1.5	0.9	0.6	0.4	0.2
Bromide, dissolved, mg/L	56	0	4.2	0.07	0.62	4.12	0.64	0.24	0.17	0.08
Silica, dissolved, mg/L	56	0	35	11	19	33	22	17	13	12
Dissolved solids, residue at 180° C, mg/L	56	0	21,200	300	4,220	20,090	4,260	3,130	1,505	304
Dissolved solids, sum of constituents	55	0	18,600	292	3,930	18,420	3,950	3,050	1,380	303
Nitrite plus nitrate, dissolved as N, mg/L	48	50	12	<.037	*1.77	*11.8	*1.80	*0.07	*0.02	*0.001
Nitrogen, ammonia, dissolved as N, mg/L	48	25	1.4	<.02	*0.31	*1.40	*0.50	*0.06	*0.02	*0.002
Nitrogen, ammonia plus organic, total as N, mg/L	51	2	1.6	<.1	0.6	1.4	1.0	0.3	0.2	0.1
Nitrogen, ammonia plus organic, dissolved as N, mg/L	48	4	1.8	<.1	0.6	1.6	1.1	0.3	0.1	0.1
Phosphorus, total as P, mg/L	51	67	0.22	<.05	* 0.05	* 0.15	* 0.06	* 0.04	* 0.03	* 0.02
Phosphorus, dissolved as P, mg/L	48	79	0.19	<.05	* 0.05	* 0.17	* 0.07	* 0.04	* 0.03	*0.02
Aluminum, dissolved as Al, µg/L	56	34	9	<1	* 2	* 6	* 3	* 2	* 1	* 0.5
Antimony, dissolved as Sb, µg/L	56	100	<7	<1	--	--	--	--	--	--
Arsenic, dissolved as As, µg/L	56	31	6	<1	* 1	* 3	* 2	* 1	* 0.7	* 0.4
Barium, dissolved as Ba, µg/L	56	7	74	<2	* 20	* 58	* 20	* 16	* 9	* 5

Table 19. Summary statistics for data from all ground-water samples collected near Deer Trail, Colorado, 1999

[censored, less than the minimum reporting level; --, statistics not calculated because all data were less than the minimum reporting limit; *, lognormal probability regression method (Helsel and Cohn, 1988) was used to estimate summary statistics; <, less than; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty; NA, not applicable]

Property or constituent	Sample size	Percent censored	Maximum	Minimum	Mean	95th percentile	75th percentile	Median	25th percentile	5th percentile
Beryllium, dissolved as Be, µg/L	56	100	<7	<1	--	--	--	--	--	--
Boron, dissolved as B, µg/L	56	0	1,030	55.1	348	858	436	312	213	69
Cadmium, dissolved as Cd, µg/L	56	100	<7	<1	--	--	--	--	--	--
Chromium, dissolved as Cr, µg/L	56	54	27	<.8	* 3	* 19	*2	* .4	* 0.1	* 0.01
Cobalt, dissolved as Co, µg/L	56	70	7	<1	* 2	* 6	* 2	* 1	* 0.6	* 0.3
Copper, dissolved as Cu, µg/L	56	7	34	<1	* 7	* 27	* 8	* 6	* 3	* 1
Iron, dissolved as Fe, µg/L	56	54	7,700	<10	* 796	* 7,100	*120	* 20	* 2	* 0.1
Lead, dissolved as Pb, µg/L	56	100	<7	<1	--	--	--	--	--	--
Manganese, dissolved as Mn, µg/L	56	7	3,930	<1	* 866	* 3,750	* 871	* 244	* 71	* 4
Mercury, dissolved as Hg, µg/L	56	98	<.2	<.1	--	--	--	--	--	--
Molybdenum, dissolved as Mo, µg/L	56	59	13	<1	* 2	* 11	* 3	* 1	* 0.5	* 0.2
Nickel, dissolved as Ni, µg/L	56	2	24	<1.	10	22	16	10	4	1
Selenium, dissolved as Se, µg/L	56	45	16	<1	* 3	* 10	* 4	* 2	* 0.7	* 0.2
Silver, dissolved as Ag, µg/L	56	100	<7	<1	--	--	--	--	--	--
Strontium, dissolved as Sr, µg/L	56	0	17,000	300	5,040	16,800	5,850	5,420	2,620	316.
Zinc, dissolved as Zn, µg/L	56	4	33	<1	* 7	* 29	* 7	* 6	* 2	* 1
Uranium, natural dissolved, µg/L	56	20	156	<1	* 33	* 153	* 40	* 35	* 6	* 2
Gross alpha, dissolved, pCi/L	14	7	110	<3	* 30.4	* 114	* 41.5	* 20.0	* 7.2	* 1.8
Gross alpha, 2-sigma precision estimate	14	NA	74	3.5	17	74	19	11	5.8	3.5
Gross beta, dissolved, pCi/L	14	7	71	<4	* 31.5	* 71.3	* 46.4	* 30.4	15.8	* 5.9
Gross beta, 2-sigma precision estimate	14	NA	68	2.1	15	68	17	13	5.7	2.1
Plutonium 238, dissolved, pCi/L	10	NA	0.001	-0.016	-0.003	0.001	0.000	-0.001	-0.004	-0.016
Plutonium 238, 2-sigma precision estimate	10	NA	1.02	0.002	0.110	1.020	0.016	0.009	0.004	0.002
Plutonium 239+240, dissolved, pCi/L	10	NA	0.012	-0.011	0.001	0.012	0.006	0.001	-0.001	-0.011
Plutonium 239+240, 2-sigma precision estimate	10	NA	0.024	0.002	0.012	0.024	0.021	0.011	0.005	0.002

