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1997 ANNUAL ROCKY FLATS CLEANUP AGREEMENT (RFCA) GROUNDWATER MONITORING REPORT

Final

Volume I and II

Environmental Restoration
Rocky Flats Environmental Technology Site

November 1998

ADMIN RECORD

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FINAL

1997 ANNUAL ROCKY FLATS CLEANUP AGREEMENT (RFCA)

GROUNDWATER MONITORING REPORT

for the

Rocky Flats Environmental Technology Site

November 11, 1998

VOLUME I OF II

This Binder includes Volume I and Volume II.
Volume II is presented in electronic format at the end of this Binder.

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
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ADMIN RECORD

317/317

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This Binder includes Volume I and Volume II. Volume II is presented in electronic format at the end of the Binder

EXECUTIVE SUMMARY

This report, which is required annually according to the Rocky Flats Cleanup Agreement (RFCA, 1996), summarizes the groundwater monitoring activities and results at the Rocky Flats Environmental Technology Site (RFETS) for calendar year (CY) 1997. The report is presented in two volumes. Volume 1 presents text, tables, figures, and plates. Volume 2 presents appendices.

Section 1 serves as a brief introduction to the report and summarizes the Site environmental history and the hydrogeologic setting. Section 2, Data Analysis, discusses the groundwater quality data collected in CY97 and contains a data quality assessment regarding the precision, accuracy, and representativeness of analytical data. In addition, Section 2 contains updated plume maps and discussion for five volatile organic compound (VOC) species, nitrate, manganese, nickel, sulfate, and total dissolved solids. Section 3 presents groundwater flow conditions during CY97, and compares them to groundwater flow conditions documented during CY96. Water levels during calendar year 1996 are considered to represent a sitewide baseline to be used in assessing annual changes to the groundwater flow system in the remaining years of plant closure and post-closure monitoring. Section 4, Groundwater Evaluations, discusses the evaluation activities that are in progress for areas of the Site having reportable concentration values or where it is known that contaminant plumes have reached surface water. Section 5 presents a summary of other CY97 groundwater characterization activities at RFETS that involved groundwater issues. Section 6 serves to outline other groundwater program activities including well permitting, bladder pump installations/low flow rate sampling, the real time groundwater monitoring network, well abandonment and replacement (WARP) activities, and a preliminary data quality assessment of historical groundwater data. Section 7 presents conclusions and recommendations for future groundwater characterization activities. Section 8 lists all references that are cited in the text of this document.

Volume 2 of this document contains six appendices. Appendix A consists of data quality assessment tables. Appendix B presents groundwater analytical data collected during CY97 for RFCA wells. Appendix C presents historical groundwater level data. Appendix D presents well hydrographs for water quality and background wells. Appendix E consists of two parts; Appendix E.1, geologic logs for wells installed in CY97, and Appendix E.2, well construction diagrams for the CY97 wells.

1.0 INTRODUCTION

This Annual Groundwater Monitoring Report summarizes the groundwater monitoring activities and results at Rocky Flats Environmental Technology Site RFETS for calendar year 1997 (CY97), as required in the Rocky Flats Cleanup Agreement (RFCA), and outlined in the Integrated Monitoring Plan (IMP) (K-H, 1997). Section 1 serves as a brief introduction to the report. Section 2 discusses the groundwater quality data collected in CY97 and contains updated plume maps for selected volatile organic compounds and metals, nitrate, and general water quality indicator parameters, including sulfate and total dissolved solids. Section 3 presents baseline hydrogeologic data for the recently defined RFCA groundwater monitoring network. Section 4 discusses the groundwater evaluation activities that are in process. Sections 5 and 6 give a brief summary of pre-remedial characterization and other activities at RFETS in CY97 that involve groundwater.

1.1 Site Description

Rocky Flats Environmental Technology Site is located 16 miles northwest of Denver in Jefferson County, Colorado. The Site is a U.S. government-owned and contractor-operated facility that encompasses approximately 6,550 acres of federally-owned land (Figure 1-1). Site ownership, however, does not include surface and subsurface minerals or water rights. Site construction was initiated in 1951 and operations were begun in 1952.

Prior to the current closure mission, RFETS was part of the nationwide nuclear weapons research, development, and production complex. The plant produced metal components for nuclear weapons from plutonium, uranium, beryllium, and stainless steel. Other production activities included chemical recovery and purification of recyclable transuranic radionuclides, metal fabrication and assembly, and related quality control functions. The plant conducted research and development programs in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. Parts manufactured at the Site were shipped offsite for final assembly.

Major plant structures, including all production buildings, are located within a centralized 400-acre Industrial Area (IA) of the Site that is surrounded by a 6,150-acre Buffer Zone. Industrial activity immediately adjoining the Site includes present and/or prior coal and clay mining, petroleum recovery, natural classified-aggregate quarrying, and fabricated-aggregate mining. Other activities include cattle ranching and wind energy research. Several irrigation ditches traverse the

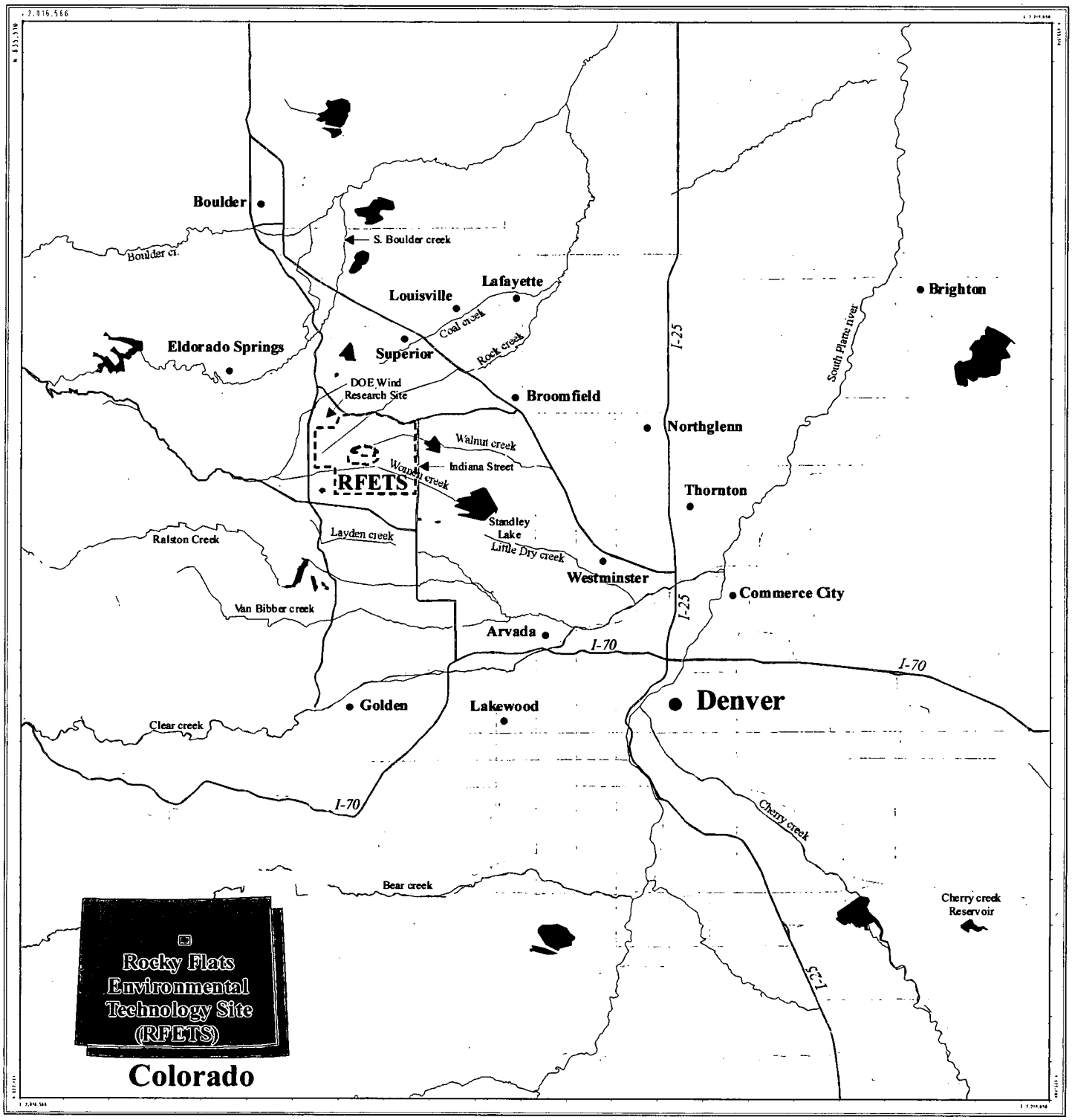

Figure 1-1 Location of Rocky Flats Environmental Technology Site (RFETS)

Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

RMRS

99-0060

5,000' 0' 10,000' 20,000'
Scale in Feet

Site, transmitting water for downstream agricultural, industrial, and municipal purposes. Three ephemeral streams drain the Site and flow eastward (see Figure 1-2).

1.2 Geology and Hydrogeology

1.2.1 Introduction

The Site is situated approximately two miles east of the Front Range of Colorado (Figure 1-1), on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province (Spencer, 1961). The geologic history of the Colorado Rocky Mountain region, which includes the Site area, has been summarized by Haun and Kent (1965). The elevation at the Site is approximately 6,000 feet above mean sea level (MSL). The Industrial Area of the Site is located on an alluvial-covered pediment. The upper surface of the alluvium slopes easterly 1 to 2 degrees. Most of the surrounding area in the Buffer Zone is more prominently dissected with intermittent streams. These small, eastward flowing streams include Rock Creek, Walnut Creek, Woman Creek, and several surface water diversion ditches.

1.2.2 Stratigraphy

The stratigraphic sequence that underlies the Site extends from the crystalline Precambrian gneiss, schist, and granitoids at 3,000 feet below MSL to the unconsolidated Quaternary deposits at the surface approximately 6,000 feet above MSL. Based upon aerial photographic interpretation, field geologic mapping, coal and aggregate mine development, petroleum exploration in the vicinity, and numerous borehole investigations, a substantial amount of lithologic information has been gained about the Site. The generalized lithologic section in the Rocky Flats area is shown in Figure 1-3.

Bedrock formations from the uppermost Cretaceous Pierre, Fox Hills, Laramie, and Arapahoe Formations are present and exposed at the surface or lie beneath the Site. The Quaternary Rocky Flats Alluvium, and to a limited extent Verdos Alluvium, unconformably overlie the Cretaceous Arapahoe and Laramie Formations in the central portion of the Site. The unconsolidated surficial deposits, combined with the weathered portion of subcropping bedrock formations, form the sequence of rocks that have the greatest importance regarding groundwater flow and contaminant transport at the Site.

1.2.2.1 Rocky Flats Alluvium

Several Quaternary alluvial formation pediment covers have been identified in the vicinity of the Site by Scott (1975). The Rocky Flats Alluvium is an unconsolidated deposit derived from quartzites and

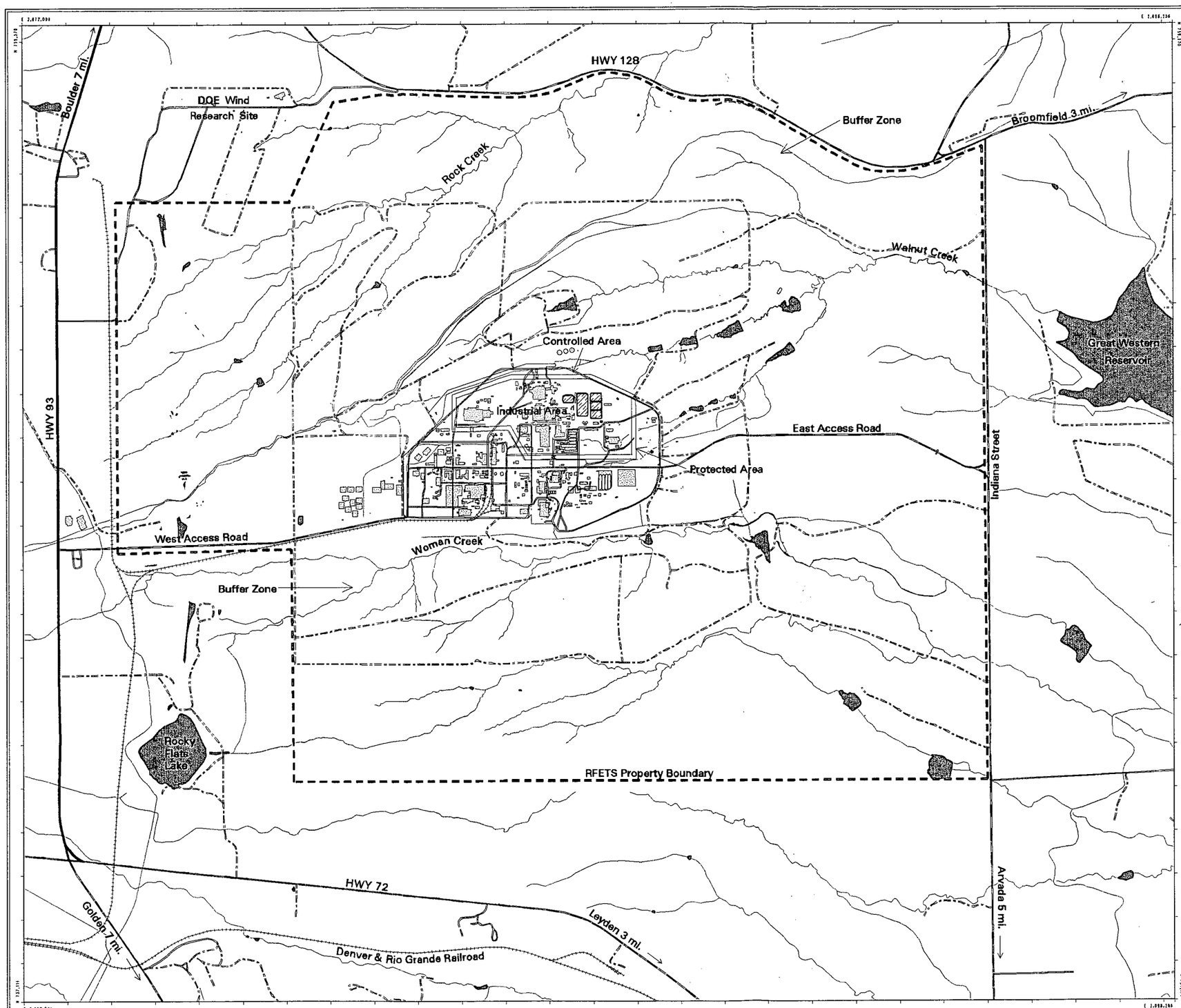

Figure 1-2

Rocky Flats Environmental Technology Site Map

EXPLANATION

Standard Map Features

- Buildings
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Heavy duty paved roads
- Medium duty paved roads
- Light duty paved roads
- Dirt roads
- Railroads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 28720
1 inch represents approximately 2393 feet

700 0 1400 2800ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: 97-0063

November 11, 1998

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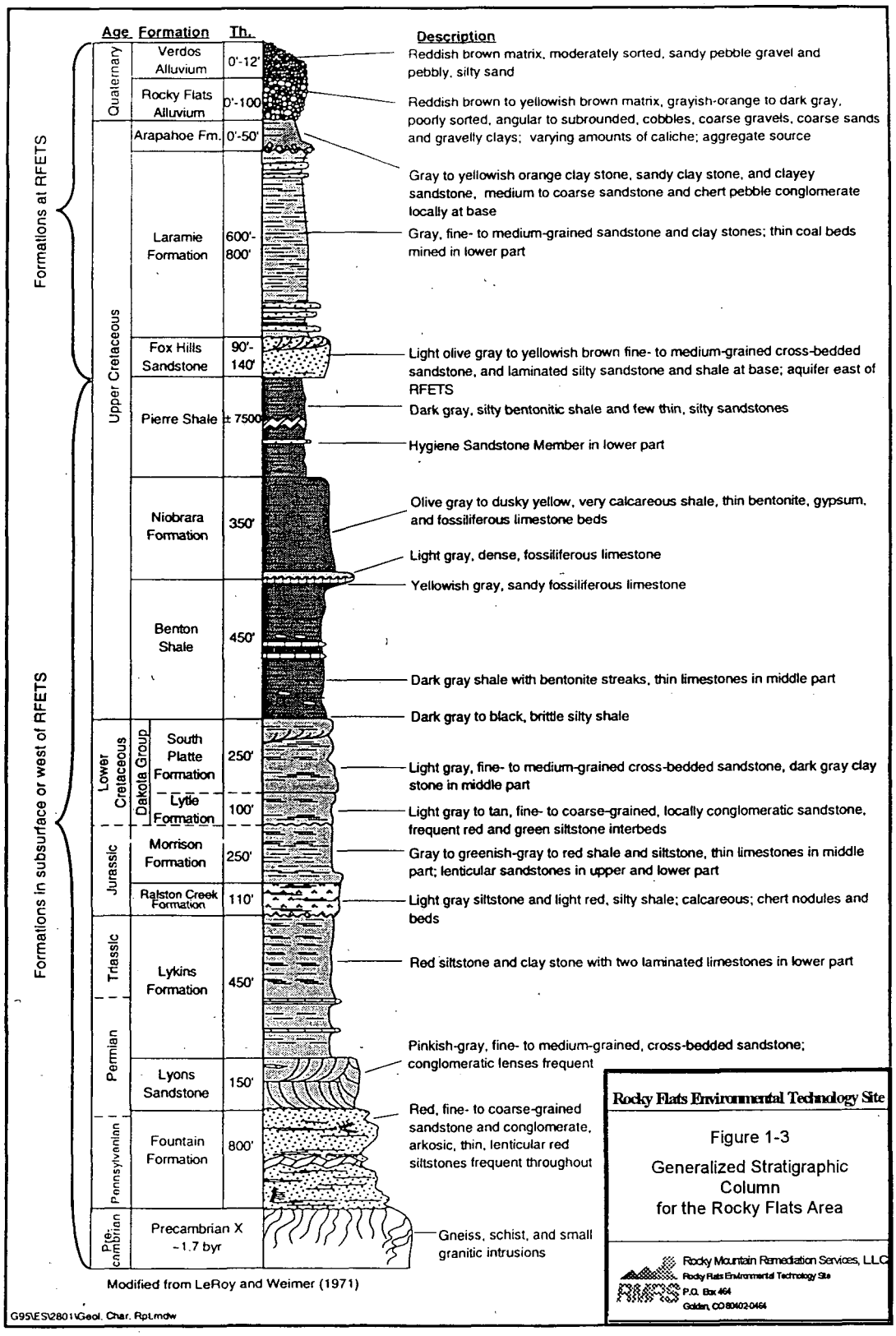

Age
Formation
Th.
Description
Formations at RFETS
Formations in subsurface or west of RFETS
Quaternary
Verdos Alluvium
0'-12'
Reddish brown matrix, moderately sorted, sandy pebble gravel and pebbly, silty sand
Rocky Flats Alluvium
0'-100'
Reddish brown to yellowish brown matrix, grayish-orange to dark gray, poorly sorted, angular to subrounded, cobbles, coarse gravels, coarse sands and gravelly clays; varying amounts of caliche; aggregate source
Upper Cretaceous
Arapahoe Fm.
0'-50'
Gray to yellowish orange clay stone, sandy clay stone, and clayey sandstone, medium to coarse sandstone and chert pebble conglomerate locally at base
Laramie Formation
600'-800'
Gray, fine- to medium-grained sandstone and clay stones; thin coal beds mined in lower part
Fox Hills Sandstone
90'-140'
Light olive gray to yellowish brown fine- to medium-grained cross-bedded sandstone, and laminated silty sandstone and shale at base; aquifer east of RFETS
Pierre Shale
± 7500
Dark gray, silty bentonitic shale and few thin, silty sandstones
Hygiene Sandstone Member in lower part
Niobrara Formation
350'
Olive gray to dusky yellow, very calcareous shale, thin bentonite, gypsum, and fossiliferous limestone beds
Light gray, dense, fossiliferous limestone
Yellowish gray, sandy fossiliferous limestone
Benton Shale
450'
Dark gray shale with bentonite streaks, thin limestones in middle part
Dark gray to black, brittle silty shale
Lower Cretaceous
Dakota Group
South Platte Formation
250'
Light gray, fine- to medium-grained cross-bedded sandstone, dark gray clay stone in middle part
Lytle Formation
100'
Light gray to tan, fine- to coarse-grained, locally conglomeratic sandstone, frequent red and green siltstone interbeds
Jurassic
Morrison Formation
250'
Gray to greenish-gray to red shale and siltstone, thin limestones in middle part; lenticular sandstones in upper and lower part
Ralston Creek Formation
110'
Light gray siltstone and light red, silty shale; calcareous; chert nodules and beds
Triassic
Lykins Formation
450'
Red siltstone and clay stone with two laminated limestones in lower part
Permian
Lyons Sandstone
150'
Pinkish-gray, fine- to medium-grained, cross-bedded sandstone; conglomeratic lenses frequent
Pennsylvanian
Fountain Formation
800'
Red, fine- to coarse-grained sandstone and conglomerate, arkosic, thin, lenticular red siltstones frequent throughout
Pre-cambrian
Precambrian X ~1.7 byr
Gneiss, schist, and small granitic intrusions
Modified from LeRoy and Weimer (1971)
G95\ES\2801\Geol. Char. Rpt.mdw
Rocky Flats Environmental Technology Site
Figure 1-3
Generalized Stratigraphic Column for the Rocky Flats Area
Rocky Mountain Remediation Services, LLC
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

granites of the Coal Creek Canyon provenance west of the Site. The deposit diminishes from west to east with thicknesses ranging from approximately 100 feet to less than one foot. In the central portion of the Site, the deposit is approximately 15 to 25 feet thick. The Rocky Flats Alluvium is a heterogeneous deposit dominantly composed of angular to subrounded, poorly-sorted, coarse, bouldery-gravel with a clay and sand matrix. Clay, silt, and sand lenses as well as varying amounts of caliche are also present.

Exposures of Rocky Flats Alluvium in the aggregate quarries north and west of the Site exhibit some large scale cross-stratification. Depositional processes include fluvial and debris-flow transport (Shroba and Carrara, 1994) infilling paleotopographic lows and leaving a widespread surface of erosion with extremely low relief.

1.2.2.2 Other Surficial Deposits

In addition to the pediment-forming alluvial deposits, younger Quaternary units consisting of colluvium, landslide alluvium, and valley fill alluvium mantle the hillslopes and valley bottoms below the pediment surface. Colluvial deposits are derived from Arapahoe and Laramie Formations and older alluvial deposits. This unit consists of sheetwash, soil creep, and landslide materials with a total thickness of 3 to 16 feet (Shroba and Carrara, 1994). These deposits locally flank the Rocky Flats Alluvium and generally extend to lower parts of the slopes along the principal drainages.

Landslide deposits more commonly flank the Rocky Flats Alluvium. They are often bounded by headwall scarps and lobate toes at the downslope margins. Seeps issuing from the base of the Rocky Flats Alluvium contribute to landslide colluvium generation. The landslide units include earth flows, slumps, and debris flows with thicknesses estimated between 10 to 33 feet (Shroba and Carrara, 1994).

Valley-fill alluvial deposits, present in the bottoms of modern stream channels, flood plains, and terraces, are composed of clay, silt, sand, and gravel. They are commonly less than 10 feet thick but can be tens of feet thick. Usually these deposits contain more sand and are better sorted than the Rocky Flats Alluvium.

1.2.2.3 Arapahoe Formation

The Arapahoe Formation is composed of claystones and silty claystones with lenticular sandstones in the basal portion of the formation. The Arapahoe Formation is generally less than 25 feet thick in the Site area, occurring as erosional remnants of fine grained sandstone above the Laramie

Formation at various locations on Site (EG&G, 1995a). This basal Arapahoe Formation sandstone, which is currently defined as the No. 1 Sandstone, is of concern as a potential contamination pathway, especially where it subcrops beneath the alluvial/bedrock unconformity.

1.2.2.4 Laramie and Fox Hills Sandstone Formations

The Laramie Formation is approximately 600 to 800 feet thick and is composed of a lower sandstone/claystone/coal interval and an upper, thick claystone interval. Within the upper claystone interval, thin, lenticular sandstone lenses (i.e., Sandstones 2 through 5 in the 1991 Geologic Characterization Report (EG&G, 1991a)) occur. The discontinuous nature of these sandstone lenses coupled with the large claystone layer that encloses them, mitigates their potential for transmitting groundwater contamination in both a horizontal and vertical direction.

The Fox Hills sandstone is primarily a fine-grained sandstone with thin siltstone and claystone interbeds and an approximate thickness of between 75 and 125 feet. The Fox Hills sandstone crops out and subcrops along a narrow, north-south trending pattern in the extreme western part of the Site upgradient from known sources of contamination.

The permeable lower sandstones and coals of the Laramie, combined with the permeable sandstones of the Fox Hills, constitute a regional aquifer system known as the Laramie-Fox Hills aquifer. This aquifer system is an important water source in the South Platte River Basin (Pearl, 1980), and is the sole water supply for some residents in the Rocky Flats area. This aquifer lies approximately 500 to 600 feet below the Industrial Area and is protected from possible contamination by the intervening Laramie Formation claystones.

1.2.2.5 Pierre Formation

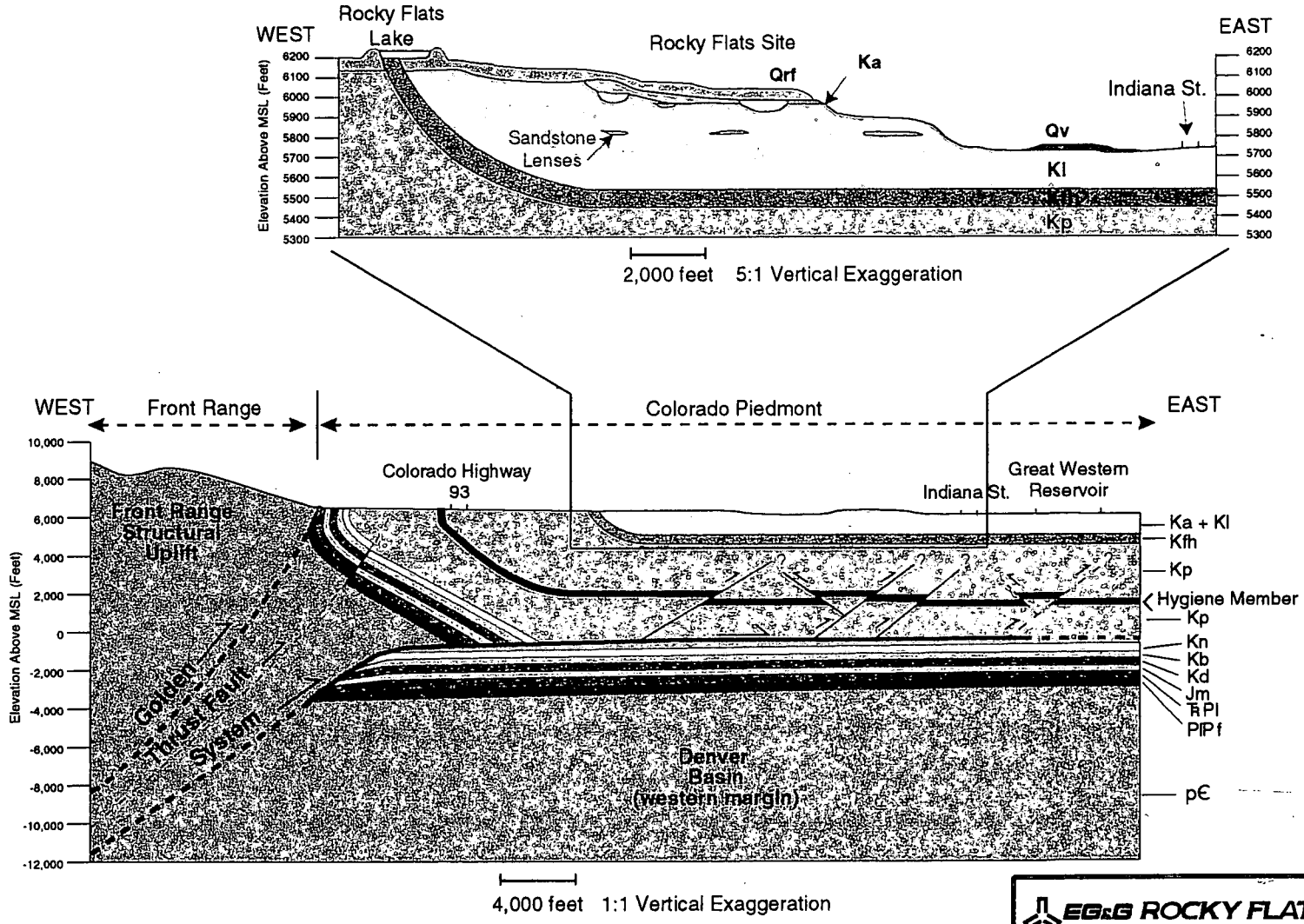
The Pierre Formation is a 7,500 foot thick, dark gray, silty bentonitic shale that acts as a lower confining layer for the Laramie-Fox Hills aquifer in the Denver Basin. This thick marine shale unit subcrops only in the extreme western part of the Site.

1.2.3 Geologic Structure

The Site is located along the western margin of the Denver Basin, an asymmetric basin with a steeply east-dipping western flank and a gentle eastern flank. The interpretation of the subsurface structure is generalized in the east-west geological cross section of the Site area presented in Figure 1-4. A monoclinal fold limb exposed west of the Site is the most significant surficial structural feature in the

Geologic Units

- Qv Verdos Alluvium
- Qrf Rocky Flats Alluvium
- Ka Arapahoe Formation
- Kl Laramie Formation
- Kfh Fox Hills Sandstone
- Kp Pierre Shale/Hygiene Member
- Kn Niobrara Formation
- Kb Benton Shale
- Kd Dakota Group
- Jm Morrison Formation
- TRPl Lykins Formation
- PIPf Lyons & Fountain Formations
- p€ Undivided Igneous & Metamorphic Units



Structural interpretation from EG&G, 1993a.

EG&G ROCKY FLATS
Rocky Flats Site, Golden, Colorado

Generalized Geologic Cross Section of the Front Range and the Rocky Flats Area

Geologic Characterization Report

March 1995

Figure 1-4

G95\ES\2801\Cross Section.ill

Site area. Along the west limb of the fold, an angular unconformity exists between the Upper Cretaceous bedrock and the base of the Quaternary Rocky Flats Alluvium.

No active faults have been identified at the Site. Several high angle bedrock faults have been inferred to exist in the IA based on various stratigraphic and borehole correlation criteria. These faults appear to have only a limited hydrologic significance with regard to vertical groundwater movement and contaminant transport (RMRS, 1996a).

1.2.4 Hydrogeology

This section presents the basic concepts about the hydrogeologic conditions at the Site that affect groundwater monitoring and protection. Characterization of the hydrogeologic setting is based on the currently accepted conceptual geologic and hydrogeologic models described in the Sitewide Geoscience Characterization Study (EG&G, 1995a, 1995b, 1995c). These conceptual geologic and hydrogeologic models are used to predict the direction and rate of groundwater flow, identify potential pathways for contaminant migration, and determine the extent of contaminant plumes given varying physical, chemical, and biological factors.

1.2.4.1 Definition of the Uppermost Aquifer for the Site

The term *aquifer* as defined by 40 CFR Section 260.10 is a "geologic formation, group of formations, or a part of a formation that is capable of yielding a significant amount of water to a well or spring." An *uppermost aquifer* is also defined as "the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's boundary." Geologic materials with similar hydrologic properties comprise a hydrostratigraphic unit (HSU) (Fetter, 1988). For purposes of this report, the uppermost aquifer or upper hydrostratigraphic unit (UHSU) consists of the unconfined saturated zone, in which unconsolidated and consolidated groundwater-bearing strata are in hydraulic communication. The UHSU consists of the following geologic units: Rocky Flats Alluvium, valley-fill alluvium, colluvium, landslide deposits, weathered Arapahoe and Laramie Formation bedrock, and all sandstones within the Arapahoe and upper Laramie Formations in hydraulic communication with the overlying unconsolidated surficial deposits. The UHSU is considered to be equivalent to the uppermost aquifer at the Site.

Beneath the surficial materials and the consolidated sandstones of the UHSU are the geologic units of the lower hydrostratigraphic unit (LHSU). The LHSU consists of the consolidated, unweathered bedrock zone of the Arapahoe and upper Laramie Formations not in hydraulic communication with

the overlying UHSU. The Arapahoe and upper Laramie Formations comprising the geologic units of the LHSU consist of lesser amounts of sandstone and greater amounts of adjacent claystones. Because of the low permeability of the claystones, they behave as aquitards restricting hydraulic communication with the UHSU. The lower Laramie and Fox Hills Sandstone Formations comprise a stratigraphically lower and third hydrostratigraphic unit beneath the Site. Groundwaters of the three hydrostratigraphic units are hydraulically separated beneath the IA. They do converge, however, and are in mutual contact immediately upgradient near the western margin of the Site due to monoclinal folding and erosional proximity. Initially, background geochemical characterization of the UHSU and LHSU revealed that these units have statistically different groundwater chemistry concluding with the delineation of separate hydrostratigraphic units (EG&G, 1993a). In addition, possible communication of the hydrostratigraphic units along other geologic structures is currently being assessed. More detailed differentiation of the LHSU will be achieved as new hydrogeologic and geochemical data are generated from Site investigations currently proposed or in progress.

1.2.4.2 Groundwater Occurrence and Distribution

The Site is located in a regional groundwater recharge area (EG&G, 1991a). Groundwater recharge occurs from the infiltration of incident precipitation and as base flow near the upgradient area of the Site drainage basin which extends west to Coal Creek. Groundwater recharge occurs from the infiltration of precipitation and from stream, ditch, and pond seepage. Much of the groundwater that discharges from the UHSU to streams and seeps evaporates as it is being discharged. Limited investigation of the former OU2 area during the period of July through October 1993 indicated that the precipitation component of recharge was lost to evapotranspiration demands (EG&G, 1993b).

In the western part of the Site, where the thickness of the Rocky Flats Alluvium reaches 100 feet, the depth to the water table is 50 to 70 feet below the surface. The depth to water generally becomes shallower from west to east as the alluvial material thins and the confining claystones are closer to the ground surface. At the head of stream drainages and along valley sides, seeps are common at the base of the Rocky Flats Alluvium where it is in contact with claystones of the Arapahoe/Laramie Formations, and where the Arapahoe Formation sandstone crops out. In general, the unconsolidated surficial materials are thicker in the western, higher elevations at the Site. Accordingly, the saturated thickness of these materials also thins eastward. The potentiometric surface of groundwater in unconsolidated surficial deposits has been mapped and is shown on Plates 2 and 3. The periods illustrated represent the times of year when static water levels are expected to be both high and low.

Areas of unsaturated and seasonally unsaturated alluvium and colluvium are indicated east and northeast of the IA.

Groundwater in the Arapahoe Formation sandstone units, which subcrop beneath the alluvial material, is not confined when in contact with the surficial materials. In this setting, a hydraulic connection exists between the bedrock sandstone and the alluvial material allowing the bedrock groundwater to exist under unconfined conditions as part of the UHSU. The subcropping Arapahoe Formation No. 1 Sandstone, located in the eastern portion of the IA and in the area between South Walnut Creek and Woman Creek, is part of the UHSU (EG&G, 1991a). The upper discontinuous sandstones of the Laramie Formation also subcrop beneath alluvium and colluvium, but in limited areas in the valleys and along valley slopes. Groundwater in the lenticular sandstone units of the Laramie Formation occurs under confined conditions over scattered areas of the Site.

Groundwater levels in UHSU wells fluctuate in response to seasonal recharge events. Approximately 15 percent of the groundwater monitoring wells are commonly dry during at least one of the quarterly sampling events. Of the remaining wells, approximately half cannot yield sufficient water volume (4.5 gallons) specified for laboratory samples. Sampling crews must return later after wells have recovered to obtain additional sample volumes.

1.2.4.3 Groundwater Flow

The shallow groundwater flow regime at the Site is illustrated by the configuration of potentiometric contours in Plates 2 and 3. These maps indicate that groundwater flow is largely controlled by the topography of the bedrock surface. Groundwater in the ridge tops generally flows toward the east-northeast. In areas where the ridge tops are dissected by east-northeast trending stream drainages, groundwater flows to the north or south toward the bottom of the valleys. In the valley bottoms, groundwater flows to the east, generally following the course of the stream. Shallow groundwater flow is primarily lateral due to the low permeability of the underlying claystone bedrock.

A potential for vertical groundwater flow, although limited by the low permeability of bedrock claystones, is indicated by the presence of strong downward vertical hydraulic gradients between the UHSU and underlying bedrock units. This situation implies a condition of poor hydraulic communication. For example, vertical gradients on the order of 0.79 to 1.05 ft/ft have been calculated between colluvial and bedrock sandstones. The vertical groundwater flux through claystones is assumed to be small, on the order of 10^{-10} to 10^{-7} cm/sec, based on calculations provided in RMRS (1996a). Fracturing, where evident, is most abundant in the weathered bedrock

zone, but is observed to decrease with depth in unweathered bedrock. Preferential vertical groundwater flow and contaminant transport along fractures or fault zones does not appear to represent a viable pathway for contaminant migration based on an assessment of available data (RMRS, 1996a).

1.2.4.4 Hydraulic Conductivity

The UHSU at the Site has a relatively low to moderate hydraulic conductivity that typically yields small amounts of water to groundwater monitoring wells. The UHSU exhibits a wide-range of hydraulic conductivities because of the diverse nature of the individual geologic units that comprise this unit. Summary statistics for UHSU hydraulic conductivities (EG&G, 1995c, Table G-2) indicate a range of 5.0×10^{-2} cm/sec (3.0×10^{-4} feet per year [ft/yr]) to 3×10^{-8} cm/sec (9.3×10^{-1} ft/yr). Listed in order of decreasing geometric mean hydraulic conductivity, the relative ranking of individual units of the UHSU is presented as follows: valley-fill alluvium (2.5×10^{-3} cm/sec); Arapahoe No. 1 sandstone (7.9×10^{-4} cm/sec); Rocky Flats Alluvium (2.1×10^{-4} cm/sec); colluvium (9.3×10^{-5} cm/sec); weathered Laramie Formation sandstones (3.9×10^{-5} cm/sec); and weathered Laramie Formation claystones (8.8×10^{-7} cm/sec).

Hydraulic conductivities for LHSU materials are generally the lowest measured at the Site with geometric mean values for individual lithologic groups ranging from 1.6×10^{-7} to 5.8×10^{-7} cm/sec (EG&G, 1995c, Table G-2). The low permeability and 600+ foot thickness of the upper Laramie Formation claystones act as an effective aquitard that restricts downward vertical groundwater flow and contaminant transport to the Laramie-Fox Hills aquifer (RMRS, 1996a).

In summary, the following major geologic and hydrologic parameters influence groundwater flow at the Site (EG&G, 1995a; 1995b):

(1) Topography controls the surface waters of the upslope drainage basin which in part recharges groundwater and the three principal streams draining the Site. The majority of shallow groundwater is intercepted by these drainages.

(2) The lithology and permeability of the unconsolidated surficial deposits permit meteoric waters to recharge the water table. The water table is contained in alluvium and weathered bedrock.

(3) Paleotopography of the bedrock pediment, which is less permeable than the overlying unconsolidated surficial deposits, serves to focus groundwater movement along bedrock "lows."

(4) Paleoweathering of shallow bedrock materials has enhanced the permeability of the upper 10 to 60 feet relative to unweathered bedrock.

(5) The permeability of bedrock units, composed primarily of claystone with lesser amounts of siltstone and sandstone, is generally several orders of magnitude less than for unconsolidated surficial deposits. The 600+ feet of unweathered bedrock between the shallow groundwater flow system and deep regional Laramie-Fox Hills aquifer provides an effective barrier to vertical groundwater and contaminant movement.

1.3 Environmental History

Processing and fabrication of weapons-related components began at the Site in 1952 and continued through 1989. Fabrication of stainless steel components continued, however, in one building through the early 1990's. During operation, environmental protection measures were established that seemed consistent with prudent environmental management. However, some activities resulted in the environmental contamination of portions of the Site. Efforts to document the extent of Site contamination are in progress, in accordance with the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the RFCA, a cooperative agreement between U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Colorado Department of Public Health and Environment (CDPHE). In addition, a historical release report (HRR) (DOE, 1992a) has been developed that documents knowledge gained to date about contamination arising from past practices. The HRR is updated on an annual basis with the knowledge gained from ongoing monitoring and investigative activities on site. The additional information is submitted on an annual basis to the EPA and CDPHE as addenda to the original document.

Documented areas of soil contamination have been designated as Individual Hazardous Substance Sites (IHSSs). Many of these IHSSs have been characterized as part of the Remedial Investigation/Feasibility Study (RI/FS) process which was conducted under the Interagency Agreement (IAG, 1991) between DOE, CDPHE and EPA. Some IHSSs have already been remediated and others are currently scheduled for excavation and treatment by the Environmental Restoration Department in accordance with a Site environmental remediation priority ranking system.

Groundwater investigations at the Site have determined that some IHSSs have released hazardous and radionuclide contaminants to groundwater. The most widespread contamination is that of

volatile organic compounds (VOCs). Plate 20 shows the distribution of VOC contamination in the UHSU. Plume definition is inexact however, because of limitations in well coverage, variability of hydrostratigraphic conditions, and local variations in groundwater transport velocity. Previously published plume maps for individual constituents can be found in the 1993 Well Evaluation Report (EG&G, 1994a), the annual RCRA Groundwater reports (EG&G, 1992, 1993c, 1994b, 1995d; RMRS/KH, 1996) and in individual OU RI/RFI reports.

Compared to all other contaminants, groundwater VOC plumes at RFETS have the greatest potential to impact surface water, based on spatial distribution and concentration considerations. These plumes have been defined on the basis of concentration values above the RFCA Tier II Action Level for individual constituents. Action levels at RFETS are derived from and are similar to regulated maximum concentration limits (MCLs). To delineate areas of highly contaminated groundwater, the Tier I groundwater action levels of 100 x Tier II Action Levels were compared against all groundwater data for the most common VOCs in groundwater. Values above Tier I and Tier II Action Levels were plotted and are shown on Plate 20. The most probable sources were identified using the results of recent field sampling programs and correlating this with our knowledge of Site processes (see RMRS, 1996b). A flow diagram (RMRS, 1996b) illustrates the method used to locate the contaminant plumes and corresponding sources, and to assist in determining which areas should be evaluated for potential remedial action. Other contaminants will also be addressed where there is a potential impact to surface water above action levels.

Six VOC groundwater contaminant plumes have been identified where contaminant concentrations are above Tier I Action Levels. These groundwater contaminant plumes include the IHSS 119.1 Plume, Mound Plume, 903 Pad and Ryan's Pit Plume, Carbon Tetrachloride Plume, East Trenches Area Plume, and Industrial Area Plume. In addition, there are two plumes with contaminant concentrations above Tier II Action Levels that have the potential to impact surface water. These plumes are the Present Landfill and the Property Utilization and Disposal (PU&D) Yard (RMRS, 1996b).

In addition to the VOC plumes, there are other constituents with concentrations above action levels in groundwater. This report will present updated plume maps for selected metals, sulfate, and total dissolved solids (TDS), as well as present individual plume maps for selected VOCs, including trichloroethene (TCE), tetrachloroethene (PCE), carbon tetrachloride, 1,2-Dichloroethene, and vinyl chloride. Evaluation of metals anomalies has been curtailed pending re-evaluation of background thresholds that will be done in FY99.

1.4 Regulatory Changes Affecting the Groundwater Monitoring Program

1.4.1 Rocky Flats Cleanup Agreement

The RFCA was officially adopted on July 19, 1996 (RFCA, 1996). The RFCA replaces the IAG as the environmental cleanup agreement for RFETS. The RFCA outlines the goals, objectives, and strategies that will lead to the RFETS cleanup and closure mission objectives. The Action Level Framework (ALF) attachment to the RFCA contains specific requirements for environmental monitoring and reporting, and it sets action levels for contaminant concentrations in groundwater and in other media. The IMP is required under RFCA to further define the monitoring programs for the Site.

To align the groundwater monitoring program with the new RFETS mission and RFCA requirements, the monitoring network was evaluated in 1996. A data quality objective (DQO) process was used to determine what decisions were necessary for groundwater and the function of each well in the network in supporting those decisions. DOE, CDPHE, EPA, and stakeholders were directly involved in decisions involving the monitoring network. Results of this evaluation are presented in the IMP discussed below.

1.4.2 Integrated Monitoring Plan for Groundwater

The IMP is a summary document that outlines the goals for groundwater monitoring (and other environmental media), and describes the various components of the groundwater monitoring program (K-H, 1997). To evaluate groundwater monitoring needs, one must know the RFCA ALF for groundwater, the Site history and areas of contamination, the physical and hydrogeologic setting of the Site, the effect of contaminated areas on groundwater, and the nature of the groundwater contaminant plumes. This information is presented in the IMP Background Document (K-H, 1998). Appendices A, B, C, and D of the groundwater section of the Background Document cover these previous topics. Appendix E of the groundwater section lists the wells that will be monitored for water quality or for groundwater flow.

In the past, two plans have been required at RFETS to comply with DOE Order 5400.1 (DOE, 1988, Page III-2), a Groundwater Protection & Management Program Plan and a Groundwater Monitoring Plan. These two plans have historically been combined into one document, the Groundwater Protection and Monitoring Program Plan (GPMPP) (EG&G, 1993d), which defines and describes the groundwater protection and monitoring programs at the Site. In addition, an assessment groundwater monitoring plan was required under RCRA for the interim status units on Site. This Plan is called

the Groundwater Assessment Plan (GWAP) (DOE, 1993a). Other monitoring plans have been developed to address groundwater monitoring requirements as outgrowths of various CERCLA Interim Measure/Interim Remedial Action (IM/IRA) decision documents. The IMP will serve as the Groundwater Monitoring Plan for the Site; and it will replace the requirements found in the group of plans named above. It will also revise the requirements of the routine groundwater monitoring portion of the IA IM/IRA decision document (DOE, 1994) and the French Drain Performance Monitoring Plan (DOE, 1992b).

The original IMP was published in May 1997. The 1998/99 version of the IMP and Background Document will be published in September, 1998.

The groundwater monitoring network, as defined in the IMP (K-H, 1997), has seven categories of monitoring wells. Table 1-1 lists the wells in the current monitoring program. Table 1-2 presents the analytical suites associated with each well in the program. The decision rules presented in the original IMP have been retained for determining Tier I and II exceedances of groundwater Action Levels. The well types and decision rules are defined below:

Boundary (B) Monitoring Wells: These wells monitor groundwater leaving the eastern Site boundary. A reportable exceedance occurs if a measured concentration is above a Tier II action level **and** the background Mean plus 2 Standard Deviations (M2SDs). When there are no previous historical data, **or** a value is greater than the M2SD of the historical concentration in the well when there have been historical exceedances of Tier II action levels, the required action is to initiate monthly sampling. Appropriate parties are notified and possible impacts to surface water are evaluated if contaminant levels are above action levels, by the above criteria, for three consecutive months.

D&D (DD) Monitoring Wells: These wells monitor for releases to groundwater from deactivation and decommissioning (D&D) activities. A concentration value is reportable when a measured concentration is above the M2SD of the established historical baseline concentration downgradient of the building(s). The required action is to inform appropriate parties and initiate an evaluation of the situation.

Plume Definition (PD) Monitoring Wells: These wells are located within known contaminant plumes and are above Tier II action levels, but are below the Tier I action levels established in the ALF. A value is reportable when a measured concentration is above a Tier I action level, **and the**

background M2SD, **and** the M2SD of the historical concentration in the well. The required action is to reclassify as a Tier I reportable well and evaluate possible impacts to groundwater.

Table 1-1 Groundwater Monitoring Wells

WELL No.	FREQUENCY	IMP WELL CLASS	PLUME AREA	DRIVERS	FORMATION	DECISION/PURPOSE
6486	Semiannual	D	881 Hillside	RFCA	AL	Drainage well monitoring the Woman Cr. drainage downgradient of the 881 Hillside Plume
5587	Semiannual	D	881 Hillside	RFCA	AL	Drainage well monitoring the Woman Cr. drainage south of the 881 Hillside Plume
5387	Semiannual	PE	881 Hillside	RFCA	AL	Plume Extent south of the 881Hillside Plume
4887	Semiannual	PE	881 Hillside	RFCA	AL	Plume Extent south of the 881 Hillside Plume
4787	Semiannual	PE	881 Hillside	RFCA	AL	Plume Extent south of the 881 Hillside Plume
38591	Semiannual	D	881 Hillside	RFCA	AL	Drainage well in Woman Cr. Drainage below 881 Hillside Plume
00797(35691)	Semiannual	PM	881 Hillside	RFCA	AL	Performance Monitoring for 881 Footing Drain Sump
11092	Semiannual	PM	881 Hillside	RFCA, IM/IRA -FD	AL	Performance Monitoring for the French Drain
10992	Semiannual	PM	881 Hillside	RFCA, IM/IRA -FD	AL	Performance Monitoring for the French Drain
10792	Semiannual	PM	881 Hillside	RFCA, IM/IRA -FD	AL	Performance Monitoring for the French Drain
10692	Semiannual	PM	881 Hillside	RFCA, IM/IRA -FD	AL	Performance Monitoring for the French Drain
10592	Semiannual	PM	881 Hillside	RFCA, IM/IRA -FD	AL	Performance Monitoring for the French Drain
0487	Semiannual	PD	881 Hillside	RFCA	AL	Plume Definition well for the 881 Hillside Plume
6586	Semiannual	D	903 Pad	RFCA	AL	Drainage well monitoring the No. side Woman Cr. below 903Pad/Ryans Pit Plume
6386	Semiannual	PD	903 Pad	RFCA	AL	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Plume
6286	Semiannual	PD	903 Pad	RFCA	BD/USHU	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Plume
3087	Semiannual	PD	903 Pad	RFCA	BD	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Plume
2987	Semiannual	PD	903 Pad	RFCA	AL	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Plume
23196	Semiannual	PE	903 Pad	RFCA	AL	Plume Extent well monitoring the southward migration of the Ryans Pit/903 Pad Plume
23096	Semiannual	PE	903 Pad	RFCA	AL	Plume Extent well monitoring the southern migration of the Ryans- OU2 VOA Plume
22996	Semiannual	DD	Bldg 886	RFCA, IM/IRA for IA	AL	Building D&D well monitoring potential rad contamination near 886 lab
41691	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well – in the Walnut Cr. Drainage at the Indiana Street Boundary
41591	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in small drainage near east access gate
10394	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in the Woman Cr. Drainage at the Indiana Street Boundary
10294	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in drainage below Pond D-2 in the southeast corner of the Site
06491	Semiannual	B	Boundary	RFCA, AIP	BD/UHSU	Boundary Well - in small drainage east of the Site at Indiana St.
0386	Semiannual	B	Boundary	RFCA, AIP	BD/UHSU	Boundary Well - in small drainage north of the east access gate
P219189	Semiannual	PD	Carbon Tet	RFCA, RCRA	AL	Plume Definition well for VOC contamination coming from Carbon Tet Plume
P209389	Semiannual	PD	Carbon Tet	RFCA, RCRA	BD	Plume Definition well in the Carbon Tet Plume
P209289	Semiannual	PD	Carbon Tet	RFCA, RCRA	AL	Plume Definition well in the Carbon Tet Plume
23296	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the northern migration of the East Trenches Area Plume
10194	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the southern migration of the East Trenches Plume
06091	Semiannual	PE	East Trenches	RFCA	AL/BD	Plume Extent well monitoring the northeast migration of the East Trenches Plume
05091	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the eastward migration of the East Trenches Plume
04991	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the eastward migration of the East Trenches Plume
04591	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the southward migration of the East Trenches Plume
04091	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the northward migration of the East Trenches Plume
03991	Semiannual	PE	East Trenches	RFCA	AL	Plume Definition well monitoring the East Trenches

Table 1-1 Groundwater Monitoring Wells

WELL No.	FREQUENCY	IMP WELL CLASS	PLUME AREA	DRIVERS	FORMATION	DECISION/PURPOSE
						Plume
10994	Semiannual	PE	IA/Old Landfill	RFCA	AL	Plume Extent IA VOA Plume/Old Landfill Plume near Woman Cr.
7086	Semiannual	PE	IA/Old Landfill	RFCA	AL	Plume Extent well monitoring IA Plume and Old Landfill Plume pathway in Woman Cr.
P416889	Semiannual	PD	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Definition of IA Plume south of Bldg. 664 along pathway to Woman Cr.
P416789	Semiannual	PD	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Definition of IA Plume south of 400 area along pathway to Woman Cr.
P416689	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent to monitor southern migration of IA Plume south of Bldg. 440
P314289	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent to monitor the southern migration of IA Plume near Bldg. 850
P313589	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent to monitor the eastward migration of IA Plume near Bldg. 881
P114389	Semiannual	PE	Ind. Area	RFCA	AL	Plume Extent well to monitor extent of PU&D yard plume pathway to Walnut Cr.
6186	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent well monitoring eastward migration of IA Plume
43392	Semiannual	PE	Ind. Area	RFCA	AL	Plume Extent well monitoring southward migration of IA Plume
22896	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent well monitoring the northward migration of IA VOA Plume
22796	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent well monitoring the northward migration of Carbon Tet Plume
22696	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent well monitoring the westward migration of the Carbon Tet Plume
22596	Semiannual	PE	Ind. Area	RFCA, IM/IRA for IA	AL	Plume Extent well monitoring the northern migration of the IA Plume
2186	Semiannual	PE	Ind. Area	RFCA	BD/UHSU	Plume Extent well monitoring the northern migration of the 'IA Plume
1986	Semiannual	PE	Ind. Area	RFCA	AL	Plume Extent well monitoring the northern migration of the IA Plume
B206989	Semiannual	RCRA	Landfill	RFCA, RCRA	BD/UHSU	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
77392	Semiannual	PD	Landfill	RFCA, RCRA	AL	Plume Definition well monitoring the eastward migration of the PU&D Yard Plume
52994	Semiannual	RCRA	Landfill	RFCA, RCRA	AL	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
52894	Semiannual	RCRA	Landfill	RFCA, RCRA	AL	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
4087	Semiannual	RCRA	Landfill	RFCA, RCRA	AL	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
00997(3786)	Semiannual	D	Mound/E. Trench	RFCA	AL	Drainage Well - below Pond B-4 in South Walnut Creek Drainage
75992	Semiannual	PE	Mound/E. Trench	RFCA	AL	Plume Extent well monitoring So. Walnut Cr. Drainage below Mound Site Plume
08091	Semiannual	PE	Mound/E. Trench	RFCA	AL	Plume Extent well monitoring the southern migration of Mound and East Trenches Plumes
00197	Semiannual	PE	Old Landfill	RFCA	AL	Plume Extent well monitoring the Industrial Area Plume
00397	Semiannual	PE	PU&D	RFCA	AL	Plume Extent well monitoring the PU&D Yard Plume
02197	Semiannual	PE	PU&D	RFCA	AL	Plume Extent well monitoring the PU&D Yard Plume
00297	Semiannual	PD	Solar Ponds	RFCA	AL	Plume Definition well monitoring the southern migration of the Solar Ponds Plume
70493	Semiannual	RCRA	PU&D	RFCA, RCRA	BD/UHSU	RCRA upgradient/Plume Definition well monitoring the edge of the PU&D Yard Plume
70393	Semiannual	RCRA	PU&D	RFCA, RCRA	AL	RCRA upgradient /Plume Definition well monitoring the edge of the PU&D Yard Plume
70193	Semiannual	RCRA	PU&D	RFCA, RCRA	BD/UHSU	RCRA upgradient/Plume Extent well monitoring the PU&D Yard Plume
5887	Semiannual	RCRA	PU&D	RFCA, RCRA	AL	RCRA upgradient/ Plume Extent Well monitoring the PU&D Yard Plume - LF
76992	Semiannual	PE	PU&D/Landfill	RFCA, RCRA	AL	Plume Extent well monitoring the eastward migration of the PU&D Yard/Landfill Plume
00197(6687)	Semiannual	PD	PU&D/Landfill	RFCA, RCRA	AL	Plume Definition well monitoring the Landfill/PU&D yard Plume
P219489	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the northern migration of the SEP Nitrate Plume
P218389	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the northern migration of

Table 1-1 Groundwater Monitoring Wells

WELL No.	FREQUENCY	IMP WELL CLASS	PLUME AREA	DRIVERS	FORMATION	DECISION/PURPOSE
						the SEP Nitrate Plume
B208289	Semiannual	PE	Solar Ponds	RFCA	BD/UHSU	Plume Extent well monitoring the northeast migration of the SEP Nitrate Plume
3386	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the southern migration of the SEP Nitrate and Carbon Tet Plumes
1786	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Definition well monitoring the migration of the SEP Nitrate and Carbon Tet Plumes
1386	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Definition well monitoring the migration of the SEP Nitrate and Carbon Tet Plumes
B208789	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the northeast migration of the SEP Nitrate Plume
02291	Semiannual	PM	Mound	RFCA		Performance Monitoring on the Mound Source remediation
00897	Semiannual	PM	Mound	RFCA		Performance Monitoring on the Mound Source remediation
07391	Semiannual	PM	903 Pad	RFCA	AL/BD	Performance Monitoring well monitoring effects of remediation downgradient of Ryans Pit
00491	Semiannual	PD	903 Pad	RFCA	BD/UHSU	Plume Definition well monitoring the 903 Pad VOC Plume
11891	Semiannual	PM	East Trenches	RFCA	BD/UHSU	Performance Montoring well monitoring effects of remediation downgradient of Trench T-3
3687	Semiannual	PM	East Trenches	RFCA	BD/USHU	Performance Monitoring well monitoring effects of remediation downgradient of Trench T-4
12691	Semiannual	PM	East Trenches	RFCA	BD/USHU	Performance Monitoring well monitoring effects of remediation downgradient of Trench T-4
05691	Semiannual	PM	East Trenches	RFCA	AL	Performance Monitoring well monitoring effects of remediation downgradient of Trench T-4
P209489	Semiannual	PD	Solar Ponds	RFCA	BD/UHSU	Plume Definition well for the Carbon Tet. Plume
3586	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well tracking migration of Solar Ponds nitrate Plume
05391	Semiannual	PD	East Trenches	RFCA	AL	Plume Definition well monitoring eastward concentration of VOCs from the East Trenches Plume
12191	Semiannual	PM	East Trenches	RFCA	BD/UHSU	Performance Monitoring at edge of T3 soil excavation
02297	Semiannual	DD	Bldg 779	RFCA/IMIRA	AL	D&D monitoring downgradient of Bldg. 779
02497	Semiannual	DD	Bldg 779	RFCA/IMIRA	AL	D&D monitoring downgradient of Bldg. 779
02397	Semiannual	DD	Bldg 779	RFCA/IMIRA	AL	D&D monitoring upgradient of Bldg. 779

Acronyms used in Table 1-1:

AIP	Agreement In Principle
AL	Alluvial
B	Boundary
BD	Bedrock
D	Drainage
DD	Decontamination & Decommissioning
FD	French Drain
IA	Industrial Area
IM/IRA	Interim Measures/Interim Remedial Actions
LHSU	Lower Hydrostratigraphic Unit
PD	Plume Definition
PE	Plume Extent
PM	Performance Monitoring
PU&D	Property Utilization & Disposal Storage Yard
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
UHSU	Upper Hydrostratigraphic Unit

Table 1-2 Groundwater Sample Analytical Suite

WELL No.	FREQUENCY	PLUME/AREA	VOC Suite	METALS Suite	TRITIUM	PU/AM	SR 89/90	URANIUM	NITRATE	FLUORIDE	SULFATE
6486	Semiannual	881 Hillside	X	X				X	X		X
5587	Semiannual	881 Hillside	X	X				X	X		X
5387	Semiannual	881 Hillside	X	X				X	X		X
4887	Semiannual	881 Hillside	X	X				X	X		X
4787	Semiannual	881 Hillside	X	X				X	X		X
38591	Semiannual	881 Hillside	X	X				X	X		X
35691	Semiannual	881 Hillside	X	X				X	X		X
11092	Semiannual	881 Hillside	X	X				X	X		X
10992	Semiannual	881 Hillside	X	X				X	X		X
10792	Semiannual	881 Hillside	X	X				X	X		X
10692	Semiannual	881 Hillside	X	X				X	X		X
10592	Semiannual	881 Hillside	X	X				X	X		X
0487	Semiannual	881 Hillside	X	X				X	X		X
6586	Semiannual	903 Pad	X	X		X		X	X		
6386	Semiannual	903 Pad	X	X		X		X	X		
6286	Semiannual	903 Pad	X	X		X		X	X		
3087	Semiannual	903 Pad	X	X		X		X	X		
2987	Semiannual	903 Pad	X	X		X		X	X		
23196	Semiannual	903 Pad	X	X		X		X	X		
23096	Semiannual	903 Pad	X	X		X		X	X		
22996	Semiannual	Bldg 886	X			X	X	X			
41691	Semiannual	Boundary	X		X	X		X	X	X	X
41591	Semiannual	Boundary	X		X	X		X	X	X	X
10394	Semiannual	Boundary	X		X	X		X	X	X	X
10294	Semiannual	Boundary	X		X	X		X	X	X	X
06491	Semiannual	Boundary	X		X	X		X	X	X	X
0386	Semiannual	Boundary	X		X	X		X	X	X	X
P219189	Semiannual	Carbon Tet	X	X	X	X	X	X	X	X	X
P209389	Semiannual	Carbon Tet	X	X	X	X	X	X	X	X	X
P209289	Semiannual	Carbon Tet	X	X	X	X	X	X	X	X	X
23296	Semiannual	East Trenches	X	X		X		X	X		
10194	Semiannual	East Trenches	X	X		X		X	X		
06091	Semiannual	East Trenches	X	X		X		X	X		
05091	Semiannual	East Trenches	X	X		X		X	X		
04991	Semiannual	East Trenches	X	X		X		X	X		
04591	Semiannual	East Trenches	X	X		X		X	X		
04091	Semiannual	East Trenches	X	X		X		X	X		
03991	Semiannual	East Trenches	X	X		X		X	X		
10994	Semiannual	IA/Old Landfill	X	X			X	X	X		X
7086	Semiannual	IA/Old Landfill	X	X			X	X	X		X
P416889	Semiannual	Ind. Area	X	X							
P416789	Semiannual	Ind. Area	X	X							
P416689	Semiannual	Ind. Area	X	X							
P314289	Semiannual	Ind. Area	X	X							
P313589	Semiannual	Ind. Area	X	X							
P114389	Semiannual	Ind. Area	X	X							
6186	Semiannual	Ind. Area	X	X							
43392	Semiannual	Ind. Area	X	X							
22896	Semiannual	Ind. Area	X	X							
22796	Semiannual	Ind. Area	X	X							
22696	Semiannual	Ind. Area	X	X							
22596	Semiannual	Ind. Area	X	X							
2186	Semiannual	Ind. Area	X	X							
1986	Semiannual	Ind. Area	X	X							
B206989	Semiannual	Landfill	X	X	X			X	X	X	X
77392	Semiannual	Landfill	X	X	X			X	X	X	X
52994	Semiannual	Landfill	X	X	X			X	X	X	X
52894	Semiannual	Landfill	X	X	X			X	X	X	X
4087	Semiannual	Landfill	X	X	X			X	X	X	X
3786	Semiannual	Mound/E. Trench	X				X X	X			

Table 1-2 Groundwater Sample Analytical Suite

WELL No.	FREQUENCY	PLUME/AREA	VOC Suite	METALS Suite	TRITIUM	PU/AM	SR 89/90	URANIUM	NITRATE	FLUORIDE	SULFATE
75992	Semiannual	Mound/E. Trench	X	X			X	X	X	X	
08091	Semiannual	Mound/E. Trench	X	X			X	X	X	X	
00197	Semiannual	Old Landfill	X	X		X		X	X	X	X
00397	Semiannual	PU&D	X	X		X			X	X	X
02197	Semiannual	PU&D	X	X		X			X	X	X
00297	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
70493	Semiannual	PU&D	X	X		X			X	X	X
70393	Semiannual	PU&D	X	X		X			X	X	X
70193	Semiannual	PU&D	X	X		X			X	X	X
5887	Semiannual	PU&D	X	X		X			X	X	X
76992	Semiannual	PU&D/Landfill	X	X		X			X	X	X
6687	Semiannual	PU&D/Landfill	X	X		X			X	X	X
P219489	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
P218389	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
B208289	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
3386	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
1786	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
1386	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
B208789	Semiannual	Solar Ponds	X	X		X		X	X	X	X
02291	Semiannual	Mound	X					X			
00897	Semiannual	Mound	X					X			
07391	Semiannual	903 Pad	X	X			X	X	X		
00491	Semiannual	903 Pad	X	X			X	X	X		
11891	Semiannual	East Trenches	X	X			X	X	X		
3687	Semiannual	East Trenches	X	X			X	X	X		
12691	Semiannual	East Trenches	X	X			X	X	X		
05691	Semiannual	East Trenches	X	X			X	X	X		
P209489	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
3586	Semiannual	Solar Ponds	X	X		X	X	X	X	X	X
05391	Semiannual	East Trenches	X	X			X	X	X		
12191	Semiannual	East Trenches	X	X			X	X	X		
02297	Semiannual	Bldg 779	X				X	X	X		
02497	Semiannual	Bldg 779	X				X	X	X		
02397	Semiannual	Bldg 779	X				X	X	X		

Plume Extent (PE) Monitoring Wells: These wells are located at the edges of known groundwater contaminant plumes, along pathways to surface water. These wells monitor for an increase in concentrations that may result in future impacts to surface water. A value is reportable if a measured concentration is above a Tier II action level **and** the background M2SD. When there are no previous historical data, **or** a value is greater than the M2SD of the historical concentration in the well when there have been historical values above Tier II action levels, the required action is to initiate monthly sampling. Appropriate parties are notified and possible impacts to surface water are evaluated if contaminant levels are above action levels, by the above criteria, for three consecutive months.

Drainage (D) Monitoring Wells: These wells are located in stream drainages, downgradient of contaminant plumes. They have the same programmatic requirements as PE wells under the IMP.

A value is reportable when a measured concentration is above the Tier II action level **and** the background M2SD. When there are no historical data, **or** a value is greater than the M2SD of the historical concentration in the well when there have been historical values above Tier II action levels, the required action is to initiate monthly sampling. Appropriate parties are notified and possible impacts to surface water are evaluated if values are above action levels, by the above criteria, for three consecutive months,.

Performance Monitoring (PM) Wells: These wells monitor the effect of a remediation or source removal action, as required in the ALF. If an increasing trend in the concentration of a contaminant is noted, then the appropriate parties are notified and an evaluation of the situation is initiated.

RCRA Monitoring Wells: These wells monitor downgradient groundwater contaminant concentrations at RCRA units. If the mean concentration of a contaminant in a downgradient well is greater than the mean concentration in upgradient wells **and** concentrations at the well show an upward trend with time, a report will be made to appropriate agencies and an investigation will be initiated to investigate possible causes.

Groundwater reporting has been integrated under the IMP. Four quarterly reports are produced annually that document concentration values above RFCA Action Levels. Also documented are changes in water quality for wells not monitored for comparison to action levels. This RFCA Annual Groundwater Report is also required to summarize all actions taken for groundwater compliance within each calendar year.

For documented values above action levels and Site background in the designated monitoring wells in the program, an evaluation of impact to surface water is required. These evaluations are determined on a case by case basis depending on the data requirements necessary to do the impacts analysis. Section 4.0 of this report discusses the status of the current evaluations that were implemented based on elevated concentrations in 1996.

1.4.3 Changes to the Groundwater Monitoring Program

Plume Degradation Monitoring Wells: A new decision element has been added to the groundwater program in the 1998/99 IMP. This decision element is for plume degradation monitoring. It is possible that natural attenuation and degradation of contaminants in groundwater may be a significant factor influencing the nature and extent of contaminant migration. Plumes (and their potential sources) that have been evaluated under the IMP evaluation criteria and show evidence of natural attenuation, may need additional characterization or monitoring to establish attenuation characteristics. Degradation monitoring would involve the placement and sampling of wells for use in decision making with respect to the methodology of source and plume remediation and will aid in assessing the priority for remediation.

Additions to the Groundwater Monitoring Network: Wells have been added to the Site monitoring network based on the results of groundwater evaluations and remediation activities. Plate 1 shows the locations for these monitoring wells.

The Mound source was removed as part of an accelerated action in 1997. Well 02291 was added to the program and a new well, 00897, was installed for performance monitoring of the effects on the mound plume from the remedial action. Both wells are believed to be in the path of the mound VOC plume and will be monitored to determine changes in concentration of VOCs with time.

An investigation of the source of the PU&D Yard VOC plume was conducted in 1997 along with an evaluation of the nature and extent of the plume itself. Based on the results of the investigation, it was determined that a discreet source did not exist so that no accelerated action is planned. It was also decided that the plume would receive additional monitoring based on likely pathways to surface water. Plume Extent wells 00397 and 02197 were installed at the locations most likely to detect migration of the PU&D Yard plume. Please refer to Section 4.3 for additional information on this investigation.

An investigation of the southern extent of the IA Plume was conducted in 1997. Based on the results of the investigation it was deemed appropriate to install Plume Extent monitoring well 00197 near Woman Creek in the potential downgradient pathway to surface water. Please refer to Section 4.2.1 for additional information on this investigation.

Plume Definition well 00297 was installed south of the Solar Ponds Nitrate Plume to better define the southern extent of this plume. This well was the result of CDPHE comments prior to approval of the original Integrated Monitoring Plan for Groundwater.

D&D monitoring wells were installed at Building 779 that is undergoing decommissioning prior to demolition. One upgradient well was installed (02397), and wells 02297 and 02497 were installed directly east and north of the building, respectively, in the downgradient direction.

Another addition to the monitoring network was instituted in response to CDPHE comment resolution on the Integrated Monitoring Plan. A real time water level monitoring network was initiated to help qualify the affects of storm events and other recharge events on groundwater flow and transport. Twenty-five wells originally identified for water level measurements in the IMP were converted to real time monitoring stations that will record water levels six times per day. Please refer to Section 6.3 for additional information on this activity.

2.0 DATA ANALYSIS

2.1 Methods

Groundwater analytical data for calendar year 1997 were retrieved by a query of the RFETS Soil & Water Database (SWD). Results for 78 of 94 RFCA monitoring wells were obtained. The sixteen wells with no data for 1997 were either dry or were added to the groundwater monitoring program as a result of changes made late in the year (see Section 1.0). Eight of these wells were successfully sampled during the first quarter of 1998. Wells 00197, 00297, 00397, 77392, and B208289 were dry throughout 1996 and the first quarter of 1997. Table 2-1 summarizes sample collection activity, by quarter, for RFCA wells sampled in 1997.

Analytical results for groundwater were imported into an ACCESS database for analysis. Data with the Quality Control (QC) identifiers "REAL" (actual analysis), "DUP" (duplicate sample), and "RNS" (rinsate blank) were tabulated and graphically examined for consistency. Duplications, mismatches, and laboratory QC data were excluded. Field QC samples were identified for use in the data quality assessment (discussion provided in Section 2.2).

Detections (results without a "U" qualifier) for analytes having Tier I and Tier II criteria were matched with the background M2SD for inorganic analytes and radionuclides. Three ratios were used to identify elevated results for each sample result with a detection. The ratios calculated were:

1. Sample result to Tier I ALF;
2. Sample result to Tier II ALF ; and,
3. Sample result to Background M2SD for inorganics.

Background values presented in the Background Geochemical Characterization Report (DOE, 1993b) were used; with the exception of americium-241, plutonium-239/240, and the uranium isotopes 233/234, 235, and 238. Background values for these radionuclides were taken from the draft Background Comparison for Radionuclides in Groundwater report (DOE, 1997a).

Results for organic compounds above Tier I or Tier II ALFs were compared to well-specific historic M2SD calculated for the five year period 1991-1995. No values have been calculated for wells installed in 1996 or 1997 in order to maintain comparability of M2SDs and trend charts for a given compound. The M2SD calculations were performed for last year's RFCA annual groundwater monitoring report (RMRS 1997a), and have not been modified for this report.

Table 2-1 Summary of Analytical Results from RFCA Groundwater Wells in 1997

Wells	Metals				Radionuclides												VOCs				Water Quality Parameters							
					Pu/Am				Tritium				Uranium								Sulfate				Nitrate/Nitrite			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
00397																												
41591							X				X				X				X				X				X	
00197																												
00297																												
00491	X	X		X	X	X		X					X	X		X	X	X		X					X	X		X
00597				X								X				X				X				X				X
00797																												
00897																			X									
00997																			X									
02197																												
02291																												
02297																												
02397																												
02497																												
0386			X				X				X				X				X				X				X	
03991	X	X		X	X	X		X					X	X		X	X	X		X					X	X		X
04091	X		X				X						X		X		X		X						X		X	
04591	X		X		X		X						X		X		X		X						X		X	
0487	X		X										X		X		X		X				X		X		X	
04991	X		X														X		X						X		X	
05091	X		X		X		X						X		X		X		X						X		X	
05391	X		X		X		X						X		X		X		X						X		X	
05691	X		X		X		X						X		X		X		X						X		X	
06091	X		X		X		X						X		X		X		X						X		X	
06491			X				X				X				X				X				X				X	
07391	X		X		X		X						X		X		X		X						X		X	
08091																												
10194			X				X								X				X								X	
10294	X		X		X		X		X		X		X		X		X		X				X		X		X	
10394		X		X		X		X		X		X		X		X		X		X		X		X		X		X
10592	X	X		X									X			X	X	X		X				X	X	X		X
10692			X												X				X				X				X	
10792		X		X														X		X						X		X
10992		X		X										X		X		X		X		X		X		X		X
10994		X		X										X		X		X		X		X		X		X		X
11092		X		X														X		X						X		X
11891	X		X		X		X						X		X		X		X						X		X	
12191	X		X		X		X						X		X		X		X						X		X	
12691	X		X		X		X						X		X		X		X						X		X	
1386			X	X				X			X	X			X	X			X	X				X			X	X
1786				X				X				X				X				X				X				X
1986	X		X														X		X									
2186	X	X		X													X	X		X								
22596	X	X		X													X	X		X								
22696	X	X															X	X										
22796	X		X	X													X		X	X								
22896	X		X														X		X									
22996		X				X								X				X										
23096			X				X								X				X								X	

Table 2-1 Summary of Analytical Results from RFCA Groundwater Wells in 1997

Wells	Metals				Radionuclides												VOCs				Water Quality Parameters							
					Pu/Am				Tritium				Uranium								Sulfate				Nitrate/Nitrite			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
23196																												
23296	X		X		X		X						X		X		X		X						X		X	
2987	X	X		X	X	X		X					X	X		X	X	X		X					X	X		X
3087			X				X								X				X								X	
3386										X																		
3586	X		X		X		X		X		X		X		X		X		X				X		X		X	
3687	X		X		X		X						X		X		X		X						X		X	
38591			X																X								X	
4087			X								X								X								X	
41691				X				X				X				X				X				X				X
43392		X																X										
4787																												
4887				X												X				X				X				X
52894				X						X		X				X				X				X		X		X
52994																												
5387			X																X								X	
5587		X												X				X								X		
5887	X		X						X		X		X		X		X		X				X		X		X	
6186			X																X									
6286			X				X								X				X								X	
6386			X												X				X								X	
6486			X												X				X				X				X	
6586		X		X		X		X						X		X		X		X						X		X
6687		X								X				X				X				X				X		
70193			X								X				X				X				X				X	
70393	X		X						X		X		X		X		X		X				X		X		X	
70493			X								X				X				X				X				X	
7086			X												X				X				X				X	
75992			X	X			X	X							X	X			X	X							X	X
76992		X		X						X		X		X				X		X		X		X		X		X
77392																												
B206989	X		X						X		X						X		X								X	
B208289																												
B208789		X		X		X		X		X		X		X		X		X		X		X		X		X		X
P114389	X	X		X													X	X		X								
P209289																												
P209389	X			X	X			X	X			X	X			X	X			X				X	X			X
P209489	X		X	X	X		X	X	X		X	X	X		X	X	X		X	X			X	X	X		X	X
P218389		X				X				X				X				X				X				X		
P219189	X		X						X	X							X		X						X	X		
P219489	X		X						X	X							X		X						X	X	X	
P313589	X	X		X													X	X		X								
P314289	X		X														X		X									
P416689	X	X		X													X	X		X								
P416789		X		X														X		X								
P416889	X		X														X		X									

2.2 Groundwater Data Quality Assessment

The quality of the analytical data was evaluated in terms of five data-quality parameters: precision, accuracy, representativeness, completeness, and comparability (PARCC) (EPA, 1992). This section summarizes the types of data available to assess the PARCC parameters, presents the results of data-quality evaluations for each analyte type, and evaluates the overall quality of the groundwater monitoring data for the calendar year 1997.

QC samples for all groundwater sampling of RFCA wells were included in the assessment. Field duplicate and equipment rinsate sample data used to assess precision and representativeness were obtained from the SWD analytical data tables.

Precision: Precision is a measure of the reproducibility of analytical results. Precision is expressed quantitatively by the relative percent difference (RPD) between duplicate field samples as defined by the following equation:

$$RPD = \frac{|(S-D)|}{(S+D)/2} \times 100$$

where:
S = first sample
D = duplicate sample

For organic compounds, RPD was not calculated for duplicate samples for which the analytical result for either member was qualified with "U", "B", or "J" by the laboratory. The "B" and "J"-flagged data were included in RPD calculations for the inorganic analytes. The data flag "U" indicates that the analyte was not present above the detection limit. The data flag "B" for organics indicates that the value is larger than the instrument detection limit, but less than the method detection limit. Results in this category have inherently poor reproducibility and are described qualitatively. Individual RPDs can be found in Appendix A, Table A-1. The QC criterion for RPDs is 20%. (EG&G, 1991b).

Accuracy: Accuracy is a measure of how closely an analytical result corresponds to the "true" concentration in a sample. Accuracy is expressed quantitatively by the percent recovery (%R) obtained from spiked samples as derived by the following equation:

$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

where:
SSR = spiked sample result
SR = sample result
SA = spike added

Percent recoveries for individual spiked samples are reported in the data set and are shown in Appendix A, Table A-2. The QC criterion for % R is adopted from EPA (1988a and 1988b) and is 75% to 125% for all analytes.

Representativeness: The discussion of representativeness in this section is limited to an evaluation of whether analytical results for field samples are truly representative of environmental concentrations or whether they may have been influenced by the introduction of contamination during collection and handling. Other aspects of representativeness such as numbers of samples and spatial distribution are addressed in the IMP for groundwater monitoring.

Possible introduction of contamination is evaluated by examination of the analytical results for equipment rinsates (Appendix A, Table A-3). Equipment rinsates are used to assess the effectiveness of the decontamination process and the possibility of cross-contamination between environmental samples. Rinsate samples consist of volatile free American Society of Testing and Materials (ASTM) Type II water that has been poured over or through decontaminated sampling equipment and subsequently handled in the same manner as environmental samples.

Although rinsates are used specifically as indicators of cross-contamination during decontamination of equipment, they are carried through the entire sampling, shipping, and laboratory process and are, consequently, also good indicators of possible introduced contamination during any of these steps.

Completeness: As of this report, data were not yet validated by a third party, or were not received. Thus, a determination of completeness based on validated samples cannot be performed. However, all samples specified in the groundwater IMP (K-H, 1997) were collected unless well disposition was prohibitive (i.e., dry or went dry during sampling). All groundwater analytical results for 1997 were retrieved from SWD. Additional 1997 analytical results are not expected. Table 2-1 presents a summary of sample collection by quarter for 1997. Completeness will not be addressed with respect to individual analyte groups.

Comparability: Analytical methods and sampling techniques remained consistent for each analyte group over the sampling period. Laboratory analyses were performed according to standard CLP protocols and results should be comparable to data produced by similar methods. Therefore, it is unnecessary to discuss comparability in terms of individual analyte groups

2.2.1 Metals

2.2.1.1 Precision

There were 168 records for duplicates in the data set for dissolved metals in 1997 (frequency = 1 in 20). There were 18 instances of detections in both samples of a REAL-DUP pair for which an RPD could be calculated. These included Ba, Li, Mg, Mn, K, Si, Na, Ca, and Sr. No RPD values were above the 20% QC criterion, indicating that the laboratory precision for metals was very good (Appendix A, Table A-1).

2.2.1.2 Accuracy

There were 319 spike recovery records for dissolved metals (1 in 10). Recovery for 18 records was reported as 0% (Ca, Na, K, Mg, Si). This is believed to be an artifact of laboratory reporting. Of the remaining 301 records, three results of 70 percent (Se, Pb, Fe) fell below the lower QC criterion (75%). One result (K) at a reported value of 135% was above the upper QC criterion (125%). Approximately 93% of results were within the QC criteria indicating an acceptable overall laboratory accuracy for 1997 metals data. A listing of the rinsate results is presented in Table A-2 in Appendix A.

2.2.1.3 Representativeness

There were 114 equipment rinsate records for metals in 1997 (1 in 29). All were "U" or "B" qualified. All equipment rinsate results were below detection limits for metals indicating that cross-contamination of groundwater samples from sampling equipment was not a significant concern for 1997.

2.2.2 Radionuclides

2.2.2.1 Precision

The data set for dissolved radionuclides contains 30 records for duplicate samples in 1997 (1 in 16). All contained detectable concentrations and could be matched with detectable REAL/DUP pairs for which an RPD could be calculated. Thirteen of the pairs (43%) had RPD greater than 20%. Three pairs (9%) had RPDs above 100% and one (1%) had an RPD greater than 200% (Appendix A, Table A-1). Due to the inherently poor reproducibility of results for radionuclides at the low concentrations typically found in RFETS groundwater, 20% is believed to be an unattainable QC criterion for radionuclides. RPDs of 100% or greater are not uncommon for data of this type, even

under ideal field and laboratory conditions (DOE, 1993a). Exceedance of the 20% RPD criterion occurred for all analytes.

2.2.2.2 Accuracy

There were 49 laboratory control sample results (1 in 10) for radionuclides in 1997. All were within the 75-125% QC criterion indicating good laboratory accuracy for radionuclide analyses in 1997 (Appendix A, Table A-2).

2.2.2.3 Representativeness

There were 31 equipment rinsate records (1 in 15) for radionuclides of which 29 (94%) were "J" (estimated) or "U" qualified indicating they were below detection limits. The analyte U-238 was detected a 0.158 pCi/L at RFCA location 5887 during the first quarter. Pu-239/240 was detected at 0.0074 pCi/L at RFCA location P209489 during the third quarter sampling. (Appendix A, Table A-3).

2.2.3 Volatile Organic Compounds

2.2.3.1 Precision

There were 349 duplicate records for organic compounds in 1997 groundwater samples (1 in 25), with over 92% reported as non-detects. Of the 25 pairs having detects for both the REAL and DUP sample, 13 were identical (RPD = 0%). RPDs for five pairs were above the QC criterion of 20% (Appendix A, Table A-1). Four of the five pair that were above the QC criterion had at least one result that was either "J" qualified or at the detection limit (1 μg/L). One sample contained methylene chloride, a typical lab contaminant, found at just above the detection limit. Values near the detection limit have inherently poor precision (DOE, 1993a). As such the result may not be a representative comparison of identical sample aliquots. Based on the fraction of pairs with true detections above the QC criterion, precision is good for organic compounds.

2.2.3.2 Accuracy

There were 40 matrix spike and 104 matrix spike duplicate sample results for volatile organics in 1997 (1 in 23). Matrix spike duplicate samples had percent recovery values between 81% and 132% (QC criterion is 75%-125%). TCE (126%) and hexachlorobutadine (132%) were the only two matrix spike duplicates outside of the QC criterion.

Of the matrix spike sample results, 17 fell below the 75% minimum QC criterion and 4 were above the 125% maximum QC criterion. Overall, 95% of the matrix spike samples are within the QC criterion. These results demonstrate an acceptable overall accuracy for these compounds (Appendix A, Table A-2).

2.2.3.3 Representativeness

There were 333 rinsate records (1 in 10) for volatile organic compounds in 1997 (Appendix A, Table A-3). Three hundred and thirty-one of these (>99%) were "U" qualified non-detects. An additional record was "J" qualified (<1µg/L). The two detections were for the common laboratory contaminants chloromethane (1.2µg/L) and methylene chloride (1.9 µg/L). Thus, there is no evidence of organic contamination introduced during sampling activities for 1997.

2.2.4 Water Quality Parameters

2.2.4.1 Precision

There were 18 duplicate sample records (1 in 14) for water quality parameters in 1997. All REAL/DUP pairs had detections for both samples and RPDs were calculated for each pair. All RPD values were less than the QC criteria of 20% (Appendix A, Table A-1). Based on the percentage of RPDs falling within the QC criterion, precision for water quality parameters is good.

2.2.4.2 Accuracy

There were 10 matrix spike sample results (1 in 25) for water quality parameters in 1997. Analytes spiked included nitrate/nitrite, sulfate, chloride, and fluoride (Appendix A, Table A-2). All percent recovery results were within the QC criteria indicating good laboratory accuracy for water quality parameters.

2.2.4.3 Representativeness

There were 19 rinsate records (1 in 18) for water quality parameters. Of these, 16 (84%) were "U" or "B" qualified (Appendix A, Table A-3). The three detections were from a sample collected in July 1997 at monitoring well 5887, and consisted of TDS (10 mg/L), sulfate (1< mg/L) and fluoride (0.1 mg/L). Because concentrations are low, and because detections in the rinsate samples occurred one time at one well, with no rinsate detections for VOCs, rads, or metals, the minor contamination introduced during sample collection is considered a single anomalous event.

2.3 Data Summary for RFCA-Designated Wells Sampled in 1997

Thirty of the 94 RFCA-designated wells yielded no results above Tier II action levels. Those wells are shown in Table 2-2. A listing of all analytical results from RFCA-designated wells is provided in Appendix B.

Sixty-four RFCA-designated monitoring wells had concentrations of one or more analytes above Tier II action levels. All reported results greater than the Tier II action levels are presented in Table 2-3 and are summarized in the following discussion. Also provided on Plates 4 through 7 are box plots that display the results of all analytes (i.e., metals radionuclides, VOCs, and water quality parameters) at monitoring wells that had at least one analyte above Tier II action levels.

Historical trends for performance monitoring and D&D wells with analyte concentrations above Tier I or II action levels are shown in Figures 2-1 through 2-90 at the end of this section. Historical trends are also shown for all wells with concentrations of organic compounds above Tier II action levels, and for wells with any analyte above Tier II action levels **and** background M2SD. Background values for inorganics are adopted from the 1993 Background Geochemical Characterization Report (DOE, 1993b) and from the draft Background Comparison for Radionuclides in Groundwater (DOE, 1997). Values above action levels have been previously reported in the 1997 RFCA Quarterly Groundwater Monitoring Reports (RMRS, 1997b, 1997c, 1998a, 1998b). In the following sections is a compilation of the data and information first provided in the quarterly reports.

In the sections that follow, values above Tier I and Tier II action levels are summarized, and those qualifying as reportable are discussed. The decision rules described in Section 1.4 define the conditions under which values above action levels become "Reportable".

2.3.1 Values Above Tier I Action Levels

There were eleven values Tier I at five performance monitoring wells and one plume definition well during 1997 (Table 2-3). The elevated values are described below.

Performance Monitoring Wells: Monitoring well 07391, with four values above Tier I action levels, continued during 1997 to have elevated concentrations of PCE (Figure 2-33) and TCE (Figure 2-44). Because the concentrations remained below historic M2SD levels and are not increasing, the values are not considered reportable.

Table 2-2 RFCA-Designated Wells with No Analytes Above Tier II Action Levels

Well Number	IMP Well Class
00197*	PLUME EXTENT
00297*	PLUME DEFINITION
00397*	PLUME EXTENT
00797*	PERF MONITORING
00897	PERF MONITORING
00997	DRAINAGE
02197*	PLUME EXTENT
02291•	PERF MONITORING
02297*	D&D
02397	D&D
02497	D&D
04991	PLUME EXTENT
08091	PLUME EXTENT
2186	PLUME EXTENT
23196*	PLUME EXTENT
3087	PLUME DEFINITION
3386	PLUME EXTENT
38591	DRAINAGE
4087	RCRA
43392	PLUME EXTENT
4787*	PLUME EXTENT
52994*	RCRA
5387	PLUME EXTENT
6186	PLUME EXTENT
70193	RCRA
70493	RCRA
77392	PLUME DEFINITION
B208289	PLUME EXTENT
P209289*	PLUME DEFINITION
P416789	PLUME DEFINITION

• Indicates well was dry throughout 1997

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
BOUNDARY	0386	20-Aug-97	U-233/234	8.7	pCi/l	B	1.07	8.13	60.70	0.14					
	0386	20-Aug-97	U-238	6.17	pCi/l	B	0.768	8.03	41.80	0.15					
	06491	27-Aug-97	U-233/234	26.8	pCi/l	B	1.07	25.05	60.70	0.44					
	06491	27-Aug-97	U-238	16.6	pCi/l	B	0.768	21.61	41.80	0.40					
	10294	29-Jan-97	Sulfate	525	mg/L		500	1.05	435.60	1.21	YES	1183.02	0.44		YES
	10294	19-Aug-97	Sulfate	670	mg/L		500	1.34	435.60	1.54	YES	1183.02	0.57		YES
	10294	19-Aug-97	U-233/234	26.6	pCi/l	B	1.07	24.86	60.70	0.44					
	10294	29-Jan-97	U-234	26.11	pCi/l		1.07	24.40	60.70	0.43					
	10294	29-Jan-97	U-235	1.034	pCi/l		1.01	1.02	1.79	0.58					
	10294	29-Jan-97	U-238	23.1	pCi/l		0.768	30.08	41.80	0.55					
	10294	19-Aug-97	U-238	21.1	pCi/l	B	0.768	27.47	41.80	0.50					
	10394	25-Nov-97	Tritium	1130	pCi/l		666	1.70	612.98	1.84	YES	338.62	3.34	YES	YES
	10394	25-Nov-97	U-233/234	1.66	pCi/l	B	1.07	1.55	60.70	0.03					
	10394	09-Jun-97	U-234	2.2	pCi/l		1.07	2.06	60.70	0.04					
	10394	09-Jun-97	U-238	1.42	pCi/l		0.768	1.85	41.80	0.03					
	10394	25-Nov-97	U-238	1.62	pCi/l		0.768	2.11	41.80	0.04					
	41591	29-Jul-97	U-233/234	7.86	pCi/l		1.07	7.35	60.70	0.13					
	41591	29-Jul-97	U-238	6.47	pCi/l		0.768	8.42	41.80	0.15					
	41691	14-Oct-97	U-233/234	1.59	pCi/l		1.07	1.49	60.70	0.03					
	41691	14-Oct-97	U-238	1.41	pCi/l		0.768	1.84	41.80	0.03					
D&D	22996	04-Jun-97	U-234	2.61	pCi/l	B	1.07	2.44	60.70	0.04					
	22996	04-Jun-97	U-238	1.92	pCi/l	B	0.768	2.50	41.80	0.05					
DRAINAGE	5587	10-Jun-97	U-234	7.55	pCi/l		1.07	7.06	60.70	0.12					
	5587	10-Jun-97	U-238	6.22	pCi/l		0.768	8.10	41.80	0.15					
	6486	26-Aug-97	U-233/234	5.88	pCi/l	B	1.07	5.50	60.70	0.10					
	6486	26-Aug-97	U-238	4.06	pCi/l	B	0.768	5.29	41.80	0.10					
	6586	26-Jun-97	Nickel	113	µg/L		100	1.13	21.37	5.29	YES	78.78	1.43	YES	YES
	6586	16-Dec-97	Nickel	367	µg/L		100	3.67	21.37	17.17	YES	78.78	4.66	YES	YES
	6586	26-Jun-97	U-233/234	2.41	pCi/l		1.07	2.25	60.70	0.04					
	6586	16-Dec-97	U-233/234	3.49	pCi/l		1.07	3.26	60.70	0.06					
	6586	26-Jun-97	U-238	2.13	pCi/l	B	0.768	2.77	41.80	0.05					
	6586	16-Dec-97	U-238	3.16	pCi/l	B	0.768	4.11	41.80	0.08					
PERFORMANCE MONITORING	00897	30-Sep-97	Tetrachloroethene	8300	µg/L		5	1660.00							
	00897	30-Sep-97	Trichloroethene	890	µg/L		5	178.00							
	05691	17-Jan-97	Carbon Tetrachloride	92	µg/L		5	18.40				561.21	0.16		
	05691	23-Jul-97	Carbon Tetrachloride	110	µg/L		5	22.00				561.21	0.20		
	05691	23-Jul-97	Methylene Chloride	5.2	µg/L		5	1.04				0.56	9.29	YES	YES
	05691	17-Jan-97	Tetrachloroethene	23	µg/L		5	4.60				149.64	0.15		
	05691	23-Jul-97	Tetrachloroethene	20	µg/L		5	4.00				149.64	0.13		
	05691	23-Jul-97	Thallium	5.6	µg/L	B	2	2.80	4.90	1.14	YES				
	05691	17-Jan-97	Trichloroethene	13	µg/L		5	2.60				95.59	0.14		
	05691	23-Jul-97	Trichloroethene	14	µg/L		5	2.80				95.59	0.15		
	05691	23-Jul-97	U-233/234	2.37	pCi/l		1.07	2.21	60.70	0.04					
	05691	17-Jan-97	U-234	3.55	pCi/l		1.07	3.32	60.70	0.06					
	05691	17-Jan-97	U-238	2.897	pCi/l		0.768	3.77	41.80	0.07					
	05691	23-Jul-97	U-238	1.68	pCi/l		0.768	2.19	41.80	0.04					
	07391	08-Sep-97	1,1,1-Trichloroethane	270	µg/L		200	1.35				2724.6	0.10		
	07391	08-Sep-97	1,1,2-Trichloroethane	25	µg/L		5	5.00				1519	0.02		

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
PERFORMANCE MONITORING	07391	08-Sep-97	1,1-Dichloroethene	200	µg/L		7	28.57				1450	0.14		
	07391	11-Feb-97	Chloroform	1400	µg/L	J	100	14.00				4439.22	0.32		
	07391	08-Sep-97	Chloroform	1600	µg/L		100	16.00				4439.22	0.36		
	07391	08-Sep-97	Cis-1,2-Dichloroethene	130	µg/L		70	1.86				1303	0.10		
	07391	11-Feb-97	Nitrate/Nitrite	20	mg/L		10	2.00	4.66	4.29	YES	33.62	0.59		
	07391	08-Sep-97	Nitrate/Nitrite	19	mg/L		10	1.90	4.66	4.07	YES	33.62	0.57		
	07391	11-Feb-97	Tetrachloroethene	1500	µg/L	J	5	300.0				3030.17	0.50		
	07391	08-Sep-97	Tetrachloroethene	1200	µg/L		5	240.0				3030.17	0.40		
	07391	11-Feb-97	Thallium	6	µg/L	B	2	3.00	4.90	1.22	YES	19.88	0.30		
	07391	11-Feb-97	Trichloroethene	96000	µg/L		5	19200				158351	0.61		
	07391	08-Sep-97	Trichloroethene	93000	µg/L		5	18600				158351	0.59		
	07391	08-Sep-97	U-233/234	18.4	pCi/l	B	1.07	17.20	60.70	0.30					
	07391	11-Feb-97	U-234	19.36	pCi/l		1.07	18.09	60.70	0.32					
	07391	11-Feb-97	U-238	39.73	pCi/l		0.768	51.73	41.80	0.95					
	07391	08-Sep-97	U-238	39.5	pCi/l	B	0.768	51.43	41.80	0.94					
	10592	8-Nov-97	Selenium	182	µg/L		50	3.64	43.72	4.16	YES	343.94	0.53		
	10592	18-Nov-97	U-233/234	11.8	pCi/l	B	1.07	11.03	60.70	0.19		18.52	0.64		
	10592	12-Feb-97	U-234	14.77	pCi/l		1.07	13.80	60.70	0.24					
	10592	12-Feb-97	U-238	9.83	pCi/l		0.768	12.80	41.80	0.24		12.9	0.76		
	10592	18-Nov-97	U-238	7.76	pCi/l	B	0.768	10.10	41.80	0.19		12.9	0.60		
	10692	17-Sep-97	U-233/234	14.5	pCi/l	B	1.07	13.55	60.70	0.24					
	10692	17-Sep-97	U-238	9.22	pCi/l	B	0.768	12.01	41.80	0.22					
	10792	20-Nov-97	Selenium	51.1	mg/L		50	1.02	43.72	1.17	YES				
	10992	28-May-97	Nitrate/Nitrite	23.2	mg/L		10	2.32	4.66	4.97	YES	37.16	0.62		
	10992	9-Dec-97	Nitrate/Nitrite	23	mg/L		10	2.30	4.66	4.93	YES	37.16	0.62		
	10992	28-May-97	Selenium	545	µg/L		50	10.90	43.72	12.47	YES				YES
	10992	9-Dec-97	Selenium	485	µg/L		50	9.70	43.72	11.09	YES				YES
	10992	9-Dec-97	U-233/234	6.69	pCi/l		1.07	6.25	60.70	0.11					
	10992	28-May-97	U-234	6.69	pCi/l	B	1.07	6.25	60.70	0.11					
	10992	28-May-97	U-238	4.95	pCi/l	B	0.768	6.45	41.80	0.12					
	10992	9-Dec-97	U-238	4.99	pCi/l		0.768	6.50	41.80	0.12					
	11092	20-Nov-97	Selenium	306	µg/L		50	6.12	43.72	7.00	YES				YES
	11891	22-Jan-97	Carbon Tetrachloride	340	µg/L		5	68.00				737.11	0.46		
	11891	12-Sep-97	Carbon Tetrachloride	370	µg/L		5	74.00				737.11	0.50		
	11891	22-Jan-97	Methylene Chloride	7	µg/L	J	5	1.40				5.29	1.32	YES	
	11891	22-Jan-97	Tetrachloroethene	240	µg/L		5	48.00				319.91	0.75		
	11891	12-Sep-97	Tetrachloroethene	200	µg/L		5	40.00				319.91	0.63		
	11891	22-Jan-97	Trichloroethene	46	µg/L		5	9.20				407.56	0.11		
	11891	12-Sep-97	Trichloroethene	40	µg/L		5	8.00				407.56	0.10		
	11891	12-Sep-97	U-233/234	2.2	pCi/l	B	1.07	2.06	60.70	0.04					
	11891	22-Jan-97	U-234	3.712	pCi/l		1.07	3.47	60.70	0.06					
	11891	22-Jan-97	U-238	2.103	pCi/l		0.768	2.74	41.80	0.05					
	11891	12-Sep-97	U-238	1.52	pCi/l	B	0.768	1.98	41.80	0.04					
	12191	17-Jan-97	Carbon Tetrachloride	140	µg/L		5	28.00				435.97	0.32		
	12191	11-Sep-97	Carbon Tetrachloride	280	µg/L		5	56.00				435.97	0.64		
	12191	17-Jan-97	Tetrachloroethene	200	µg/L		5	40.00				486.46	0.41		
	12191	11-Sep-97	Tetrachloroethene	310	µg/L		5	62.00				486.46	0.64		
	12191	17-Jan-97	Trichloroethene	26	µg/L		5	5.20				67.86	0.38		
	12191	11-Sep-97	Trichloroethene	38	µg/L		5	7.60				67.86	0.56		
	12191	11-Sep-97	U-233/234	1.62	pCi/l	B	1.07	1.51	60.70	0.03					
	12191	17-Jan-97	U-234	2.296	pCi/l		1.07	2.15	60.70	0.04					

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
PERFORMANCE MONITORING	12191	17-Jan-97	U-238	1.758	pCi/l		0.768	2.29	41.80	0.04					
	12191	11-Sep-97	U-238	1.11	pCi/l	B	0.768	1.45	41.80	0.03					
	12691	30-Jan-97	Carbon Tetrachloride	470	µg/L		5	94.00				2968.95	0.16		
	12691	23-Sep-97	Carbon Tetrachloride	530	µg/L		5	106.0				2968.95	0.18		
	12691	23-Sep-97	Cis-1,2-Dichloroethene	71	µg/L		70	1.01				131	0.54		
	12691	30-Jan-97	Nitrate/Nitrite	10.3	mg/L		10	1.03	4.66	2.21	YES	8.75	1.18	YES	YES
	12691	30-Jan-97	Tetrachloroethene	98	µg/L		5	19.60				646.52	0.15		
	12691	23-Sep-97	Tetrachloroethene	150	µg/L		5	30.00				646.52	0.23		
	12691	30-Jan-97	Trichloroethene	62	µg/L		5	12.40				362.45	0.17		
	12691	23-Sep-97	Trichloroethene	62	µg/L		5	12.40				362.45	0.17		
	12691	23-Sep-97	U-233/234	2.28	pCi/l		1.07	2.13	60.70	0.04					
	12691	30-Jan-97	U-234	2.836	pCi/l		1.07	2.65	60.70	0.05					
	12691	30-Jan-97	U-238	2.097	pCi/l		0.768	2.73	41.80	0.05					
	12691	23-Sep-97	U-238	1.76	pCi/l	B	0.768	2.29	41.80	0.04					
	3687	24-Jul-97	1,1-Dichloroethene	18	µg/L		7	2.57				187	0.10		
	3687	27-Jan-97	Carbon Tetrachloride	330	µg/L	J	5	66.00				1255.4	0.26		
	3687	24-Jul-97	Carbon Tetrachloride	350	µg/L	J*	5	70.00				1255.4	0.28		
	3687	27-Jan-97	Chloroform	200	µg/L	J	100	2.00				1213.32	0.16		
	3687	27-Jan-97	Tetrachloroethene	240	µg/L	J	5	48.00				814.46	0.29		
	3687	24-Jul-97	Tetrachloroethene	270	µg/L	E	5	54.00				814.46	0.33		
	3687	24-Jul-97	Thallium	4.2	µg/L	B	2	2.10	4.90	0.86					
	3687	27-Jan-97	Trichloroethene	19000	µg/L		5	3800				91325	0.21		
	3687	24-Jul-97	Trichloroethene	6500	µg/L		5	1300				91325	0.07		
	3687	24-Jul-97	U-233/234	1.71	pCi/l		1.07	1.60	60.70	0.03					
	3687	27-Jan-97	U-234	2.506	pCi/l		1.07	2.34	60.70	0.04					
	3687	27-Jan-97	U-238	1.206	pCi/l		0.768	1.57	41.80	0.03					
	3687	24-Jul-97	U-238	1.15	pCi/l		0.768	1.50	41.80	0.03					
PLUME DEFINITION	00491	11-Feb-97	Carbon Tetrachloride	99	µg/L		5	19.80				545.16	0.18		
	00491	20-May-97	Carbon Tetrachloride	120	µg/L		5	24.00				545.16	0.22		
	00491	24-Nov-97	Carbon Tetrachloride	120	µg/L		5	24.00				545.16	0.22		
	00491	24-Nov-97	Methylene Chloride	150	µg/L		5	30.00							
	00491	11-Feb-97	Tetrachloroethene	21	µg/L		5	4.20				54.23	0.39		
	00491	20-May-97	Tetrachloroethene	18	µg/L		5	3.60				54.23	0.33		
	00491	24-Nov-97	Tetrachloroethene	17	µg/L		5	3.40				54.23	0.31		
	00491	11-Feb-97	Thallium	9.4	µg/L	B	2	4.70	4.90	1.92	YES	3	3.13	YES	YES
	00491	11-Feb-97	Trichloroethene	55	µg/L		5	11.00				153.2	0.36		
	00491	20-May-97	Trichloroethene	45	µg/L		5	9.00				153.2	0.29		
	00491	24-Nov-97	Trichloroethene	41	µg/L		5	8.20				153.2	0.27		
	00491	24-Nov-97	U-233/234	4.27	pCi/l		1.07	3.99	60.70	0.07					
	00491	11-Feb-97	U-234	5.674	pCi/l		1.07	5.30	60.70	0.09					
	00491	20-May-97	U-234	5.15	pCi/l		1.07	4.81	60.70	0.08					
	00491	11-Feb-97	U-238	4.717	pCi/l		0.768	6.14	41.80	0.11					
	00491	20-May-97	U-238	3.96	pCi/l		0.768	5.16	41.80	0.09					
	00491	24-Nov-97	U-238	3.23	pCi/l		0.768	4.21	41.80	0.08					
	00597	15-Dec-97	1,1-Dichloroethene	7	µg/L		7	1.00							
	00597	15-Dec-97	Trichloroethene	5	µg/L		5	1.00							
	0487	23-Jan-97	Antimony	26.5	µg/L	B	6	4.42	39.54	0.67					
	0487	23-Jan-97	Selenium	118	µg/L		50	2.36	43.72	2.70	YES	699.76	0.17		
	0487	13-Aug-97	Selenium	107	µg/L		50	2.14	43.72	2.45	YES	699.76	0.15		
	0487	23-Jan-97	Trichloroethene	130	µg/L		5	26.00				5685.6	0.02		
	0487	13-Aug-97	Trichloroethene	86	µg/L		5	17.20				5685.6	0.02		