Table 20. Statistical comparison of median concentrations for selected chemical constituents in ground-water samples collected near Deer Trail, Colorado, 1999, and lowest applicable water-quality regulatory standard

[--, not computed or missing; standard is from Colorado Department of Public Health and Environment (1997); concentrations are in micrograms per liter, except nitrate in milligrams per liter; <, less than; *, value estimated because variance was zero; H, health-based standard; A, agricultural standard; E, value estimated by laboratory]

Well	Sample size	Minimum	Maximum	Median	Colorado standard	Type of standard	Probability that the median concentration exceeded the regulatory standard[1]
				Nitrate[2]			
D6	4	11	12	12	10	H	0.9375
D13	3	<.037	<.05	<.05	10	H	.1250*
D17	4	1.2	3.5	2.2	10	H	.0625
D25	3	3.4	7.4	6.3	10	H	.1250
D29	4	<.037	<.05	<.05	10	H	.0625*
D30	4	<.037	.06	<.05	10	H	.0625
DTX1	3	1.1	1.9	1.2	10	H	.1250
DTX10A	4	<.037	<.05	<.05	10	H	.0625*
DTX2	4	<.037	<.05	<.05	10	H	.0625*
DTX3	4	1.6	4.3	3.4	10	H	.0625
DTX4	4	<.037	.36	.10	10	H	.0625
DTX5	4	<.037	.1	<.05	10	H	.0625
DTX6	4	.22	.32	.26	10	H	.0625
DTX8A	4	<.037	.06	.06	10	H	.0625
				Arsenic[3]			
D6	4	E1	3	2	5	H	.0625
D13	4	<1	<2	1	5	H	.0625*
D17	4	E1	2	2	5	H	.0625
D25	4	2	6	2	5	H	.3125
D29	4	<1	2	1	5	H	.0625
D30	4	<1	<2	1	5	H	.0625*
DTX1	4	1	2	2	5	H	.0625
DTX10A	4	<1	<2	1	5	H	.0625*
DTX2	4	<1	2	1	5	H	.0625
DTX3	4	<1	<2	<1	5	H	.0625*
DTX4	4	<1	2	1	5	H	.0625
DTX5	4	<1	<2	1	5	H	.0625*
DTX6	4	<1	<2	1	5	H	.0625*
DTX8A	4	<1	<2	<1	5	H	.0625*
				Cadmium			
D6	4	<2	<7	<6	5	H	[4]--
D13	4	<1	<1	<1	5	H	.0625*
D17	4	<1	<1	<1	5	H	.0625*
D25	4	<2	<3	<2	5	H	.0625*
D29	4	<2	<2	<2	5	H	.0625*
D30	4	<1	<2	<2	5	H	.0625*
DTX1	4	<2	<2	<2	5	H	.0625*
DTX10A	4	<1	<2	<2	5	H	.0625*
DTX2	4	<2	<2	<2	5	H	.0625*
DTX3	4	<1	<1	<1	5	H	.0625*
DTX4	4	<1	<2	<2	5	H	.0625*
DTX5	4	<1	<2	<2	5	H	.0625*
DTX6	4	<2	<2	<2	5	H	.0625*
DTX8A	4	<1	<1	<1	5	H	.0625*

Table 20. Statistical comparison of median concentrations for selected chemical constituents in ground-water samples collected near Deer Trail, Colorado, 1999, and lowest applicable water-quality regulatory standard —Continued

[--, not computed or missing; standard is from Colorado Department of Public Health and Environment (1997); concentrations are in micrograms per liter, except nitrate in milligrams per liter; <, less than; *, value estimated because variance was zero; H, health-based standard; A, agricultural standard; E, value estimated by laboratory]

Well	Sample size	Minimum	Maximum	Median	Colorado standard	Type of standard	Probability that the median concentration exceeded the regulatory standard[1]
				Chromium			
D6	4	<1	<4	<2	100	H, A	.0625
D13	4	<.8	2	<1	100	H, A	.0625
D17	4	<.8	<1	<1	100	H, A	.0625*
D25	4	<1	27	10	100	H, A	.0625
D29	4	<1	18	2	100	H, A	.0625
D30	4	<1	10	<2	100	H, A	.0625
DTX1	4	<1	14	<1	100	H, A	.0625
DTX10A	4	<1	6	1	100	H, A	.0625
DTX2	4	<1	11	1	100	H, A	.0625
DTX3	4	<.8	<1	<1	100	H, A	.0625*
DTX4	4	<1	11	1	100	H, A	.0625
DTX5	4	<1	8	2	100	H, A	.0625
DTX6	4	<1	11	1	100	H, A	.0625
DTX8A	4	<.8	<1	<1	100	H, A	.0625*
				Copper			
D6	4	11	34	28	200	A	.0625
D13	4	2	4	2	200	A	.0625
D17	4	<1	<1	<1	200	A	.0625*
D25	4	7	11	8	200	A	.0625
D29	4	6	8	8	200	A	.0625
D30	4	7	9	8	200	A	.0625
DTX1	4	6	9	7	200	A	.0625
DTX10A	4	4	6	6	200	A	.0625
DTX2	4	5	8	6	200	A	.0625
DTX3	4	2	4	2	200	A	.0625*
DTX4	4	4	8	6	200	A	.0625
DTX5	4	4	8	6	200	A	.0625
DTX6	4	6	11	8	200	A	.0625
DTX8A	4	2	3	2	200	A	.0625*
				Lead[5]			
D6	4	<2	<7	<6	50	H	.0625*
D13	4	<1	<1	<1	50	H	.0625*
D17	4	<1	<1	<1	50	H	.0625*
D25	4	<2	<3	<2	50	H	.0625*
D29	4	<2	<2	<2	50	H	.0625*
D30	4	<1	<2	<2	50	H	.0625*
DTX1	4	<2	<2	<2	50	H	.0625*
DTX10A	4	<1	<2	<2	50	H	.0625*
DTX2	4	<2	<2	<2	50	H	.0625*
DTX3	4	<1	<1	<1	50	H	.0625*
DTX4	4	<1	<2	<2	50	H	.0625*
DTX5	4	<1	<2	<2	50	H	0.0625*
DTX6	4	<2	<2	<2	50	H	.0625*
DTX8A	4	<1	<1	<1	50	H	.0625*

Table 20. Statistical comparison of median concentrations for selected chemical constituents in ground-water samples collected near Deer Trail, Colorado, 1999, and lowest applicable water-quality regulatory standard —Continued

[--, not computed or missing; standard is from Colorado Department of Public Health and Environment (1997); concentrations are in micrograms per liter, except nitrate in milligrams per liter; <, less than; *, value estimated because variance was zero; H, health-based standard; A, agricultural standard; E, value estimated by laboratory]