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
PLUME DEFINITION	0487	13-Aug-97	U-233/234	12.5	pCi/l	B	1.07	11.68	60.70	0.21					
	0487	23-Jan-97	U-234	17.14	pCi/l		1.07	16.02	60.70	0.28					
	0487	23-Jan-97	U-238	11.04	pCi/l		0.768	14.38	41.80	0.26					
	0487	13-Aug-97	U-238	9.76	pCi/l	B	0.768	12.71	41.80	0.23					
	05391	21-Jan-97	Carbon Tetrachloride	16	µg/L		5	3.20				32.88	0.49		
	05391	10-Sep-97	Carbon Tetrachloride	14	µg/L		5	2.80				32.88	0.43		
	05391	10-Sep-97	U-233/234	1.85	pCi/l	B	1.07	1.73	60.70	0.03					
	05391	21-Jan-97	U-234	2.982	pCi/l		1.07	2.79	60.70	0.05					
	05391	21-Jan-97	U-238	1.256	pCi/l		0.768	1.64	41.80	0.03					
	05391	10-Sep-97	U-238	1.36	pCi/l	B	0.768	1.77	41.80	0.03					
	22896	11-Feb-97	Thallium	7.3	µg/L	B	2	3.65	4.90	1.49	YES				YES
	22896	18-Mar-97	Thallium	4.9	µg/L	B	2	2.45	4.90	1.00	YES				YES
	22896	18-Aug-97	Trichloroethene	3100	µg/L		5	620.0							YES
	22896	16-Jan-97	Trichloroethene	3500	µg/L		5	700.0							YES
	22896	11-Feb-97	Trichloroethene	4200	µg/L		5	840.0							YES
	22896	18-Mar-97	Trichloroethene	3100	µg/L		5	620.0							YES
	2987	22-Jan-97	Nickel	536	µg/L		100	5.36	21.37	25.08	YES	1741.6	0.31		
	2987	23-May-97	Nickel	1080	µg/L		100	10.80	21.37	50.54	YES	1741.6	0.62		
	2987	1-Dec-97	Nickel	2150	µg/L		100	21.50	21.37	100.61	YES	1741.6	1.23	YES	YES
	2987	22-Jan-97	Selenium	343	µg/L		50	6.86	43.72	7.85	YES	406.45	0.84		
	2987	23-May-97	Selenium	211	µg/L		50	4.22	43.72	4.83	YES	406.45	0.52		
	2987	1-Dec-97	Selenium	306	µg/L		50	6.12	43.72	7.00	YES	406.45	0.75		
	2987	1-Dec-97	U-233/234	9.88	pCi/l	B	1.07	9.23	60.70	0.16					
	2987	22-Jan-97	U-234	11.9	pCi/l		1.07	11.12	60.70	0.20					
	2987	23-May-97	U-234	11.1	pCi/l		1.07	10.37	60.70	0.18					
	2987	22-Jan-97	U-238	10.17	pCi/l		0.768	13.24	41.80	0.24					
	2987	23-May-97	U-238	7.92	pCi/l		0.768	10.31	41.80	0.19					
	2987	1-Dec-97	U-238	7.66	pCi/l		0.768	9.97	41.80	0.18					
	6286	26-Aug-97	Carbon Tetrachloride	6.7	µg/L		5	1.34				9.76	0.69		
	6286	26-Aug-97	Selenium	61.8	µg/L		50	1.24	43.72	1.41	YES	65.97	0.94		YES
	6286	26-Aug-97	U-233/234	3.86	pCi/l	B	1.07	3.61	60.70	0.06					
	6286	26-Aug-97	U-238	2.85	pCi/l	B	0.768	3.71	41.80	0.07					
	6386	26-Aug-97	U-233/234	5.64	pCi/l	B	1.07	5.27	60.70	0.09					
	6386	26-Aug-97	U-238	5.18	pCi/l	B	0.768	6.74	41.80	0.12					
	P209389	31-Jan-97	1,1-Dichloroethene	24	µg/L		7	3.43				88.48	0.27		
	P209389	15-Oct-97	U-238	0.910	pCi/l		0.768	1.18	41.80	0.02					
	P209489	31-Jan-97	Carbon Tetrachloride	37	µg/L		5	7.40				83.26	0.44		
	P209489	24-Sep-97	Carbon Tetrachloride	36	µg/L		5	7.20				83.26	0.43		
	P209489	9-Dec-97	Carbon Tetrachloride	52	µg/L	E	5	10.40				83.26	0.62		
	P209489	31-Jan-97	Nitrate/Nitrite	158	mg/L		10	15.80	4.66	33.88	YES	90.4	1.75	YES	
	P209489	9-Dec-97	Nitrate/Nitrite	120	mg/L		10	12.00	4.66	25.73	YES	90.4	1.33	YES	
	P209489	24-Sep-97	Nitrate/Nitrite	160	mg/L		10	16.00	4.66	34.31	YES	90.4	1.77	YES	
	P209489	9-Dec-97	Thallium	3.6	µg/L		2	1.80	4.90	0.73					
	P209489	31-Jan-97	Trichloroethene	51	µg/L		5	10.20				90.4	0.56		
	P209489	24-Sep-97	Trichloroethene	52	µg/L		5	10.40				90.4	0.58		
	P209489	9-Dec-97	Trichloroethene	59	µg/L	E	5	11.80				90.4	0.65		
	P209489	31-Jan-97	Tritium	670	pCi/l		666	1.01	612.98	1.09	YES	1252.51	0.53		
	P209489	24-Sep-97	Tritium	720	pCi/l		666	1.08	612.98	1.17	YES	1252.51	0.57		
	P209489	24-Sep-97	U-233/234	18.8	pCi/l		1.07	17.57	60.70	0.31					
	P209489	9-Dec-97	U-233/234	15.1	pCi/l		1.07	14.11	60.70	0.25					
	P209489	31-Jan-97	U-234	29.96	pCi/l		1.07	28.00	60.70	0.49					

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
PLUME DEF.	P209489	31-Jan-97	U-238	28.48	pCi/l		0.768	37.08	41.80	0.68					
	P209489	24-Sep-97	U-238	15.4	pCi/l	B	0.768	20.05	41.80	0.37					
	P209489	9-Dec-97	U-238	13.4	pCi/l		0.768	17.45	41.80	0.32					
	P219189	04-Feb-97	1,1-Dichloroethene	26	µg/L		7	3.71				46.8	0.56		
PLUME EXTENT	1786	1-Dec-97	Tritium	670	pCi/l		666	1.01	612.98	1.09	YES	1076.5	0.62		YES
	03991	16-Jan-97	Carbon Tetrachloride	10	µg/L		5	2.00				27.22	0.37		YES
	03991	11-Jun-97	Carbon Tetrachloride	9	µg/L		5	1.80				27.22	0.33		YES
	03991	20-Nov-97	Carbon Tetrachloride	6	µg/L		5	1.20				27.22	0.22		YES
	03991	11-Jun-97	Thallium	4.4	µg/L	B	2	2.20	4.90	0.90					
	03991	20-Nov-97	U-233/234	1.58	pCi/l		1.07	1.48	60.70	0.03					
	03991	16-Jan-97	U-234	1.884	pCi/l		1.07	1.76	60.70	0.03					
	03991	11-Jun-97	U-234	1.39	pCi/l		1.07	1.30	60.70	0.02					
	03991	16-Jan-97	U-238	1.324	pCi/l		0.768	1.72	41.80	0.03					
	03991	11-Jun-97	U-238	0.919	pCi/l	J	0.768	1.20	41.80	0.02					
	03991	20-Nov-97	U-238	1.20	pCi/l	B	0.768	1.56	41.80	0.03					
	04091	08-Sep-97	U-233/234	1.9	pCi/l	B	1.07	1.78	60.70	0.03					
	04091	21-Jan-97	U-234	2.173	pCi/l		1.07	2.03	60.70	0.04					
	04091	21-Jan-97	U-238	1.119	pCi/l		0.768	1.46	41.80	0.03					
	04091	08-Sep-97	U-238	1.46	pCi/l	B	0.768	1.90	41.80	0.03					
	04591	10-Feb-97	Thallium	5.1	µg/L	B	2	2.55	4.90	1.04	YES	3.98	1.28	YES	YES
	04591	15-Sep-97	U-233/234	2.83	pCi/l	B	1.07	2.64	60.70	0.05					
	04591	10-Feb-97	U-234	2.91	pCi/l		1.07	2.72	60.70	0.05					
	04591	10-Feb-97	U-238	1.534	pCi/l		0.768	2.00	41.80	0.04					
	04591	15-Sep-97	U-238	1.49	pCi/l	B	0.768	1.94	41.80	0.04					
	05091	20-Aug-97	U-233/234	3.76	pCi/l	B	1.07	3.51	60.70	0.06					
	05091	20-Jan-97	U-234	6.672	pCi/l		1.07	6.24	60.70	0.11					
	05091	20-Jan-97	U-238	3.742	pCi/l		0.768	4.87	41.80	0.09					
	05091	20-Aug-97	U-238	2.03	pCi/l	B	0.768	2.64	41.80	0.05					
	06091	24-Jul-97	Carbon Tetrachloride	6.3	µg/L		5	1.26				4.44	1.42	YES	YES
	06091	16-Jan-97	Thallium	5.7	µg/L	B	2	2.85	4.90	1.16	YES	4.71	1.21	YES	YES
	06091	12-Feb-97	Thallium	8	µg/L	B	2	4.00	4.90	1.63	YES	4.71	1.70	YES	YES
	06091	24-Jul-97	Thallium	5.1	µg/L	B	2	2.55	4.90	1.04	YES	4.71	1.08	YES	YES
	06091	24-Jul-97	U-233/234	2.85	pCi/l		1.07	2.66	60.70	0.05					
	06091	16-Jan-97	U-234	3.143	pCi/l		1.07	2.94	60.70	0.05					
	06091	12-Feb-97	U-234	5.357	pCi/l		1.07	5.01	60.70	0.09					
	06091	17-Mar-97	U-234	3.653	pCi/l		1.07	3.41	60.70	0.06					
	06091	16-Jan-97	U-238	1.881	pCi/l		0.768	2.45	41.80	0.05					
	06091	12-Feb-97	U-238	1.568	pCi/l		0.768	2.04	41.80	0.04					
	06091	17-Mar-97	U-238	2.078	pCi/l		0.768	2.71	41.80	0.05					
	06091	24-Jul-97	U-238	1.79	pCi/l		0.768	2.33	41.80	0.04					
	10194	16-Sep-97	U-233/234	2.07	pCi/l	B	1.07	1.93	60.70	0.03					
	10194	16-Sep-97	U-238	1.39	pCi/l	B	0.768	1.81	41.80	0.03					
	10994	22-Jun-97	Selenium	401	µg/L		50	8.02	43.72	9.17	YES	1097.22	0.37		YES
	10994	16-Dec-97	Selenium	393	µg/L		50	7.86	43.72	8.99	YES	1097.22	0.36		YES
	10994	22-Jun-97	Thallium	3.6	µg/L	B	2	1.80	4.90	0.73		4.87	0.74		YES
	10994	22-Jun-97	U-233/234	6.35	pCi/l		1.07	5.93	60.70	0.10					
	10994	16-Dec-97	U-233/234	7.53	pCi/l		1.07	7.04	60.70	0.12					
	10994	22-Jun-97	U-238	4.24	pCi/l		0.768	5.52	41.80	0.10					
	10994	16-Dec-97	U-238	5.61	pCi/l	B	0.768	7.30	41.80	0.13					
	1386	28-Aug-97	Nickel	176	µg/L		100	1.76	21.37	8.24	YES	308.75	0.57		YES
	1386	10-Dec-97	Nickel	805	µg/L		100	8.05	21.37	37.67	YES	308.75	2.61	YES	YES

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
PLUME EXTENT	1386	28-Aug-97	U-233/234	6.22	pCi/l	B	1.07	5.81	60.70	0.10					
	1386	10-Dec-97	U-233/234	9.57	pCi/l		1.07	8.94	60.70	0.16					
	1386	28-Aug-97	U-238	5.62	pCi/l	B	0.768	7.32	41.80	0.13					
	1386	10-Dec-97	U-238	9.49	pCi/l		0.768	12.36	41.80	0.23					
	1786	1-Dec-97	Nitrate/Nitrite	640	mg/L		10	64.00	4.66	137.22	YES	689.31	0.93		YES
	1786	1-Dec-97	Selenium	224	µg/L		50	4.48	43.72	5.12	YES	245.75	0.91		YES
	1786	1-Dec-97	U-233/234	31.3	pCi/l	B	1.07	29.25	60.70	0.52					
	1786	1-Dec-97	U-235	1.33	pCi/l		1.01	1.32	1.79	0.74					
	1786	1-Dec-97	U-238	22.8	pCi/l		0.768	29.69	41.80	0.55					
	1986	28-Jan-97	Manganese	2400	µg/L		183	13.11	162.33	14.78	YES	3304.5	0.73		YES
	1986	19-Aug-97	Manganese	236	µg/L		183	1.29	162.33	1.45	YES	3304.5	0.07		YES
	22596	16-Jan-97	Manganese	808	µg/L		183	4.42	162.33	4.98	YES	1274.8	0.63		YES
	22596	11-Feb-97	Manganese	1010	µg/L		183	5.52	162.33	6.22	YES	1274.8	0.79		YES
	22596	18-Mar-97	Manganese	197	µg/L		183	1.08	162.33	1.21	YES	1274.8	0.15		YES
	22596	17-Dec-97	Manganese	183	µg/L		183	1.00	162.33	1.13	YES	1274.8	0.14		YES
	22596	11-Feb-97	Thallium	5.3	µg/L	B	2	2.65	4.90	1.08	YES				YES
	22596	18-Mar-97	Thallium	5.6	µg/L	B	2	2.80	4.90	1.14	YES				YES
	22696	04-Feb-97	Manganese	1210	µg/L		183	6.61	162.33	7.45	YES				YES
	22796	16-Jan-97	Manganese	1870	µg/L		183	10.22	162.33	11.52	YES	2376.31	0.79		YES
	22796	11-Feb-97	Manganese	1400	µg/L		183	7.65	162.33	8.62	YES	2376.31	0.59		YES
	22796	18-Mar-97	Manganese	765	µg/L		183	4.18	162.33	4.71	YES	2376.31	0.32		YES
	22796	18-Aug-97	Manganese	582	µg/L		183	3.18	162.33	3.59	YES	2376.31	0.24		YES
	22796	17-Dec-97	Manganese	1080	µg/L		183	5.90	162.33	6.65	YES	2376.31	0.45		YES
	22796	11-Feb-97	Thallium	5.9	µg/L	B	2	2.95	4.90	1.20	YES				YES
	22796	18-Mar-97	Thallium	5.5	µg/L	B	2	2.75	4.90	1.12	YES				YES
	22796	16-Jan-97	Trichloroethene	12	µg/L		5	2.40				41.49	0.29		YES
	22796	11-Feb-97	Trichloroethene	13	µg/L		5	2.60				41.49	0.31		YES
	22796	18-Mar-97	Trichloroethene	13	µg/L		5	2.60				41.49	0.31		YES
	22796	18-Aug-97	Trichloroethene	52	µg/L		5	10.40				41.49	1.25	YES	YES
	22796	17-Dec-97	Trichloroethene	13	µg/L		5	2.60				41.49	0.31		YES
	23096	13-Aug-97	U-233/234	2.4	pCi/l	B	1.07	2.24	60.70	0.04					
	23096	13-Aug-97	U-238	2.48	pCi/l	B	0.768	3.23	41.80	0.06					
	23296	15-Jan-97	Carbon Tetrachloride	6	µg/L	J	5	1.20							YES
	23296	12-Feb-97	Carbon Tetrachloride	10	µg/L		5	2.00							YES
	23296	19-Mar-97	Carbon Tetrachloride	12	µg/L		5	2.40							YES
	23296	15-Jan-97	Tetrachloroethene	11	µg/L		5	2.20							YES
	23296	12-Feb-97	Tetrachloroethene	14	µg/L		5	2.80							YES
	23296	19-Mar-97	Tetrachloroethene	13	µg/L		5	2.60							YES
	23296	30-Jul-97	Tetrachloroethene	6.5	µg/L		5	1.30							YES
	23296	15-Jan-97	Thallium	6.2	µg/L	B	2	3.10	4.90	1.27	YES				YES
	23296	12-Feb-97	Thallium	9.4	µg/L	B	2	4.70	4.90	1.92	YES				YES
	23296	30-Jul-97	Thallium	4.7	µg/L	B	2	2.35	4.90	0.96					YES
	23296	15-Jan-97	Trichloroethene	300	µg/L		5	60.00							YES
	23296	12-Feb-97	Trichloroethene	370	µg/L		5	74.00							YES
	23296	19-Mar-97	Trichloroethene	340	µg/L		5	68.00							YES
	23296	30-Jul-97	Trichloroethene	140	µg/L		5	28.00							YES
	23296	30-Jul-97	U-233/234	15.8	pCi/l		1.07	14.77	60.70	0.26					
	23296	15-Jan-97	U-234	15.17	pCi/l		1.07	14.18	60.70	0.25					
	23296	12-Feb-97	U-234	16.82	pCi/l		1.07	15.72	60.70	0.28					
	23296	19-Mar-97	U-234	17.16	pCi/l		1.07	16.04	60.70	0.28					
	23296	15-Jan-97	U-238	12.37	pCi/l		0.768	16.11	41.80	0.30					

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
PLUME EXTENT	23296	12-Feb-97	U-238	14.01	pCi/l		0.768	18.24	41.80	0.34					
	23296	19-Mar-97	U-238	10.45	pCi/l		0.768	13.61	41.80	0.25					
	23296	30-Jul-97	U-238	12.3	pCi/l		0.768	16.02	41.80	0.29					
	3586	22-Jan-97	Manganese	4590	µg/L		183	25.08	162.33	28.28	YES	4357	1.05	YES	YES
	3586	27-Aug-97	Manganese	4300	µg/L		183	23.50	162.33	26.49	YES	4357	0.99		YES
	3586	27-Aug-97	Methylene Chloride	8.1	µg/L	B	5	1.62				8.6	0.94		YES
	3586	27-Aug-97	U-233/234	2.55	pCi/l	B	1.07	2.38	60.70	0.04					
	3586	22-Jan-97	U-234	2.581	pCi/l		1.07	2.41	60.70	0.04					
	3586	22-Jan-97	U-238	1.808	pCi/l		0.768	2.35	41.80	0.04					
	3586	27-Aug-97	U-238	2.39	pCi/l	B	0.768	3.11	41.80	0.06					
	3586	22-Jan-97	Vinyl Chloride	59	µg/L		2	29.50				776	0.08		YES
	3586	27-Aug-97	Vinyl Chloride	110	µg/L		2	55.00				776	0.14		YES
	4887	9-Dec-97	U-233/234	4.29	pCi/l		1.07	4.01	60.70	0.07					
	4887	9-Dec-97	U-238	3.92	pCi/l		0.768	5.10	41.80	0.09					
	7086	31-Jul-97	Manganese	346	µg/L		183	1.89	162.33	2.13	YES	760.75	0.45		YES
	7086	31-Jul-97	Thallium	3.2	µg/L	B	2	1.60	4.90	0.65		3.77	0.85		YES
	75992	3-Dec-97	Manganese	183	µg/L		183	1.00	162.33	1.13	YES	388.82	0.47		YES
	75992	3-Dec-97	Methylene Chloride	6	µg/L		5	1.20				13.2	0.45		YES
	75992	27-Aug-97	U-233/234	9.75	pCi/l	B	1.07	9.11	60.70	0.16					
	75992	3-Dec-97	U-233/234	8.24	pCi/l	B	1.07	7.70	60.70	0.14					
	75992	27-Aug-97	U-238	8.54	pCi/l	B	0.768	11.12	41.80	0.20					
	75992	3-Dec-97	U-238	6.79	pCi/l		0.768	8.84	41.80	0.16					
	76992	21-Jun-97	U-234	3.05	pCi/l		1.07	2.85	60.70	0.05					
	76992	21-Jun-97	U-238	1.54	pCi/l		0.768	2.01	41.80	0.04					
	B208789	10-Dec-97	Manganese	353	µg/L		183	1.93	162.33	2.17	YES	624.21	0.57		YES
	B208789	10-Dec-97	U-233/234	11	pCi/l		1.07	10.28	60.70	0.18					
	B208789	13-Jun-97	U-234	8.06	pCi/l	B	1.07	7.53	60.70	0.13					
	B208789	13-Jun-97	U-238	6.89	pCi/l	B	0.768	8.97	41.80	0.16					
	B208789	10-Dec-97	U-238	9.56	pCi/l		0.768	12.45	41.80	0.23					
	P114389	23-Jan-97	Antimony	28.7	µg/L	B	6	4.78	39.54	0.73					
	P114389	23-Jan-97	Manganese	914	µg/L		183	4.99	162.33	5.63	YES	662.18	1.38	YES	YES
	P114389	04-Jun-97	Manganese	616	µg/L		183	3.37	162.33	3.79	YES	662.18	0.93		YES
	P114389	21-Nov-97	Manganese	942	mg/L		183	5.15	162.33	5.80	YES	662.18	1.42	YES	YES
	P218389	18-Jun-97	Nitrate/Nitrite	10.8	mg/L		10	1.08	4.66	2.32	YES	32.95	0.33		YES
	P218389	18-Jun-97	U-234	3.38	pCi/l		1.07	3.16	60.70	0.06					
	P218389	18-Jun-97	U-238	3.17	pCi/l		0.768	4.13	41.80	0.08					
	P219489	04-Feb-97	Nitrate/Nitrite	36.7	mg/L		10	3.67	4.66	7.87	YES	51.57	0.71		YES
	P219489	18-Jun-97	Nitrate/Nitrite	44.3	mg/L		10	4.43	4.66	9.50	YES	51.57	0.86		YES
	P219489	23-Sep-97	Nitrate/Nitrite	40	mg/L		10	4.00	4.66	8.58	YES	51.57	0.78		YES
	P313589	4-Dec-97	Methylene Chloride	8	µg/L		5	1.60				1.23	6.50	YES	YES
	P313589	03-Jun-97	Nickel	117	µg/L		100	1.17	21.37	5.47	YES	254.49	0.46		YES
	P314289	13-Aug-97	Manganese	3000	µg/L		183	16.39	162.33	18.48	YES				YES
	P416689	3-Dec-97	Methylene Chloride	9	µg/L		5	1.8				1.32	6.82	YES	YES
RCRA	52894	16-Jun-97	Thallium	3.8	µg/L	B	2	1.90	4.90	0.78					
	52894	18-Nov-97	U-233/234	25.9	pCi/l	B	1.07	24.21	60.70	0.43					
	52894	18-Nov-97	U-235	1.17	pCi/l		1.01	1.16	1.79	0.65					
	52894	18-Nov-97	U-238	18.7	pCi/l	B	0.768	24.35	41.80	0.45					
	5887	29-Jul-97	Thallium	3.5	µg/L	B	2	1.75	4.90	0.71		5.22	0.67		
	70393	23-Jan-97	1,1-Dichloroethene	15	µg/L		7	2.14				20.72	0.72		
	70393	31-Jul-97	1,1-Dichloroethene	22	µg/L		7	3.14				20.72	1.06	YES	
	70393	23-Jan-97	Tetrachloroethene	7	µg/L		5	1.40				8.87	0.79		

Table 2-3 1997 Groundwater Values Above Tier II Action Levels & Standard Framework Criteria (ALF) in RFCA – Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II Action Level	Tier II Ratio	Back-Ground M2SD	BKGD Ratio	Above BKGD?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?
RCRA	70393	31-Jul-97	Tetrachloroethene	8.5	µg/L		5	1.70				8.87	0.96		
	70393	23-Jan-97	Trichloroethene	25	µg/L		5	5.00				36.33	0.69		
	70393	31-Jul-97	Trichloroethene	26	µg/L		5	5.20				36.33	0.72		
	B206989	24-Sep-97	Nitrate/Nitrite	41	mg/L		10	4.10	4.66	8.79	YES	75.35	0.54		
	B206989	29-Jan-97	Sulfate	2760	mg/L		500	5.52	435.60	6.34	YES				

Well 12691 had one sample with a concentration of CT above the Tier I action level. The concentration was below historic M2SD, and as shown on Figure 2-15, there has been no upward trend in concentration. As a result, the value is not reportable.

Well 3687 had two samples with concentrations of TCE above Tier I, though they do not constitute reportable values. As with the other two wells with values above Tier I, concentrations have not been increasing (Figure 2-50), nor have they been above the historic M2SD.

Well 00897 was installed during the third quarter of 1997 as a RFCA-designated performance monitoring well. A sample collected from the well in September, 1997 indicated PCE at a concentration of 8,300 μg/L; and TCE at a concentration of 890 μg/L; above the Tier I action levels of 500 μg/L for both compounds.

Plume Definition Well: Well 22896 was installed and first sampled in the third quarter of 1996. The well is located in the IA, and was installed as a plume extent well with the intent of monitoring the leading edge of the IA VOC plume in an area considered at the time to contain groundwater with concentrations below Tier I action levels. Results of the initial sampling, reported in the 1996 Third Quarter RFCA Groundwater Monitoring Report (RMRS, 1997d), indicated levels of TCE above the Tier I action level. Monthly sampling from January 1997, to March 1997, confirmed the elevated TCE concentrations from the initial sampling (RMRS, 1997e). Based on the confirmed reportable values, the well was reclassified to a plume definition well. The sampling results of well 22896 have shown the area of Tier I contamination to be further north than originally estimated. An evaluation of the possible impacts to surface water was initiated during the third quarter of 1997, the results of which will be evaluated in 1998.

2.3.2 Values Above Tier II Action Levels

Boundary Wells: Six RFCA designated boundary wells were sampled in 1997. Sulfate was detected in well 10294 above the Tier II action level and the background benchmark for two sampling events. Although the values are reportable, concentrations have remained below historic M2SD, and trends have not been upward (Table 2-3 and Figure 2-90).

There were values for the uranium isotopes of U-233/234, U-234, U-235, and-238 above the Tier II action levels in all six boundary wells. All of the uranium isotope analytical results were below the background benchmarks, and are not considered reportable values. Well 10394 also contained tritium at a concentration above the Tier II action level and background M2SD (Table 2-3). Because there

had been no historical elevated values for this well, monthly confirmation sampling was initiated during the fourth quarter of 1998.

***D&D Wells*:** One D&D well was sampled in 1997. Well 22996 was sampled during the second quarter, and yielded U-234 and U-238 at levels over the Tier II action level but much lower than the background M2SD benchmark. (Table 2-3). The values are not at reportable levels, and aside from RFCA-required semi-annual sampling, no further action is required.

Three D&D wells, wells 02297, 02397, and 02497, were installed in the third quarter of 1997 but were dry or lacked sufficient water for sampling following their installation.

***Drainage Wells*:** Three drainage wells were sampled in 1997. Nickel was reported above the Tier II action level, and both the background M2SD and historic M2SD for two samples from well 6586 (Table 2-3). Evident on Figure 2-63 is an increasing trend for nickel beginning in the third quarter 1996 and continuing through 1997. As such, the values are reportable.

There were reported results of uranium-233/234 and uranium-238 above the Tier II action levels in all three of the sampled Drainage wells. However, the results were below the background benchmarks and are not reportable values.

Performance Monitoring Wells: Performance monitoring wells monitor the effect of a remedial action or source removal on downgradient groundwater quality. As such, contaminant trends over time are the basis for determining reportable values. In considering results for performance monitoring wells, Tier II action levels and background benchmarks are applied only to determine which analytes are to be monitored using trend charts. Twelve performance monitoring wells had analytes with concentrations above Tier II action levels (Table 2-3). As shown on Table 2-4, historic trends are summarized, and the trend plots are referenced for each organic compound above Tier II and for each inorganic analyte above both Tier II and background M2SD.

Elevated values from the initial sampling of the two RFCA-designated performance monitoring wells installed in 1997 consisted of PCE and TCE in well 00897 (Table 2-3). As indicated on Table 2-4, there is insufficient data to plot a trend for that well.

Well 05691 with methylene chloride, and well 12691 with nitrate/nitrite are the only performance monitoring wells with contaminants displaying upward trends (Figures 2-25 and 2-84, respectively). The upward trend for nitrate/nitrite appears to have begun in 1995 and has persisted since that time. Therefore the presence of nitrate/nitrite in well 12691 constitutes reportable values.

Table 2-4 Performance Monitoring Wells With Organic Compounds Reported Above RFCA Action Levels and Inorganic Analytes Above RFCA Action Level and the Background M2SD.

Well	Analyte	Trend	Figure No.
000897	Tetrachloroethene	NP	NP
000897	Trichloroethene	NP	NP
05691	Carbon Tetrachloride	Down	2-11
05691	Methylene Chloride	Up	2-25
05691	Tetrachloroethene	Down	2-32
05691	Thallium	NP	NP
05691	Trichloroethene	Down	2-43
07391	1,1,1-Trichloroethane	No	2-6
07391	1,1,2-Trichloroethane	No	2-7
07391	1,1-Dichloroethene	No	2-1
07391	Chloroform	No	2-22
07391	Cis-1,2-Dichloroethene	No	2-20
07391	Nitrate/Nitrite	No	2-82
07391	Tetrachloroethene	Down	2-33
07391	Thallium	No	2-74
07391	Trichloroethene	Up	2-44
10592	Selenium	No	2-66
10992	Nitrate/Nitrite	No	2-83
10992	Selenium	NP	NP
11891	Carbon Tetrachloride	No	2-13
11891	Methylene Chloride	No	2-26
11891	Tetrachloroethene	Up	2-34
11891	Trichloroethene	No	2-45
12191	Carbon Tetrachloride	No	2-14
12191	Tetrachloroethene	No	2-35
12191	Trichloroethene	Down	2-46
12691	Carbon Tetrachloride	Down	2-15
12691	Cis-1,2-Dichloroethene	Down	2-21
12691	Nitrate/Nitrite	Up	2-84
12691	Tetrachloroethene	No	2-36
12691	Trichloroethene	Down	2-47
3687	1,1-Dichloroethene	No	2-2
3687	Carbon Tetrachloride	Down	2-17
3687	Chloroform	Down	2-23
3687	Tetrachloroethene	Down	2-38
3687	Trichloroethene	Down	2-50

Note: NP indicates insufficient data to plot trend chart.

The plot for methylene chloride in well 05691 shows a similar response during 1997 as the other plots for that compound (Figures 2-24 through 2-30). As a group, the plots suggest the concentrations of methylene chloride above Tier II in 1997 are not representative of in situ conditions, but rather are related to laboratory contamination during sample preparation and analysis. Consequently the results are not considered to be reportable.

Plume Definition Wells: Plume definition wells are located in areas of known or suspected groundwater contaminant plumes and generally have one or more analytes above the Tier II action levels. Well 22896 was reclassified in 1997 from a plume extent to a plume definition well based on sampling results during 1996 and on confirmatory sampling in the first quarter of 1997 (RMRS, 1997b).

Twelve plume definition wells had analytes at concentrations above Tier II action levels during 1997. From those wells, 85 results were greater than Tier II action levels (Table 2-3). Only well 22896, with three results for TCE over the Tier I action level, are considered reportable. Discussion of well 22896 is presented in Section 2.3.1.

Well 00597, a replacement well for well 6687, was installed and sampled for the first time in fourth quarter of 1997. Analytical results indicate the presence of TCE and 1,1-dichloroethene (1,1-DCE) at concentrations equal to the Tier II action levels. As such, the results are not reportable.

Concentration trends in plume definition wells are presented in Table 2-5 for organic compounds above Tier II action levels and for inorganic analytes above both Tier II action levels and background M2SDs.

Plume Extent Wells: In 1997, 28 of the 41 plume extent wells in the RFCA monitoring program produced 141 analytical results with concentrations over Tier II action level criteria. Seventy-two results in 24 wells fit the criteria for being reportable; that is, organic compounds at concentrations above Tier II action levels, and inorganic constituents above Tier II and background M2SD (Table 2-3). All of the values above action levels were reported in the 1997 quarterly RFCA groundwater monitoring reports (RMRS, 1997b, 1997c, 1998a, 1998b).

Three RFCA-designated plume extent wells were installed in 1997 (00197, 00397, 02197). These wells were dry following installation.

Table 2-5 Plume Definition Monitoring Wells With Organic Compounds Reported Above RFCA Action Levels and Inorganics Analytes Above RFCA Action Level and the Background M2SD.

Well	Analyze	Trend	Figure No.
00491	Carbon Tetrachloride	Down	2-8
00491	Methylene Chloride	No	2-24
00491	Tetrachloroethene	Down	2-31
00491	Thallium	Up	2-71
00491	Trichloroethene	Down	2-41
00597	1,1-Dichloroethene	NP	NP
00597	Trichloroethene	NP	NP
0487	Selenium	Down	2-65
0487	Trichloroethene	No	2-42
05391	Carbon Tetrachloride	No	2-10
22896	Thallium	NP	NP
22896	Trichloroethene	UP	2-49
2987	Nickel	Up	2-62
2987	Selenium	Up	2-69
6286	Carbon Tetrachloride	Up	2-18
6286	Selenium	Up	2-70
P209389	1,1-Dichloroethene	Down	2-4
P209489	Carbon Tetrachloride	No	2-19
P209489	Nitrate/Nitrite	Down	2-87
P209489	Trichloroethene	No	2-53
P209489	Tritium	No	2-80
P219189	1,1-Dichloroethene	No	2-5
P219189	Tritium	Down	2-81
P416889	Tetrachloroethene	Down	2-40

Note: NP indicates insufficient data to plot trend chart.

Concentrations above Tier II action levels occurred during 1997 for both organic and inorganic compounds at wells 03991, 06091, 22796, 23296, 3586, 75992, P313589, and P416689. Elevated concentrations of only inorganic constituents occurred at wells 10994, 1386, 1786, 1986, 22596, 22696, 7086, B208789, P114389, P218389, and P219489. There were no instances in which a plume extent well had concentrations above Tier II for only organic compounds.

CT was detected in well 06091 at a concentration of 6.3 μg/L; above the Tier II action level and historical M2SD (Table 2-3). The well is located northeast of trenches T-3 and T-4 and historical data indicate an upward trend consistent with a possible advancing plume front (Figure 2-12). Monthly sampling initiated in January, 1997, confirmed the presence of low concentrations of CT in excess of the Tier II action level, (RMRS 1997c).

Well 23296 is located in the South Walnut Creek drainage below the Pond B-2 drain. The well was installed in 1996 as a plume extent well. It had been thought at the time that the East Trenches Plume had not reached the drainage and the well was intended to detect increasing concentrations of plume contaminants as they migrated toward the drainage. The results of the first sampling in 1996 contained three organic compounds at concentrations above Tier II criteria suggesting the plume had reached the drainage (RMRS, 1997a). Results of monthly sampling during the first quarter of 1997 confirmed concentrations above Tier II action levels for CT, PCE, and TCE (RMRS, 1997b). The concentration of CT appears to be increasing, while concentrations of PCE and TCE remain static. In addition, 1,2-dichloroethene (1,2-DCE) occurred in one sample at a concentration equal to the Tier II criterion (RMRS, 1997b). An impacts evaluation was conducted during 1997 based on the confirmed reportable values at wells 06091 and well 23296. Discussion of that evaluation is presented in Section 4.1.

In terms of inorganic constituents, well 22596, installed in 1996, had concentrations of dissolved manganese above the Tier II action level. Subsequent monthly confirmatory sampling which took place during the first quarter of 1997 confirmed these results. Dissolved nickel concentrations occurred in well 1386 above Tier II action levels. The concentrations have been highly variable over the last four years (Figure 2-61) and do not exhibit a definite trend. Selenium concentrations in well 1786 were above the Tier II action level, and appear to have increased in the last two years (Figure 2-68). It is recommended that semi-annual sampling of this well continue, pending reevaluation of the background benchmarks for metals.

RCRA Wells: Four RCRA wells had 13 values above Tier II action levels in 1997 (Table 2-3). No RCRA wells contained inorganic constituents at concentrations above Tier II and background M2SD. In terms of organic compounds, well 70393 is the only RFCA-designated RCRA well with concentrations above the Tier II action levels. PCE, TCE, and 1,1-DCE were above the action levels. The compound 1,1-DCE was also above the historic M2SD in a sample collected during the third quarter of 1997. Figures 2-36 and 2-3, respectively, show that concentrations of PCE and 1,1-DCE in well 70393 have been increasing. Figure 2-51 shows that in the same well, concentrations of TCE have not been increasing.

Values above action levels in RCRA wells are reportable if concentrations show an increasing trend over time, and if mean concentrations for an analyte are higher in wells downgradient from a RCRA-regulated unit than in wells upgradient from that unit. The comparisons between upgradient and downgradient concentrations follow RCRA statistical evaluation methods (DOE, 1996). From a groundwater contamination point of view, the principal RCRA-regulated unit at RFETS is the Present Landfill. Wells monitoring the Present Landfill that had values in 1997 above Tier II action levels are shown on Table 2-3. A detailed discussion of the groundwater conditions at the Present Landfill is presented in RMRS (1998c). That report concluded that groundwater quality downgradient of the landfill in 1997 was consistent with those found in 1996. Concentrations of fluoride, sulfate, total dissolved solids, barium, copper, iron, lithium, manganese, selenium, strontium, nitrate, and zinc are elevated in one or more downgradient versus upgradient wells. However, the trends over time of those analytes do not appear to be increasing. The upward trending concentrations of PCE and 1,1-DCE occurred in wells upgradient of the landfill. Therefore, based on those conditions, values above the Tier II action levels are not considered reportable (RMRS, 1998c).

2.4 Discussion of Groundwater Plumes

Plume maps have been generated with 1997 data for selected VOCs (TCE, PCE, CT, 1,2-DCE, and vinyl chloride(VC)), dissolved nitrate, dissolved manganese, nickel, sulfate, and TDS. Groundwater chemistry data extracted from the SWD were used in constructing the plume maps. All monitoring wells with analytical results for the years 1991 through 1997, regardless of the number of samples collected during that time, were used to produce the plume maps. The maps consist of data compiled from approximately 600 wells. Chemical data were prepared using the methods specified in Section 2.1. The mean concentration of each analyte for each well from 1991 through 1997 was calculated and plotted. Results below the Contract Reportable Detection Limit (CRDL) were identified in the data as "U" qualified. U-qualified data were given values of one-half the reported CRDL. VOCs

have action levels low enough that the variation in CRDLs from one laboratory to another has caused some averages from wells with predominantly non-detect results to be above the Tier II action levels. The CRDLs exhibited the greatest variation for VOCs as a result of sample dilution reruns. For VOCs only, all CRDLs above 1 micrograms per liter (μg/L) were adjusted to 1 μg/L, and the averages were calculated using one-half the adjusted CRDLs.

It should be noted that the term "plume map" is used here to delineate potential areas of elevated contaminant concentrations derived from each data set. In fact the map for a particular analyte may not show a plume at all, but rather just the distribution of the historical average chemical data results for that analyte. Because of assumptions made during data reduction, it is expected that these maps may contain a limited number of false values above Tier II action levels. Plume boundaries, where drawn, represent the best estimates of the spatial distribution of concentrations of selected chemicals of concern in groundwater at RFETS.

2.4.1 Volatile Organic Compound Plumes

PCE and TCE are two of the most common commercially produced chlorinated organic solvents (Pankow and Cherry, 1996). These two compounds were historically used at RFETS while the plant was in production stage. Natural degradation products of these two chemicals are 1,2-DCE and VC. Besides its commercial occurrence, TCE can be found in nature as a degradation product of PCE. CT, also historically used at the site as a solvent, is a chlorinated compound that is not found along the PCE-TCE degradation chain. All five of these chlorinated compounds are found in groundwater at RFETS.

For TCE, the Tier I and Tier II action levels in the groundwater at RFETS are 5 μg/L and 500 μg/L, respectively. In 1997 there are 19 values above Tier I for TCE. The highest average concentration of TCE, 84,778 μg/L, is found in groundwater from monitoring well 07391 which is located approximately 330 feet south of the 903 Pad. This concentration is nearly an order of magnitude higher than the TCE concentration in the next highest well. There are 116 wells which have an average historical concentration greater than Tier II action levels. As seen on Plate 8, there are four distinct areas where TCE plumes are mapped in excess of the Tier I action level. In addition, there are two other areas plotted with lesser (Tier II or greater) TCE concentrations. The most extensive plume of TCE contamination is located east and southeast of the IA, and appears to be composed of several source areas which have coalesced into one extensive plume. The sources for this plume appear to be the Mound Site, the 903 Pad, the East Trenches, and an area south southeast of the 903 Pad, originating in the area of monitoring well 07391, which coincides with the Ryan's Pit trench.

Ten values above Tier I are associated with this plume. The next two plumes have a relatively small areal extent. One is located at the western portion of the Solar Evaporation Ponds (SEPs). One value over Tier I is associated with this plume. The other is south of the IA, along the eastern portion of the 881 Hillside. There are five values over Tier I associated with this plume. The last plume is located in the west central portion of the IA to the southeast of Building 371. The plume is fairly extensive, although generally of lower concentration than those previously discussed. Two values above Tier I are associated with this plume. As noted above, there are two areas of lesser TCE concentration which have been plotted. One is associated with the PU&D yard, and the other is associated with the Old Landfill. Beyond these areas there are a few isolated, low concentration, occurrences of TCE observed at RFETS. Two of these occurrences deserve further discussion. Monitoring wells B304789 and B305389 are located south of Woman Creek and show historical average TCE concentrations of 5.22 μg/L and 13.75 μg/L, respectively. Upon review of the laboratory data, it was found that these elevated values are based on the results of only one detection out of 9 sampling events at well. All the samples with a detection were collected on the same day. These results are clearly spurious, and are not considered to be representative of actual field conditions.

For PCE, Tier I and Tier II action levels in groundwater at RFETS are 5 μg/L and 500 μg/L, respectively. There are 18 values above Tier I for PCE. The highest average concentration of PCE, 51,500 μg/L, was found in groundwater from abandoned monitoring well 0174 located within the Mound Site. There are 108 monitoring wells that have an average historical concentration greater than Tier II. As seen on Plate 9, there are two widespread areas, which are mapped as PCE plumes. These two areas generally coincide with the two large plumes on the TCE plume map. The larger PCE plume is located east and southeast of the IA and is associated with the Mound Site, the 903 Pad, the East Trenches, and possibly the Ryan's Pit trench. Fifteen values over Tier I action levels are associated with this plume. The other large area of PCE contamination is located south and southeast of Building 371. One value over Tier I is associated with this plume. In addition to the two large plumes, there is a small area of relatively high concentration along the eastern portion of the 881 Hillside that contains two values over Tier I. There is also a small area of moderate PCE concentration immediately southeast of the SEPs. Monitoring well B206389, located in the southeast portion of the Present Landfill, had a single value above Tier II (124.5 μg/L) associated with that facility. A few additional wells with concentrations of PCE above Tier II are also observed on the map.

For CT, the Tier I and Tier II action levels in groundwater at RFETS are 5 µg/L and 500 ug/L, respectively. There are 22 values above Tier I for CT. The highest average concentration of CT, 50,100 µg/L, is found in groundwater from monitoring well 06691, located on the 903 Pad. This concentration is five times greater than the concentration of CT in the next highest well. There are 80 monitoring wells that have an average historical concentration greater than Tier II. As seen on Plate 10 there is one large CT plume, another smaller plume, and two minor CT plumes. The large CT plume is located east and southeast of the IA and roughly coincides in areal extent to major TCE and PCE plumes. The most noticeable difference is that the CT plume appears to have fewer sources; those being the 903 Pad and the East Trenches. Eighteen values above Tier I are associated with this plume. The next CT plume is located in the PA. It originates southeast of Building 771 and extends under the central portion of the SEPs. The source for the western edge of the plume is IHSS 118.1, a known area of dense non-aqueous phase liquid (DNAPL) contamination (see Section 5.2). An additional source is located immediately south of the westernmost SEP, possibly an older SEP or Building 779. Two values above Tier I are associated with this plume. The minor plumes are located on the eastern edge of the 881 Hillside, and approximately 600 feet southeast of Building 371. Each of these plotted areas contains one value above Tier I for CT.

The 1,2-DCE concentration in groundwater was plotted for the years 1991 through 1997. For 1,2-DCE, the Tier I and Tier II action levels in groundwater at RFETS are 70 µg/L and 7,000 µg/L, respectively. No values above Tier I are reported for 1,2-DCE. The highest average concentration in groundwater of 1,2-DCE, 1,642 µg/L, is found in monitoring well 08891, which is situated in the northeast portion of the 903 Pad. There are 17 wells that have an average historical concentration higher than Tier II. As seen on Plate 11, there are relatively few areas of 1,2-DCE contamination. All of the plotted areas shown are associated with previously discussed VOC plumes. As noted above, 1,2-DCE is a degradation product of TCE and PCE. The only value above Tier II that is not associated with a previously discussed area of VOC contamination occurs in monitoring well 01391, located approximately 250 feet north of the 904 Pad, with an average 1,2-DCE concentration of 178 µg/L.

For VC, the Tier I and Tier II action levels in groundwater at RFETS are 2 µg/L and 200 µg/L, respectively. There is one value above Tier I for VC. This value, which is the highest average concentration of VC (315 µg/L), is found in groundwater from monitoring well 3586 located in the seep SW059 area just east of the PA perimeter road and is associated with the distal end of the Mound Site/SW059 plume. There are 13 wells that have an average historical concentration higher

than Tier II. As seen on Plate 12, there are relatively few areas of VC contamination. All of the plotted areas shown are associated with previously discussed VOC plumes. As noted above, VC is a degradation product of TCE and PCE.

2.4.2 Nitrate Plumes

The background level for nitrate in groundwater is 4.7 mg/L (EG&G, 1993a). The Tier I and Tier II action levels for nitrate in groundwater at RFETS are 10 mg/L and 1,000 mg/L, respectively. There are seven values above Tier I for nitrate. The highest average concentration of nitrate, 4,346 mg/L, is found in groundwater from monitoring well P209589 located in the PA approximately 130 feet northeast of the northeast SEP. There are 66 wells that have an average historical concentration greater than Tier II. As seen on Plate 13, there is one major nitrate plume and four minor areas that should be noted. The major nitrate plume is located in the northeast portion of the PA and extends to the northeast towards North Walnut Creek. This plume emanates from the SEPs. All seven values of nitrate over Tier I are associated with this plume. The four minor areas of nitrate concentration above the Tier II action level are associated with the Old Landfill, the 903 and 904 Pads, the eastern portion of the 881 Hillside, and an area immediately downgradient of the Present Landfill. A single, relatively high nitrate concentration of 444 mg/L is found at monitoring well 08391, which is located approximately 1200 feet east of the IA.

2.4.3 Metals Plumes

The background level for dissolved manganese in groundwater is 162µg/L (EG&G, 1993a). The Tier I and Tier II action levels for dissolved manganese in groundwater at RFETS are 183 µg/L and 18,300 µg/L, respectively. There are no values above Tier I for dissolved manganese. The highest average concentration of dissolved manganese, 6,207 µg/L, is found in groundwater from monitoring well 72093 at the eastern edge of the Present Landfill. There are 93 wells which have an average historical concentration greater than Tier II action level. As seen on Plate 14, there are two localized areas that could be considered dissolved manganese plumes. They are both located at the north end of the site. The first area is in the IA in the immediate vicinity of Building 771. The second area appears to be associated with the Present Landfill. In addition, there are areas of elevated dissolved manganese concentration at the southern edge of the IA which deserve consideration as potential dissolved manganese plumes. One area is associated with the Old Landfill, and the other is associated with the 881 Hillside. There are eight values above Tier II for dissolved manganese associated with the West Spray Field. In addition, there are a number of concentrations over Tier II in the eastern portion of the IA which are associated with the 903 Pad, the East Trenches, and the

SW059 area. Beyond these areas there are a few random values above Tier II for dissolved manganese in groundwater.

The background level for dissolved nickel in groundwater is 21.4 µg/L (EG&G 1993). The Tier I and Tier II action levels for dissolved nickel in groundwater at RFETS are 100 µg/L and 10,000 µg/L, respectively. There are no values for dissolved nickel above Tier I. The highest average concentration for dissolved nickel, 4,950 µg/L, is found in groundwater from monitoring well 5487 which is located approximately 200 feet south of Building 881. There are 13 wells that have an average historical concentration greater than Tier II Action Levels. As seen on Plate 15, there are no areas which could be mapped as dissolved nickel plumes. The two highest occurrences of dissolved nickel in groundwater at RFETS, monitoring wells 5487 and 4887 (854.5 µg/L), are seen as potential point sources along the 881 Hillside. The third highest occurrence of nickel is found at monitoring well 2987 which is located approximately 1,600 feet southeast of the 903 Pad. Two values above Tier II, from wells 58194 and 57994, are probably associated with the Old Landfill. The remaining values over Tier II are scattered randomly throughout the site, generally downgradient of the IA. It is notable that of the 13 wells with dissolved nickel at concentrations over Tier II, eight are constructed with are stainless steel casing. It has also been observed that stainless steel "turnings" from past lathe machining processes were placed in the Old Landfill. Nickel comprises approximately 8 to 14 percent of 300 series austenitic stainless steels commonly used for fabricating monitoring well casings (Driscoll, 1986).

2.4.4 Water Quality Parameter Plumes

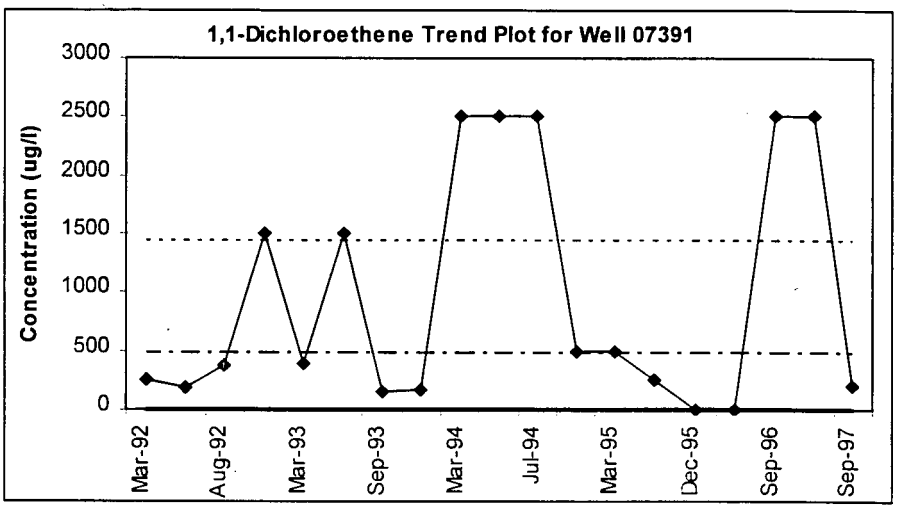
The background level for sulfate in groundwater is 436 mg/L (EG&G, 1993a). The Tier I and Tier II action levels for sulfate in groundwater at RFETS are 500 mg/L and 50,000 mg/L, respectively. There are no sulfate values above Tier I. The highest average concentration for sulfate, 3,431 mg/L, is found in groundwater from background monitoring well B303089 which is located in the extreme southeast corner of the site adjacent to Indiana Street. There are 36 wells which have an average historical concentration greater than Tier II action levels. As seen on Plate 16, there are four distinct areas which can be plotted as sulfate plumes. One area is north of the IA just downgradient of the Present Landfill and may be the result of past Site activities. The next plume is located northeast and downgradient of the SEPs and is probably associated with past wastewater storage activities. This plume covers the largest areal extent. The third area of high sulfate concentration in groundwater begins just northeast of Pond B-4, continues past Pond B-5, and ends due east of Pond A-4. The fourth and least extensive sulfate plume is located along the eastern margin of the 881 Hillside.

Most of the remaining values over Tier II are scattered throughout the eastern portion of the Site. As noted earlier, the highest sulfate concentration is at well B303089, located at the extreme southeast corner of the buffer zone. In addition to B303089, there are concentrations above Tier II at three other locations in drainages to the southeast of the IA.

The background level for TDS in groundwater is 980 mg/L (EG&G, 1993a). Tier I and Tier II action levels for TDS in groundwater have not been established at RFETS. TDS plumes are shown here only as an indicator of potential groundwater contamination. The highest average concentration for TDS, 32,117 mg/L, is found in groundwater from monitoring well P209589 (also the highest nitrate well) which is located approximately 130 feet northeast of the northeast SEP. There are 89 wells that have an average historical concentration of TDS higher than background. As seen on Plate 17, there are four areas that can be plotted as TDS plumes and one minor area that should be considered. The four larger areas coincide to the same localized areas mapped for sulfate plumes, except that the areal extent of three of the TDS plumes is greater, generally beginning further upgradient than the sulfate plumes. The first plume begins within the Present Landfill and continues downgradient of the landfill. The next plume (similar to the nitrate plume) encompasses a large area including most of the SEPs, downgradient to the northeast between Pond A-1 and Pond A-2, downgradient to the southeast to the SW059 area, and upgradient to the north of Building 771. The third area of high TDS concentration in groundwater begins just northeast of Pond B-4, continues past Pond B-5, and ends due east of Pond A-4. This plume encompasses the same five monitoring wells as the coinciding sulfate plume. The fourth TDS plume extends from just southwest of Building 881 approximately 1650 feet east along the 881 Hillside. A minor area of high TDS concentration is located south of the 903 and 904 Pads trending to the southeast. The four wells with sulfate values over Tier II found in the drainages southeast of the IA are the only four wells in the area with TDS concentrations above background.

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-1



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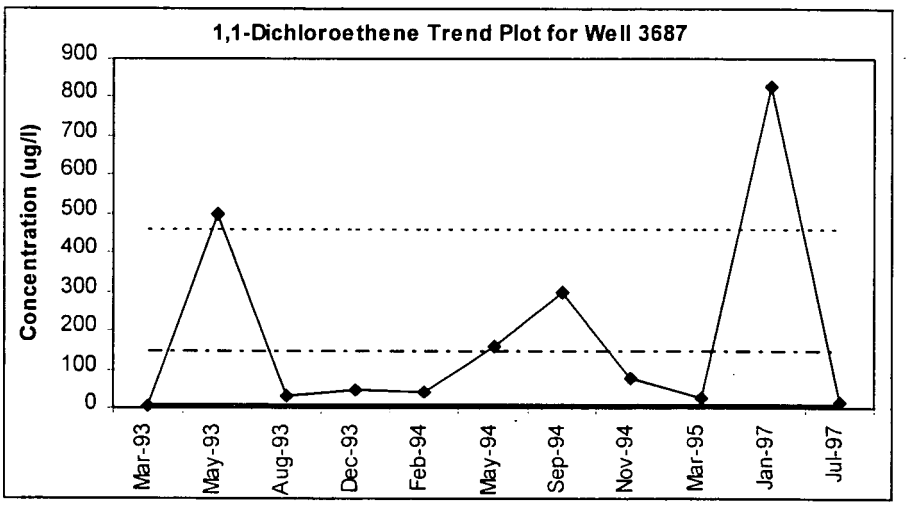

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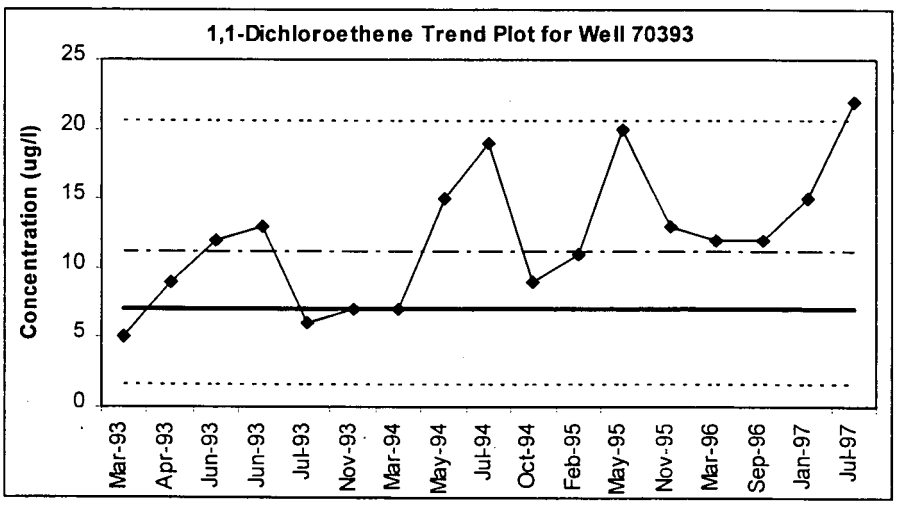
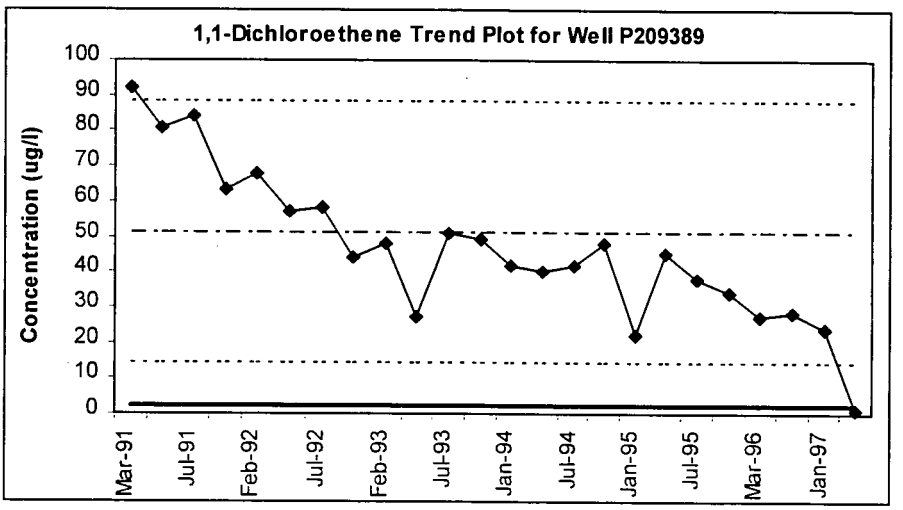


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-4



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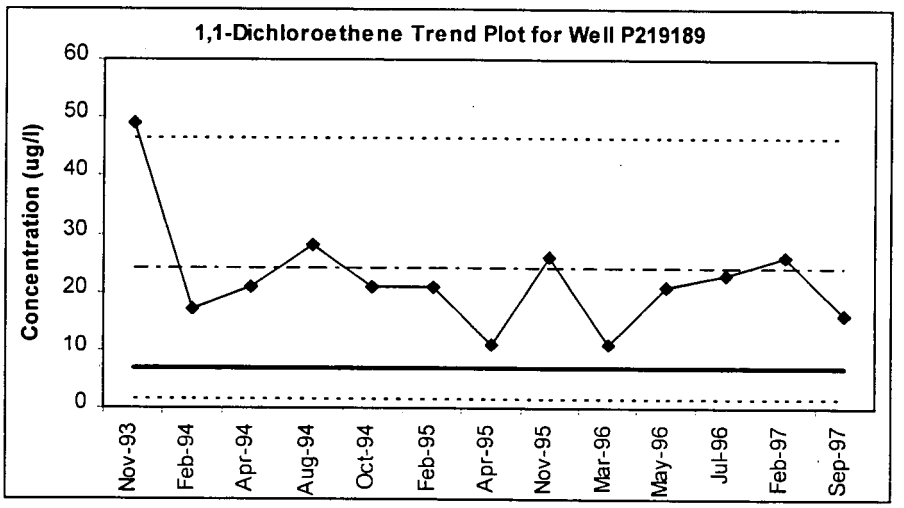

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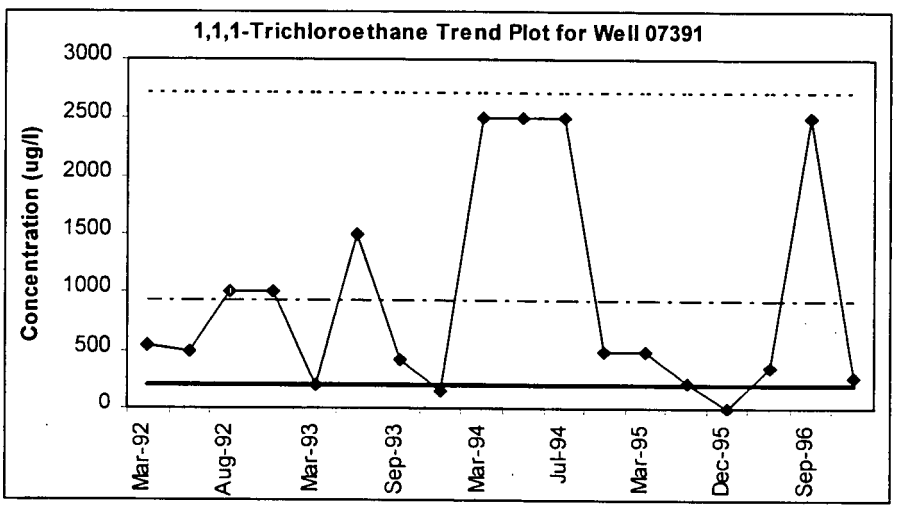
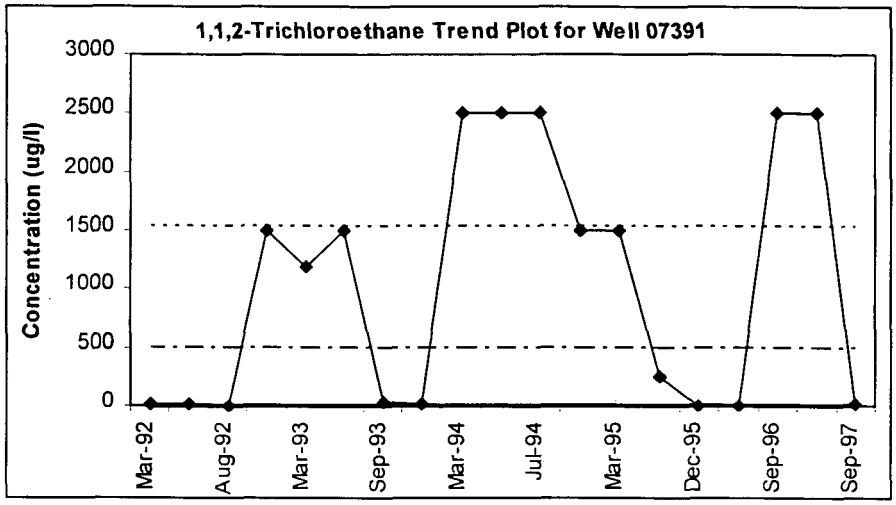


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-7



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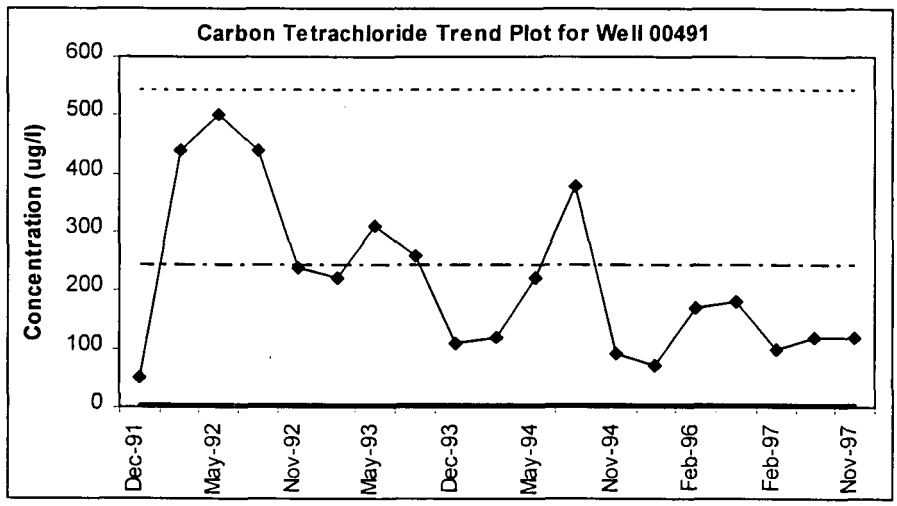

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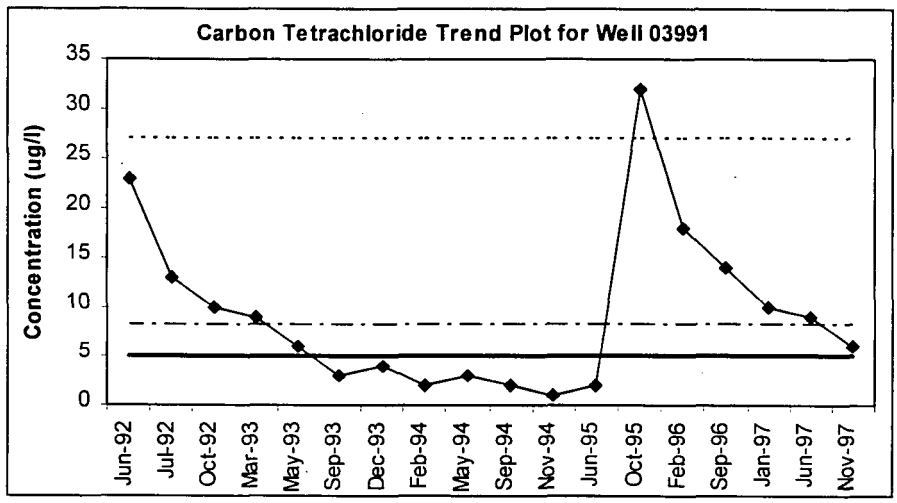
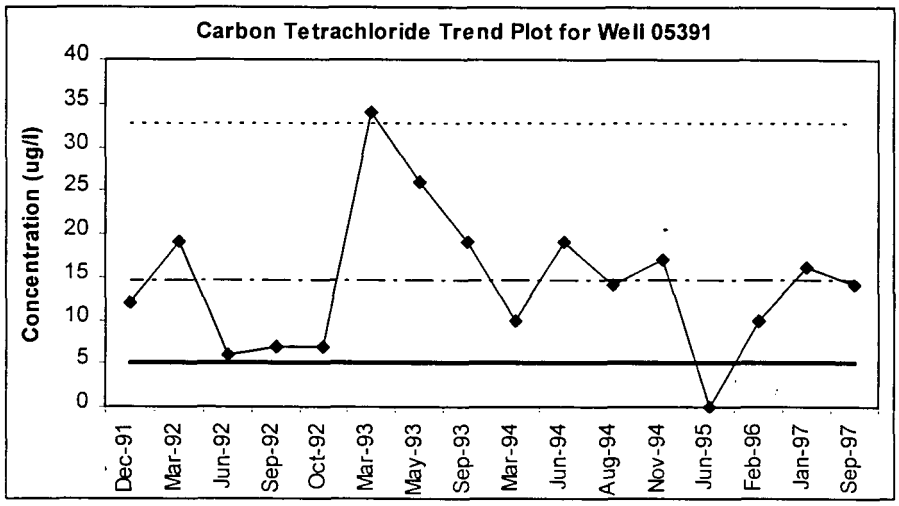


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-10



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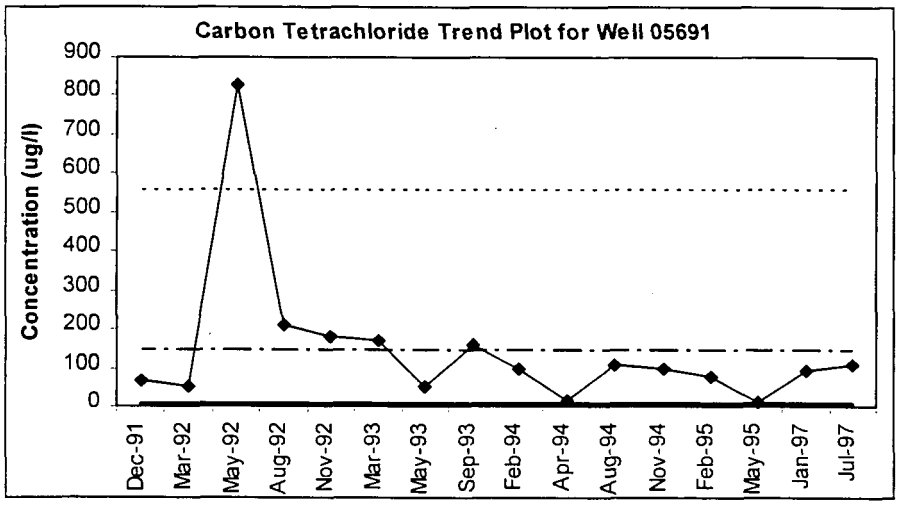

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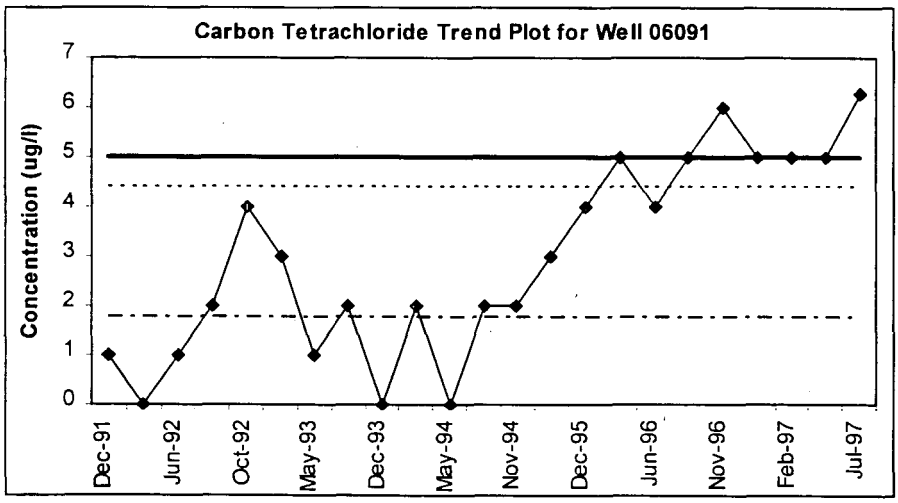
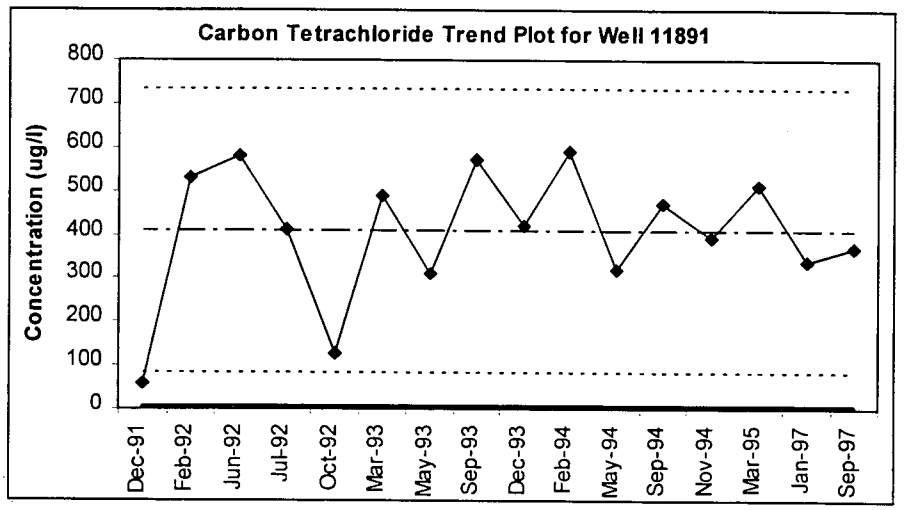


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-13



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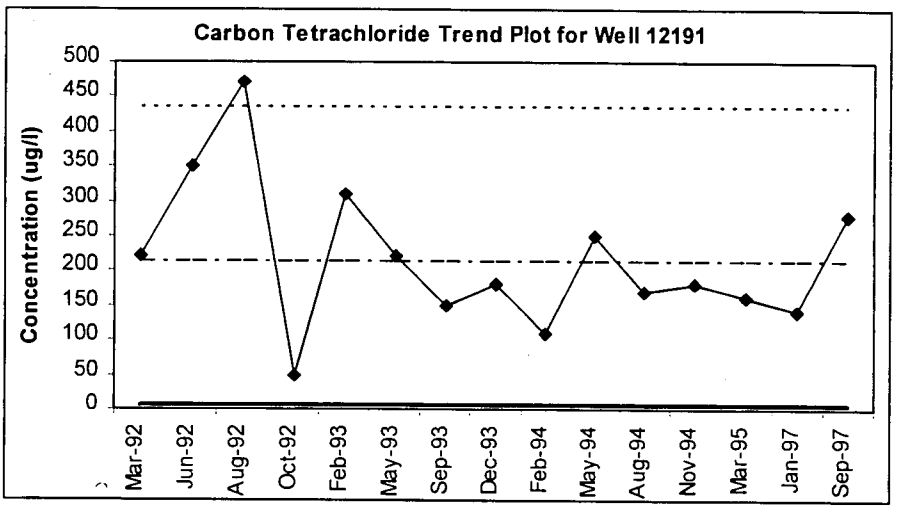

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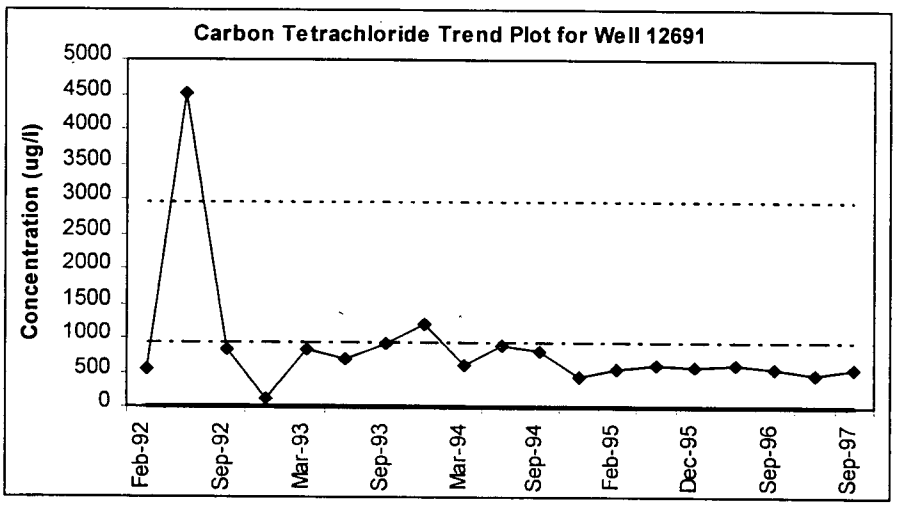
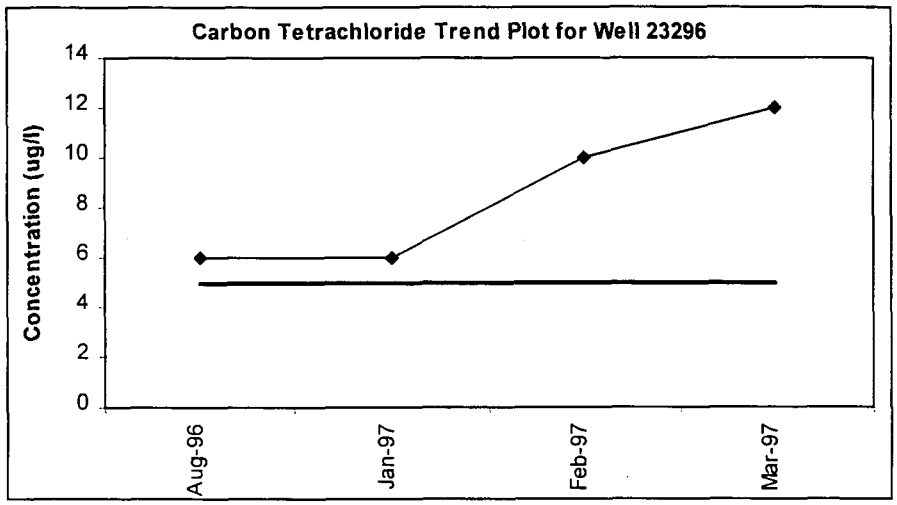


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-16



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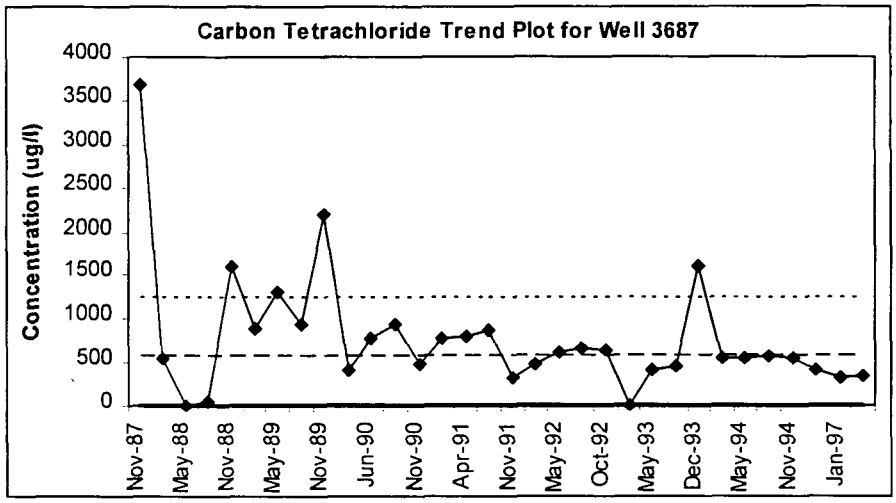

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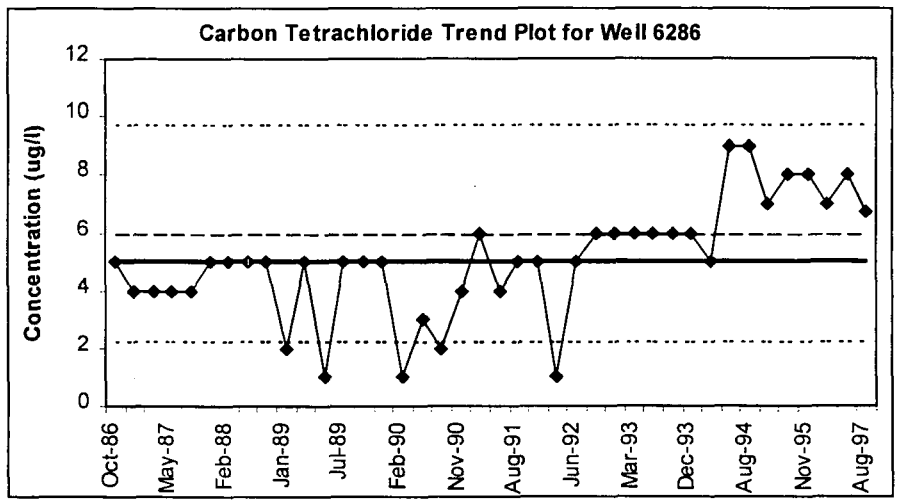
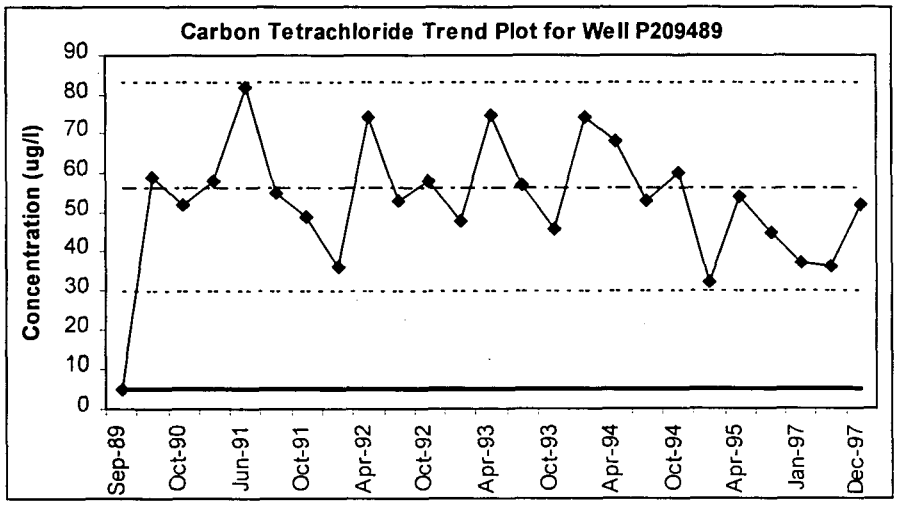


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-19



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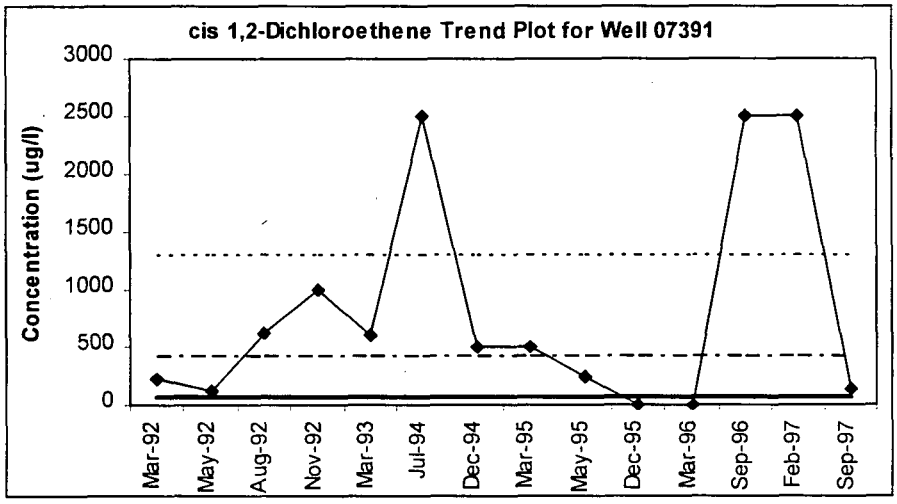

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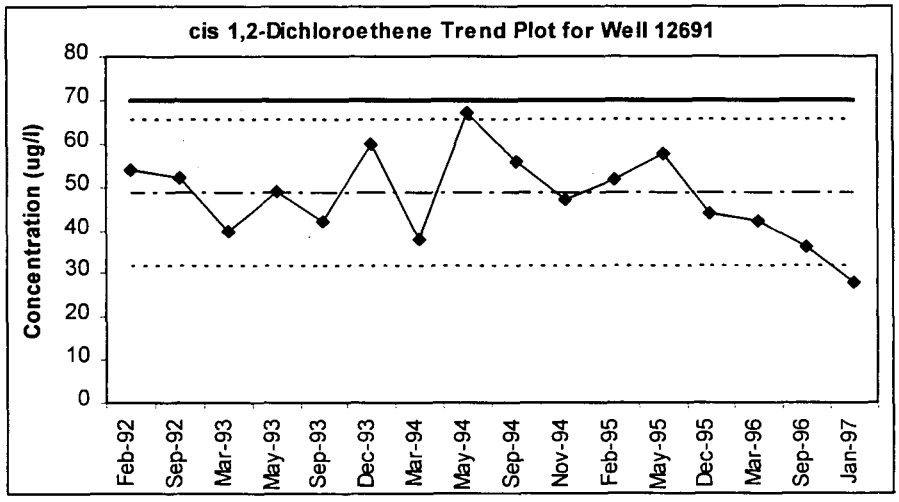
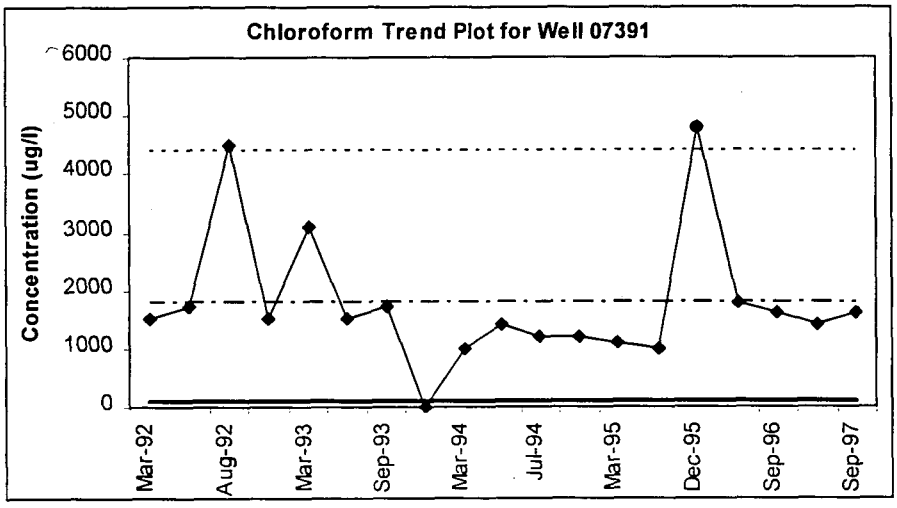


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-22



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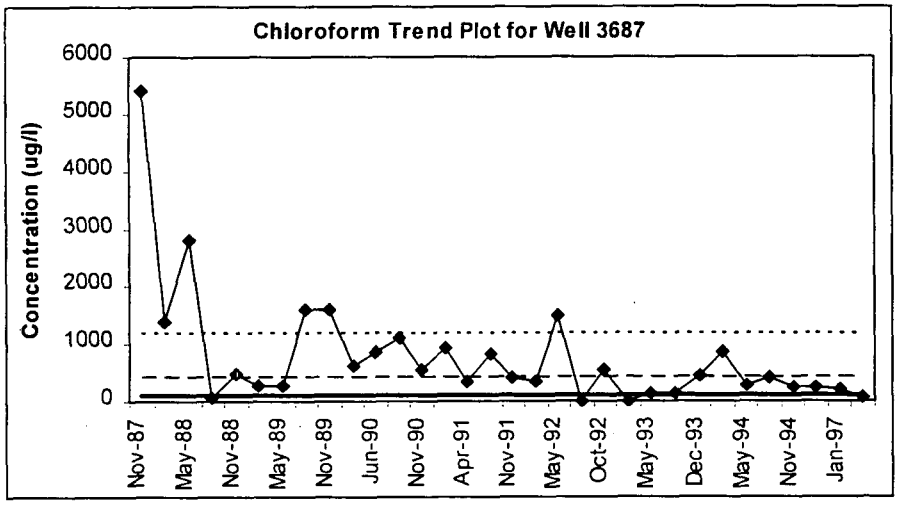

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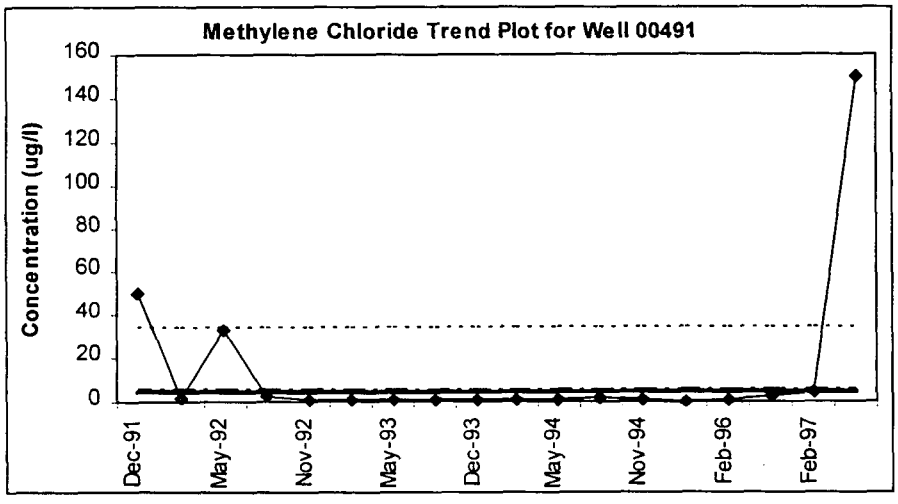
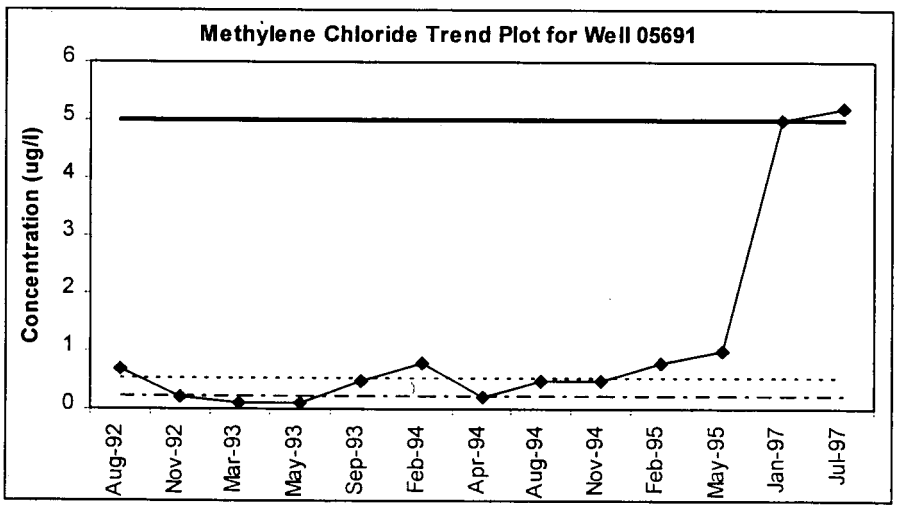


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-25



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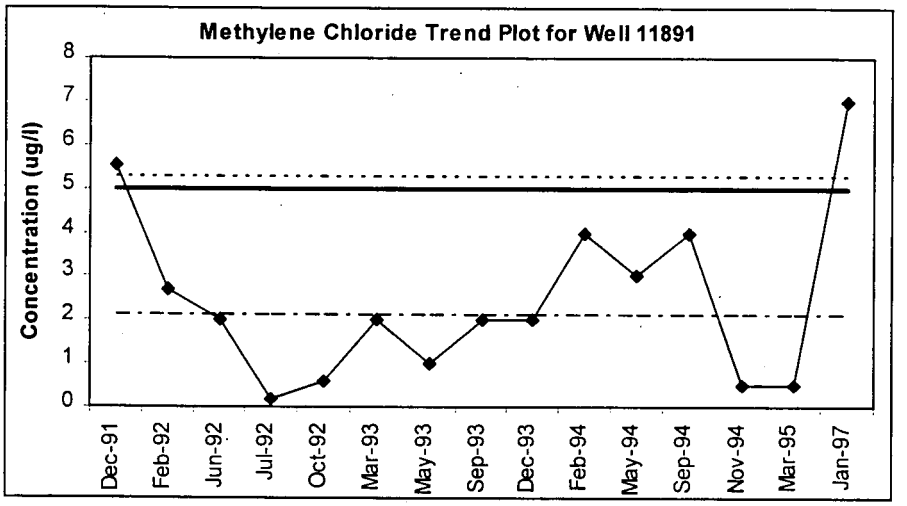

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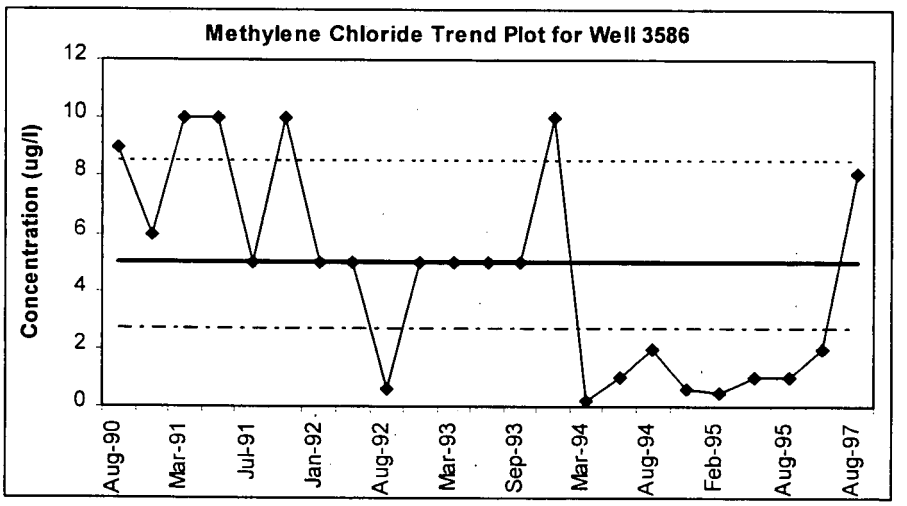
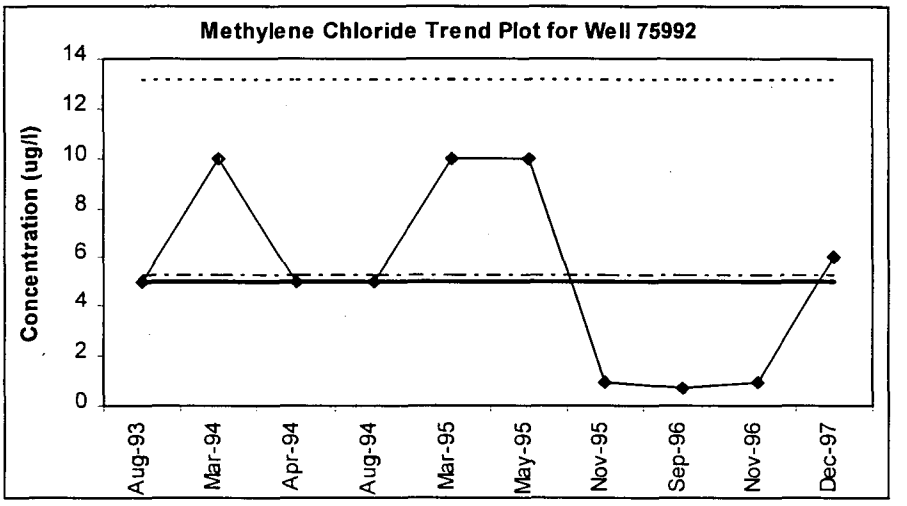


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-28



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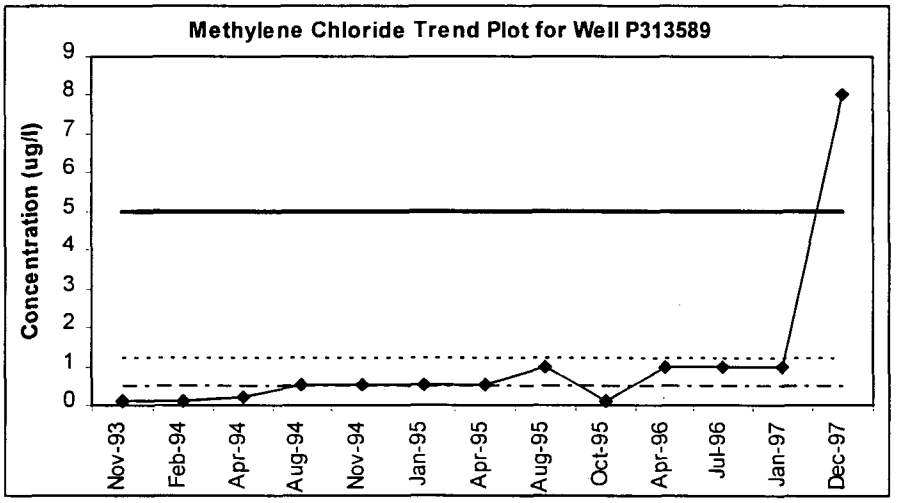

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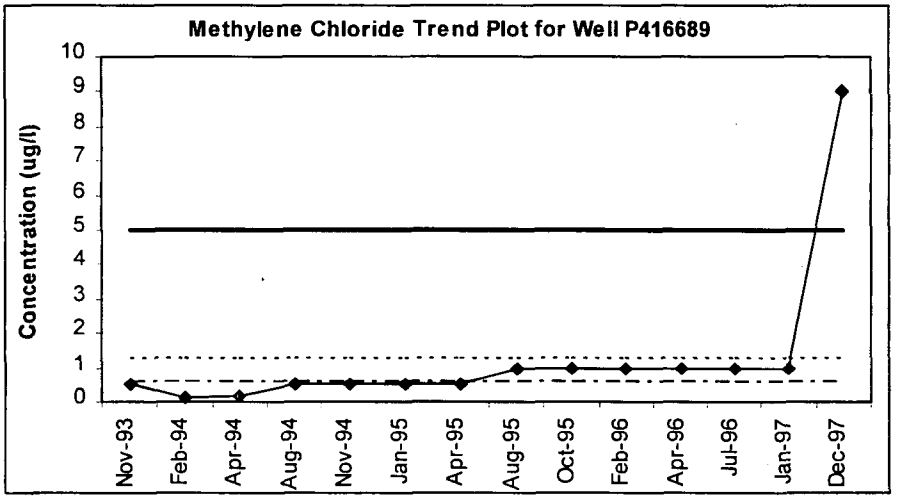

Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

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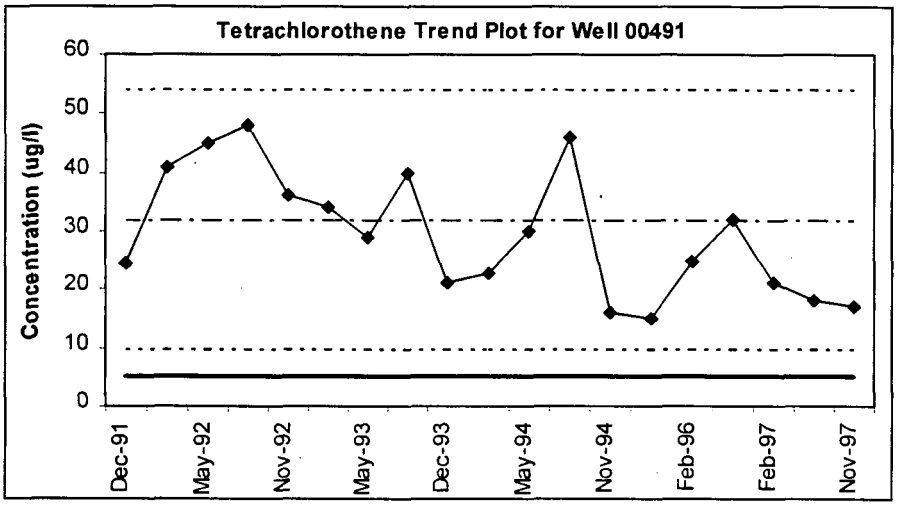

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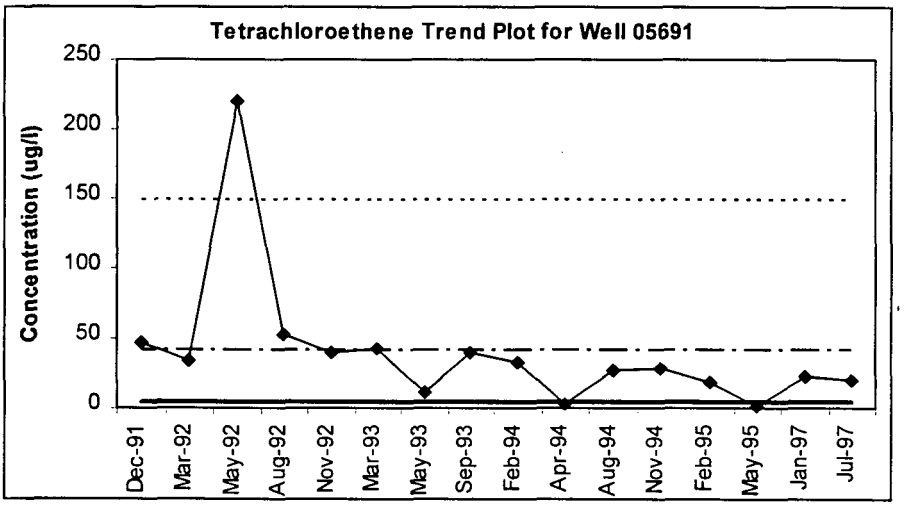

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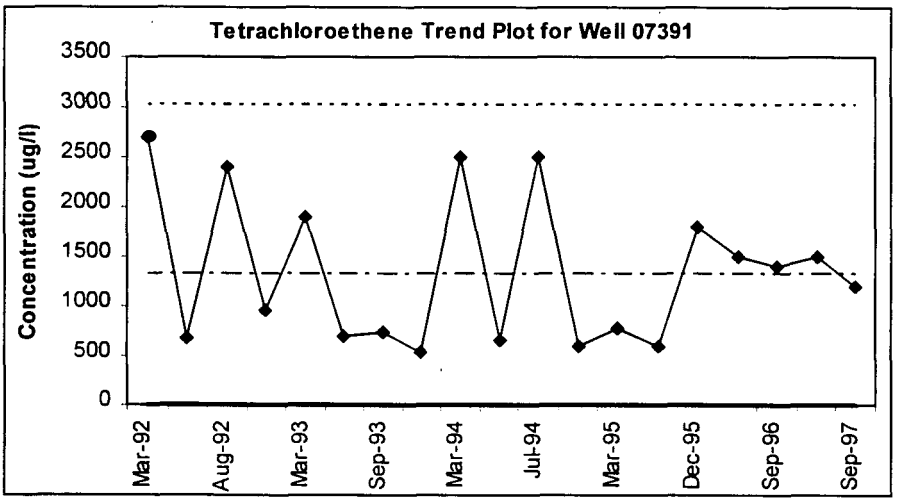

Dash-Dot line = Historic Mean
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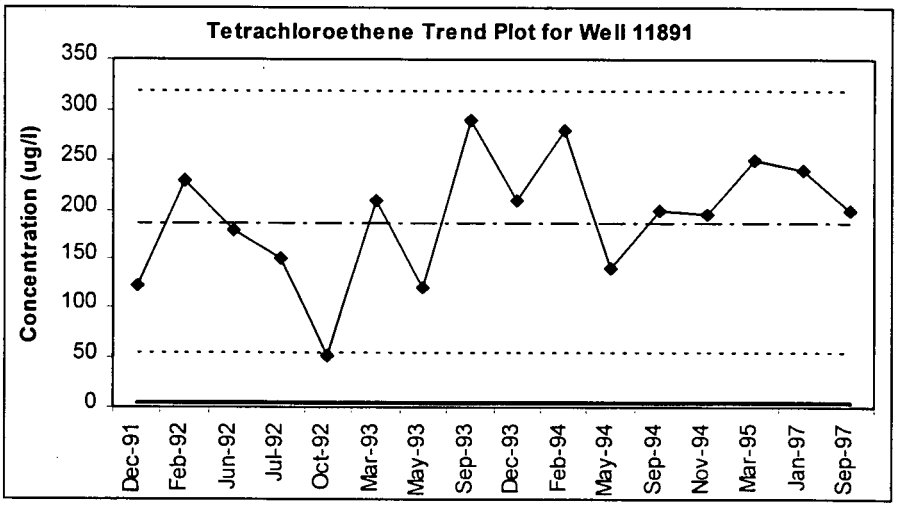
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-34



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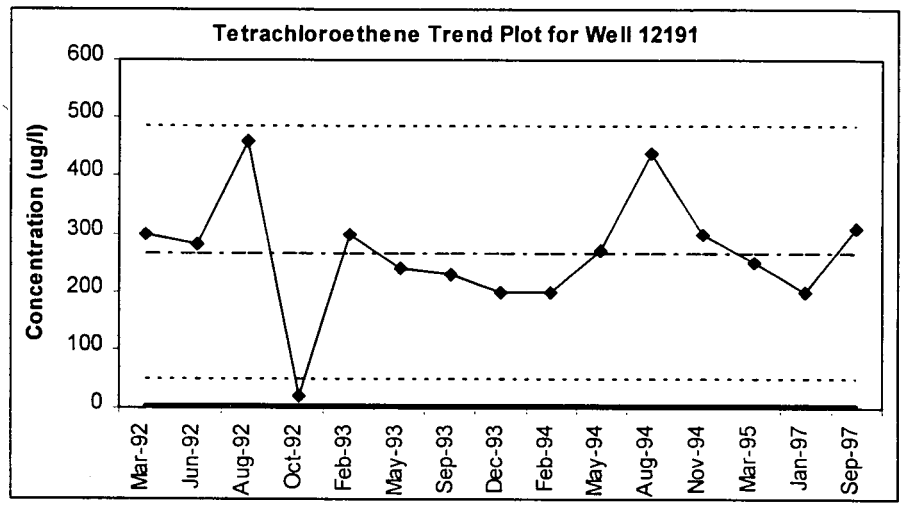