Well	Sample size	Minimum	Maximum	Median	Colorado standard	Type of standard	Probability that the median concentration exceeded the regulatory standard[1]
				Mercury			
D6	4	<.1	<.2	<.1	2	H	.0625*
D13	4	<.1	<.2	<.1	2	H	.0625*
D17	4	<.1	<.2	<.1	2	H	.0625*
D25	4	<.1	<.2	<.1	2	H	.0625*
D29	4	<.1	<.2	.1	2	H	.0625*
D30	4	<.1	<.2	<.1	2	H	.0625*
DTX1	4	<.1	<.2	<.1	2	H	.0625*
DTX10A	4	<.1	<.2	<.1	2	H	.0625*
DTX2	4	<.1	<.2	<.1	2	H	.0625*
DTX3	4	<.1	<.2	<.1	2	H	.0625*
DTX4	4	<.1	<.2	<.1	2	H	.0625*
DTX5	4	<.1	<.2	<.1	2	H	.0625*
DTX6	4	<.1	<.2	<.1	2	H	.0625*
DTX8A	4	<.1	<.2	<.1	2	H	.0625*
				Molybdenum[6]			
D6	4	<2	<7	<6	--[6]	--	--
D13	4	<1	1	1	--[6]	--	--
D17	4	6	7	6	--[6]	--	--
D25	4	10	13	11	--[6]	--	--
D29	4	<2	<2	<2	--[6]	--	--
D30	4	<2	4	2	--[6]	--	--
DTX1	4	5	5	5	--[6]	--	--
DTX10A	4	1	3	2	--[6]	--	--
DTX2	4	<2	<2	<2	--[6]	--	--
DTX3	4	<1	<1	<1	--[6]	--	--
DTX4	4	<1	<2	<2	--[6]	--	--
DTX5	4	<1	<2	<2	--[6]	--	--
DTX6	4	<2	<2	<2	--[6]	--	--
DTX8A	4	<1	2	1	--[6]	--	--
				Nickel			
D6	4	6	23	17	100	H	.0625
D13	4	3	5	4	100	H	.0625
D17	4	<1	2	1	100	H	.0625
D25	4	16	20	16	100	H	.0625
D29	4	14	22	17	100	H	.0625
D30	4	8	14	12	100	H	.0625
DTX1	4	13	21	14	100	H	.0625
DTX10A	4	3	16	7	100	H	.0625
DTX2	4	9	17	13	100	H	.0625
DTX3	4	2	5	3	100	H	.0625
DTX4	4	11	20	14	100	H	.0625
DTX5	4	6	24	10	100	H	0.0625
DTX6	4	5	13	8	100	H	.0625
DTX8A	4	1	4	3	100	H	.0625

Table 20. Statistical comparison of median concentrations for selected chemical constituents in ground-water samples collected near Deer Trail, Colorado, 1999, and lowest applicable water-quality regulatory standard —Continued

[--, not computed or missing; standard is from Colorado Department of Public Health and Environment (1997); concentrations are in micrograms per liter, except nitrate in milligrams per liter; <, less than; *, value estimated because variance was zero; H, health-based standard; A, agricultural standard; E, value estimated by laboratory]

Well	Sample size	Minimum	Maximum	Median	Colorado standard	Type of standard	Probability that the median concentration exceeded the regulatory standard[1]
				Selenium			
D6	4	6	8	8	20	A	.0625
D13	4	<1	<2	<1	20	A	.0625*
D17	4	8	9	8	20	A	.0625
D25	4	<2	6	2	20	A	.0625
D29	4	<1	3	<2	20	A	.0625
D30	4	<1	2	<1	20	A	.0625
DTX1	4	<2	4	2	20	A	.0625
DTX10A	4	<1	2	1	20	A	.0625
DTX2	4	<1	2	1	20	A	.0625
DTX3	4	4	16	11	20	A	.0625
DTX4	4	1	2	1	20	A	.0625
DTX5	4	<1	2	1	20	A	.0625
DTX6	4	<1	4	3	20	A	.0625
DTX8A	4	<1	<2	<1	20	A	.0625*
				Zinc			
D6	4	9	33	30	2,000	A	.0625
D13	4	1	3	2	2,000	A	.0625
D17	4	<1	<1	<1	2,000	A	.0625*
D25	4	5	25	8	2,000	A	.0625
D29	4	8	14	11	2,000	A	.0625
D30	4	6	10	8	2,000	A	.0625
DTX1	4	5	6	6	2,000	A	.0625
DTX10A	4	3	10	5	2,000	A	.0625
DTX2	4	6	7	6	2,000	A	.0625
DTX3	4	1	2	2	2,000	A	.0625
DTX4	4	3	6	4	2,000	A	.0625
DTX5	4	3	5	4	2,000	A	.0625
DTX6	4	6	7	6	2,000	A	.0625
DTX8A	4	2	2	2	2,000	A	.0625