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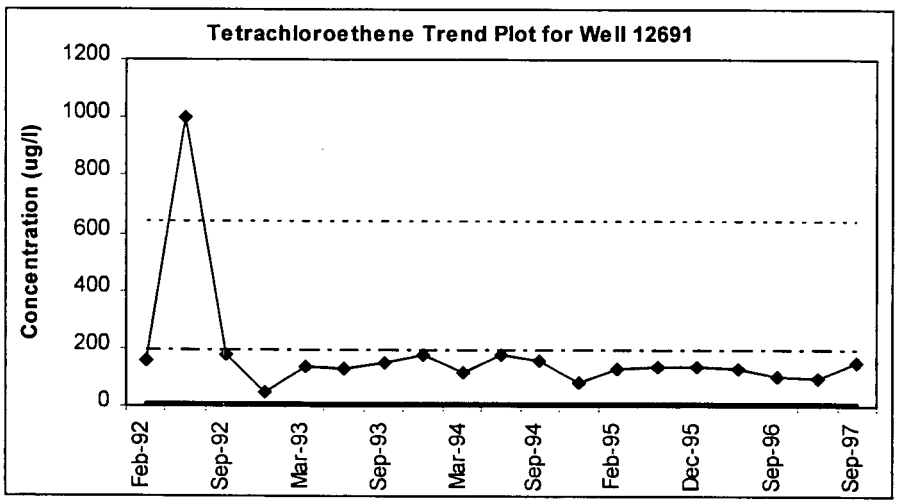
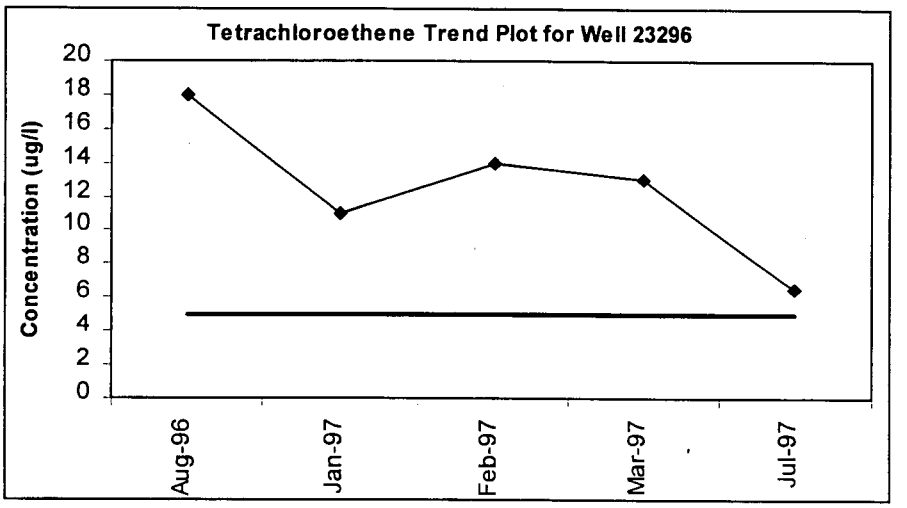


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-37



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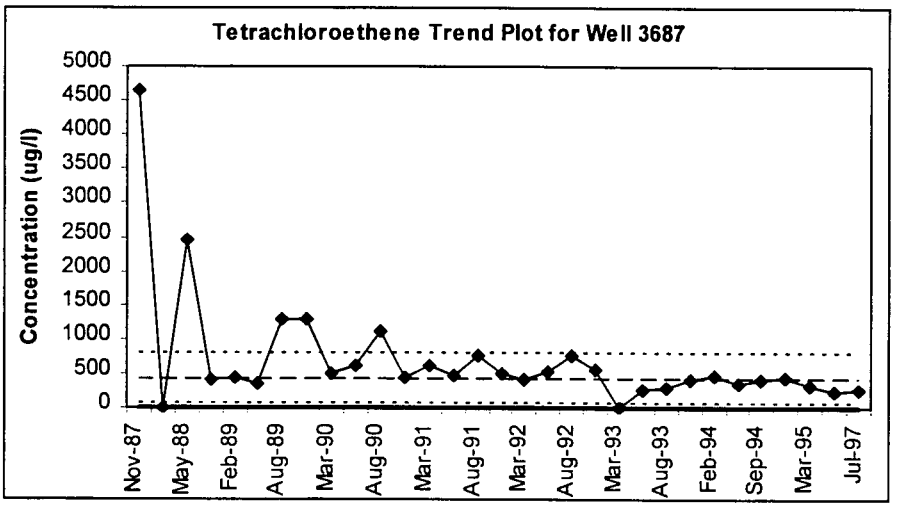

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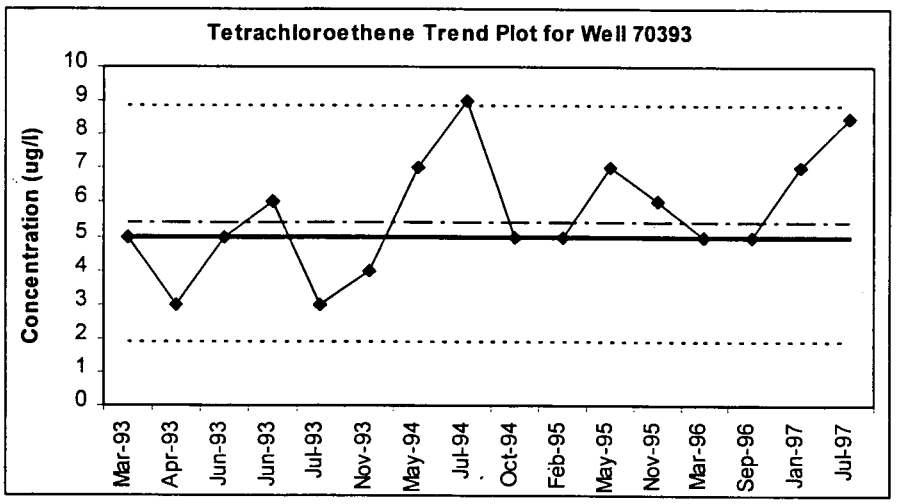
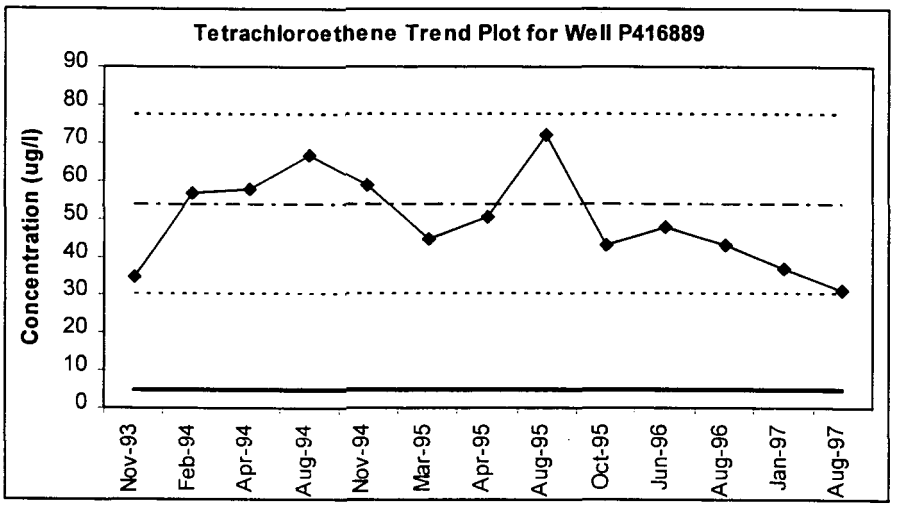


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-40



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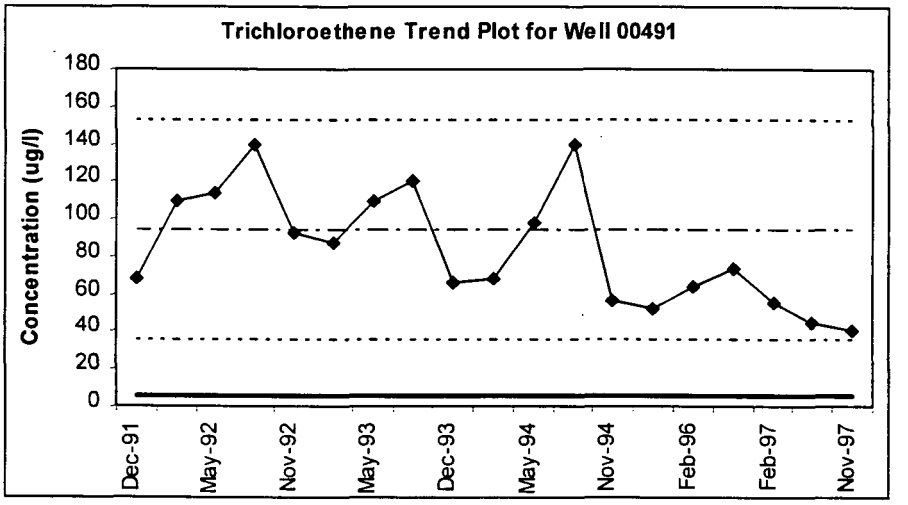

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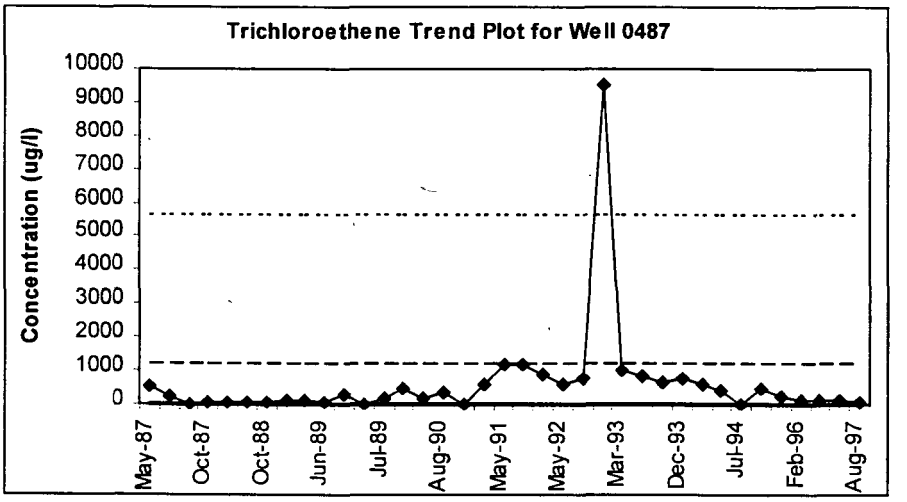
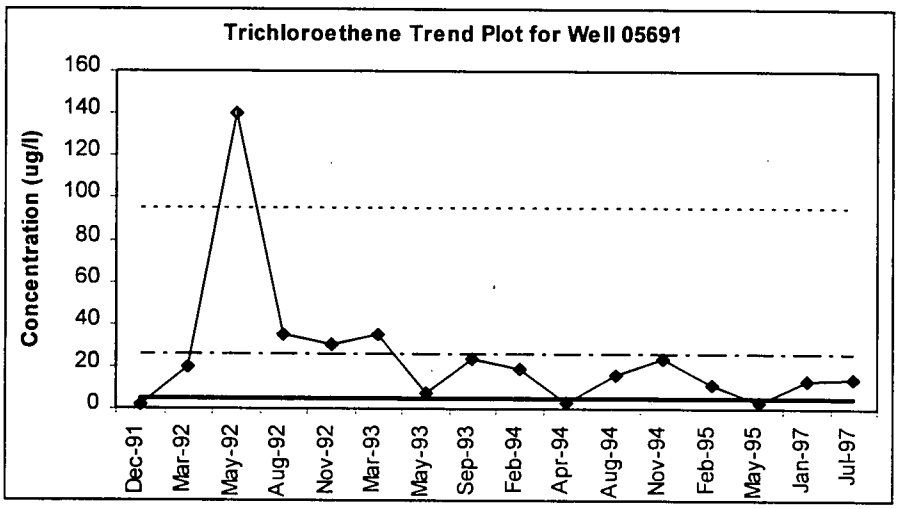


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-43



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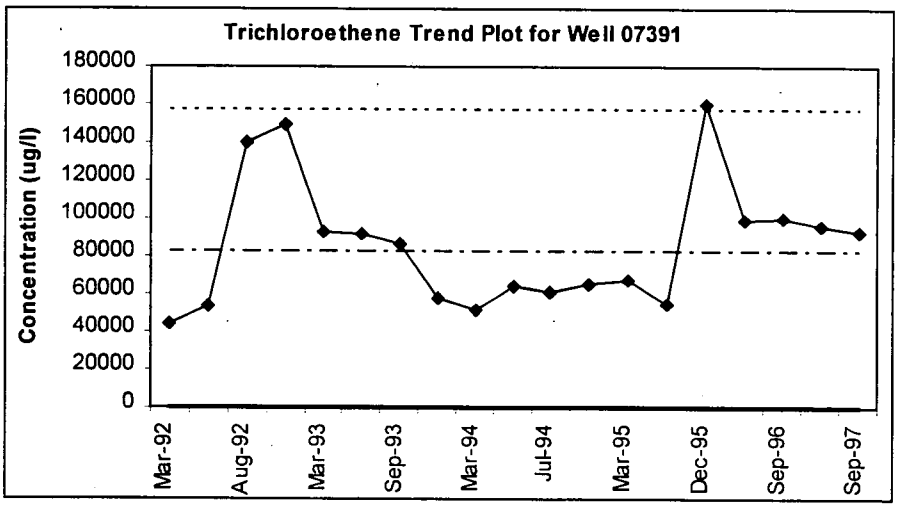

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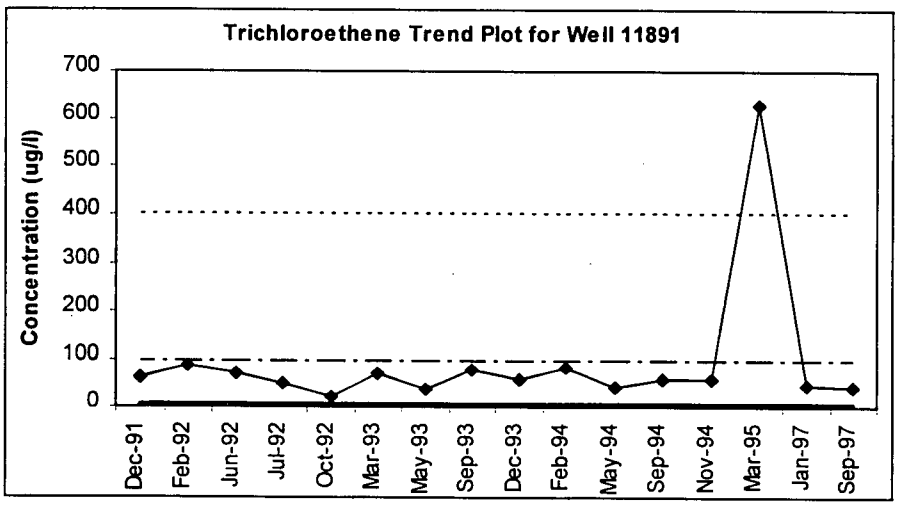
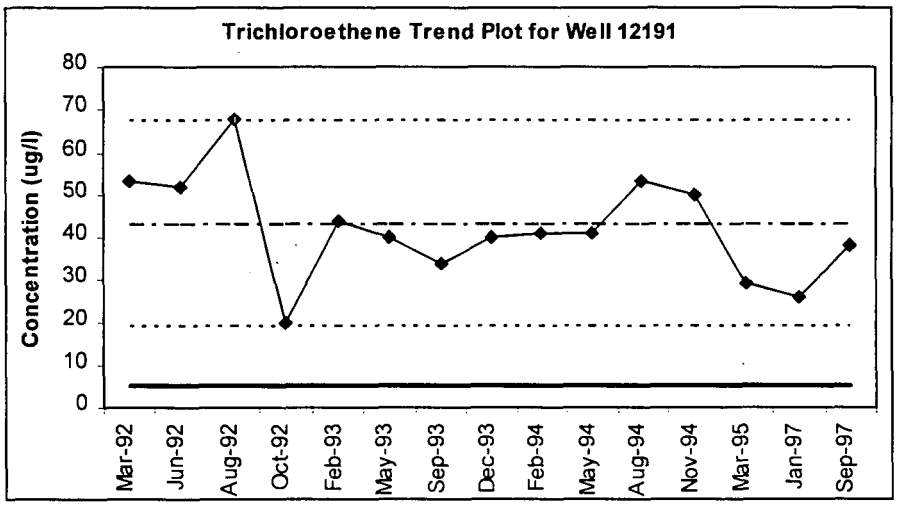


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-46



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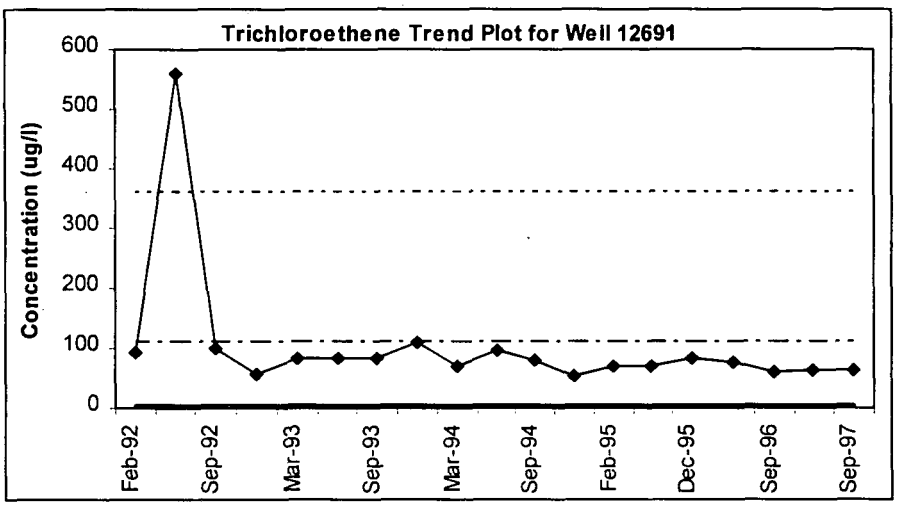

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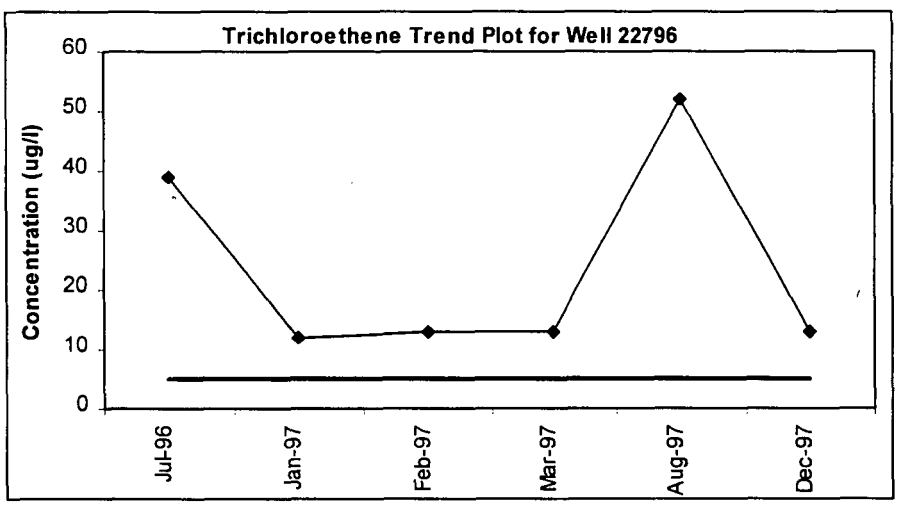
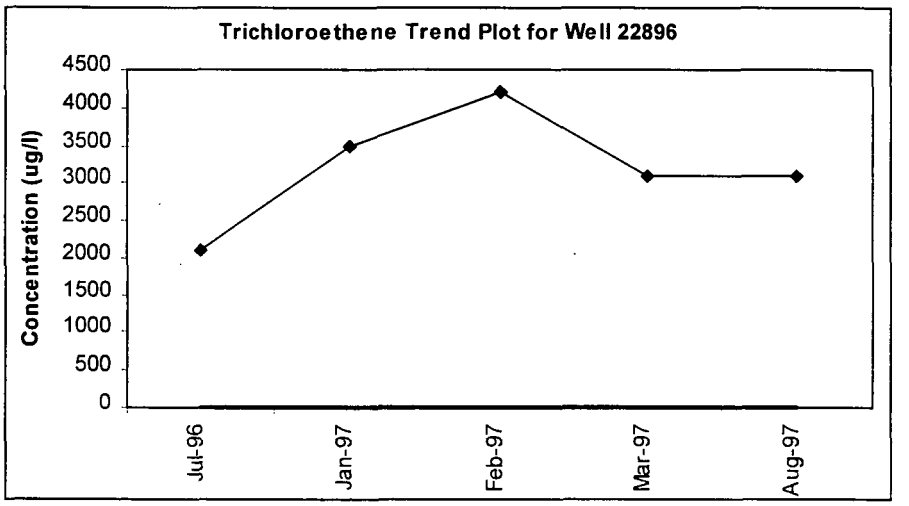


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-49



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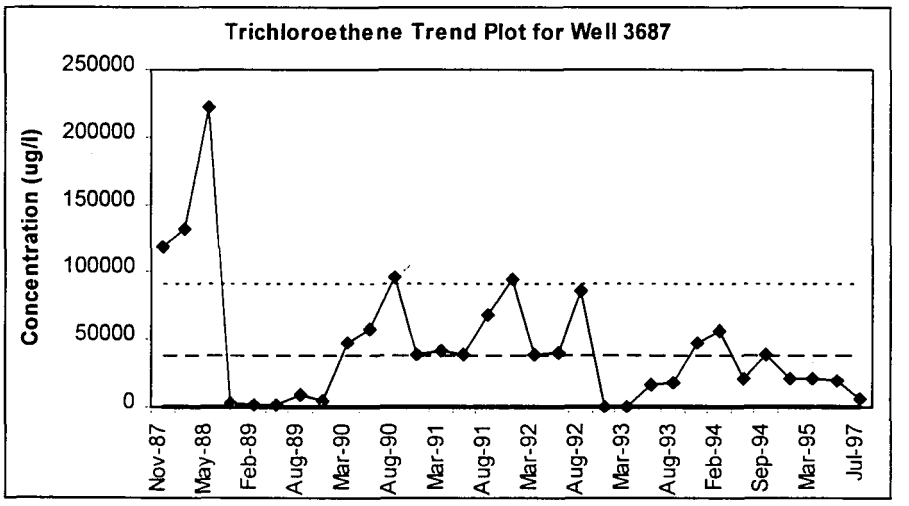

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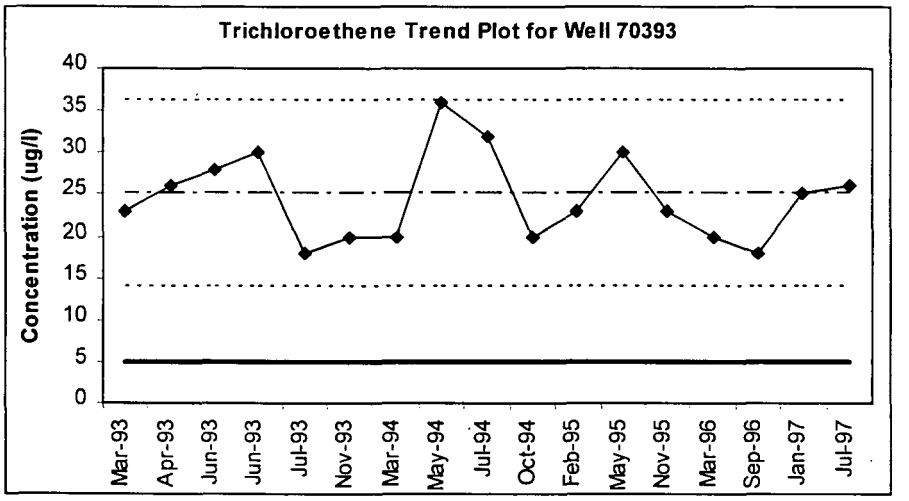
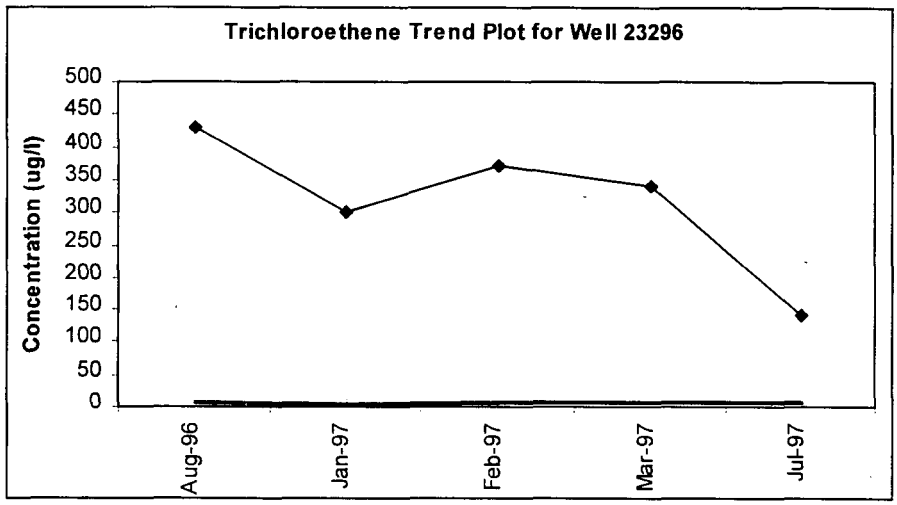


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-52



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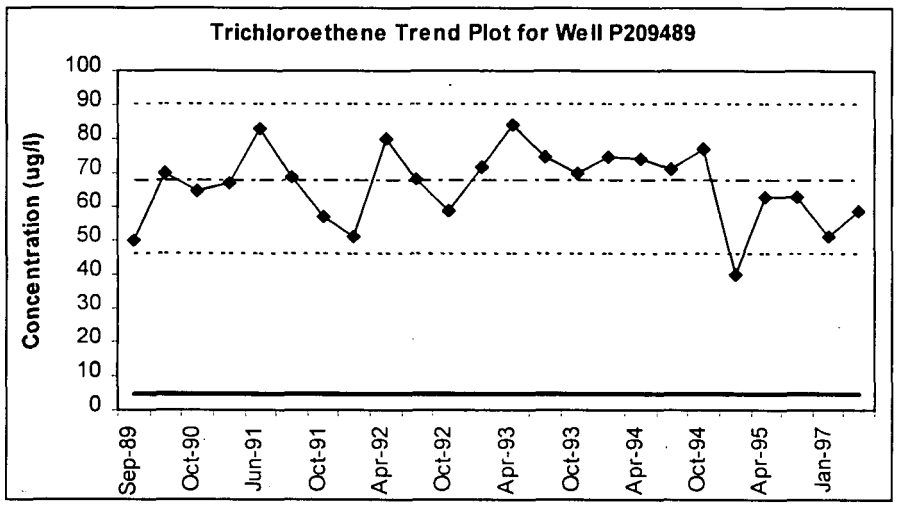

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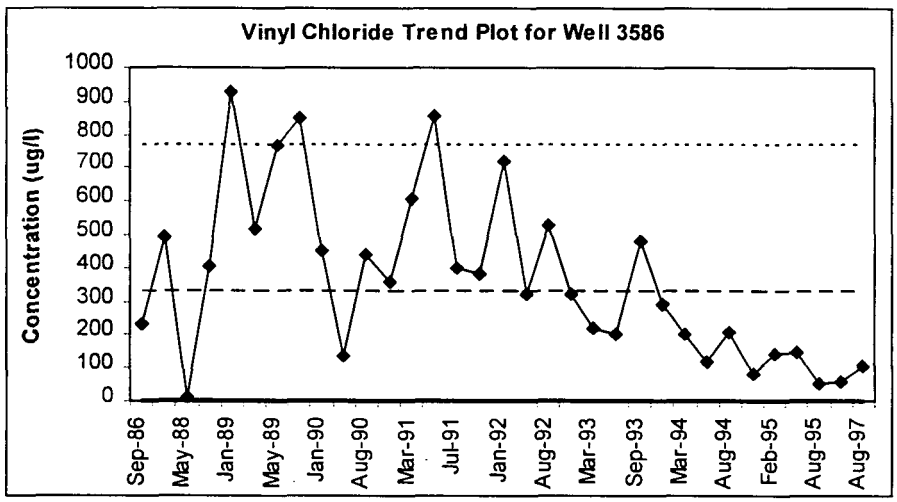
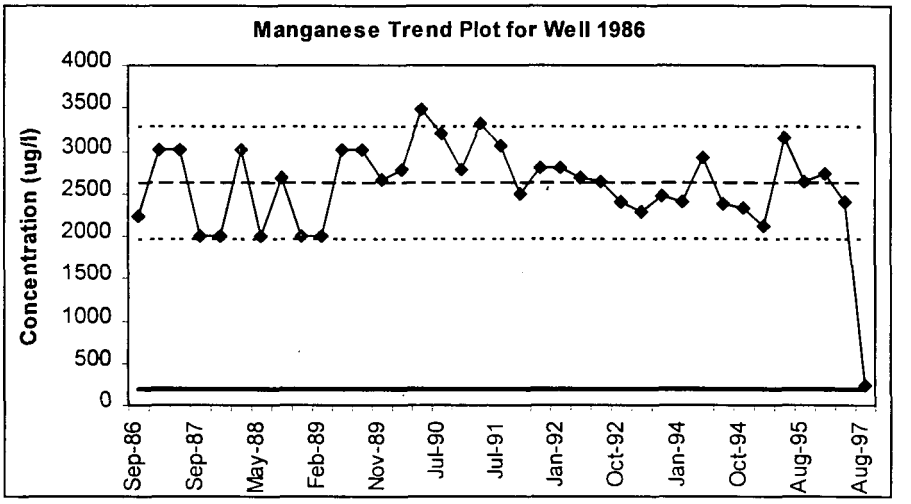


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-55



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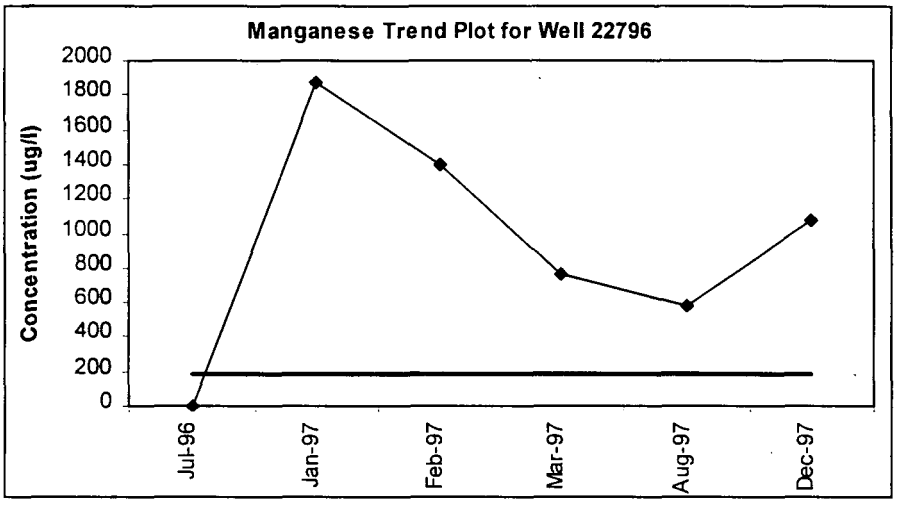

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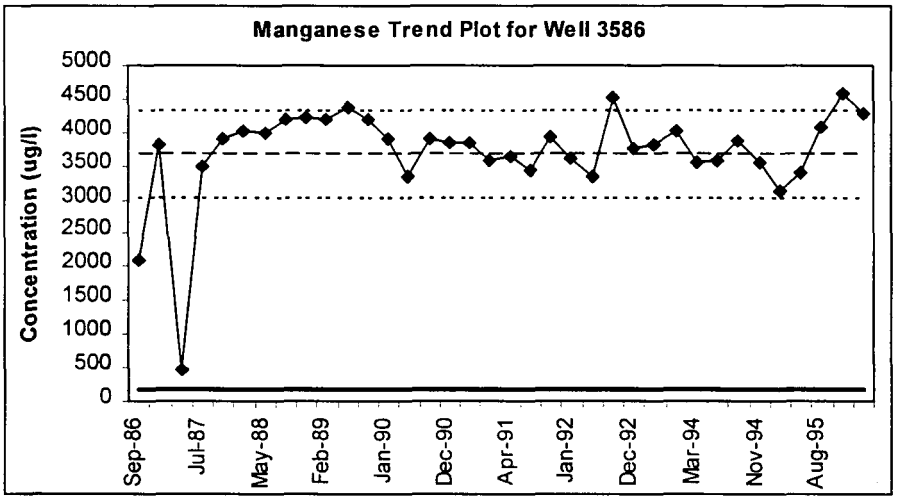
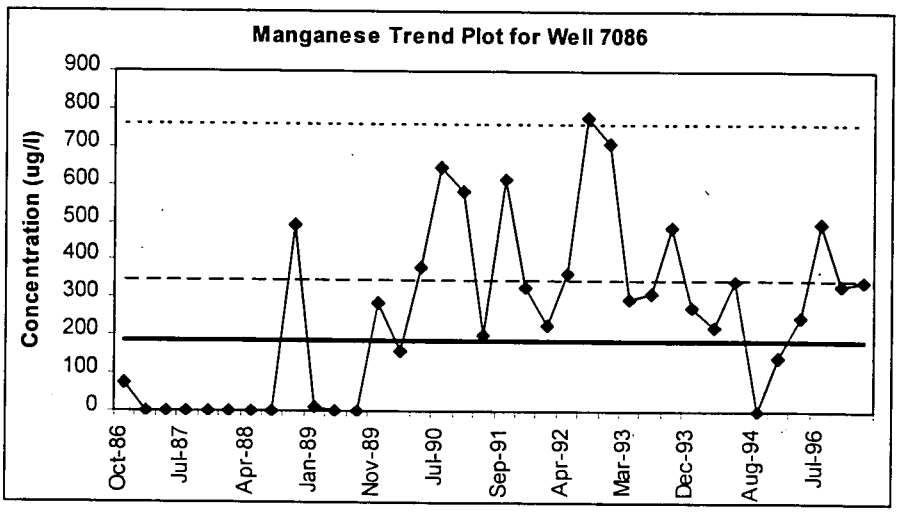


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-58



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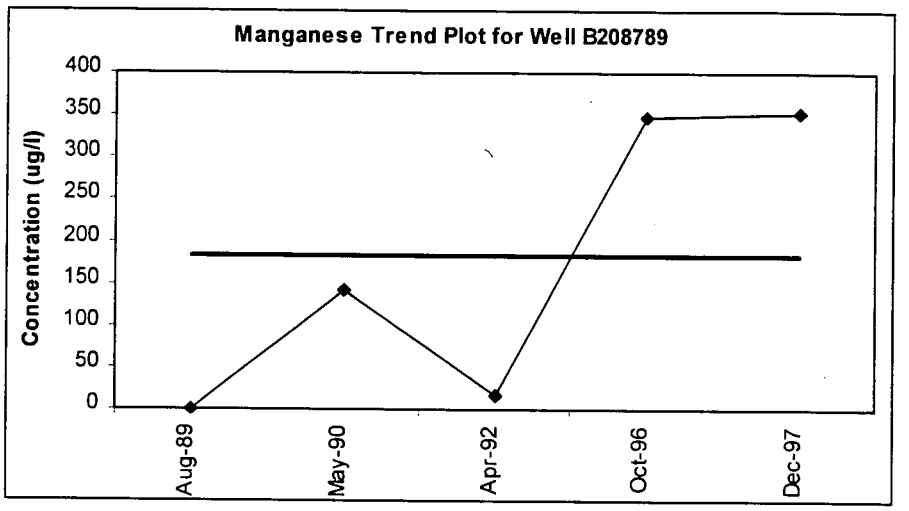

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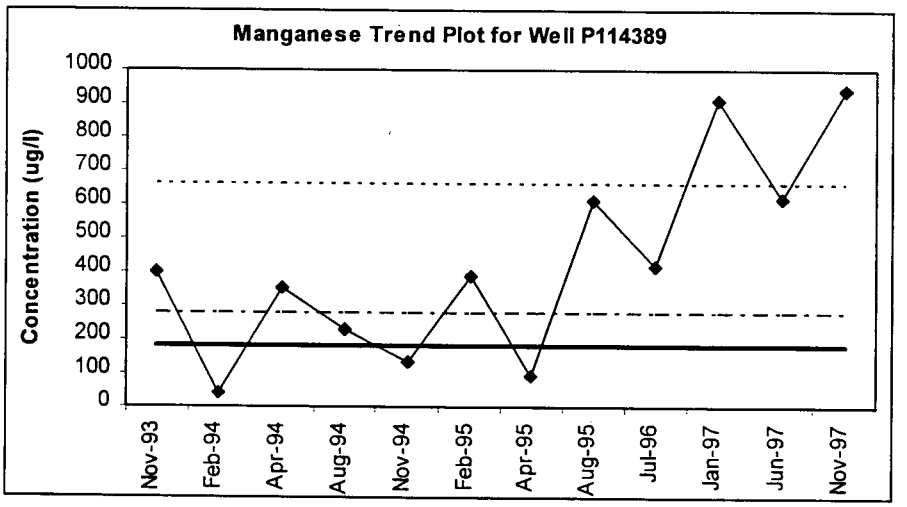
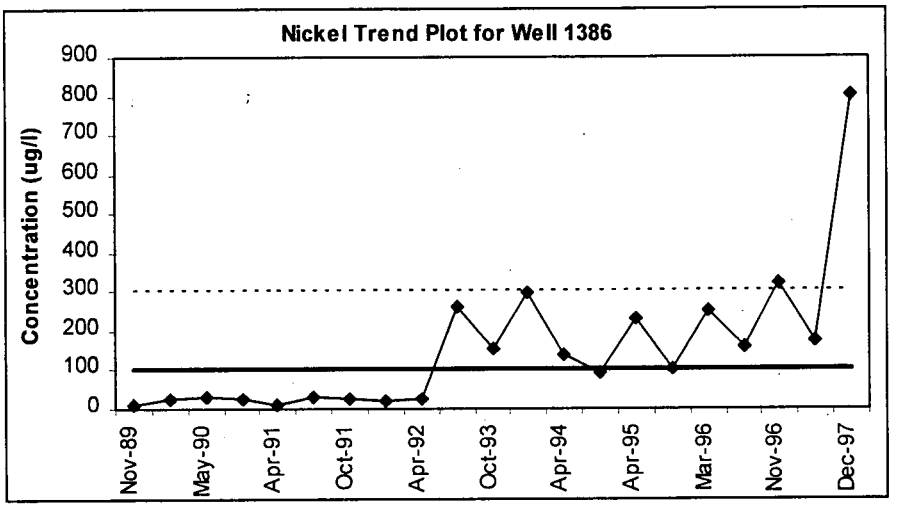


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-61



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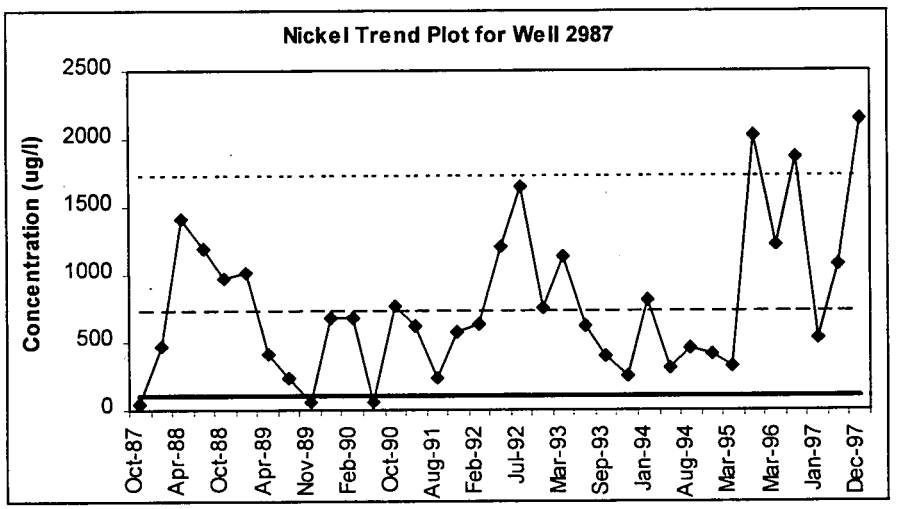

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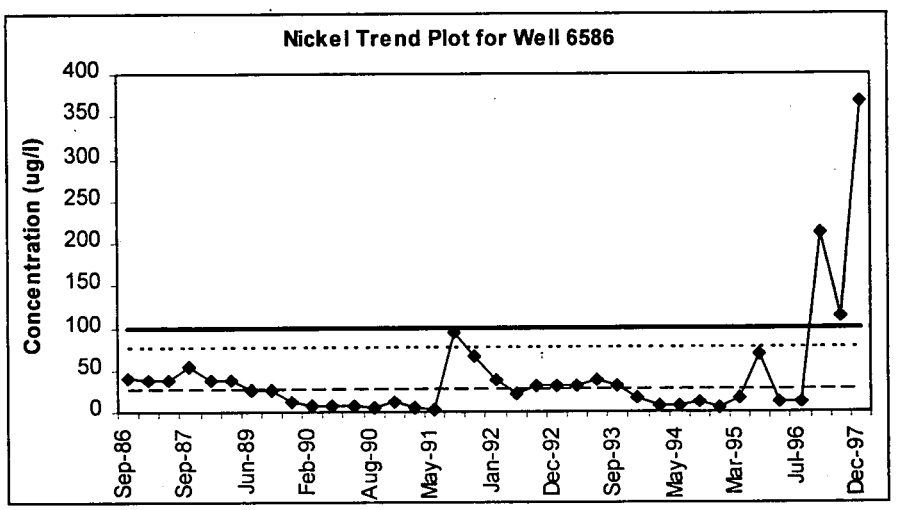
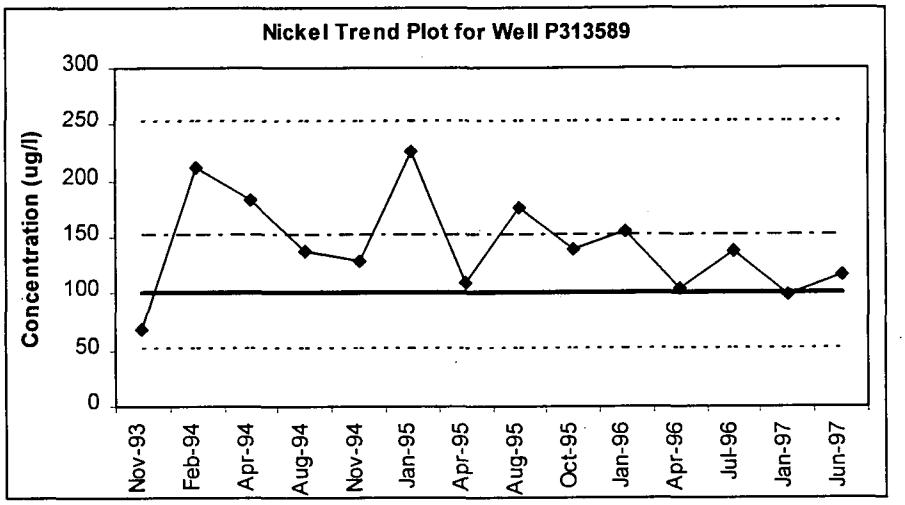


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-64



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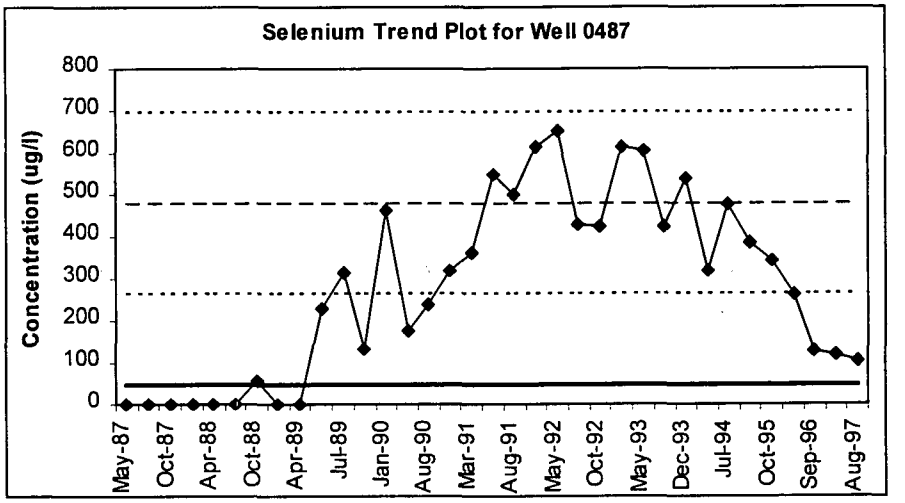

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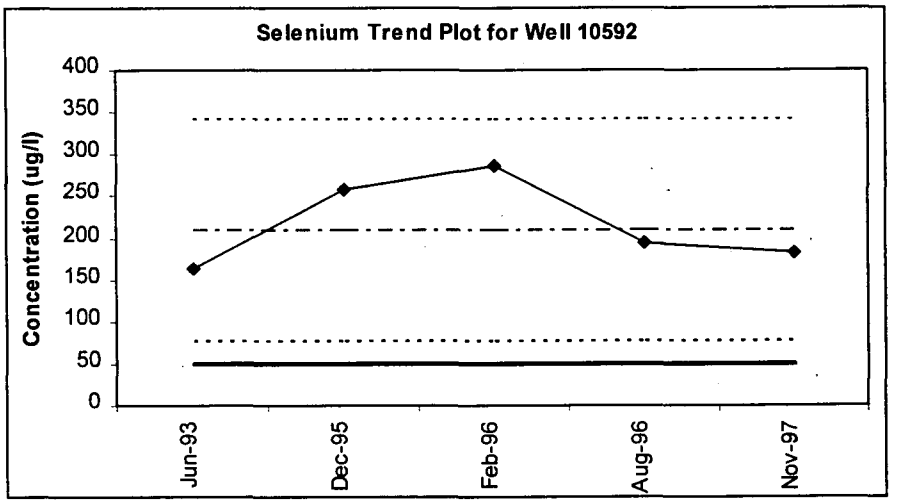
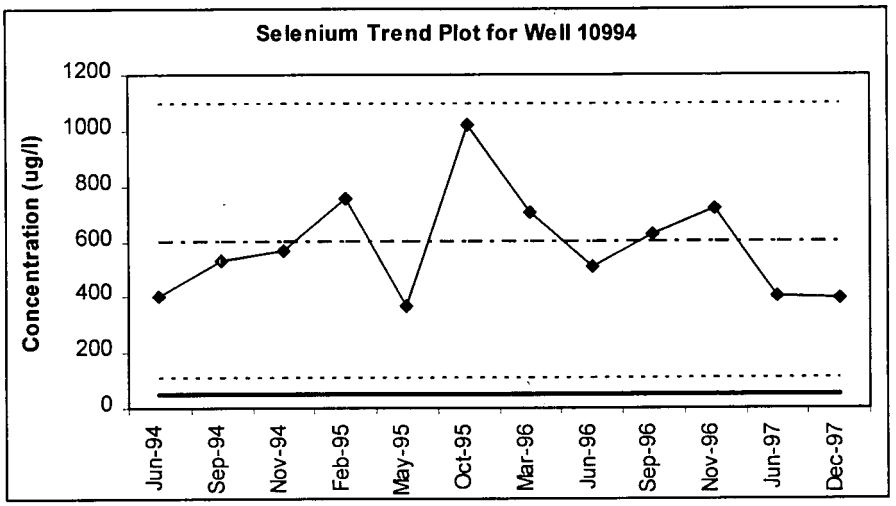


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-67



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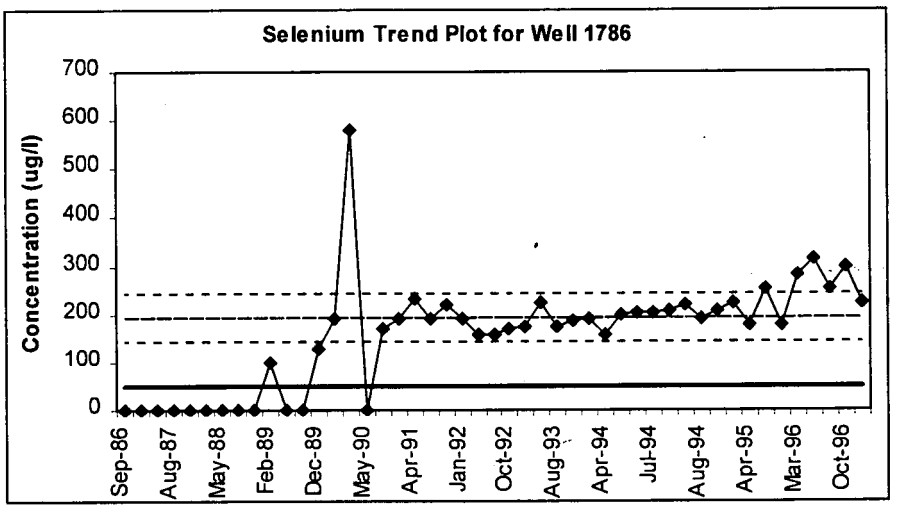

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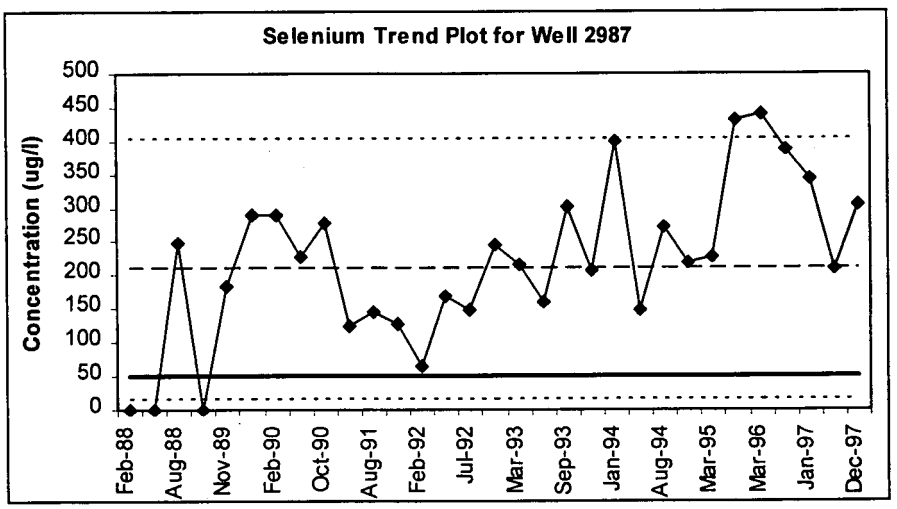
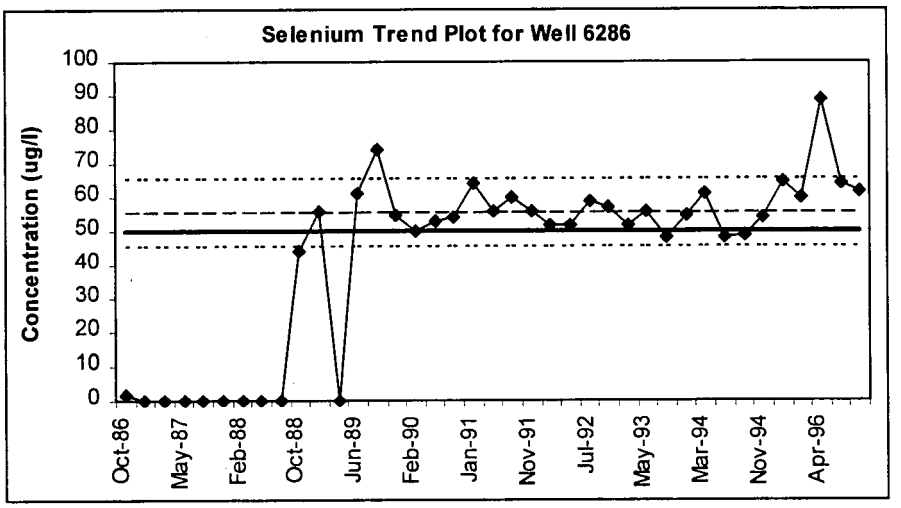


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-70



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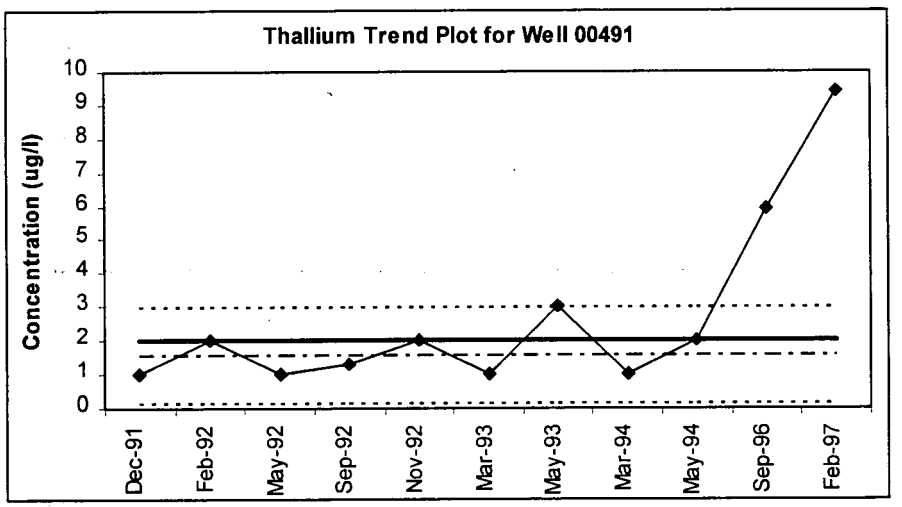

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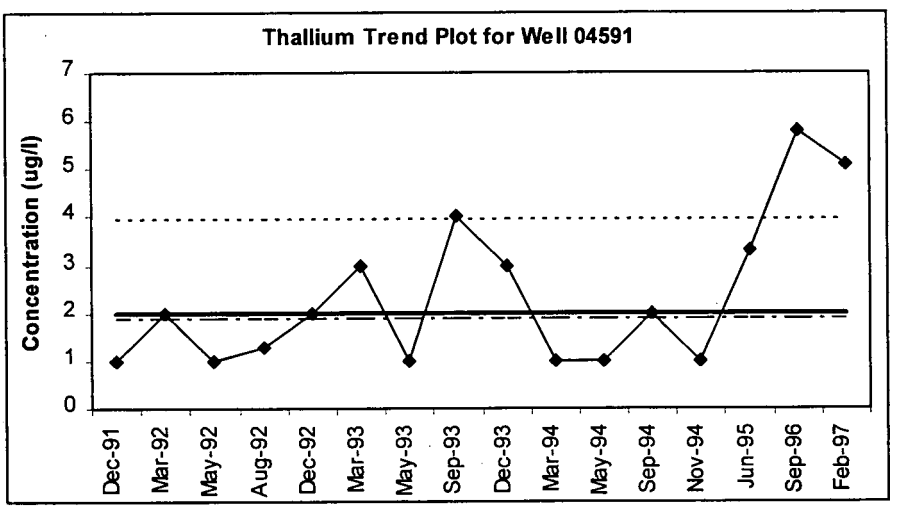
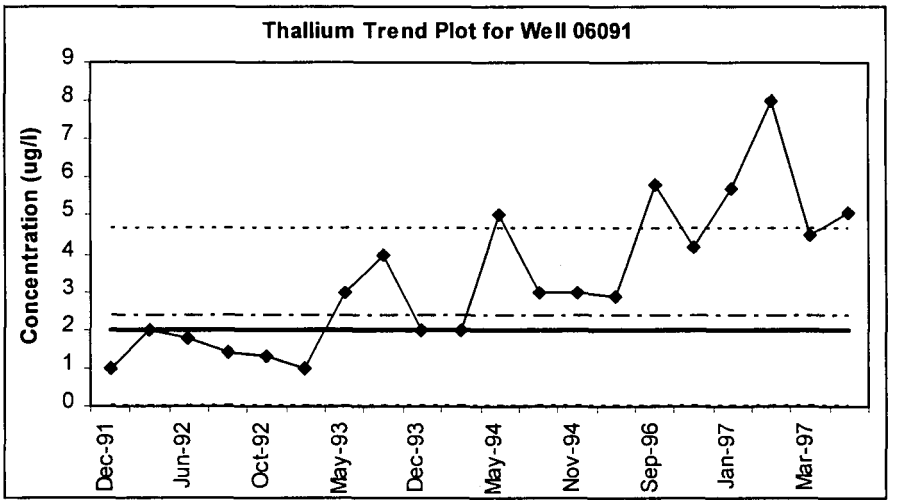


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-73



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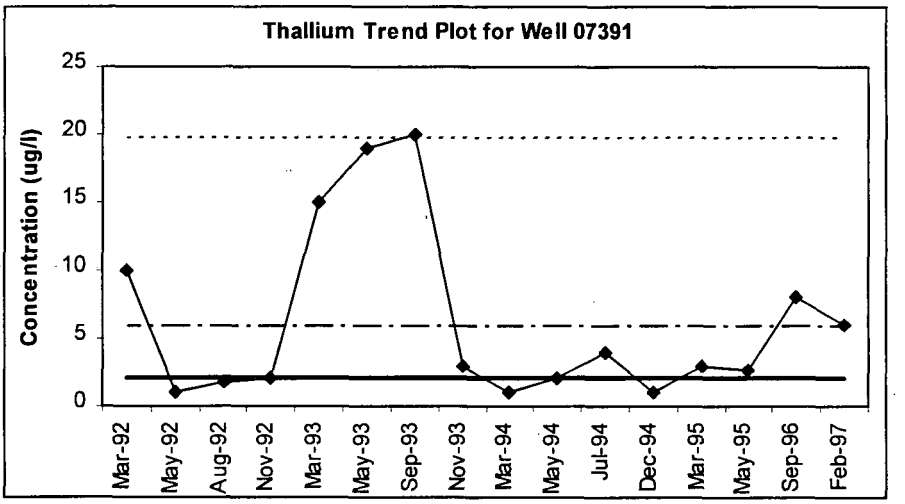

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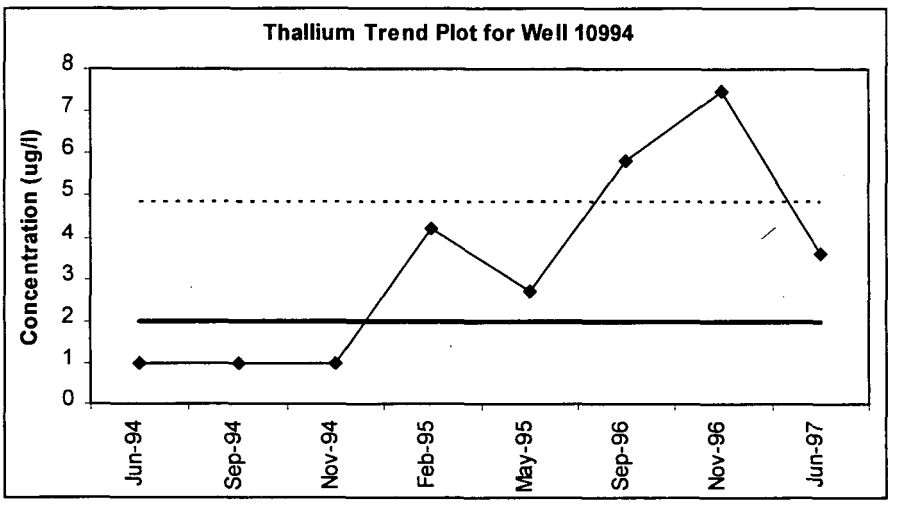
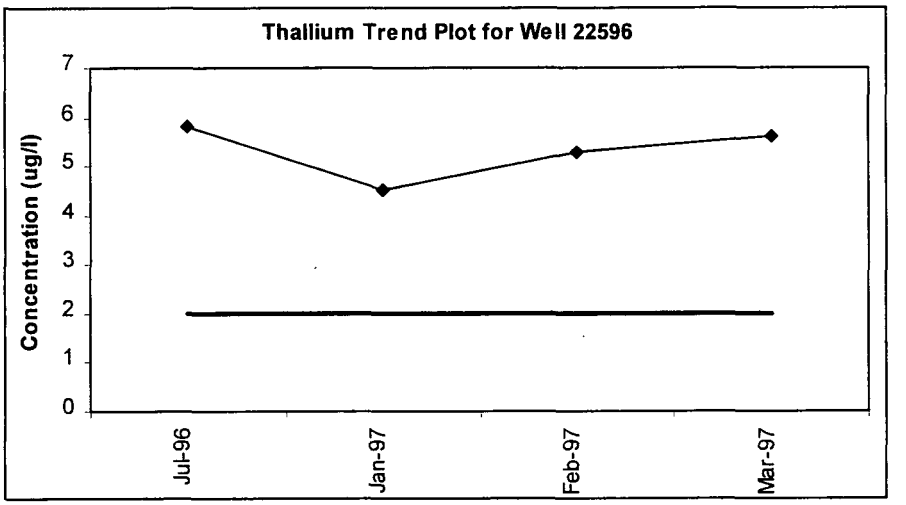


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-76



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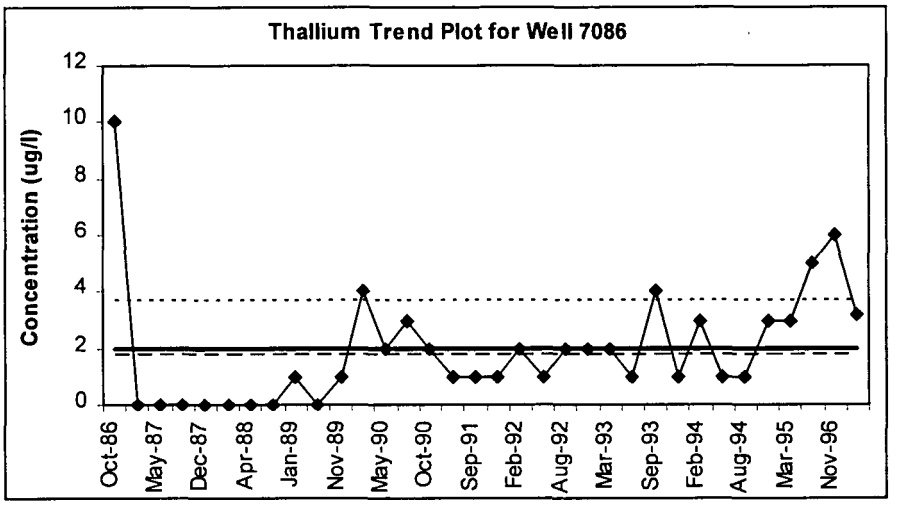

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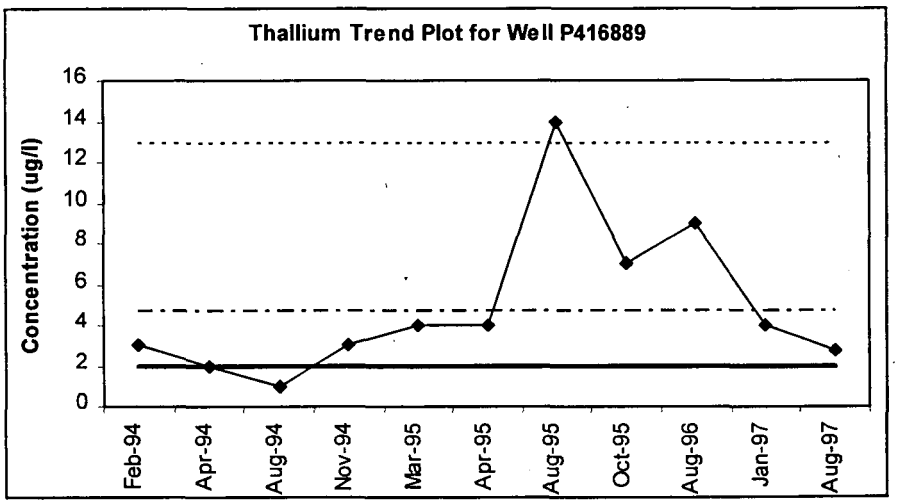
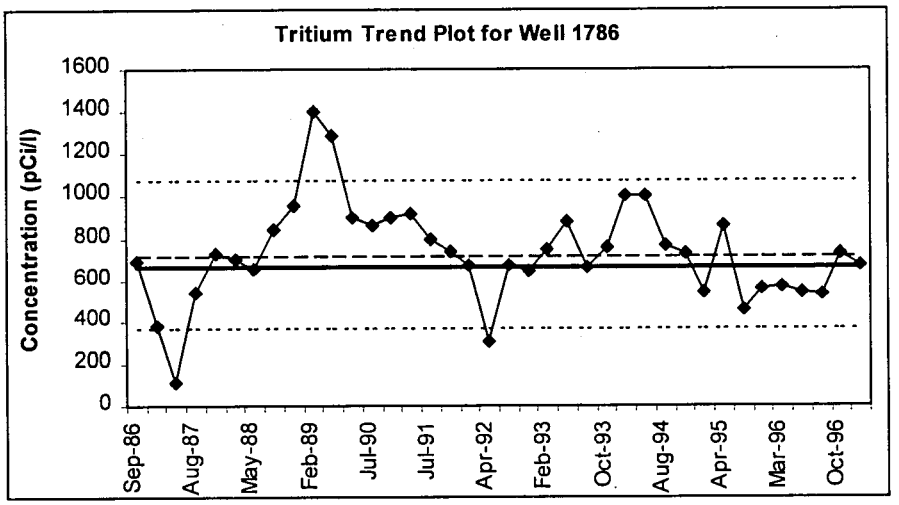


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-79



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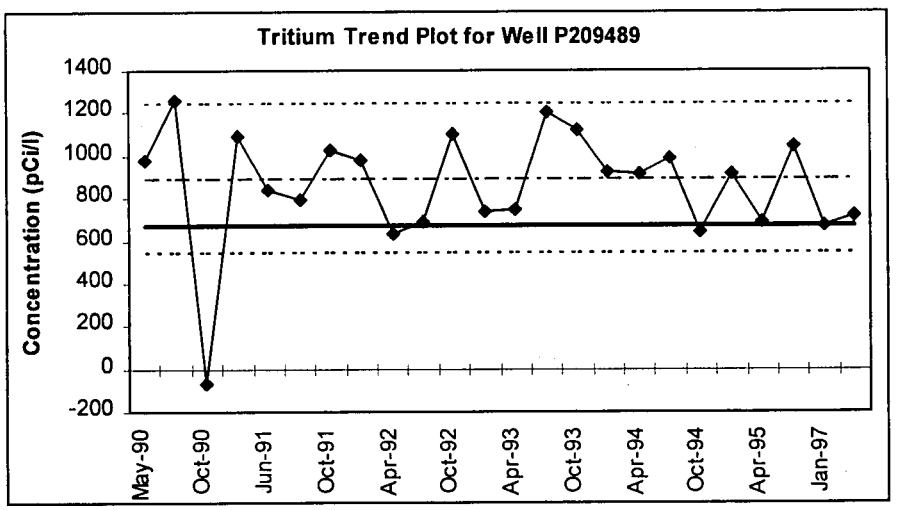

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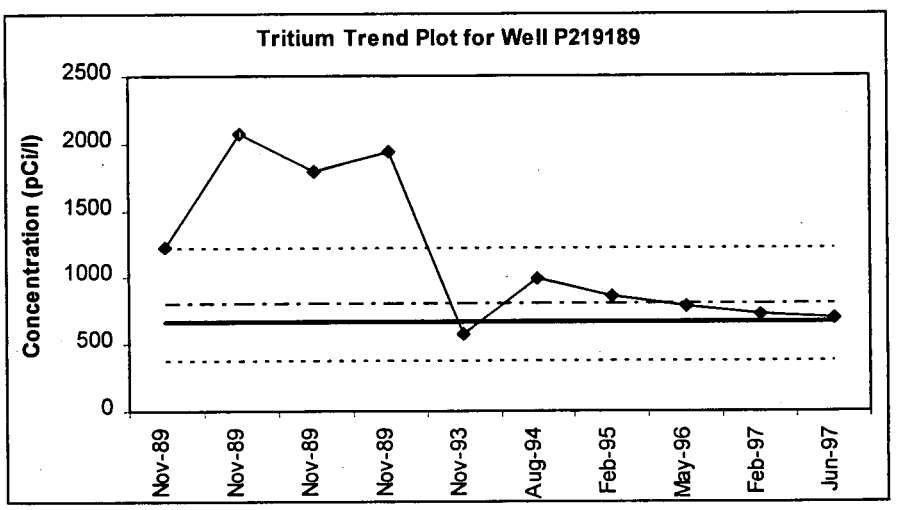
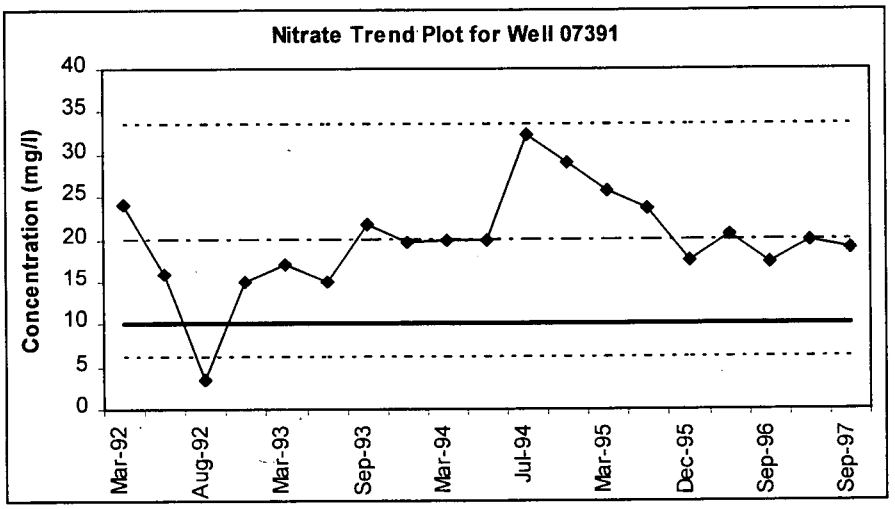


Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-82



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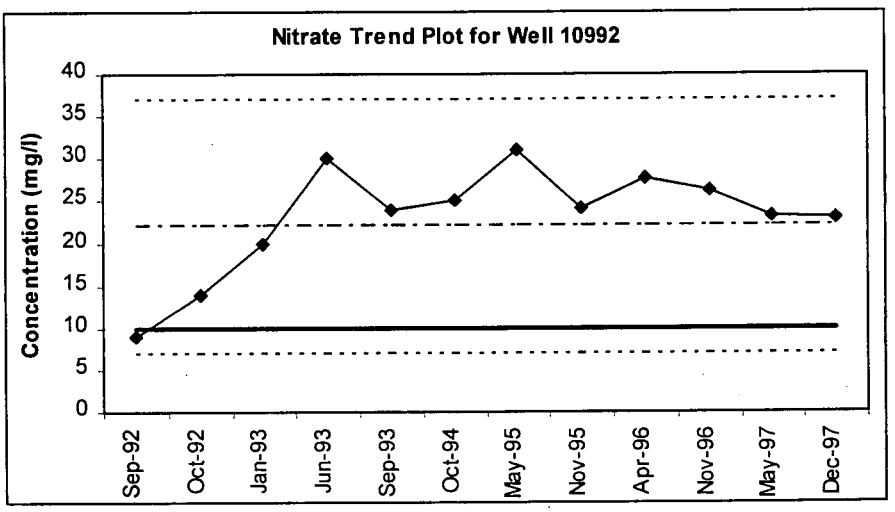

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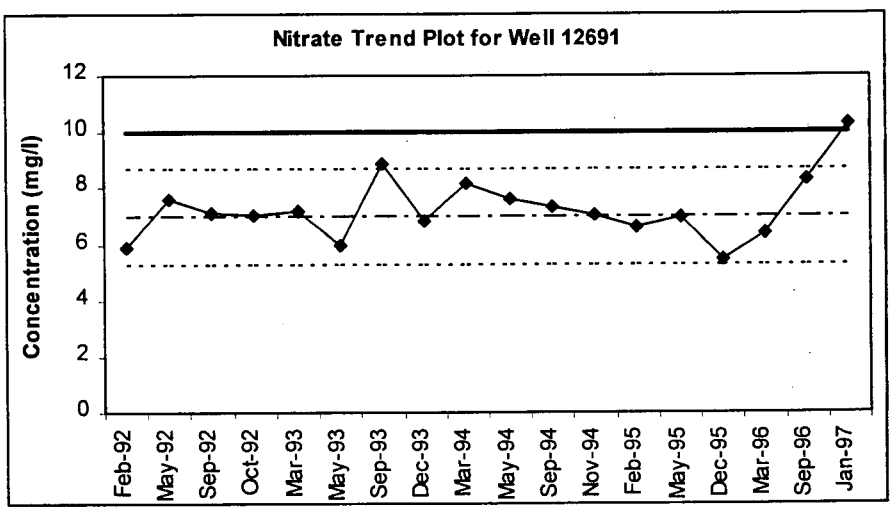
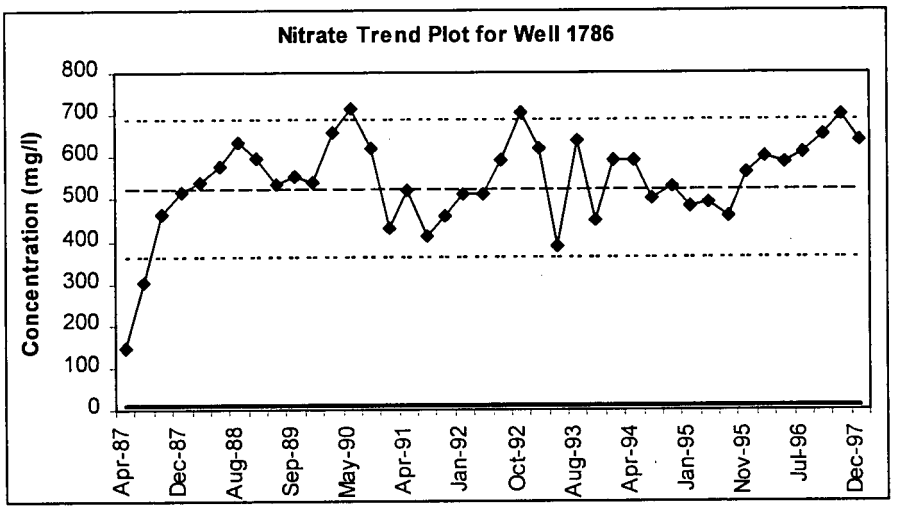


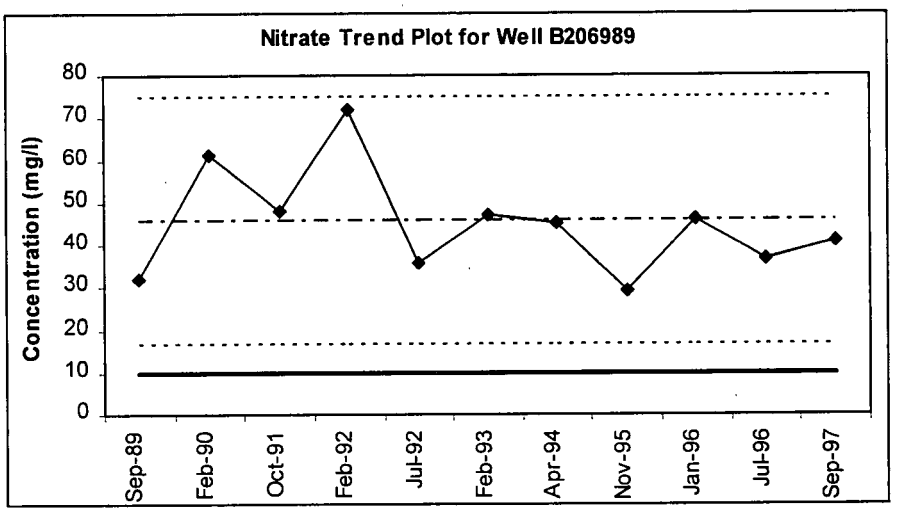
Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

2-85



2-86



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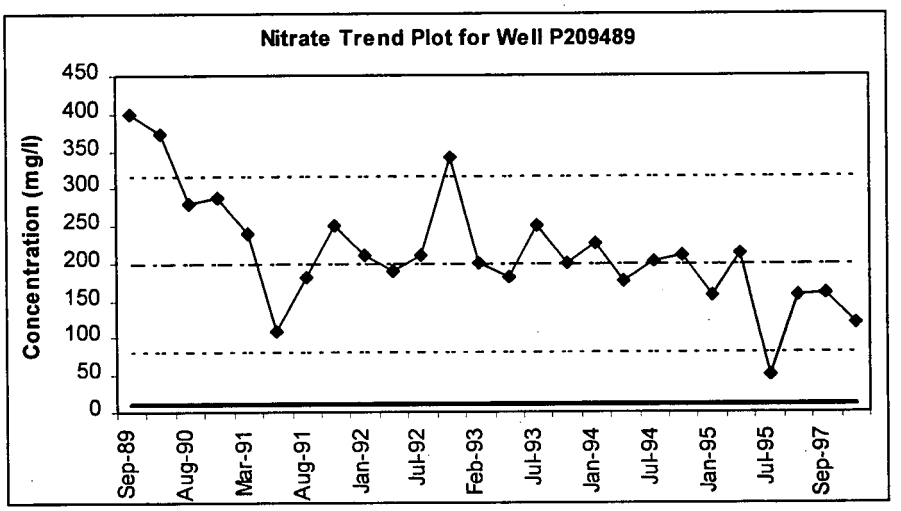
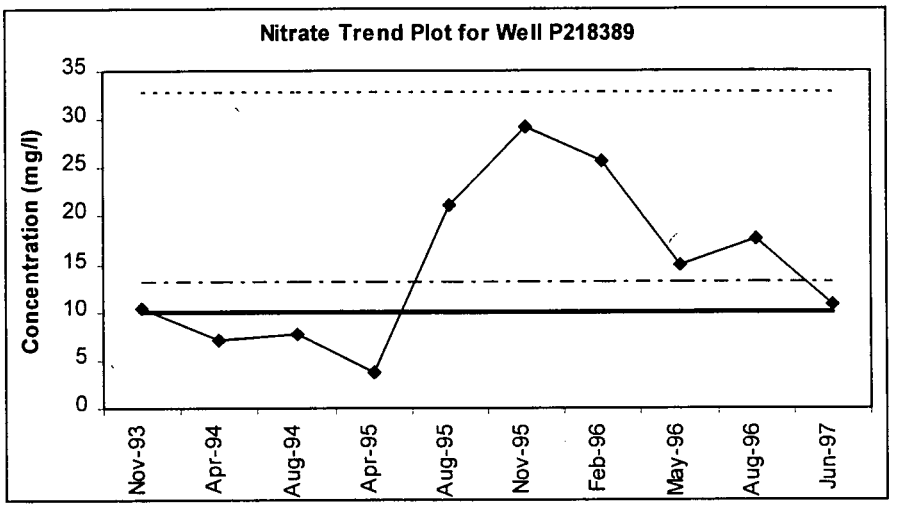


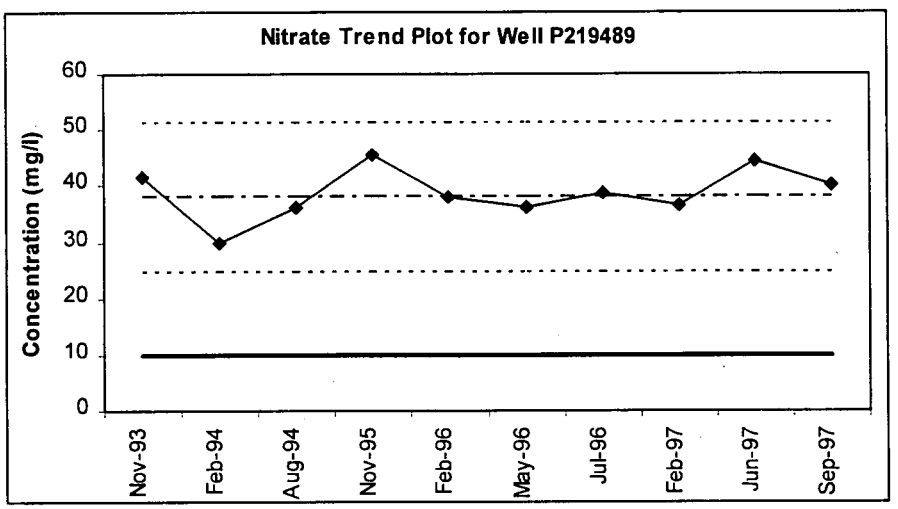
Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

FIGURES 2-1 THRU 2-90. Trend Plots For Selected Analytes and Wells

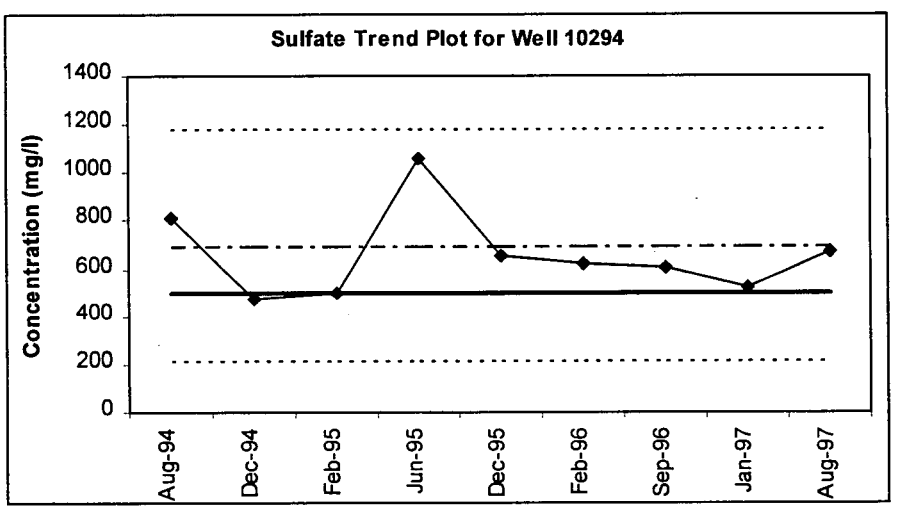
2-88



2-89



2-90



Dash-Dot line = Historic Mean
Short Dashed lines = Historic Mean +/- 2(SD)
Heavy Solid line = Tier II Action Level

3.0 GROUNDWATER FLOW CONDITIONS DURING 1997

Groundwater level data collected throughout calendar year 1997 were reviewed to determine whether significant changes in groundwater flow direction, flow velocity, and quantity have occurred to the upper hydrostratigraphic unit since 1996 and previous years. This review included evaluations of semiannual potentiometric surface maps, quarterly well pair velocity calculations, selected well hydrographs, and water level change maps. Comparison of the 1997 data to historical potentiometric surface maps (from previous annual reports) and historical water level trends presented in the individual well hydrographs provide a framework for identifying the type of potentiometric configurations, seasonal fluctuations, and long-term trends typically associated with pre-1996 plant operations. The 1996 data set, because it is the last year before the commencement of D&D activities, comprises a sitewide baseline that will be used for assessing annual changes to the groundwater flow system during the remaining years of plant closure and post-closure monitoring.

3.1 Potentiometric Surface Maps

Groundwater potentiometric surface maps (Plates 2 and 3) were constructed from water level data collected during the second and fourth quarters (April and October data, respectively) of 1997 for the unconsolidated surficial deposits and selected weathered bedrock components comprising the UHSU. These maps provide information on groundwater flow direction and saturated extent that were used in the selection of well pairs for velocity calculations and definition of plume extent and movement. For map construction, it was assumed that well construction details, borehole logs, and water level measurements were accurate. When the measured depth to water was below the bottom of the well screen, the well was assumed to be dry.

Maps constructed for the UHSU were based entirely on data from fully penetrating wells screened in surficial deposits thought to be representative of regional shallow groundwater flow conditions. For this reason, wells completed in perched alluvial groundwater zones, such as wells 50494 and 51594 located west of the IA, were not utilized for construction of potentiometric contours. Information on unsaturated areas from previous UHSU potentiometric maps, particularly the 1993 maps, were used in the construction of the second and fourth quarter 1997 maps. Historically unsaturated areas were evaluated and reconfigured utilizing new monitoring well coverage (i.e., IA IM/IRA wells) and recent water level data. Shaded, non-contoured areas of the maps indicate areas where well coverage is absent.

The configuration of the potentiometric surfaces for the second and fourth quarters of 1997 generally matches the configurations depicted for earlier quarterly maps. Conceptual refinements were made in areas with new well coverage and at the west boundary of the Site where the Laramie-Fox Hills Sandstone subcrop forms a north-south oriented barrier to alluvial groundwater flow. In this area, it is also believed that the Laramie-Fox Hills Sandstone functions as a bedrock recharge sink for alluvial groundwater, hence the steeper hydraulic gradients shown between the Site west boundary and Laramie-Fox Hills Sandstone subcrop zone (delineated approximately by the alignment of gravel mine pits).

Plant operations have potentially impacted groundwater flow patterns in areas where potentiometric contours appear to deviate from topographic or bedrock topographic configurations. For example, a prominent and persistent eastward distention of the 6,000 through 6,040-foot contour lines in the west IA deviates significantly from the pattern expected from the surface topography. The coincidence of this broad, mound-like feature within an industrialized portion of the Site suggests that a greater amount of recharge is occurring in this area compared to background areas with similar geologic conditions situated to the north and south. Likewise, the convergence and/or redirection of potentiometric contour lines in the immediate vicinity of Buildings 371, 771, 881, 885, and 997 suggest that foundation drains have localized impacts on groundwater flow in the IA. Unsaturated areas shown on the 1997 maps were generally less extensive than drawn on the 1996 maps (which were a reflection of the 1993 maps). This condition probably reflects the effects of higher than average precipitation at the site for the period of 1995 through 1997, in addition to improved sitewide well coverage.

3.2 Average Linear Flow Velocities

Average linear groundwater flow velocities (seepage velocities) were calculated for 24 UHSU well pairs within the Industrial Area and perimeter based on flow direction considerations derived from the 1997 potentiometric surface maps. The Darcy equation was used to calculate the seepage velocity (v):

$$v = \frac{K}{n}(dh / dl)$$

where:

K = hydraulic conductivity
n = effective porosity
dh/dl = hydraulic gradient

Values for hydraulic gradient were calculated from quarterly water level measurements made between well pairs located along a groundwater pathway. These well pairs were chosen on the basis of their perpendicular orientation to potentiometric contour lines. Hydraulic conductivity values used for velocity calculations were derived from the geometric mean values reported for the Rocky Flats Alluvium, colluvium, and Arapahoe Formation sandstone (No. 1 Sandstone) presented in Table G-2 of EG&G (1995b). For each well pair, the K value chosen for the calculation was based on the predominant lithologic unit comprising the flow path between the wells. In the absence of measured values of n, a conservative value of 0.1 is assumed based on its predominant usage in previous velocity calculations performed at the Site.

Groundwater flow velocities can be used as estimates of the migration rates for conservative (i.e., non-reactive) groundwater chemical constituents. Because they do not consider the effects of dispersion and chemical reactions (e.g., volatilization, biodegradation, dissolution/precipitation, and adsorption) on the concentrations of constituents along a flow path, seepage velocities approximate only the unattenuated rate of migration for dissolved constituents in groundwater. Attenuated, volatile, biodegradable, or redox-sensitive species will likely exhibit migration rates slower than the average linear velocity of groundwater flow.

Large-scale changes in the hydraulic gradient distribution caused by reconfiguration of the groundwater recharge and discharge regime during plant closure have the potential to impact groundwater flow directions and velocities which, in turn, can affect plume concentration, configuration, and movement. Although actual linear flow velocities at any given well pair are not known with certainty, changes in relative flow velocities, combined with potentiometric mapping and hydrograph analysis, can provide some insight into plume dynamics and movement. Linear flow velocity calculations are sensitive only to the magnitude and direction of the hydraulic gradient, assuming that the assigned values of K and n are kept constant. Temporal analysis of relative linear flow velocities using 1996 as a baseline year is expected to compliment the other available assessment tools (potentiometric and water level change maps, hydrographs, plume extent maps, etc.) in monitoring plume migration toward surface water.

As shown in Table 3-1, the calculated 1997 groundwater flow velocities ranged from approximately 15 feet per year (ft/yr) to almost 500 ft/yr. Linear flow velocities below 80 ft/yr tend to be associated with the Rocky Flats Alluvium while linear flow velocities above 80 ft/yr tend to be associated with colluvial (hillslope) material. The high value of 472 ft/yr, calculated for well pair 3687/60296, is

Table 3-1 Average Linear Flow Velocities for the Industrial Area and Vicinity

WELL PAIR	AREA	1997 QTR	dh/dl	K (cm/sec)	n_e	v (cm/sec)	v (ft/yr)
P416289/P416689	Industrial Area	1	0.02911	2.10E-04	0.1	6.11E-05	63.29
		2	0.03196	2.10E-04	0.1	6.71E-05	69.48
		3	0.03172	2.10E-04	0.1	6.66E-05	68.97
		4	0.03207	2.10E-04	0.1	6.74E-05	69.74
P419689/P416889	Industrial Area	1	0.00728	2.10E-04	0.1	1.53E-05	15.82
		2	0.00879	2.10E-04	0.1	1.84E-05	19.10
		3	0.00739	2.10E-04	0.1	1.55E-05	16.07
		4	0.00712	2.10E-04	0.1	1.49E-05	15.47
P314289/10492	Industrial Area /S. Buffer	1	0.12561	9.33E-05	0.1	1.17E-04	121.34
		2	0.12511	9.33E-05	0.1	1.17E-04	120.85
		3	0.12748	9.33E-05	0.1	1.19E-04	123.15
		4	0.12820	9.33E-05	0.1	1.20E-04	123.84
5387/35691	881 Hillside	1	0.14857	9.33E-05	0.1	1.39E-04	143.51
		2	0.14971	9.33E-05	0.1	1.40E-04	144.62
		3	0.14833	9.33E-05	0.1	1.38E-04	143.28
		4	n/d	9.33E-05	0.1	n/d	n/d
34791/6386	SE Buffer	1	0.18460	9.33E-05	0.1	1.72E-04	178.32
		2	0.19444	9.33E-05	0.1	1.81E-04	187.83
		3	0.18347	9.33E-05	0.1	1.71E-04	177.23
		4	n/d	9.33E-05	0.1	n/d	n/d
07291/07391	903 Pad	1	0.07840	2.10E-04	0.1	1.65E-04	170.45
		2	0.08268	2.10E-04	0.1	1.74E-04	179.77
		3	0.07849	2.10E-04	0.1	1.65E-04	170.66
		4	n/d	2.10E-04	0.1	n/d	n/d
00491/23196	SE Buffer	1	0.15882	9.33E-05	0.1	1.48E-04	153.42
		2	0.16291	9.33E-05	0.1	1.52E-04	157.37
		3	0.16483	9.33E-05	0.1	1.54E-04	159.22
		4	0.16009	9.33E-05	0.1	1.49E-04	154.65
04591/10194	903 Pad	1	0.01250	2.10E-04	0.1	2.62E-05	27.18
		2	0.01273	2.10E-04	0.1	2.67E-05	27.69
		3	0.01290	2.10E-04	0.1	2.71E-05	28.05
		4	0.01253	2.10E-04	0.1	2.63E-05	27.25
05291/05091	East Trenches	1	0.02381	2.10E-04	0.1	5.00E-05	51.77
		2	0.02412	2.10E-04	0.1	5.07E-05	52.44
		3	0.02288	2.10E-04	0.1	4.81E-05	49.75
		4	0.02244	2.10E-04	0.1	4.71E-05	48.79
05391/06091	East Trenches	1	0.01653	2.10E-04	0.1	3.47E-05	35.94
		2	0.01782	2.10E-04	0.1	3.74E-05	38.75
		3	0.01755	2.10E-04	0.1	3.69E-05	38.17
		4	0.01746	2.10E-04	0.1	3.67E-05	37.95
4286/20291	East Trenches	1	0.02222	2.10E-04	0.1	4.67E-05	48.31
		2	0.02215	2.10E-04	0.1	4.65E-05	48.16
		3	0.02613	2.10E-04	0.1	5.49E-05	56.81
		4	0.02291	2.10E-04	0.1	4.81E-05	49.80
3687/60295	East Trenches	1	0.05209	7.88E-04	0.1	4.10E-04	425.00
		2	0.05028	7.88E-04	0.1	3.96E-04	410.18
		3	0.05768	7.88E-04	0.1	4.55E-04	470.58
		4	0.05779	7.88E-04	0.1	4.55E-04	471.51
00191/13491	903 Pad	1	0.02195	2.10E-04	0.1	4.61E-05	47.72
		2	0.02484	2.10E-04	0.1	5.22E-05	54.02
		3	0.01785	2.10E-04	0.1	3.75E-05	38.80
		4	0.01826	2.10E-04	0.1	3.84E-05	39.71
1987/3586	Mound	1	0.09848	9.33E-05	0.1	9.19E-05	95.13
		2	0.09740	9.33E-05	0.1	9.09E-05	94.09
		3	0.10108	9.33E-05	0.1	9.43E-05	97.64
		4	0.09857	9.33E-05	0.1	9.20E-05	95.22

Table 3-1 Average Linear Flow Velocities for the Industrial Area and Vicinity

WELL PAIR	AREA	1997 QTR	dh/dl	K (cm/sec)	n_e	v (cm/sec)	v (ft/yr)
05293/3386	Solar Pond	1	0.05270	2.10E-04	0.1	1.11E-04	114.58
		2	0.05390	2.10E-04	0.1	1.13E-04	117.18
		3	n/d	2.10E-04	0.1	n/d	n/d
		4	0.05080	2.10E-04	0.1	1.07E-04	110.46
P218389/B208089	Solar Pond	1	0.05361	9.33E-05	0.1	5.00E-05	51.78
		2	0.05798	9.33E-05	0.1	5.41E-05	56.01
		3	0.05407	9.33E-05	0.1	5.04E-05	52.23
		4	0.05228	9.33E-05	0.1	4.88E-05	50.51
2286/45793	Solar Pond	1	0.05157	2.10E-04	0.1	1.08E-04	112.12
		2	0.05626	2.10E-04	0.1	1.18E-04	122.32
		3	0.05690	2.10E-04	0.1	1.19E-04	123.71
		4	0.05580	2.10E-04	0.1	1.17E-04	121.32
1986/77492	Solar Pond	1	0.02671	9.33E-05	0.1	2.49E-05	25.80
1986/77492	Solar Pond	2	0.02608	9.33E-05	0.1	2.43E-05	25.19
		3	0.02156	9.33E-05	0.1	2.01E-05	20.82
		4	0.02010	9.33E-05	0.1	1.88E-05	19.42
P114689/22896	Industrial Area/PA	1	0.02873	2.10E-04	0.1	6.03E-05	62.46
		2	0.02949	2.10E-04	0.1	6.19E-05	64.12
		3	0.02963	2.10E-04	0.1	6.22E-05	64.43
		4	0.02900	2.10E-04	0.1	6.09E-05	63.05
P215789/P218089	Industrial Area/PA	1	0.00789	2.10E-04	0.1	1.66E-05	17.16
		2	0.00743	2.10E-04	0.1	1.56E-05	16.16
		3	0.00784	2.10E-04	0.1	1.65E-05	17.05
		4	0.00775	2.10E-04	0.1	1.63E-05	16.85
P313489/6186	Industrial Area	1	0.01084	2.10E-04	0.1	2.28E-05	23.57
		2	0.01168	2.10E-04	0.1	2.45E-05	25.40
		3	0.01178	2.10E-04	0.1	2.47E-05	25.61
		4	0.01242	2.10E-04	0.1	2.61E-05	27.01
4486/P115689	Industrial Area	1	0.02215	2.10E-04	0.1	4.65E-05	48.16
		2	0.01887	2.10E-04	0.1	3.96E-05	41.03
		3	0.02099	2.10E-04	0.1	4.41E-05	45.63
		4	0.02067	2.10E-04	0.1	4.34E-05	44.95
P415989/P115489	Industrial Area	1	0.01869	2.10E-04	0.1	3.93E-05	40.64
		2	0.01955	2.10E-04	0.1	4.11E-05	42.51
		3	0.01925	2.10E-04	0.1	4.04E-05	41.85
		4	0.02006	2.10E-04	0.1	4.21E-05	43.61
P115089/P119389	Industrial Area/PA	1	0.02113	2.10E-04	0.1	4.44E-05	45.94
		2	0.02185	2.10E-04	0.1	4.59E-05	47.50
		3	0.02384	2.10E-04	0.1	5.01E-05	51.82
		4	0.02245	2.10E-04	0.1	4.71E-05	48.81

associated with the Arapahoe No. 1 Sandstone, which discharges to the hillside above South Walnut Creek.

Linear flow velocity data from 1997 are more comprehensive than for 1996. Generally, water level data were collected for more quarters per well pair in 1997 compared to 1996. Water level data for many well pairs were reported for only one quarter in 1996. For well pairs that had more than one quarter of data for both years, the velocities are more consistent (less variant) from quarter to quarter during 1997 than for 1996. This is a response to very little change in hydraulic gradient from quarter to quarter, and could be the result of relatively evenly dispersed precipitation resulting in even recharge to the UHSU with respect to time.

In general, velocities for the 24 well pairs vary by less than 25 percent when comparing the same quarters from 1996 to 1997. The most notable exception is well pair P314289/10492, located in the IA, where all four quarters in 1997 showed an approximately 50 percent increase in linear flow velocity from the same quarters in 1996. This indicates that the hydraulic gradient was consistently steeper between these two wells in 1997. The other exceptions were for well pairs where only one quarter of water level data was available for 1996, or only one quarter out of four showed a variance of greater than 25 percent. At well pair 04591/10194, in the vicinity of the 903 Pad, first quarter data reveals an increase in linear flow velocity of approximately 60 percent from 1996 to 1997. At well pair P115089/P119389, located in the IA, fourth quarter data reveals a decrease in linear flow velocity of approximately 40 percent from 1996 to 1997. Velocities reported for 1996 and 1997 are generally higher than velocities reported in pre-1996 annual RCRA groundwater monitoring reports largely because sitewide mean K values are now employed in the calculations instead of individual operable unit mean K values.

3.3 Well Hydrographs and Water Level Change Maps

Hydrograph plots for many RFCA water quality wells have been constructed in order to observe changes in water table elevation with time (see Appendix D). In addition to illustrating seasonal fluctuations in water table elevation, hydrographs are useful for evaluating long-term trends that might result from either artificial activities (plant closure) or natural causes (climatic change). For example a comparison of IA well hydrograph data to background well hydrograph data may suggest whether any of the observed trends are natural or artificially induced. Assuming that groundwater levels within the Site have reached a quasi-steady state condition since the cessation of production operations in 1989, it is conceivable that plant closure activities could cause local water levels to rise or fall, depending on the closure action. These changes in water level elevations will be evaluated in

future years using annual and life-of-closure water level change maps that will be based on water levels collected during the 1996 baseline year.

Water levels measured during 1997 were, for the most part, observed to fluctuate within normal limits. Most wells, including recharge-sensitive wells such as 20691 and P416289, exhibited only moderate recharge peaks during the spring season. In general, water levels were slightly higher during the second half of 1997 compared to the first half, and overall are comparable to 1996 levels. Water levels in 1996, which were higher than average, were thought to reflect the residual influence of the record high water levels experienced in 1995. Sitewide precipitation data from 1993 through 1997 suggests that although precipitation was very high in 1995, 1996 produced near average precipitation, and 1997 produced well above average precipitation. The continuing higher than average water levels are based as much on recurrent high precipitation (ample recharge) since 1995 as they are on the residual effects of 1995. The sitewide scale of this trend, also observed in background wells, implies that climate is the dominant cause of water level changes during 1997.

Water level change maps (Plates 18 and 19) utilizing 1997 and 1996 water level data, are presented for the first time in an annual report. These data are used to compare the 1997 water levels for the second (April) and fourth (October) quarters to the second and fourth quarter water level data for 1996. Data plotted on these water level change maps indicate areas of the site where changes in saturated thickness, either positive or negative, have taken place between two given years. The water level change map for the second quarter 1996-1997 generally shows that increases of 1 to 2 feet in saturated thickness in the east central and southern portion of the IA. The north central and northeast portion of the IA generally showed no change or a 1-foot decrease in saturated thickness from 1996 to 1997. The extreme west portion of the IA generally showed no change from 1996 to 1997. East of the IA, changes in saturated thickness from 1996 to 1997 ranged from being negligible to a 1-foot increase. No large areas were observed that varied by more than 1 foot, either positive or negative, from 1996 to 1997. Isolated areas were observed in which the second quarter saturated thickness varied substantially from 1996 to 1997. The greatest water level change observed was at well P119389, located approximately 200 feet southwest of Building 771, which exhibited a decrease of 9.35 feet from 1996 to 1997. To the south of Building 881, monitoring well 5387 showed an increase of 4.45 feet from second quarter 1996 to 1997, and approximately 800 feet to the east southeast, monitoring well 4887 showed a decrease of greater than 3.7 feet between 1996 and 1997. To the south and southeast of the MST tanks, located immediately north of the PA, monitoring wells B208789 and B208689 exhibited decreases of 3.46 and 4.33 feet, respectively. Other major

differences were to the far north; monitoring well B202589, an increase of 3.67 feet, and to the far southwest; monitoring well B400389, an increase of 5.51 feet. In addition, along the eastern margin of the site adjacent to Indiana Street, monitoring well 06491 showed an increase of 4.7 feet, and monitoring well 41591 showed a decrease of 3.94 feet. The last four wells described are more than a mile from the IA, which suggests that the changes are driven by climate and geology rather than artificial sources.

The water level change map for the fourth quarter 1996-1997 shows that, in the IA, the change in saturated thickness generally varies by less than two feet. The western portion of the IA shows an increase between 0 and 2 feet in saturated thickness for the fourth quarter from 1996 to 1997. The eastern portion of the IA varies subtly between a 1-foot decrease and a 1-foot increase in saturated thickness between 1996 and 1997. Besides these general comparisons, there are many localized areas where substantial differences exist from1996 to 1997 for the fourth quarter data. The most striking difference is in the area immediately west and south of Building 371. Monitoring wells P114589, P119389, and P114889 show decreases of 31.37, 11.36, and 7.9 feet, respectively. Another substantial difference is along the northwest perimeter of the present Landfill where monitoring wells 6087 and 70093 show decreases of 16.48 and 10.03 feet, respectively. At the southern edge of Building 881, monitoring well 0187 shows an increase of 4.52 feet from 1996 to 1997, whereas, approximately 400 feet to the south monitoring wells 10592 and 10692 show decreases of 3.41 and 3.89 feet, respectively. Along the B-Ponds drainage, from west to east, well B210389 shows a decrease of 5.4 feet, well B208689 shows a decrease of 8.92 feet, well 10594 shows an increase of 3.92 feet, and well 41091 shows a decrease of 4.44 feet. Just east of the SEPs, monitoring well P207989 shows a decrease of 8.03 feet. Monitoring wells 12691 and 03191, located 70 feet apart approximately 1,500 feet east of the IA, showed a decrease of 3.94 feet and an increase of 3.49 feet, respectively, for fourth quarter 1996 to 1997 data.

In summary, groundwater flow conditions for 1997 appear to generally resemble flow conditions described for recent years with slight variations depending on the location within RFETS. This situation is not unexpected because major plant closure activities have yet to be undertaken. The variations in water levels and linear flow velocities are probably in response to the timing of water level measurements with respect to natural recharge (precipitation), artificial recharge, or artificial dewatering events. Artificial events may involve recharge or dewatering related to construction, demolition, onsite industrial processes, and building perimeter drain activity and/or inactivity. The

1996 data set, and to some extent the 1997 data set, will represent the baseline for future annual evaluations.

4.0 GROUNDWATER EVALUATIONS

4.1 East Trenches Plume/B-Series Ponds

Well 06091 Evaluation: Well 06091 is located at the eastern portion of the former OU2 and has been monitored for many years. In 1996 it was noticed that the trend plot for carbon tetrachloride showed a marked increase in concentration with time and was at the 5 µg/L action level. The three monthly confirmation samples verified concentrations at this level. In 1997 an evaluation was done to establish whether VOCs above action levels were migrating farther east of 06091.

Three new wells were installed (Figure 4-1). Well 02697 was installed north of well 06091 at the head of a small groundwater fed creek that runs northward toward Walnut Creek. Well 02797 was installed approximately 150 feet east of 06091, and well 02897 was installed approximately 300 feet east of 06091. All wells were screened in the Rocky Flats Alluvium. VOC results from the three new wells showed no detections for VOCs above action levels (see Table 4-1).