[1] Value is 1 minus the p-value resulting from a one-tailed Sign Test (Helsel and Hirsch, 1995), which is used to indicate the level of statistical evidence that selected median constituent concentrations are significantly greater than regulatory standards. A value close to 1.0 indicates more evidence that the median concentration exceeded the standard, whereas a value close to 0 indicates little evidence that the median concentration exceeded the standard. The percent confidence of the test can be determined by subtracting the p-value from 1 and multiplying by 100. For example, if the p-value is 0.10, 1-p is 0.90, so the median concentration is greater than the regulatory standard with 90-percent confidence. For this statistical test, all values that were less than the minimum reporting limit were set equal to one-half that limit.

[2] Data compared to standard are for nitrite plus nitrate. Results indicate nitrite is a minor component.

[3] Standard is a proposed maximum contaminant level.

[4] All data were less than laboratory minimum reporting limit. Minimum reporting limits were sometimes greater than the water-quality standard.

[5] All data were less than laboratory minimum reporting limit. The minimum reporting limit is less than the water-quality standard.

[6] No regulatory standard for this constituent.

Table 21. Statistical evaluation of monotonic time-series trend using the Kendall's tau correlation coefficient for selected constituents in ground-water samples collected near Deer Trail, Colorado, 1999

[Tau, the Kendall's tau statistic (Helsel and Hirsch, 1995) is used as an indicator of monotonic correlation between concentration and time. By this method, positive values of Kendall's tau indicate upward trends and negative values indicate downward trends. Kendall's tau is a number between -1 and 1 that indicates increasing strength of the correlation. For this statistical test, all values that were less than the minimum reporting limit were set equal to one-half that limit; p-value indicates the level of significance of the correlation; --, not computed; <, less than]

Well	Nitrate		Arsenic		Cadmium		Chromium		Copper		Lead	
	Tau	p-value	Tau	p-value	Tau	p-value	Tau	p-value	Tau	p-value	Tau	p-value
D6	0.667	0.308	-0.833	.174	--[1]	--[1]	-.167	1	<0.001	1.000	--[1]	--[1]
D13	--[1]	--[1]	.167	1.000	--[1]	--[1]	-.167	1	.167	1.000	--[1]	--[1]
D17	.667	.308	-.500	.497	--[1]	--[1]	-.500	.500	--[1]	--[1]	--[1]	--[1]
D25	-1.000	.296	-.167	1.000	--[1]	--[1]	-.167	1.000	-.167	1.000	--[1]	--[1]
D29	--[1]	--[1]	-.167	1.000	--[1]	--[1]	.167	1.000	-.500	.500	--[1]	--[1]
D30	-.500	.500	-.500	.500	--[1]	--[1]	-.167	1.000	-.833	.174	--[1]	--[1]
DTX1	.333	1.000	-.500	.500	--[1]	--[1]	.167	1.000	-.500	.500	--[1]	--[1]
DTX10A	--[1]	--[1]	-.167	1.000	--[1]	--[1]	.500	.500	-.833	.174	--[1]	--[1]
DTX2	--[1]	--[1]	-.830	.174	--[1]	--[1]	.500	.500	-.500	.500	--[1]	--[1]
DTX3	-.667	.308	--[1]	--[1]	--[1]	--[1]	-.500	.500	-.500	.500	--[1]	--[1]
DTX4	-.333	.734	-.167	1.000	--[1]	--[1]	.500	.500	-.500	.500	--[1]	--[1]
DTX5	.167	1.000	.167	1.000	--[1]	--[1]	.667	.308	-.667	.308	--[1]	--[1]
DTX6	.333	.734	.167	1.000	--[1]	--[1]	-.333	.734	-.333	.734	--[1]	--[1]
DTX8A	-.667	.308	--[1]	--[1]	--[1]	--[1]	-.500	.500	-.167	1.000	--[1]	--[1]

Well	Mercury		Molybdenum		Nickel		Selenium		Zinc	
	Tau	p-value	Tau	p-value	Tau	p-value	Tau	p-value	Tau	p-value
D6	--[1]	--[1]	--[1]	--[1]	<.001	1.000	-.500	.500	<.001	1.000
D13	--[1]	--[1]	<.001	1.000	.833	.174	--[1]	--[1]	.167	1.000
D17	--[1]	--[1]	.167	1.000	.167	1.000	<.001	1.000	--[1]	--[1]
D25	--[1]	--[1]	-.167	1.000	-.500	.500	-.333	.734	-.333	.734
D29	.500	.500	--[1]	--[1]	-.667	.308	-.500	.500	<.001	1.000
D30	--[1]	--[1]	<.001	1.000	-.500	.500	-.500	.500	-.833	.174
DTX1	--[1]	--[1]	<.001	1.000	-.167	1.000	<.001	1.000	-.167	1.000
DTX10A	--[1]	--[1]	-.833	.174	-1.000	.089	-.500	.500	-.833	.174
DTX2	--[1]	--[1]	--[1]	--[1]	-.500	.500	-.500	.500	.500	.500
DTX3	--[1]	--[1]	--[1]	--[1]	-.167	1.000	-.667	.308	-.667	.308
DTX4	--[1]	--[1]	--[1]	--[1]	-.667	.308	-.167	1.000	-.500	.500
DTX5	--[1]	--[1]	<.001	1.000	-1.000	.089	-.500	.500	-.667	.308
DTX6	--[1]	--[1]	--[1]	--[1]	<.001	1.000	-.167	1.000	-.167	1.000
DTX8A	--[1]	--[1]	-.500	.500	-.167	1.000	--[1]	--[1]	<.001	1.000

[1] No concentrations were greater than the laboratory minimum reporting limit.

Table 22. Selection criteria and information for basin pairs considered by the U.S. Geological Survey for streambed-sediment monitoring near Deer Trail, Colorado, 1999

[Basin locations are shown in figure 9; bedrock-geology information from Sharps (1980); soil type from Larsen and others (1966), and Larsen and Brown (1971); other information from U.S. Geological Survey (1969, 1973a, 1973b); DCP, data-collection platform mi, mile; ft, feet; ft/mi, feet per mile]

Criteria	Basin Pair 1		Basin Pair 2		Basin Pair 3	
	Badger Creek		Muddy Creek		Rattlesnake Creek	
	Biosolids basin	Nonbiosolids basin	Biosolids basin	Nonbiosolids basin	Biosolids basin	Nonbiosolids basin
Property	Metro Wastewater Reclamation District north property	Private	Metro Wastewater Reclamation District central property	Private	Metro Wastewater Reclamation District south property	Private
Nearest well with DCP (fig. 1)	DTX2	DTX2	D25	D25	DTX5	DTX5
Accessibility	Good	Excellent	Good	Good	Fair	Good
Bedrock geology	Sandstone, siltstone, and shale	Sandstone, siltstone, and shale	Sandstone and siltstone	Sandstone and siltstone	Sandstone, siltstone, and shale	Sandstone, siltstone, and shale
Soil type	Thedalund-Baca (loamy uplands)	Thedalund-Baca (loamy uplands)	Thedalund-Baca (loamy uplands)	Weld-Baca-Wiley (loamy uplands)	Litle-Samsil (clayey uplands)	Weld-Adena-Colby (loamy clayey divides)
Aspect	Northwest	North-northwest	Northwest	North-northwest	North-northeast	North-northeast
Stream order[1]	First	First	Third	Third	Second	Second
Channel length	1.04 mi	1.00 mi	3.45 mi	3.25 mi	4.2 mi	2.1 mi
Channel slope	154 ft/mi (2.9 percent)	158 ft/mi (3.0 percent)	72 ft/mi (1.4 percent)	63 ft/mi (1.2 percent)	74 ft/mi (1.4 percent)	102 ft/mi (1.9 percent)
Relief	160 ft	158 ft	247 ft	205 ft	310 ft	215 ft
Channel morphology (ponding)	Ponding present	Ponding present	Ponding present	Ponding present	Ponding present	Ponding present
Biosolids application	1995	None	1995, 1997, 1998	None	1998, 1999	None
Other factors	None	Possible contamination from highway	Unstable slopes	None	Poor road--lots of sand	Biosolids are applied in next basin to the west