In conclusion, it appears that well 06091 is accurately defining the extent of VOC contamination for the East Trenches Plume. This well will continue to be monitored as part of the IMP monitoring program and if concentrations increase with time, the three evaluation wells will be re-sampled to establish plume extent.

Well 23296 Evaluation: In 1996, Plume Extent well 23296 was installed in Walnut Creek as part of the original re-design of the Sitewide groundwater monitoring network. The well is located between Pond B-2 and Pond B-3 and was placed so as to detect contaminants in the Walnut Creek drainage. Subsequent sampling of well 23296 in August 1996 showed elevated values for PCE of 18 µg/L, CT of 6 µg/L and TCE of 420 µg/L. Because the well showed concentrations above action levels, three monthly confirmation samples were collected as required under RFCA. The confirmatory samples also contained concentrations above action levels and an impact evaluation project was scoped, and implemented in 1997.

The plume evaluation project was designed to establish the extent and probable pathways for the VOC plume to reach surface water. The plume was assumed to be an extension of the East Trenches plume based on location and similar organic constituents. Historic data was compiled for nearby groundwater wells and seep or surface water sampling locations. A review of the surface water data revealed that historic samples for VOCs for Pond B-2 from 1991 and 1992 showed elevated values of TCE, PCE and CT above current groundwater and surface water action levels. It was also noted that historic data showed increases in concentration during the winter months, presumably when the

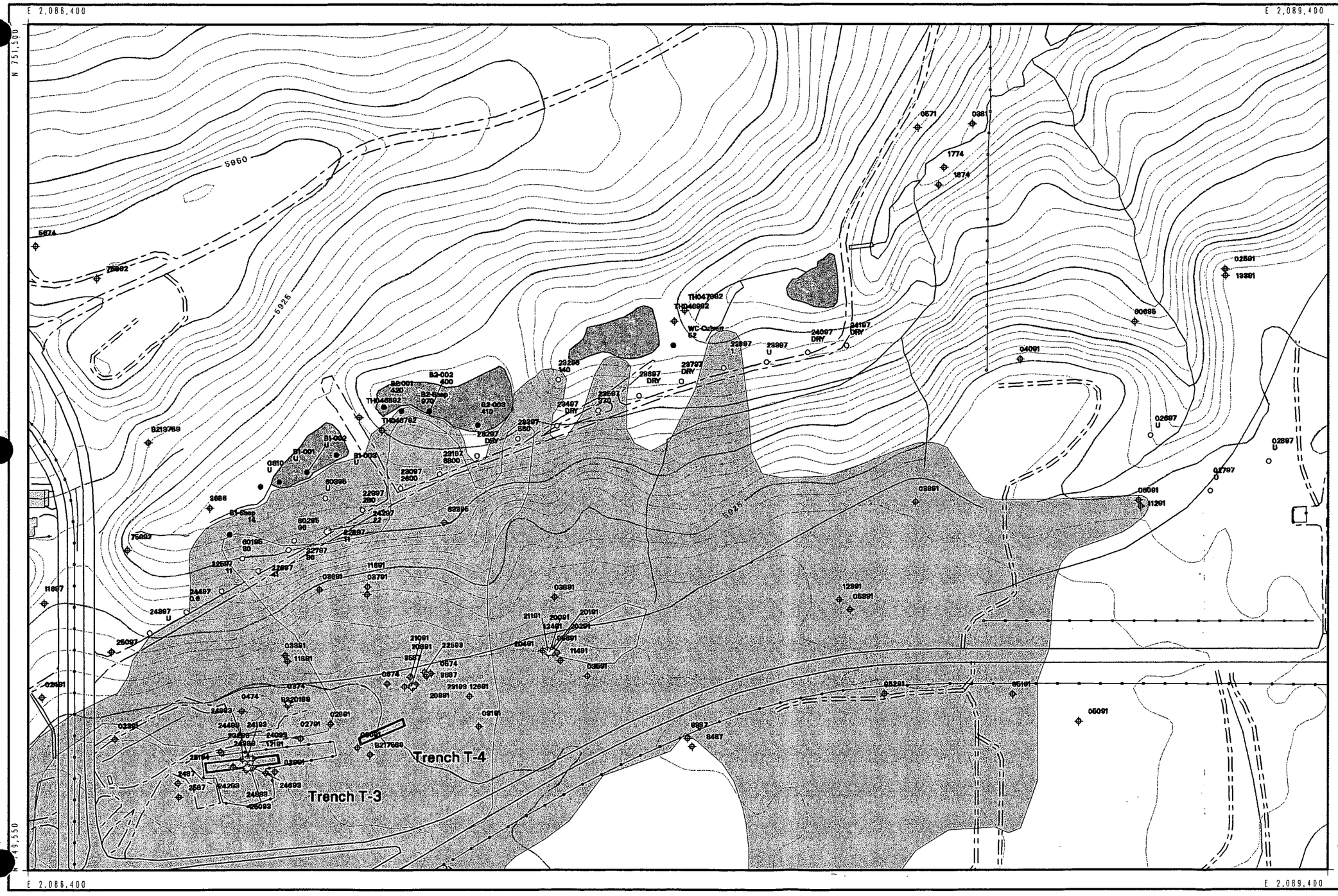


Figure 4-1
Well Location Map and Trichloroethene Concentrations For East Trenches and B-Series Ponds Area

- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)
- Sampled Well Locations
- Well Locations (Not Sampled)
- Surface Water Sample Points

Note:

U = Not detected, DRY = Not Sampled (dry or insufficient water).

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads

NOTE:
Source of GIS data available upon request.

Scale = 1 : 2700
1 inch represents 225 feet

100 0 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: 99-0246
September 28, 1999

/gis2/projects/fy99/rfets-rpt/rfets_figures/b_ponds/fig4.aml

Table 4-1 Volatile Organic Compounds in Groundwater B Ponds Area

				Concentration in µg/L							
Well	Sample Type	Comment	Sample Date	cis 1,2 Dichlorothene	Methylene Chloride	Chloroform	Carbon Tetrachloride	Trichloroethene	1,1 Dichloroethene	Tetrachloroethene	Total VOCs
24297	Geoprobe well		11/05/97	U	U	23	110	22	U	210	365
24397	Geoprobe well		11/12/97	U	U	U	U	U	U	31	31
24497	Geoprobe well		11/12/97	U	U	U	0.7	0.6	U	17	18.3
22597	Geoprobe well		11/10/97	U	U	U	12	11	U	250	273
22697	Geoprobe well		11/07/97	U	U	U	71	41	U	730	842
22797	Geoprobe well		11/03/97	U	U	10	95	36	U	560	701
22897	Geoprobe well		11/07/97	2	U	38	20	11	U	63	134
22997	Geoprobe well		11/07/97	12	U	49	460	280	9	440	1250
23097	Geoprobe well		11/05/97	U	U	71	280	2600	U	320	3271
23197	Geoprobe well		11/04/97	U	U	150	140	6800	U	190	7280
23297	Geoprobe well	DRY									
23397	Geoprobe well		11/12/97	6	U	27	69	560	U	37	699
23497	Geoprobe well	DRY									
23597	Geoprobe well		11/04/97	6	U	18	64	370	U	17	475
23697	Geoprobe well	DRY									
23797	Geoprobe well	DRY									
23897	Geoprobe well		11/07/97	U	U	2	8	1	U	1	12
23997	Geoprobe well		11/12/97	U	U	U	4	U	U	U	4
24097	Geoprobe well	DRY									
24197	Geoprobe well	DRY									
60195	Seep Piezometer		7/6/95	U	U	4	30	30	2	510	576
60295	Seep Piezometer		7/6/95	U	U	13	120	23	U	190	346
60395	Seep Piezometer		7/7/95	U	U	5	U	U	U	30	35
GS10	Surface Water		2/13/98	U	U	U	U	U	U	U	0
B1-001	Pond B1(west)		2/13/98	U	U	U	U	U	U	U	0
B1-002	Pond B1(middle)		2/13/98	U	U	U	U	U	U	U	0
B1-003	Pond B1(east)		2/13/98	U	U	U	U	U	U	U	0
B2-001	Pond B2(west)		2/16/98	94	U	12	16	420	U	16	558
B2-002	Pond B2(Middle)		2/16/98	100	U	14	18	400	U	16	548
B2-003	Pond B2(east)		2/16/98	100	U	14	19	410	U	16	559
WC-Culvert	Bypass Culvert		2/16/98	1	U	2	8	52	U	8	71
SW00198	B1 Seep		2/17/98	4	U	1	13	14	U	280	312
SW00298	B2 Seep		2/17/98	32	U	30	98	970	5	120	1255
23296	Well		7/30/97	55	U	U	U	140	U	7	202
02697	Well		10/30/97	U	U	U	U	U	U	U	0
02797	Well		11/4/97	U	U	U	U	U	U	U	0
02897	Well		11/3/97	U	U	U	U	U	U	U	0
06091	Well		3/4/98	U	U	U	5	0.8	U	2	7.8

ponds were frozen over. An additional historic data point was a seep that occurs uphill of Pond B-1 on the south side of the drainage. This seep had been sampled in 1993 and showed elevated concentrations of VOCs. In 1995, small diameter piezometers were installed above known springs and seeps as part of a sitewide spring and seep characterization project. Seep piezometer 60195 was installed upgradient of the seep previously mentioned. 60295 and 60395 were installed in smaller seeps east of the seep near Pond B-1. Samples taken in 1995 showed elevated values of PCE, TCE and CT. There were no conventional wells installed in the hillslope drainage in the vicinity of 23296 except those that were located near the East Trenches IHSSs on the plateau south of the B Ponds. Table 4-1 presents the data from the historic sampling activities.

Based on the analysis of historic data, a project was initiated to define plume extent and the potential groundwater pathways to Walnut Creek. Using the seep piezometers and well 23296 as a guide, a line of twenty temporary wells were installed using the Groundwater Geoprobe Vehicle. The wells were installed on 100-foot intervals along the B Ponds access road. Sampling for VOCs was initiated in October, 1997 in these wells. Figure 4-1 shows the composite plume that represents the results of the sampling for TCE. Figure 4-2 shows PCE concentrations.

Additional surface water sampling was also done. Walnut Creek was sampled for VOCs at an upstream point of its diversion around the B-1, B-2 and B-3 Ponds. This sample showed no VOC contamination. Another VOC sample was collected at the outfall of the Walnut Creek diversion below Pond B-3. This sample contained CT (8 μg/L), PCE (8 μg/L) and TCE (52 μg/L) at concentrations above groundwater action levels. Table 4-1 shows the data used for the B Ponds evaluation.

Ponds B-1 and B-2 were sampled while the surface was still covered with ice. VOC samples were collected from the southern edge of the ponds at the west, middle and east ends. The three samples collected from Pond B-1 showed no VOC concentrations above action levels. The sample taken on the west end of Pond B-2 showed CT (16 μg/L), PCE (16 μg/L) and TCE (420 μg/L) and cis 1,2 Dichloroethene (94 μg/L) to be above action levels. The sample from the middle of Pond B-2 showed CT (18 μg/L), PCE (16 μg/L), TCE (100 μg/L) and cis 1,2 Dichloroethene (100 μg/L) to be above action levels. The sample from the east end of Pond B-2 showed concentrations of CT (19 μg/L), PCE (16 μg/L), TCE (410 μg/L) and cis 1,2 Dichloroethene (100 μg/L) above action levels.

Two surface seeps were sampled. The seep near well 60195 was sampled and showed CT (13 μg/L), PCE (280 μg/L) and TCE (14 μg/L) above action levels. A new seep was discovered near the south

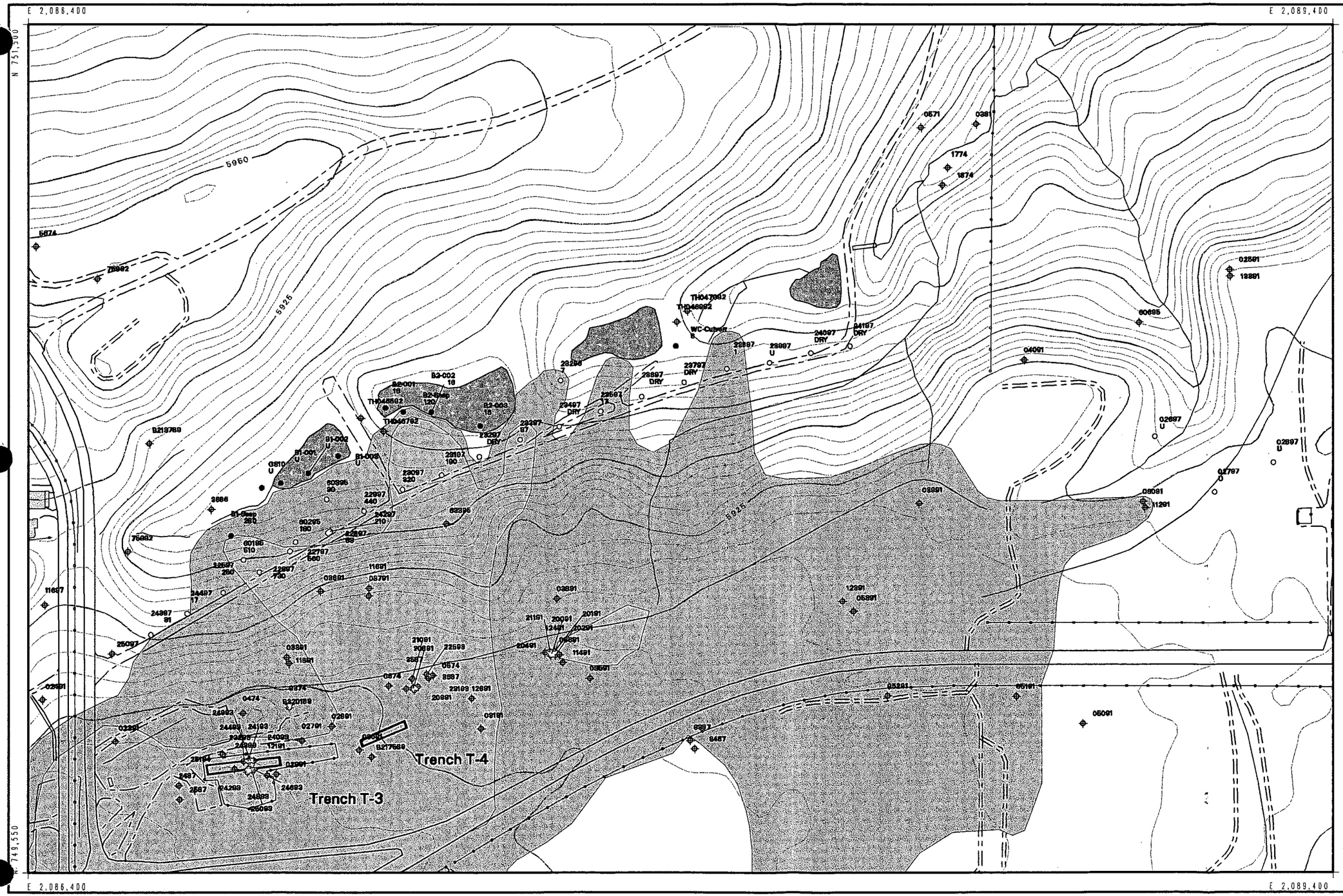

Figure 4-2
Well Location Map and Tetrachloroethene Concentrations For East Trenches and B-Series Ponds Area

- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)
- Sampled Well Locations
- Well Locations (Not Sampled)
- Surface Water Sample Points

Note:

U = Not detected, DRY = Not Sampled (dry or insufficient water).

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads

NOTE:
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edge of Pond B-2. This seep showed CT (98 µg/L), PCE (120 µg/L) and TCE (970 µg/L) above action levels.

The general conclusions reached by the evaluation and sampling is that the highest concentration part of the plume entering surface water is in the vicinity of Pond B-2. The plume may have multiple sources in the East Trenches area because PCE is higher in the western portion of the plume whereas TCE is higher in the eastern portion of the plume. Plume contaminants are directly discharging to surface water at B-2 and contaminated groundwater is infiltrating into the Walnut Creek diversion pipe prior to discharge below Pond B-3. Pond B-3 was not sampled because it is used as a temporary holding pond for STP water prior to discharge to B-5, and therefore would not show the effects of groundwater infiltration.

The geology of the area of investigation consists of a hillslope that dips to the north off the main plateau which contains the East Trenches. The geology, as interpreted from the line of wells drilled for the plume evaluation, is heterogeneous. The surficial deposits encountered are composed of colluvium with varying amounts of sandy clay to clayey sand, with some cobbles derived from the Rocky Flats Alluvium which caps the plateau. Colluvium averages eight feet thick along the line and sits unconformably on bedrock. The underlying bedrock is composed of a fine-grained sandstone which is correlative to the No. 1 Sandstone in the East Trenches area. The No. 1 Sandstone varies in thickness from 2 to 12 feet. Sandstone thickness decreases to under 5 feet to both the west and east and is gradational to a clayey sandstone in some wells. Claystone bedrock underlies the sandstone or clayey sandstone and can be variably weathered with minor iron staining and a greater degree of friability. Based on the geology, relative permeability and static water level in the wells, it is clear that the bedrock sandstone is the predominant pathway for groundwater and contaminant migration. The water level data suggests that the colluvium is typically dewatered in this area, which again points to the sandstone unit as the preferred pathway. Figure 4-3 depicts a representative potentiometric surface in the B-Pond area.

Impact to surface water can be evaluated based on influx of contaminated groundwater into the stream, and on the persistence of organic contaminants in groundwater migrating downstream. The persistence of organic contaminants down stream in groundwater can be deduced from concentrations recorded in monitoring well 3786. This well is located approximately 1,500 feet downstream of well 23296 in Walnut Creek near the west end of Pond B-5. The well is screened in valley fill alluvium as is well 23296, and is similar in saturated thickness to the latter. VOC analyses from 1991 to present have never shown detections of VOC contaminants of concern in well 3786.

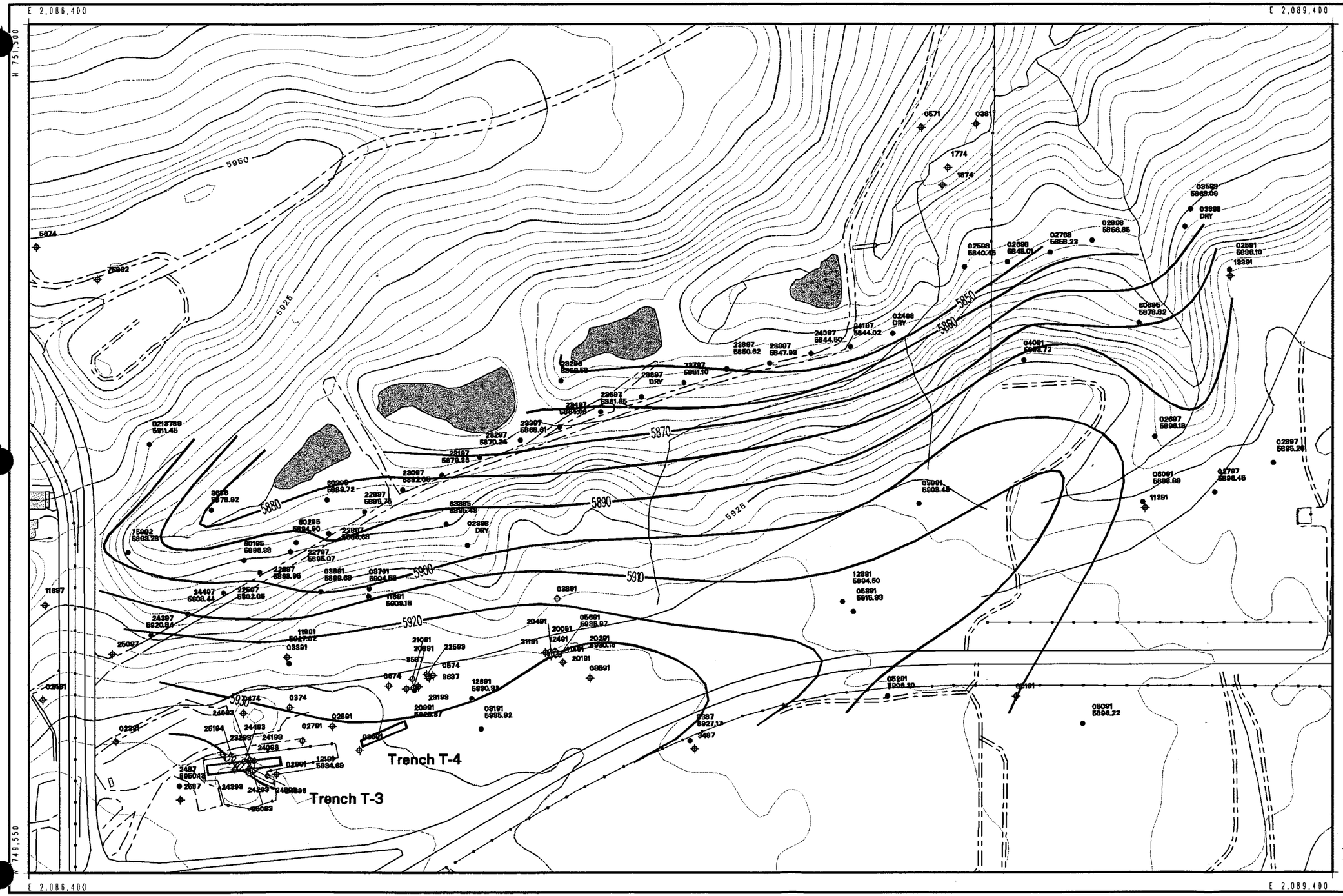

Figure 4-3
Potentiometric Surface of UHSU Deposits, 2nd Quarter 1998 For East Trenches and B-Series ponds Areas

- Well Location With Measured Water Table Elevation (April-June 1998)
- Existing Data Location (Not Measured)
- Water Table Elevation Contour

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads

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Pond samples taken in B-5 as pre-discharge samples have also shown no detections for VOCs for the contaminants of concern. Therefore, persistence of VOCs downstream to points of compliance is probably not an issue.

Impact to surface water in the immediate area of Walnut Creek where VOCs have been detected has been estimated. Geologic data from the line of temporary wells and hydraulic gradient information from potentiometric surface plots have been used to estimate discharge to Walnut Creek. Organic data from these wells has been used to determine pathways, plume extent and concentration gradients. Contaminant flux estimates were calculated in conjunction with the Conceptual Remediation Design project for treatment of the East Trenches Plume (IT Corp, 1998).

In the lower portion of the South Walnut Creek drainage, groundwater flows horizontally out of colluvium and weathered bedrock, discharging to the surface water system. Discharge from weathered bedrock is quantified only to the base of the shallow sandstone unit, if present in the uppermost weathered bedrock. If no sandstone is present, flow within bedrock is estimated to the base of the potential remediation system (barrier). The calculations will show that the component of flow and contaminant load in weathered claystone is negligible.

The following ranges and geometric means of hydrogeologic units, derived from sitewide data (EG&G, 1995) are considered representative of the hydrogeology of the East Trenches plume study area:

- Colluvium - 4.0×10^{-6} to 9.3×10^{-4} cm/sec, geometric mean of 9.3×10^{-5} cm/sec.
- Weathered Arapahoe/Laramie claystone - 3.0×10^{-8} to 5.6×10^{-4} cm/sec, geometric mean of 9.98×10^{-7} cm/sec.
- Weathered Arapahoe/Laramie sandstones other than Arapahoe No. 1 sandstone - 5.7×10^{-6} to 2.1×10^{4} cm/sec, geometric mean of 3.9×10^{-5}.
- Weathered Arapahoe No. 1 Sandstone - 4.0×10^{-5} to 9.3×10^{-3} cm/sec, geometric mean of 7.9×10^{-4} cm/sec.

The horizontal hydraulic gradient in the vicinity of the well alignment is approximately 0.14 in a northerly direction. This estimate is based on spring 1998 groundwater elevations in two separate sets of three wells, 23097/23197/63395 and 02798/04091/60695, calculated by the method of Pinder, et al. (1981). The existing well network does not provide a means to assess the vertical component of hydraulic conductivity. Loss or destruction of contaminants through volatilization, biodegredation etc. is not factored into the analysis.

Table 4-2 summarizes the saturated thickness and resultant transmissivity data for the wells that are in the area of plume extent. It can be shown that due to the unsaturated condition of the colluvium and lower hydraulic conductivity, discharge through this media is an order of magnitude less than that through bedrock sandstones.

Table 4-3 shows the mean contaminant loads estimated from the transmissivity, hydraulic gradient and measured VOC concentrations. Based on the total contaminant load (sandstone + colluvium) and mean hydraulic conductivity values, the average VOC contaminant load is 4.8×10^{-2} g/day/foot. Using a 1,100-foot length for the contaminant plume, and the mean contaminant load, contaminant flux to the stream is 5.2×10^{-2} kg/day.

In conclusion, the East Trenches/B-Series pond groundwater evaluations for VOCs have defined the nature and extent of the contaminant plume causing the elevated concentrations. It has been established that concentrations above action levels have impacted surface waters locally but may not persist downstream. The area has been prioritized for remediation for which additional data may be collected and a remedial design approved in early FY99.

4.2 Industrial Area Plume

4.2.1 Woman Creek

Monitoring well P416889 is a plume definition well that is well above the Tier II action level for PCE and monitors the southern edge of the IA plume. A large seep complex is located to the south of this well in the Woman Creek drainage. A piezometer (62893) installed just north of the southern edge of the seep shows a historical concentration of TCE in the 30 µg/L range. This occurrence is an indication of a potential pathway to surface water. Through 1996 there was no monitoring well located further to the south in the Woman Creek drainage that monitored this potential pathway downgradient of the IA plume.

As part of the Industrial Area plume investigation, six new monitoring wells were installed during 1997 in a line trending northwest-southeast on the north hillslope of Woman Creek. These wells were installed in order to ascertain if the IA VOC plume has advanced south of its location as mapped in the 1996 RFCA Annual Groundwater Report. Monitoring wells that were installed to investigate Woman Creek during 1997 were 20197, 20397, 20597, 20697, 20797, and 21097. Well construction details for the new monitoring wells can be found in Section 6.4 of this report. Four of the six new wells were dry during 1997. Monitoring wells 20697 and 20797 produced enough

Table 4-2 Flow in Colluvium

B Ponds Area

Wells	Elevation above MSL (feet) Groundwater 5/98 – 6/98	Top of Bedrock	Creekbed on Flowpath	Saturated Thickness Colluvium	Bedrock Type [1]	Saturated Sandstone Thickness (ft)	Estimated Bedrock Saturated Thickness (ft) [2]	Minimum T[3] Colluvium sq.ft./day	Minimum T[3] Bedrock sq.ft./day [2]	Maximum T[3] Colluvium sq.ft./day	Maximum T[3] Bedrock sq.ft./day [2]	Geo Mean T[3] Colluvium sq.ft./day	Geo Mean T[3] Bedrock sq.ft./day [2]
24397	5920.84	5920.7	5885	0.10	CS		--	--	--	--	--	--	--
24497	5908.44	5911.8	5884	0.00	CS		--	--	--	--	--	--	--
22597	5902.05	5913.2	5883	0.00	SS	23.2	12.1	0.0E+00	1.9E-01	0.0E+00	7.2E+00	0.0E+00	1.3E+00
22697	5898.95	5905.1	5883	0.00	SS#1	12	7.9	0.0E+00	9.0E-01	0.0E+00	2.1E+02	0.0E+00	1.8E+01
22797	5895.07	5891.0	5882	4.10	SS#1	5.5	5.5	4.6E-02	6.2E-01	1.1E+01	1.5E+02	1.1E+00	1.2E+01
22897	5886.68	5896.0	5882	0.00	CS		7.7	0.0E+00	6.5E-04	0.0E+00	1.2E+01	0.0E+00	1.9E-02
22997	5885.75	5885.2	5881	0.60	SS#1	9.25	9.3	6.8E-03	1.0E+00	1.6E+00	2.4E+02	1.6E-01	2.1E+01
23097	5882.05	5880.8	5868	1.30	SS#1	7.9	7.9	1.5E-02	9.0E-01	3.4E+00	2.1E+02	3.4E-01	1.8E+01
23197	5879.36	5880.7	5867	0.00	SS	8.6	7.3	0.0E+00	1.2E-01	0.0E+00	4.3E+00	0.0E+00	8.0E-01
23297	5870.24	5871.9	5868	0.00	CS(Ssu)	1.1	8.2	0.0E+00	7.0E-04	0.0E+00	1.3E+01	0.0E+00	2.1E-02
23397	5868.61	5873.5	5868	0.00	CS(Ssu)	3.3	7.6	0.0E+00	6.5E-04	0.0E+00	1.2E+01	0.0E+00	1.9E-02
23497	5864.06	5873.6	5855	0.00	CS(Ssu)	5	5.1	0.0E+00	4.3E-04	0.0E+00	8.0E+00	0.0E+00	1.3E-02
23597	5861.65	5871.4	5853	0.00	CS		3.6	0.0E+00	3.1E-04	0.0E+00	5.8E+00	0.0E+00	9.1E-03
23697	DRY	5865.3	5852	DRY	CS		DRY	DRY	DRY	DRY	DRY	DRY	DRY
23797	5851.1	5850.0	5849	1.10	CS		--	--	--	--	--	--	--
23897	5850.62	5849.5	5841	1.10	SS	3.3	--	--	--	--	--	--	--
23997	5847.93	5852.1	5838	0.00	SS	6.8	--	--	--	--	--	--	--
24097	5844.5	5853.5	5837	0.00	SS	9.5	--	--	--	--	--	--	--
24197	5844.02	5849.0	5836	0.00	SS	5.5	--	--	--	--	--	--	--
							In-Plume Average T	6.2E-03	3.4E-01	1.4E+00	7.9E+01	1.4E-01	6.4E+00

dh/dl = 0.14 Horizontal hydraulic gradient, from spring 98 groundwater elevations in wells 23097, 23197, 63395; and wells 02798, 04098, 60695.

L = 1100ft Planned intercepted plume length, perpendicular to flow.

Q = KA(dh/dl)

Q = TL(dh/dl) Using average in-plume Transmissivity (T) values above:

	Flow in cu.ft./day					
	Minimum		Maximum		Geo Mean	
	Colluvium	Bedrock	Colluvium	Bedrock	Colluvium	Bedrock
Q=	1.0	53.0	221	12173	22	990

Footnotes:

1 Bedrock types: SS#1 = Arapahoe Sandstone No. 1, SS = Undifferentiated Arapahoe/Laramie weathered sandstone, CS = Weathered claystone, CS(Ssu) = Weathered claystone with unsaturated sandstone at top

2 Estimated saturated thickness and transmissivities are calculated for locations within the plume. If saturated sandstone (SS#1 or SS) is present, saturated claystone is negligible in terms of transmissivity and flow, and full (or estimated) thickness of the sandstone is used to calculate bedrock transmissivity. If only claystone is present, saturated thickness and transmissivity of claystone is calculated based on estimated depth of barrier. Ranges of transmissivities (per minimum and maximum estimates of K) and best estimate of representative T (per geometric mean estimates of K) are presented.

3 T = Transmissivity

Table 4-3 Groundwater Contaminant Load and Flux through the Colluvium and Bedrock, B- Ponds Area

Contaminant Load Estimated from the Geometric Mean of Hydraulic Conductivity Values					
Well	Carbon Tetrachloride	Trichloroethene	1,1 Dichloroethene	Tetrachloroethene	Total VOCs
Colluvium Contaminant Load in g/day/ft					
22597	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
22697	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
22797	4.1E-04	1.5E-04	0.0E+00	8.1E-04	1.4E-03
22897	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
22997	2.9E-04	1.8E-04	5.6E-06	2.8E-04	7.5E-04
23097	3.8E-04	3.5E-03	0.0E+00	4.3E-04	4.3E-03
23197	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
23297					
23397	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
23497					
23597	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Average	1.2E-04	4.3E-04	6.3E-07	1.7E-04	7.2E-04
Bedrock Contaminant Load in g/day/ft					
22597	6.3E-05	5.8E-05	0.0E+00	1.3E-03	1.4E-03
22697	5.0E-03	2.9E-03	0.0E+00	5.2E-02	5.9E-02
22797	4.6E-03	1.8E-03	0.0E+00	9.3E-03	1.6E-02
22897	8.4E-06	8.4E-07	0.0E+00	1.6E-05	2.5E-05
22997	3.8E-02	2.3E-02	7.4E-04	3.6E-02	9.8E-02
23097	2.0E-02	1.8E-01	0.0E+00	2.2E-02	2.2E-01
23197	4.5E-04	2.2E-02	0.0E+00	6.0E-04	2.3E-02
23297					
23397	5.2E-06	4.2E-05	0.0E+00	2.8E-06	5.0E-05
23497					
23597	2.3E-06	1.3E-05	0.0E+00	6.1E-07	1.6E-05
Average	7.5E-03	2.6E-02	8.2E-05	1.3E-02	4.7E-02
Total Contaminant Load in g/day/ft					
22597	6.3E-05	5.8E-05	0.0E+00	1.3E-03	1.4E-03
22697	5.0E-03	2.9E-03	0.0E+00	5.2E-02	5.9E-02
22797	5.0E-03	1.9E-03	0.0E+00	1.0E-02	1.7E-02
22897	8.4E-06	8.4E-07	0.0E+00	1.6E-05	2.5E-05
22997	3.8E-02	2.3E-02	7.4E-04	3.6E-02	9.8E-02
23097	2.0E-02	1.9E-01	0.0E+00	2.3E-02	2.3E-01
23197	4.5E-04	2.2E-02	0.0E+00	6.0E-04	2.3E-02
23297					
23397	5.2E-06	4.2E-05	0.0E+00	2.8E-06	5.0E-05
23497					
23597	2.3E-06	1.3E-05	0.0E+00	6.1E-07	1.6E-05
Average	7.6E-03	2.6E-02	8.3E-05	1.4E-02	4.8E-02

Contaminant Flux Estimated from Geometric Mean of Hydraulic Conductivities--Best Estimate of Flux in kg/day					
	Carbon Tetrachloride	Trichloroethene	1,1-Dichloroethene	Tetra-chloroethene	Total VOCs
Colluvium	1.3E-04	4.7E-04	6.9E-07	1.9E-04	7.9E-04
Bedrock	8.3E-03	2.8E-02	9.0E-05	1.5E-02	5.2E-02
Total Flux	8.4E-03	2.9E-02	9.1E-05	1.5E-02	5.2E-02

X = T(dh/dl)C g/day/ft	Contaminant load equals transmissivity times hydraulic gradient times concentration Unit conversion: T(sq.ft/day) x dh/dl (unitless) x C (ug/L) x 28.32 L/cu.ft x 10-6 g/ug =TC (g/(day/ft)
T	is taken from the values calculated for both colluvium and bedrock at individual wells on the "Flow" sheet
dh/dl = 0.14	is the horizontal hydraulic gradient, from spring 98 groundwater elevations in wells 23097, 23197,63395; and wells 02798, 04098, 60695.
C	is from Table 4-1.

F = Contaminant Flux equals flow times concentration Load times Length

F = XL Contaminant Flux equals Contaminant

F = [TL(dh/dl)]C = [T(dh/dl)C]L

L 1100 Estimated plume length (ft..), perpendicular to flow.

groundwater to be sampled during the third quarter of 1997. Well 20797 had no detections for VOCs. Monitoring well 20697 will have an impact on the mapped southern plume extent of the IA because of a reading of slightly above Tier II for TCE (7 μg/L). TCE was the only analyte at well 20697 above Tier II. TCE and PCE (3 μg/L) were the only VOCs reported above detection limits at well 20697.

The IA plume is a composite of all the VOC releases and spills which took place on plant site during production. The major activities that contributed to the IA plume took place in the 300 and 400 Building complexes. Based on the new well coverage, the IA VOC plume has been extended to the south through monitoring wells 63193 and 20697. Figure 4-4 shows the updated extent of the plume. The change in Figure 4-4 does not mean that the plume has actually moved since last year, it merely means that the plume coverage has been refined. Additional definition of the IA VOC plume will be possible in 1998 as wells 20197, 20397, 20597, and 21097, which were dry in 1997, have been observed to contain measurable amounts of groundwater during 1998.

The smaller plume seen in Figure 4-4 that encompasses monitoring wells 60993 and 61093 is either associated with the Old Landfill or with a former storm sewer outfall that terminated in this area of the Old Landfill. The storm sewer line originates in the 400 Building complex, and may intercept VOC contaminated groundwater associated with the IA VOC plume.

4.2.2 North Industrial Area Plume

Groundwater monitoring results obtained for wells 22796 and 22896 installed during FY96 and P219189, an existing monitoring well, have documented the existence of unexpected values above VOC Tier I and II action levels in the northwestern portion of the IA (RMRS, 1997a). Subsequent monthly sampling confirmed the elevated concentrations, thus suggesting that the VOC composite plume boundaries near North Walnut Creek were more extensive than previously believed. On this basis, a field evaluation of IA VOC plume pathways toward North Walnut Creek and an unnamed tributary was proposed for implementation in FY97. This evaluation was postponed until FY98 due to delays in Geoprobe availability caused by other ER GMP projects (i.e., Building 779 IA IM/IRA well installations; IHSS 118.1 pre-remedial characterization; and B-Series Ponds, PU&D Yard, and Woman Creek groundwater evaluations).

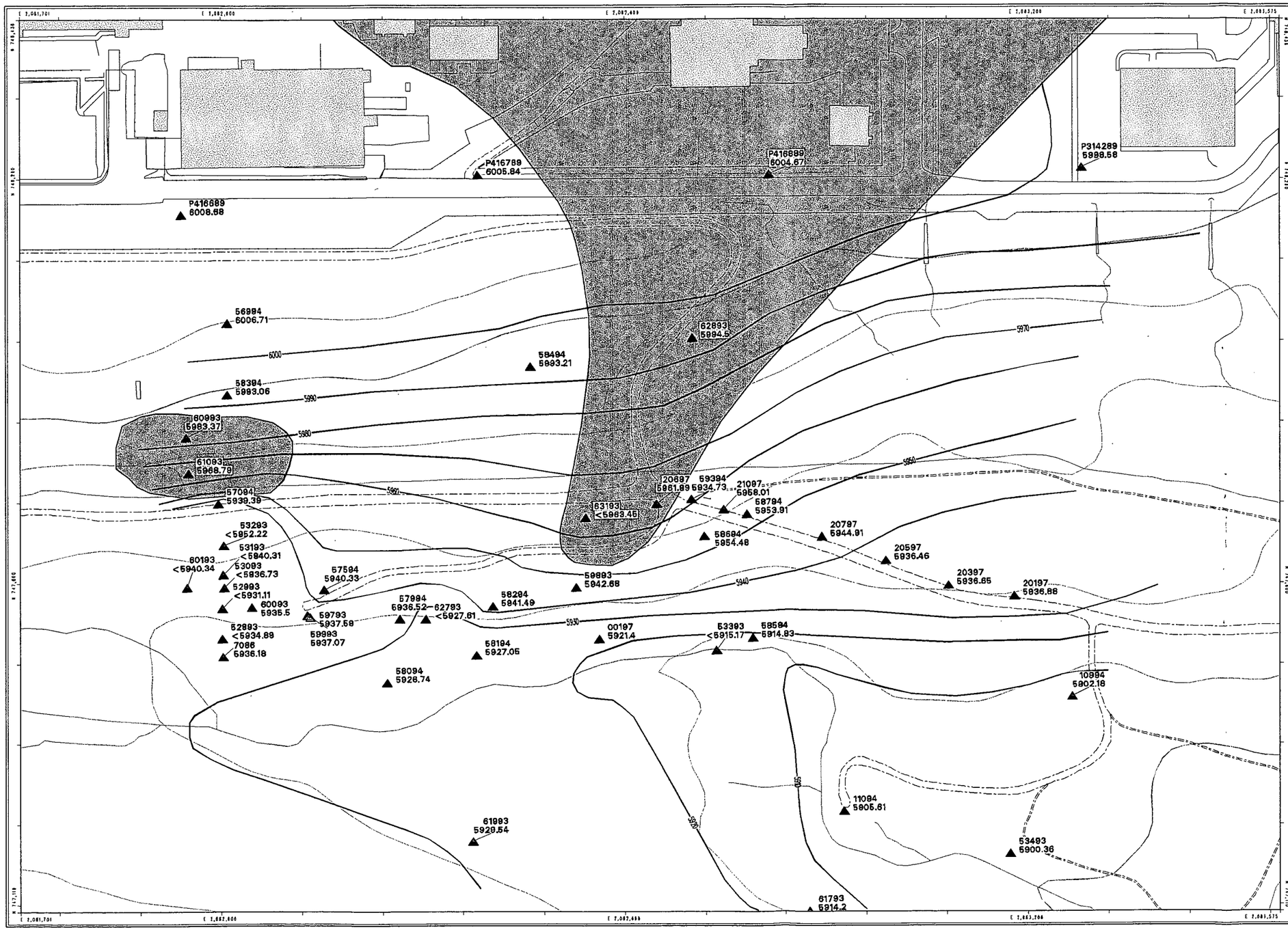

Figure 4-4
Potentiometric Surface of UHSU Deposits, 2nd Quarter 1998 for South Industrial Area Plume and Vicinity

EXPLANATION

- Groundwater Well
- Groundwater Intercept System
- Landfill Slurry wall
- Water Level Contour
- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

NOTE:
Source of GIS data available upon request.

Scale = 1 : 1660
1 inch represents approximately 154 feet

50 0 100 200 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0199

September 21, 1998

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As shown in Figure 4-5, the North IA plume groundwater evaluation will investigate potential pathways for VOC migration to surface water at the north IA boundary. The following evaluation is planned:

1) Historic data will be evaluated to predict the location of pathways to surface water from the area around wells 22796 and 22896. Well 1986 will be evaluated to ensure that it is located and screened appropriately to detect potential contamination associated with stream alluvium.

2) Temporary wells will be installed to help locate saturated pathways to surface water. Information concerning subsurface conduits, footing drains, and outfalls in nearby buildings will also be collected.

3) Once sufficient field data exist to quantify the nature and extent of the groundwater contamination, plume flux calculations will be performed to assess the impact of VOC migration to North Walnut Creek.

The field evaluation will consist of a series of temporary Geoprobe wellpoints spaced at 100 feet intervals along roadways that parallel plume front boundaries. Each wellpoint will be developed and sampled for VOCs upon completion, and the results presented in the FY98 Annual RFCA Groundwater Monitoring Report.

4.3 PU&D Yard Plume

VOC groundwater contamination has historically been detected in well 70393 located at the upgradient periphery of the Present Landfill, and in seep well point 61495 positioned along the north hillslope of North Walnut Creek. The presence of contamination in upgradient landfill groundwater indicates that non-landfill contaminants are currently or potentially entering the landfill representing a potential impact to downgradient landfill groundwater. Additionally, the contamination represents

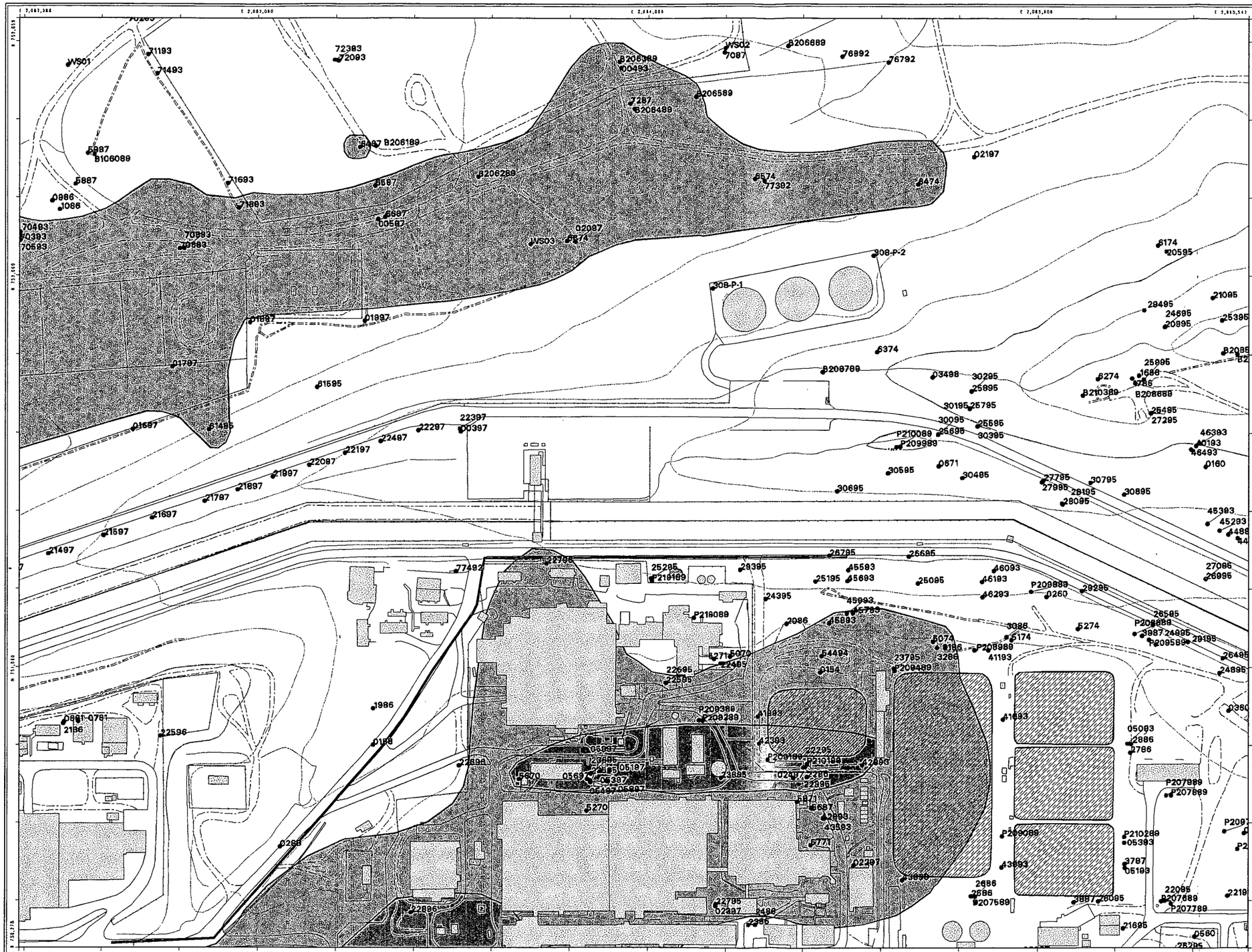

Figure 4-5
Proposed CY98 Groundwater Evaluation of North Industrial Area Plume

EXPLANATION

- Groundwater Wells
- Geoprobe Well Siting Area
- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

NOTE:
Source of GIS data available upon request.

Scale = 1 : 3120
1 inch represents 260 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: RFCA

September 28, 1998

/gis2/projects/fy98/rfca-rpt/rcfs_figures/ind_area/ind_plume.aml

a threat to surface water quality as evidenced by the presence of numerous hillside seeps located south of the landfill that discharge to the North Walnut Creek drainage basin. The most likely source of groundwater contamination in this area based on historical documentation, land usage, and hydrogeologic considerations, has been tentatively identified as the Property Utilization and Disposal Storage Yard (PU&D Yard), also known as IHSS 170, including IHSSs 174A and 174B. From 1974 to 1994 these three IHSSs were former storage areas for empty drums, cargo boxes, and dumpsters that contained unknown residual quantities of various solvents and waste materials. Two areas within IHSS 170, IHSSs 174A and 174B, were designated for the storage of hazardous materials, specifically empty drums at IHSS 174A and a dumpster for the storage of stainless steel sheet metal chips and lathe turnings coated with freon-based or oil-based lathe coolant. Potential VOC contamination is probably due to leaking drums containing oil-solvents or metal turnings coated with oil-solvents, or as surface spills.

Subsequent soil-gas and field sampling studies indicated the possible presence of subsurface VOC contamination in three areas, 1) the east-southeast side of IHSS 170, 2) the northeast corner of IHSS 170 and the north side of IHSS 174A, and 3) an oil stain area in IHSS 174B (RMRS, 1997a). Based on these results and recent detections of VOCs in routine well samples, a pre-remedial field investigation of PU&D Yard soils and groundwater was undertaken in 1997. Goals for the project were to confirm the identity of the PU&D Yard as a source for upgradient landfill groundwater contamination and characterize the source, extent, and pathways for VOC contamination in the area. Twelve new monitoring wells and well points were installed within and around the perimeter of the PU&D Yard and downgradient areas, as shown in Figure 4-6. In addition, groundwater grab samples were obtained for VOC analysis from six shallow borings during drilling in IHSSs 174A and 174B, and near the west boundary of IHSS 170, as described in RMRS (1997b). Completion details for the new PU&D Yard monitoring wells are presented in Table 6-4.

Table 4-4 presents the results of VOC groundwater sampling conducted at the PU&D Yard and surrounding area in wells 01097 through 02197 and 21197 through 22497 during the third and fourth quarters of 1997. For wells 01097 through 02197, detections of VOC compounds were found in all wells containing groundwater, including values above Tier II action level for TCE in wells 01497 and 02097; PCE in wells 01297 and 01397; and 1,1-DCE in wells 01497 and 01897. TCE, PCE, 1,1-DCE and 1,1,1-trichloroethane (1,1,1-TCA) were the most commonly detected compounds. The remaining compounds (CT, chloroform, napthalene, 1,2-DCE, toluene, and 1,2,4-trimethylbenzene) were reported mainly at below detection levels as estimated quantitations (J qualified).