[1]Stream order is a numbering system for stream channels based on drainage network as portrayed on a map. In this system, the smallest delineated tributaries in the upper watershed are designated order 1. A channel segment formed by the joining of two first-order channels is designated order 2. A channel segment formed by the joining of two second-order channels is designated order 3, and so on. The trunk stream in the drainage network has the highest order.

Table 23. Methods used to analyze streambed-sediment samples collected near Deer Trail, Colorado, 1999

[Samples were analyzed at the U.S. Geological Survey National Water Quality Laboratory in Denver except for radioactivity samples which were analyzed by a contract laboratory in Richland, Washington; MRL, minimum reporting level; MDC, minimum detectable concentration analyzed for each radiochemical sample; GFAA, graphite furnace atomic absorption; DCP, data collection platform; AA, atomic absorption; ASF, automated segmented-flow spectrophotometry; *, not applicable; dilutions for samples having high specific conductance may result in higher MRL's for some samples; µg/g, micrograms per gram; pCi/g, picocuries per gram]

Constituent or property	Units	Analytical method	MRL or MDC
Trace elements			
Aluminum	µg/g	DCP	10
Arsenic	µg/g	GFAA	1
Cadmium	µg/g	AA	1
Chromium	µg/g	AA	1
Copper	µg/g	AA	1
Lead	µg/g	AA	10
Mercury	µg/g	AA manual cold vapor	.01
Molybdenum	µg/g	AA	.1
Nickel	µg/g	AA	10
Selenium	µg/g	AA, Hydride generation, ASF	1
Zinc	µg/g	AA	1
Radioactivity			
Gross alpha, dissolved	pCi/g	Thorium-230	6.
Plutonium 238, dissolved	pCi/g	Alpha spectrometry	*
Plutonium 239+240, dissolved	pCi/g	Alpha spectrometry	*

Table 24. Streambed-sediment trace-element data collected from the biosolids-applied basin near Deer Trail, Colorado, August 31, 1999

[µg/g, micrograms per gram; <, less than]

Constituent	Units	Concentration
Aluminum	µg/g	14,400
Arsenic	µg/g	2
Cadmium	µg/g	.2
Chromium	µg/g	12
Copper	µg/g	14
Lead	µg/g	15
Mercury	µg/g	.01
Molybdenum	µg/g	.1
Nickel	µg/g	17
Selenium	µg/g	<1
Zinc	µg/g	53

Table 25. Radioactivity data for quality-control samples and streambed-sediment samples collected from the biosolids-applied basin near Deer Trail, Colorado, August 31, 1999

[pCi/g, picocuries per gram; 2-sigma precision estimate for radioactivity analyses is a laboratory-calculated combined standard analytical uncertainty]

Constituent or property	DTX2 sample	Laboratory replicate	Laboratory blank
Alpha radioactivity, pCi/g	29.6	19.6	0.48
Alpha radioactivity, 2-sigma precision estimate, pCi/g	9.1	6.1	.94
Beta radioactivity, pCi/g	31.5	35.4	.31
Beta radioactivity, 2-sigma precision estimate, pCi/g	5.5	6.5	.71
Plutonium 238, pCi/g	0.0022	0.0056	-.0040
Plutonium 238, 2-sigma precision estimate, pCi/g	.0044	.0093	.0055
Plutonium 238, calculated MDC, pCi/g	.0060	.0180	.0199
Plutonium 239+240, pCi/g	.010	.0076	.0011
Plutonium 239+240, 2-sigma precision estimate, pCi/g	.010	.0089	.0039
Plutonium 239+240, calculated MDC, pCi/g	.012	.0069	.0102