Table 4-4 Detected VOCs in Groundwater (ug/L) for PU&D Yard Monitoring Wells

Wells	Sample Date	Sample Number	TCE		PCE		Carbon Tetrachloride		Chloroform		Napthalene		cis-1,2 DCE		1,1 DCE		1,1 DCA		1,1,1 TCA		Toluene		1,2,4 Trimethylbenzene	
01097	9/25/97	GW05613TE	1	U	2		1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.4	J	0.3	J
01197	9/29/97	GW05619TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
01297	9/25/97	GW05616TE	1	U	7		1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
01397	9/30/97	GW05620TE	0.2	J	5		0.2	J	1	U	0.4	JB	1	U	1		1	U	5		1	U	1	U
01497	9/25/97	GW05614TE	30		4	J	5	J	6	U	6	U	6	U	80		3	J	170		6	U	6	U
01597	9/26/97	GW05617TE	1	U	2		1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
01697	9/30/97	GW05623TE	4		0.5	J	1	U	1	U	1	U	1	U	2		1	U	4		1	U	1	U
01797	Dry - sample not collected																							
01897	9/29/97	GW05622TE	4		0.6	J	0.8	J	0.3	J	1	U	1	U	7		1	U	20		1	U	1	U
01997	9/30/97	GW05621TE	2		4		1	U	1	U	1	U	1	U	2		1	U	6		1	U	1	U
02097	9/30/97	GW05618TE	10		2		1	U	0.4	J	1	U	0.8	J	2		3		7		1	U	1	U
02197	Dry - sample not collected																							
21197	8/14/97	GW05599TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
21297	8/14/97	GW05598TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
21397	11/12/97	GW05656TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
21497	11/12/97	GW05657TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.2	JB	1	U
21597	11/12/97	GW05658TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.2	JB	1	U
21697	11/12/97	GW05659TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.3	JB	1	U
21797	11/12/97	GW05660TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
21897	Dry - sample not collected																							
21997	11/12/97	GW05661TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
22097	11/11/97	GW05655TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
22197	11/11/97	GW05654TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
22297	11/10/97	GW05644TE	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
22397	Insufficient water for sample																							
22497	Insufficient water for sample																							

Note: U = Analyzed chemical was not detected
J = Estimated result - chemical detected below SQL
B = Chemical also found in method blank

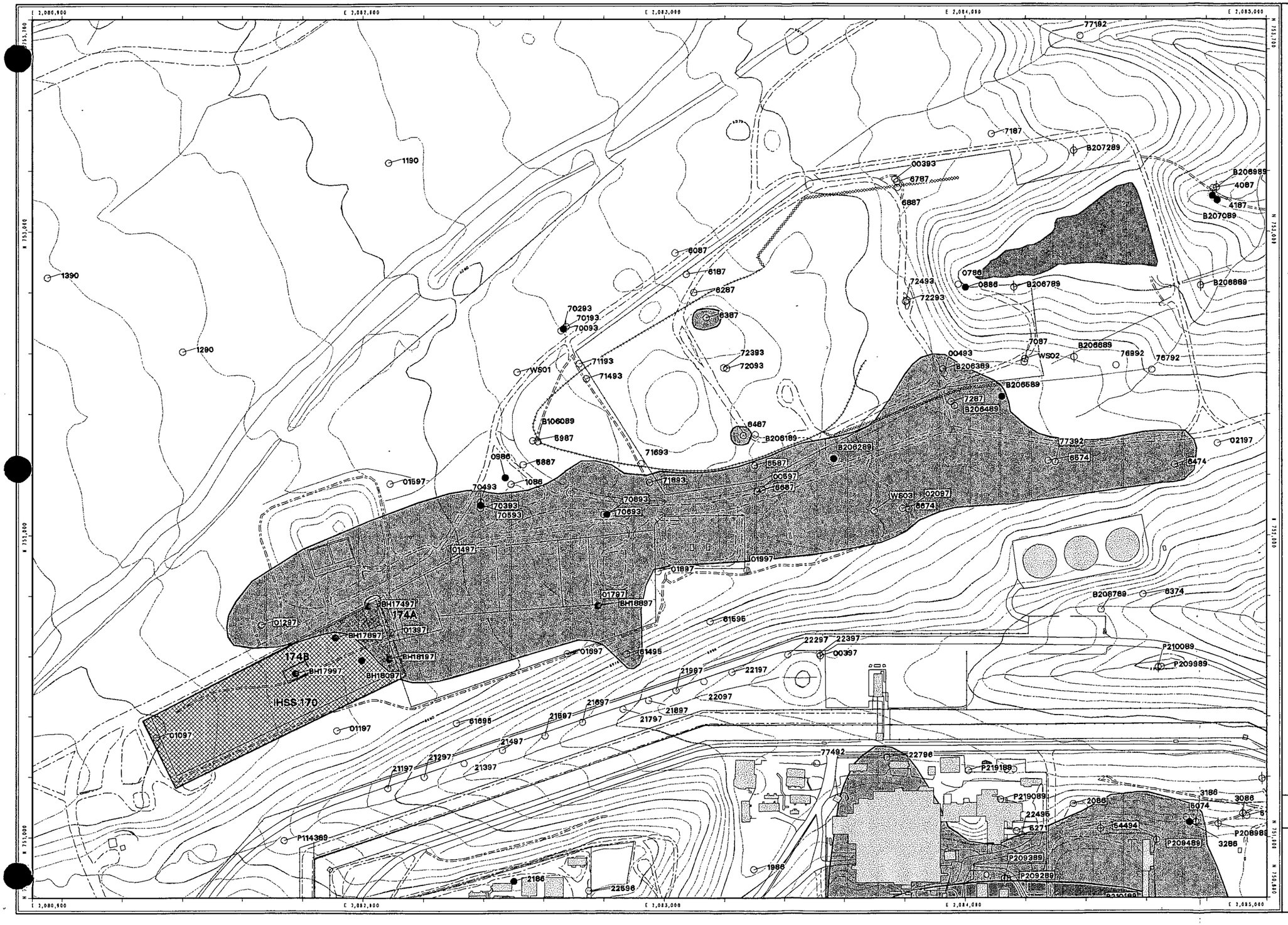

Figure 4-6
PU&D Yard 1997
Groundwater VOC Plume

EXPLANATION

- PU&D Yard Monitoring Well
- Groundwater Monitor Well UHSU Surficial Material
- Groundwater Monitor Well UHSU Bedrock
- Groundwater Monitor Well LHSU Bedrock
- Borehole Locations
- Groundwater Intercept System
- Landfill Slurry wall
- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)
- PU&D Yard IHSS

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

NOTE:
Source of GIS data available upon request.

N

Scale = 1 : 3810
1 inch represents approximately 318 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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MAP ID: 98-0160PLM

September 28, 1998

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Wells 01797 and 02197 were dry at the time of sampling. Except for a few trace detections (<1 μg/L) of toluene, no VOC detections were reported for wells 21197 through 22497, thus indicating the absence of any significant PU&D Yard VOC plume movement towards North Walnut Creek. The B qualifier associated with the toluene results suggests that laboratory contamination is the probable cause for the positive detections in these samples.

Groundwater grab samples collected during IHSS 174A and 174B pre-remedial drilling activities revealed the presence of PCE at concentrations above Tier I and II action levels in boreholes 17497 (1,700 μg/L) and 18197 (15 μg/L), respectively, as reported in RMRS (1997b). Borehole 17497 is located at the north edge of IHSS 174A, which appears to be a potential source for groundwater PCE contamination. However, the presence of relatively low PCE concentration and other VOC detections in many wells (including well 01097 and borehole 18197) located up and sidegradient of IHSS 174A indicates that the PU&D Yard might be acting as a diffuse (non-point) source for groundwater contamination.

As shown in Plate 20, the distribution of composite VOC contamination in groundwater (consisting of greater than Tier II concentration levels of TCE, PCE, CT, and VC confirm that the PU&D Yard is the probable source of upgradient landfill VOC contamination. The relatively high concentration of TCE (30 μg/L) in well 01497, located approximately 200 feet upgradient of landfill background well 70393 and 400 feet upgradiant of the landfill boundary, and PCE (1,700 μg/L) in borehole 17497, indicates that VOC contamination probably originates near the north boundary of the PU&D Yard. From the PU&D Yard, the plume is observed to migrate longitudinally eastward along the south boundary of the landfill and laterally to the south, where alluvial groundwater containing plume contaminants discharges to the North Walnut Creek drainage as hillside seeps (i.e., well 61495) and shallow subsurface flow.

Considering the fact that groundwater once discharged to the No Name Gulch valley headcut (indicated by seepage areas present in a 1937 aerial photograph), now filled with landfill refuse, the shape and orientation of the plume strongly suggests that plume migration is influenced by interaction with groundwater control structures (groundwater-intercept and slurry wall system) and is diverted around the landfill. Previous analyses of intercept system function using potentiometric configurations, well hydrograph responses, saturated thickness maps, and total dissolved solids distributions (EG&G, 1994c) have indicated that the south groundwater intercept and slurry wall system appears to be functioning effectively in excluding upgradient groundwater flow from entering the landfill (Figure 4-7). While restricting groundwater from entering landfill refuse, the intercept

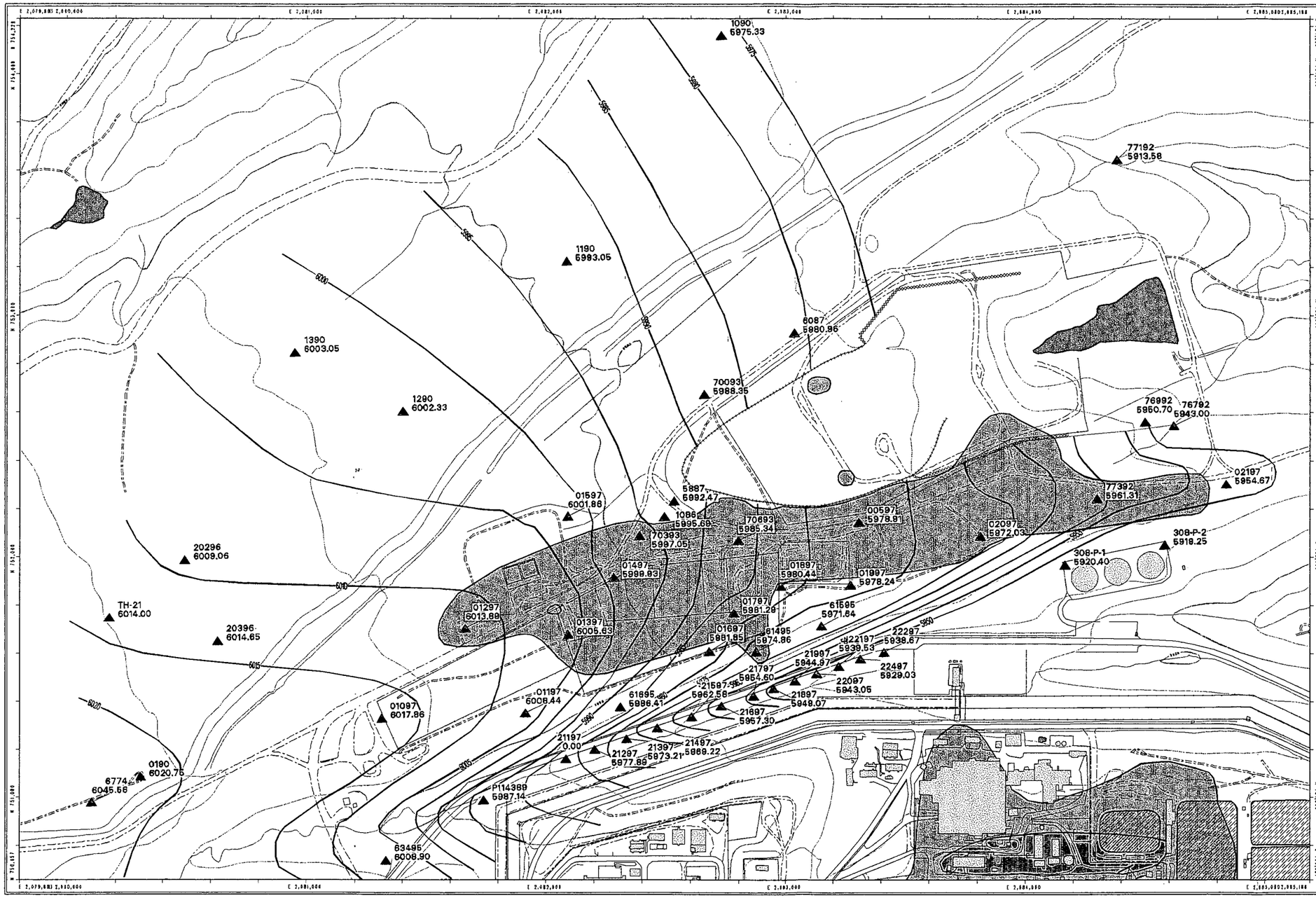

Figure 4-7
Potentiometric Surface Map of The PU&D Yard

EXPLANATION

- Groundwater Well
- Groundwater Intercept System
- Landfill Slurry wall
- Water Level Contour
- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

NOTE:
Source of GIS data available upon request.

Scale = 1 : 5330
1 inch represents approximately 444 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0199

September 17, 1998

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drain probably contributes to longitudinal plume spreading, as indicated by the correspondence between plume configuration and length with the position of the drain.

A comparison of VOC compounds from the PU&D Yard investigation was made with data reported in recent RCRA groundwater reports (e.g. EG&G, 1995d; RMRS/K-H, 1996) and selected VOCs presented in Plates 8 through 12. The data suggest that the chlorinated organic compounds observed in the PU&D Yard plume are prevalent in landfill wells located south of the groundwater intercept system, while organic compounds found within the boundaries of the intercept system show more variable organic affinities (EG&G, 1995d; RMRS/K-H, 1996). Of special note is the presence of 1,1,1-TCA, which is a good indicator compound for PU&D Yard contamination. This compound is detected in wells south of the intercept system but, with the exception of well B206389, not in wells within the intercept boundaries. The presence of trace levels (<5 μg/L) of 1,1,1-TCA and similarities in PCE and TCE concentrations in this well compared to that of upgradient well 7287 suggest that the south slurry wall may be ineffective in restricting groundwater flow at its east end, as depicted in Figure 4-6. The easternmost lobe of the composite plume, defined solely by single detections of vinyl chloride in wells 6474 and 6574, appears to be unrelated to PU&D Yard contamination and may represent a spurious set of laboratory results. Monitoring at plume extent well 02197 located 160 feet east of well 6474 should eventually reveal if vinyl chloride contamination exists in the groundwater at this location. Tentatively, the boundaries of the PU&D Yard plume have been revised in Plate 20 and Figure 4-6 to more accurately differentiate present landfill from PU&D Yard VOC contamination, assuming that degradation of chlorinated organic compounds is minimal in the landfill.

5.0 GROUNDWATER CHARACTERIZATION ACTIVITIES

The following groundwater characterization activities were ongoing or were performed completely during calendar year 1997. The projects were performed jointly between the GMP and other ER groups at RFETS and are discussed here because of their pertinence to groundwater issues. The following sections are condensed discussions of the various groundwater characterization activities performed during 1997. Greater detail regarding each investigation may be obtained by reviewing the referenced reports for each area, which are referenced below and listed in Section 8.0, References.

5.1 Mound Plume/SW059

The Mound consists of a former waste burial area, where approximately 1,400 drums containing uranium and beryllium contaminated waste oil, carbon tetrachloride, tetrachloroethene (PCE), other VOCs, and low levels of plutonium were stored. The drums, initially stored on the ground, were buried with soil between April 1954 and September 1958. In 1970 all of the drums were exhumed from the Mound Site along with some radiologically contaminated soil. The Mound Site area has been disturbed often, generally by construction projects, since the initial source removal. Additional radioactive soils were identified during these projects and removed at later dates. Recent investigations have detected VOCs, primarily PCE, in subsurface soils above subsurface soil action levels that required cleanup

The Mound Site groundwater plume is located north of Central Avenue and east of the PA fence. The plume, comprised primarily of VOC contamination, discharges as seeps and subsurface flow into the South Walnut Creek drainage in the vicinity of seep SW059 (Figure 5-1). The VOC contamination is found along a line of monitoring wells downgradient (north) of the Mound Site and between the Mound Site and South Walnut Creek, indicating that the Mound Site is the primary source of the plume.

An accelerated soil removal action was completed during the spring of 1997 to remove VOC contaminated soils above the Tier I action levels from the Mound Site. Low temperature thermal desorption was utilized to remove the VOCs from the excavated soils. The treated soils were returned to the Mound Site excavation. As part of the Mound Site soil removal action, a permanent culvert was installed in the unlined Central Avenue Ditch in the vicinity of the Mound Site. The ditch is immediately upgradient of the source area and contributed water to the Mound Site Plume.

Figure 5-1
SW059 Site Area
Water Table Elevation
April 30 - May 8, 1997
with values above Tier I and II Action Levels

EXPLANATION

- Surface Water Monitoring Locations
- Groundwater Monitoring Wells Piezometers & Geoprobe Boreholes
  * = dry or insufficient water to sample
  NS = not sampled
- GW Monitoring Wells, Piezometers & Boreholes with values above Tier I Action Level for VOCs
- GW Monitoring Wells, Piezometers & Boreholes with values above Tier II Action Level for VOCs
- SW059 Holding Tank
- Water Table Elevation Contour Dashed Where Inferred
- Approximate Location of 72" Storm Sewer
- Large Diameter Culvert
- Unsaturated Area Boundaries Uncertain

Standard Map Features

- Buildings
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads

Scale = 1 : 560
1 inch represents approximately 47 feet

15 0 30 60ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 97-0044

November 11, 1998

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It is anticipated that the culvert will decrease the amount of water that is recharging the Mound Site Plume.

A pre-remedial groundwater investigation was performed in March and April of 1997 to examine the nature and extent of the Mound Site Plume adjacent to South Walnut Creek (RMRS, 1997g). The purpose of the investigation was to determine the elevation of the bedrock surface within the investigation area, and determine the lateral extent of saturated groundwater above the bedrock surface. Another goal was to define the lateral extent of the Mound Site VOC plume to support the design of an interception/collection trench, and provide information to plan the proper disposal of soil removed during construction of the interception/collection trench. The results of the investigation indicate that the downgradient end of the Mound Site groundwater plume extends from just west of seep SW059 to the vicinity of monitoring well 10997. The highest groundwater levels were observed near the central portion of the plume, near monitoring well 10497, where the water level was approximately one foot below ground surface. The water level, and quantity of groundwater present, generally declines towards the east and west margins of the plume. The most commonly detected organic contaminants from the source area to the distal end of the groundwater plume are PCE and TCE. Other VOCs are present in the plume, mainly towards the distal end, as degradation products of PCE and TCE.

Work performed during 1998 on this project pertaining to groundwater will involve design and construction of a groundwater collection and treatment system.

5.2 IHSS 118.1 Carbon Tetrachloride Plume

Individual Hazardous Substance Site (IHSS) 118.1 is an area of known subsurface soil and groundwater contamination associated primarily with a 5,000 gallon leaking underground storage tank (UST) which contained carbon tetrachloride. The steel tank, which was installed in 1963, had a concrete containment structure on its south side near the intake area. Numerous surface spills occurred before 1970, some involving as much as 200 gallons of carbon tetrachloride. In the late 1970s the tank level gauge malfunctioned and the tank was overfilled, resulting in approximately 1,000 gallons of carbon tetrachloride being spilled on the ground. The intake to the UST failed in June 1981 and carbon tetrachloride was released into the containment structure. Carbon tetrachloride was pumped out of the containment structure onto the surrounding ground surface. The UST was removed in 1981, as was a small amount of soil that had surrounded the tank. It is not known whether the concrete containment structure was ever removed.

The OU8 Phase I Remedial Investigation (DOE, 1995a) found carbon tetrachloride product in the soil and groundwater in the vicinity of IHSS 118.1. Very high concentrations of VOCs were observed in soil, and groundwater collected from one of the borings separated into two immiscible liquid phases. Carbon tetrachloride is present in the area at concentrations sufficient to remain as a dense non-aqueous phase liquid (DNAPL), as well as what is dissolved into the groundwater. Because it has a higher specific gravity than water, carbon tetrachloride product will migrate to the bottom of the water column and collect above a low permeability soil or bedrock layer. Soils in the IHSS 118.1 area are composed predominantly of reworked Rocky Flats Alluvium with some undisturbed Rocky Flats Alluvium. This material is mostly clay interbedded with gravel and sand. Immediately beneath the alluvial material is weathered claystone of the Laramie Formation.

A pre-remedial investigation of IHSS 118.1 was performed in 1997 (RMRS, 1997h). The objectives of the investigation were to better determine the extent of the DNAPL, determine the bedrock topography of the area, and obtain information for the design of potential remedial actions. Refining the extent of the dissolved VOC plume associated with IHSS 118.1 was not a primary objective of the investigation. A groundwater investigation of the dissolved VOC plume is planned for the future. The results of the 1997 investigation indicate that there are four monitoring wells, in an area approximately 45 feet square, where carbon tetrachloride product is found. This DNAPL occurs as a thin layer at a depth of approximately 21 feet below ground surface (bgs) along a bedrock low associated with an excavation for the large underground process waste tanks related to IHSS 132. The IHSS 118.1 UST was located in this excavation. It is not known whether the DNAPL layer is continuous or consists of isolated pools on the excavated bedrock surface. Groundwater is present at depths ranging from six to nine feet bgs. In addition to carbon tetrachloride, other VOCs including methylene chloride and chloroform were identified as well as No. 2 diesel fuel.

The low permeability claystone at the base of the excavation prevents vertical migration of the carbon tetrachloride. Dissolution of carbon tetrachloride into the overlying alluvial groundwater may be retarded locally because the bottom of the excavation may isolate the DNAPL somewhat from the active groundwater flow path. The DNAPL layer is too deep to migrate along utility corridors or along the undisturbed bedrock surface. The only potential risk to surface water is through migration of the dissolved carbon tetrachloride phase in alluvial groundwater.

Work performed on this project during 1998 pertaining to groundwater will be summarized in the 1998 RFCA Groundwater Annual Report.

5.3 Solar Evaporation Ponds Nitrate/Uranium Plume

The Rocky Flats Cleanup Agreement (RFCA) set a milestone of fiscal year 1999 for the implementation of a remedial action which would control contaminated groundwater emanating from the SEPs and prevent it from causing North Walnut Creek to have concentrations above its in-stream standards. The Solar Ponds Plume (SPP) is an area of groundwater contamination which extends from the SEPs, located in the northeastern portion of the Protected Area, to the northeast towards North Walnut Creek and to the southeast towards South Walnut Creek (See Plate 13). The primary analytes of concern are nitrate/nitrite and various uranium isotopes; however, other inorganic and organic compounds have also been identified at concentrations above the Tier II action levels.

The SPP emanates from the Solar Evaporation Ponds. VOCs have been detected in wells located in the western portion of the SEPs and south of the SEPs. The VOCs are thought to have originated from sources to the west and southeast of the SEPs. Several metals have also been detected in SPP monitoring wells at concentrations above groundwater action levels.

An Interceptor Trench System (ITS) was constructed in 1971, and expanded in 1981 to prevent the SPP from advancing to North Walnut Creek. The ITS traverses the hillside to the north of the SEPs and collects surface water infiltration and alluvial groundwater; however, the ITS does not collect groundwater from the weathered bedrock immediately below the alluvium. Groundwater flowing through weathered bedrock may continue on towards North Walnut Creek. Water collected by the ITS since 1993 has been stored in modular storage tanks prior to treatment at Building 374.

As an initial phase in determining the appropriate remedial action for the SPP, RMRS began a study in 1997 to evaluate alternatives for the management and treatment of the water collected by the ITS (RMRS, 1998e). The objective of the study was to determine a permanent remedy for the SPP. Eleven alternatives were evaluated and ultimately three were deemed feasible for further study. Final evaluation of the retained alternatives requires a detailed characterization of the water quality in the alluvium and the weathered bedrock in the vicinity of and downgradient of the SEPs. The 1997 and current (1998) field activities associated with this study will collect the data necessary to complete a Solar Evaporation Ponds conceptual hydrogeologic model and groundwater flow model, as well as evaluate the three remedial alternatives.

Characterization work completed on this project in 1997 included collection and analysis of groundwater samples in the SEPs area including samples outside the SPP from the North and South Walnut Creek areas and upgradient (background) areas (RMRS, 1998e). Work planned for 1998

includes the installation of additional monitoring wells in the SEPs area to supply hydrogeological and geochemical information where data gaps exist or to replace older wells that have been destroyed. The primary objective of the project is to determine the nature and extent of the SPP during low flow season (late fall/winter) and high flow season (spring) and identify potential contaminant sources. The secondary objective is to evaluate the amount and distribution of uranium in the groundwater associated with the SPP, and estimate what portion of it is attributable to Site activities. A summary of this investigation will be presented in the 1998 RFCA Groundwater Annual Report.

5.4 Industrial Area IM/IRA Activities In CY97

In March 1998, the Site published the Interim Measures/Interim Remedial Action (IM/IRA) annual report (RMRS, 1998c). This report describes the status of IA environmental monitoring activities performed in support of the IA IM/IRA Decision Document for FY97 The IA IM/IRA was developed to focus monitoring efforts on specific decontamination and decommisioning (D&D) or environmental restoration (ER) activities in the IA, and to provide the flexible coverage necessary to respond to the remediation and closure of the Site. Groundwater monitoring under the IA IM/IRA serves the dual purpose of establishing baseline IA groundwater quality conditions prior to the implementation of D&D and remedial activities and comparing present and future monitoring data to RFCA groundwater action level criteria. RMRS (1998c) covers monitoring activity performed during the fiscal year 1997 period starting in October 1996 and extending through September 1997.

IA IM/IRA groundwater monitoring activities conducted in FY97 included routine sampling of wells in accordance with the IMP: installation of three wells (02297, 02397, and 02497) upgradient and downgradient of Building 779 for D&D monitoring purposes; and installation of one well (00297) south of the SEPs for monitoring plume movement toward South Walnut Creek (see Figure 6-4). The results of routine groundwater sampling indicated that wells with pre-existing concentrations above Tier II (manganese in well 1986, nickel in well P313589, uranium 233/234 in well 6186, and nitrate/nitrite in well P218389) continue to show flat or downward trends in time-series graphs. Trend plots for newer program wells with values above Tier II action levels of dissolved manganese, dissolved thallium, TCE, uranium 233/234, uranium-235, uranium-238, and nitrate/nitrite were also constructed, but lacked the necessary data for historical statistical comparisons or trend assessment. Further monitoring will be required to establish whether or not short-term increasing trends observed in some of these graphs result from an advancing plume front or represent an artifact of an insufficient sample population.

One upgradient D&D well, 02397, and two downgradient D&D wells, 02297 and 02497, were installed at Building 779 in September 1997 to monitor D&D activities. All three wells consist of 0.75-inch inside diameter polyvinyl chloride (PVC) well casing and screen installed using the Geoprobe system. Additional well construction specifications are summarized in Table 6-3. None of these wells were sampled in CY97 due to lack of water. Analytical results for CY98 groundwater sampling at Building 779 will be presented in the FY98 IA IM/IRA report and summarized in the CY98 Annual RFCA Groundwater Monitoring Report.

As indicated by fourth quarter 1997 potentiometric data (see Plate 3), groundwater flow diverges away from Building 779 in a northerly to easterly direction. Based on initial water level measurements, the depth to groundwater is estimated to range from 7 to 11 feet, resulting in an alluvial saturated thickness of between 0 (well 02397) and 4 feet. Groundwater flow beneath the building may be influenced by the undrained basement of the original building (finished floor elevation of 5,959 feet), and by an east-west trending foundation drain installed along the west and north side of a building addition completed in 1968 (finished floor elevation of 5,979 feet, drain invert elevation of approximately 5,975 to 5,978 feet) (EG&G, 1994d). At an elevation of 5,959 feet, the original basement floor is projected to extend 8 to 16 feet into the bedrock and intercept much of the alluvial and shallow bedrock flow. Groundwater has been reported to seep into sub-floor tanks during high water table months, and is intermittently collected and sent to Building 374 for treatment. The building addition foundation drain discharges to the hillside north of the SEPs, presumably at a 10-inch tile pipe (SW85) or an adjacent 18-inch corrugated-metal pipe (EG&E, 1994d).

Plume definition well 00297 was installed in August 1997 to monitor the southward migration of nitrate/nitrite and uranium plumes released from the SEPs. This well consists of 2-inch I.D. PVC well casing and screen completed in alluvium using conventional hollow-stem auger drilling methods (see Table 6-3 for construction details). Water level measurements taken during 1997 since installation have indicated consistently dry conditions for this well, thus no analytical results exist for interpretation in CY97.

5.5 Plutonium and Americium in Groundwater Report

An evaluation of the significance of historical plutonium and americium detections reported for wells that monitor shallow groundwater quality was conducted in 1997. Over 30 wells at RFETS contain mean activity-concentrations above the Tier II groundwater action levels for plutonium-239/240 (0.15 pCi/L) and americium-241 (0.145 pCi/L). Many of these wells are associated with known

radionuclide source areas, particularly the 903 Pad and Lip area, and off-site migration pathways, such as the Walnut Creek valley-fill alluvium. The evaluation, documented in "*Evaluation of Plutonium and Americium in Groundwater at the Rocky Flats Environmental Technology Site*" (RMRS, 1998d), will be independently reviewed by the CDPHE in FY99.

The principal issues evaluated in the report involve groundwater sample representativeness; pathways and mechanisms for transport of plutonium and americium to groundwater; and the potential for long-term migration of plutonium and americium to surface water via groundwater.

A summary of the major conclusions of the report are presented below.

(1) Judging from the results of sampling technique comparison studies and the close relationship observed for radionuclide and total suspended solids (TSS) contaminant trends in these wells, the presence of Pu-239/240 and Am-241 in unfiltered groundwater appears to be principally caused by residual contamination from drilling and well installation operations in areas containing contaminated surface soils.

(2) Historical unfiltered groundwater Pu-239/240 and Am-241 data exaggerate the levels of contamination residing in shallow groundwater. Bailer sampling techniques greatly exacerbate the suspended solids load of samples which, combined with drilling artifact contamination, produce sample results that are meaningless for application to groundwater transport problems.

(3) Transport of particulate/colloidal phase Pu-239/240 and Am-241 from surface soils to groundwater in the 903 Pad area remains a possibility given the relatively high recharge potential of soils inferred from hydrographs from local wells. If transport occurs via this pathway, contaminant levels are expected to be low based on the available results of samples collected by low pumping rate methods, and vertical distributions observed in shallow soils. Assuming that soil-leached Pu-239/240 is transported to groundwater, the results of Harnish et. al. (1996) suggest that Pu-239/240 activity-concentrations can be above groundwater action levels even if drilling artifact contamination is minimal in carefully sampled wells. Overall, the lateral mobility of Pu-239/240 and Am-241 in shallow groundwater is expected to be limited considering the lithologic and hydraulic characteristics of the alluvium, and association with the >0.45 μm particulate and colloid size fraction.

(4) Non-aqueous phase liquid facilitated transport of radionuclides at the 903 Pad does not appear to be an important pathway for Pu-239/240 and Am-241 release to groundwater based on differing patterns of contamination found in wells contaminated by high levels of volatile organic compounds and radionuclides.

(5) Off-site release of Pu-239/240 and Am-241 contaminated groundwater at the RFETS east boundary is not supported by the available well data from the Walnut and Woman Creek drainages. The occurrence of low level Pu-239/240 and Am-241 contamination in groundwater samples from well 41691 in Walnut Creek is mainly attributable to drilling artifact contamination derived from locally contaminated surface soils and recently deposited sediments. In addition to the surface/groundwater interaction hypothesis proposed by CDPHE (1996), the cause of seasonal fluctuations in Pu-239/240 and Am-241 levels at this well may be related to near-borehole effects, such as contaminated fines removal from the top of the intake zone during high water level periods and from short circuiting into shallow well intake zones during periods of infiltration and flooding.

(6) Precautions for isolating actinide-contaminated soil zones must be taken when installing future monitoring wells to minimize the potential for drilling cross-contamination. In addition, the installation of long well screens with shallow intake depths should be avoided.

(7) The relatively low activity-concentration of filtered sample results compared to unfiltered sample results observed in all wells reflects the particle-reactivity of Pu-239/240 and Am-241 for the solid phases suspended in groundwater. Filtered activity-concentrations of these radionuclides are typically well below groundwater action levels.

6.0 OTHER GROUNDWATER PROGRAM ACTIVITIES

6.1 Well Permitting

A total of 282 well permit applications, including 252 existing monitoring wells and 30 new monitoring wells, were prepared and submitted to the State Engineers Office during 1997, as identified in Table 6-1.

6.2 Bladder Pump Installations/Low Flow Rate Sampling

The geology of RFETS includes fined-grained lithologies which, when disturbed by drilling and well installation activities, can create an abundance of sediment in groundwater samples. Because of the nature of the sediment, standard bailing procedures performed during groundwater sampling results in highly turbid samples that are non-representative of natural groundwater flow conditions. High turbidity samples can result in erroneous analytical results, especially for metals and radionuclides. In an attempt to control turbidity problems, dedicated bladder pump systems were installed in selected monitoring wells with hydrologic conditions (such as a thick saturated thickness and a high well yield) favorable for continuous low flow rate sampling. In addition to helping to control turbidity problems, the dedicated systems were expected to improve VOC sample quality by providing an airtight flowpath from the pump intake to the sample vial. Low flow rate sampling techniques have the added benefit of greatly reducing the amount of purge water that must be disposed of.

During 1997, twenty-three RFCA monitoring wells were fitted with dedicated bladder pump systems, as shown in Figure 6-1. The primary purpose of installing dedicated pumps in the wells was to alleviate CDPHE concerns regarding the filtering of groundwater samples. Objections to filtering include concerns about sample degassing, introduction of contaminants from the filter medium, and the potential for filtration to remove colloidal particles (<0.45 microns), which occur as natural groundwater constituents. Analysis of unfiltered bailed samples may result in higher concentrations of metals or radionuclides than are actually present in groundwater. By filtering sample aliquots, and thereby removing the sediment, the case could be made that sample results had been compromised by physically removing some percentage of the transportable analyte fraction in the sample. On the other hand, the case could be made that filtering groundwater samples removes the non-transportable fraction of solids introduced by sampling and, therefore, provides a more accurate representation of the analyte concentration in solution.

Table 6-1 Summary of FY97 Well Permit Applications

Well Number										
20891	45293	53693	61993	10694	51494	58494	21095	28395	63795	00897
TH04629	45393	53793	62093	10794	51594	58594	21195	28595	63895	00997
TH04649	45593	53893	62193	10894	51694	58694	21295	29395	64595	01097
TH04659	45693	54093	62293	10994	51794	58794	21495	29495	TH-19	01197
TH04679	45793	54193	62393	11094	52894	59194	21595	29795	TH-21	01297
TH04699	45893	54293	62493	11294	52994	59294	21695	29895	20196	01397
TH04709	45993	54393	62593	11394	53094	59394	22895	30095	20296	01497
TH04729	46093	54493	62693	11494	53194	59594	23095	30595	20396	01597
TH04749	46193	54593	62793	11594	54494	59694	23195	30695	20496	01697
46392	46293	54693	62893	11694	55194	59794	23995	60195	20596	01797
05193	46393	54793	63293	11794	55394	59894	24095	60295	20696	01897
22593	46493	59893	63393	11894	55594	68194	24195	60395	20796	01997
40193	51293	59993	63493	11994	55794	68294	24295	60495	22596	02097
41193	51393	60093	63593	12094	56294	68394	24495	60595	22696	02197
41693	51493	60193	63693	25194	56494	68494	24695	60695	22796	02297
41993	52293	60293	63793	50194	56594	71194	24995	60795	22896	02397
42393	52393	60393	63893	50294	56994	71394	25295	60895	22996	02497
42893	52493	60493	63993	50394	57094	71494	25395	60995	23096	02697
42993	52593	60593	64093	50494	57194	20195	26195	61295	23196	02797
43293	52693	60693	308-P-1	50694	57594	20395	26495	61495	23296	02897
43593	52793	60793	308-P-2	50794	57894	20495	27295	61595	00197	30197
43893	52893	60893	10094	50894	57994	20595	27395	61695	00297	30297
43993	52993	61593	10194	50994	58094	20695	27495	62095	00397	
44893	53093	61693	10294	51094	58194	20795	27795	62195	00597	
44993	53193	61793	10394	51194	58294	20895	27995	63395	00697	
45093	53593	61893	10594	51294	58394	20995	28295	63495	00797	

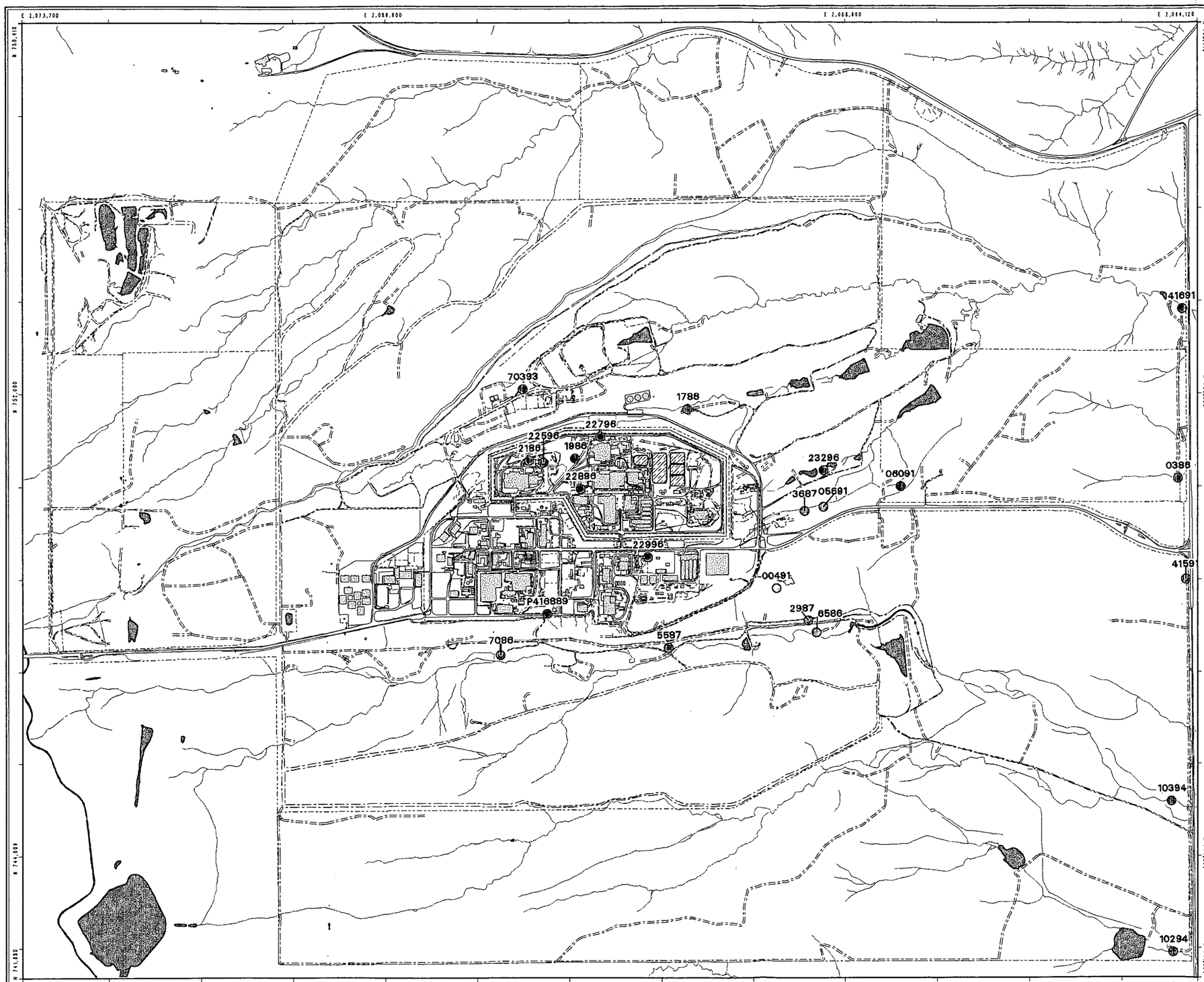

Figure 6-1
Dedicated Bladder Pump/Low Flow Rate Sampling Well Locations

EXPLANATION

Dedicated bladder pump/low flow rate sampling well locations

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

N

Scale = 1 : 21330
1 inch represents approximately 1778 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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These submittals represented a renewed effort to bring the Groundwater Monitoring Program (GMP) into compliance with 2CCR 402-2. For the most part, the list consists of a large group of pre-1997 wells remaining from the last major permitting initiative undertaken in 1995 (1993 through 1994 wells); SEPs and Seepage Characterization project wells (1995); and New Sanitary Landfill and GMP wells (1996). Permits for all applications were approved by the State Engineers Office and are currently being held on file. Geoprobe wellpoints installed for the groundwater evaluations described in Sections 4.0 and 6.4.2 were generally not permitted with the State Engineer because of the temporary purpose of these devices, but will have to be either permitted or permanently abandoned within a year of installation. The utility and fate of these wells is currently under review.

Low flow rate sampling, as an alternative to sample filtration, is based on the theory that groundwater located within the screened interval of a monitoring well is representative of the groundwater in the formation adjacent to the well screen. Low flow rate sampling, also called micropurging, is accomplished by pumping the well at rates that approximate the natural flow rates through the well. Stagnant water, potentially present in the unscreened portion of the well casing, either above or below the screen, is avoided.

RFCA monitoring wells were chosen for dedicated bladder pumps if they had relatively high flow (recharge) conditions combined with a medium to high saturated thickness. These wells correspond to 1-day wells, including wells completed in the No. 1 Arapahoe Sandstone, as opposed to wells that are purged dry and sampled the next day or for two days following purging. Monitoring wells that dewater quickly or have a thin saturated thickness are not good candidates for sampling with dedicated bladder pumps. When utilizing dedicated bladder pumps, field parameters such as pH, temperature, and electrical conductivity are allowed to stabilize prior to sampling without regard to the actual purge volume.

The following RFCA wells have dedicated bladder pumps, all of which were installed during 1997: 0386, 1786, 1986, 2186, 6586, 7086, 2987, 3687, 5587, P416889, 00491, 05691, 06091, 41591, 41691, 70393, 10294, 10394, 22596, 22796, 22896, 22996, and 23296.

6.3 Real Time Groundwater Monitoring Network

As a requirement of the RFETS Integrated Monitoring Plan, a real time water level monitoring network has been established for the UHSU. Twenty-five monitoring wells were selected for the program based on surface location, historical groundwater occurrence at each location, stratigraphic completion interval, and well construction details. The network provides for simultaneous

measurement of groundwater levels using In-Situ Inc., Model SP4000, Troll® data logging systems. The Troll is a compact downhole instrument that contains a data logger, sensors, and power unit all in a self-contained watertight unit. It measures and records temperature and temperature-corrected water level and allows for unattended long-term monitoring. It is programmed and downloaded with a portable computer. In-Situ's Win-Situ® software allows the user to communicate with the Trolls in order to set up a variety of short-term tests or long-term monitoring schemes, such as currently implemented at RFETS, or to download data.

The goals of the real time groundwater monitoring network are to provide ample, simultaneous, water level measurements for environmentally sensitive areas of RFETS, such as within and downgradient of the IA, and along stream channels to the east of the IA. This data, when used alone or in conjunction with similarly collected surface water data, will allow a greater understanding of the effects of precipitation and infiltration events on the UHSU.

As shown in Figure 6-2, monitoring wells utilized for the network are loosely arranged in north/south oriented rows. In addition, they were chosen to monitor water levels in colluvial, alluvial, and weathered bedrock (pediment surface) deposits within the UHSU. The informal north/south lines will allow observation, simultaneously across the site, of the impact of a precipitation infiltration event on the UHSU. The location of Trolls within the various sedimentary depositional environments and weathered bedrock which comprise the UHSU will allow for a better understanding of the relationship between groundwater and surface water at various locations around the site.

The real time groundwater monitoring network was fully activated on Wednesday, June 17, 1998. At this time the Trolls are set to measure the water level in each well every four hours; twelve A.M., four A.M., eight A.M, twelve P.M., four P.M., and eight P.M. Data collected from the network will be analyzed and presented in the 1998 RFCA Annual Groundwater Report. This section serves to introduce the program and notify stakeholders that the program has been implemented in accordance with the Integrated Monitoring Plan.

The monitoring wells included in the real time groundwater monitoring network are listed below: 1086, 3686, 4786, 5586, 6886, 0187, 1487, P114889, P115489, P119389, P209889, P213689, P415889, P416589, B200589, B210489, 03791, 05191, 20691, 20991, 37591, 77492, 05293, 10794, and 51494.

Figure 6-2
Real-Time Groundwater Monitoring Well Locations

EXPLANATION

● Groundwater well with real time water level monitoring

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 21330
1 inch represents approximately 1778 feet

500 0 1000 2000Ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0191

September 28, 1998

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6.4 Well Abandonment, Installation, and Maintenance Activities

Well abandonments and installations completed in 1997 were performed by the GMP under the Well Abandonment and Replacement Program (WARP) and by other ER programs, including the SW059 and IHSS 118.1 pre-remedial field investigations. This section summarizes the changes to the monitoring well network over the past year that have resulted from routine well maintenance and ER investigation activities.

WARP is a maintenance program for the GMP at RFETS. Implementation of WARP achieves the general objective of ensuring the viability of groundwater monitoring wells and piezometers for the purpose of collecting representative samples of groundwater and measuring groundwater indicator parameters. WARP provides a means to eliminate and selectively replace wells and piezometers where sample and water level readings are suspected of not being representative of subsurface conditions, or to eliminate wells that are no longer needed.

As stated in the FY97 WARP work plan (RMRS, 1996c), the specific objectives of FY97 WARP related to the GMP were to meet the following goals:

- Abandon 50 obsolete wells associated with the routine groundwater monitoring program maintenance activity;
- Abandonment of 25 wells associated with closure of the Present Landfill and source removal action planned at IHSS 108;
- Installation of ten new wells at locations where water quality and piezometric data is needed for monitoring plume migration under the RFCA per the draft IMP (K-H, 1997);
- Pre-installation Geoprobe investigations to assist in well siting of four of the new GMP well locations associated with groundwater VOC plume evaluations;
- Installation of four replacement monitoring wells at RFCA well locations 3786, 6687, 31791 and 35691 due to downhole sampler obstructions caused by casing failure or off-plumb borings, or due to submergence of the well;
- Installation of one new downgradient monitoring well to monitor the performance of remediation planned for the Mound site in FY97;
- Installation of thirteen Geoprobe wellpoints or monitoring wells (four around Building 779; six near the PU&D Yard, and three near well 06091) for collection of water quality and piezometric data; and
- Installation of additional Geoprobe boreholes and wellpoints in the Building 771 and Pond B-3 areas to better characterize potential contaminant pathways to surface water.

Some aspects of WARP, specifically the Geoprobe field activities associated with the Building 771 and Pond B-3 groundwater evaluations, were scheduled for completion in FY98 and will be addressed in the CY98 Annual RFCA Groundwater Monitoring Report.

Additional well installations were completed in support of the SW059 and IHSS 118.1 pre-remedial investigations. These activities were previously described in Sections 5.1 and 5.2, respectively, of this report.

6.4.1 Well Abandonments

A total of 72 groundwater monitoring wells were abandoned at RFETS during CY97 (Figure 6-3 and Table 6-2). These wells were selected for abandonment due to 1) impending remedial or facility closure actions that threatened the physical integrity of the wells or the hydraulic integrity of the associated hydrostratigraphic zones; 2) poor well construction or lack of adequate well construction documentation, and 3) dry well conditions that were documented for eight or more consecutive calendar quarters. All wells were abandoned in accordance with GT.11, *Plugging and Abandonment of Wells.* Where feasible, wells were abandoned using in-place techniques to minimize investigation-derived waste materials.

Although scheduled for abandonment, wells 1288, 1388, and 6774 were not abandoned because they could not be located in the field. For wells 1288 and 1388, it is believed that either the available coordinates are incorrect or the wells are damaged and/or obscured by soil cover. Well 6774 was eventually located and was found to be damaged, but only after WARP field activities were completed. This well remains a candidate for future abandonment.

6.4.2 Well Installations and Replacements

Ninety-one (91) new well and wellpoints were installed in 1997 for plume evaluations associated with VOC concentrations above Tier II action levels and potential unmonitored pathways to surface water (see Figure 6-4 and Tables 6-3 and 6-4). Of these, twelve (12) wells, including four replacement RFCA wells, were installed for compliance with IMP objectives; six (6) wells were installed at IHSS 118.1; eighteen (18) were installed near SW059 to delineate the extent of the Mound plume; and fifty-five (55) wells were installed. Appendices E.1 and E.2 contain copies of borehole geologic and well completion logs (respectively), for all wells installed in 1997.

Table 6-2 Well Abandonment Summary

Well Number	Well Type	Completion Zone	Abandonment Method	Reason
5074	Well	Bedrock	In Place	Obsolete, nonviable
5174	Well	Bedrock	In Place	Obsolete, nonviable
5274	Well	All/Bdrk	In Place	Obsolete, nonviable
5374	Well	Bedrock	In Place	Obsolete, nonviable
5474	Well	Bedrock	In Place	Obsolete, nonviable
5574	Well	Bedrock	In Place	Obsolete, nonviable
5674	Well	Bedrock	In Place	Obsolete, nonviable
5774	Well	Bedrock	In Place	Obsolete, nonviable
5874	Well	Bedrock	In Place	Obsolete, nonviable
5974	Well	All/Bdrk	In Place	Obsolete, nonviable
6074	Well	Bedrock	In Place	Obsolete, nonviable
6174	Well	Bedrock	In Place	Obsolete, nonviable
6274	Well	Bedrock	In Place	Obsolete, nonviable
6374	Well	Bedrock	In Place	Obsolete, nonviable
6474	Well	Bedrock	In Place	Obsolete, nonviable
6574	Well	Bedrock	In Place	Obsolete, nonviable
6674	Well	Bedrock	In Place	Obsolete, nonviable
6774	Well	All/Bdrk	Unable to locate	Obsolete, nonviable
0786	Well	Alluvium	In Place	Landfill closure
0886	Well	Bedrock	In Place	Landfill closure
3786	Well	Alluvium	In Place	Submerged, need RFCA replacement
6187	Well	Alluvium	In Place/Overdrill	Landfill closure
6287	Well	Alluvium	In Place/Overdrill	Landfill closure
6487	Well	Alluvium	In Place/Overdrill	Landfill closure
6587	Well	Bedrock	In Place/Overdrill	Landfill closure
6687	Well	Alluvium	In Place/Overdrill	Obstruction, need RFCA replacement
7087	Well	Bedrock	In Place/Overdrill	Landfill closure
7287	Well	Alluvium	In Place/Overdrill	Landfill closure
1288	PZ	Alluvium?	Unable to locate	Obsolete, nonviable
1388	PZ	Alluvium?	Unable to locate	Obsolete, nonviable
B106089	Well	Alluvium	In Place/Casing Dest.	Landfill closure
B206289	Well	Bedrock	In Place/Casing Dest.	Landfill closure
B206489	Well	All/Bdrk	In Place/Casing Dest.	Landfill closure
B206589	Well	Bedrock	In Place/Casing Dest.	Landfill closure
B206789	Well	Bedrock	In Place/Casing Dest.	Landfill closure
01891	Well	Bedrock	Casing Destruction	Trench T-1 remediation
12091	Well	Bedrock	Casing Destruction	Trench T-1 remediation
31791	Well	Alluvium	In Place	Obstruction, need RFCA replacement
35691	Well	Alluvium	In Place	Obstruction, need RFCA replacement
00393	Well	Alluvium	In Place/Casing Dest.	Landfill closure
00493	Well	Alluvium	In Place/Casing Dest.	Landfill closure
71193	Well	Alluvium	In Place/Casing Dest.	Landfill closure
71493	Well	Alluvium	In Place/Casing Dest.	Landfill closure
71693	Well	Alluvium	In Place/Casing Dest.	Landfill closure
71893	Well	Alluvium	In Place/Casing Dest.	Landfill closure
72093	Well	Alluvium	In Place/Casing Dest.	Landfill closure
72293	Well	Alluvium	In Place/Casing Dest.	Landfill closure
72393	Well	Alluvium	In Place/Casing Dest.	Landfill closure
72493	Well	Alluvium	In Place/Casing Dest.	Landfill closure
0686	Well	Alluvium	In Place	Obsolete, damaged
5886	Well	Alluvium	In Place	Perennially dry
3587	Well	Alluvium	In Place	Perennially dry
B201289	Well	Alluvium	In Place	Obsolete
B303089	Well	Alluvium	In Place	Obsolete
B207289	Well	Bedrock	In Place	Perennially dry
B208389	Well	Bedrock	In Place	Perennially dry
B208489	Well	Bedrock	In Place	Perennially dry
P213889	Well	Bedrock	In Place	Perennially dry
P213989	Well	Alluvium	In Place	Perennially dry
B317189	Well	Bedrock	In Place	Perennially dry
00691	Well	Alluvium	In Place	Perennially dry
00791	Well	Alluvium	In Place	Perennially dry

Table 6-2 Well Abandonment Summary

Well Number	Well Type	Completion Zone	Abandonment Method	Reason
00991	Well	Bedrock	In Place	Perennially dry
02191	Well	Alluvium	In Place	Perennially dry
02391	Well	Alluvium	In Place	Perennially dry
02791	Well	Alluvium	In Place	Perennially dry
03891	Well	Alluvium	In Place	Perennially dry
05991	Well	Alluvium	In Place	Perennially dry
11291	Well	Alluvium	In Place	Perennially dry
40491	Well	Alluvium	In Place	Perennially dry
40791	Well	Alluvium	In Place	Perennially dry
43492	Well	Alluvium	In Place	Obsolete
75892	Well	Alluvium	In Place	Perennially dry
44993	Well	Alluvium	In Place	Perennially dry
46493	Well	Alluvium	In Place	Perennially dry

Table 6-3 FY97 RFCA and IM/IRA Well Locations and Rationale

Well No.	Location	Well Type	Siting Rationale	Total Depth (ft)	Screen Interval (ft)	Completion Interval*	Drilling Method
00197	North side of Woman Creek	Plume Extent	Monitor migration of IA plume front toward Woman Creek	10.4	4.5-9.4	UHSU/Qal, Kwbr	Geoprobe
00297	South of Solar Ponds	Plume Extent	Monitor migration of Solar Pond plume front toward South Walnut Creek	10.3	3.3-8.3	UHSU/Qal	Hollow Stem Auger
00397	South of PU&D Yard	Plume Extent	Monitor migration of PU&D Yard plume front toward North Walnut Creek	11.0	4.0-9.0	UHSU/Kwbr	Hollow Stem Auger
00597	Well 6687	Plume definition	Replacement well for RFCA	22.9	5.9-20.9	UHSU/Qal, Kwbr	Hollow Stem Auger
00697	Well 31791	RFCA Replacement	Replacement well for RFCA	10.4	3.0-8.0	UHSU/Qal, Kwbr	Hollow Stem Auger
00797	Well 35691	Performance Monitoring	Replacement well for RFCA	28.8	16.8-26.8	UHSU/Qal	Hollow Stem Auger
00897	North of Mound (IHSS 113)	Performance Monitoring	Monitor downgradient groundwater quality associated with IHSS 113 remediation.	30.6	13.5-28.5	UHSU/Kwbr	Hollow Stem Auger
00997	Well 3786	Drainage	Replacement well for RFCA	12.4	5.4-10.4	UHSU/Qal	Hollow Stem Auger
02197	East of PU&D Yard	Plume Extent/ Characterization	Define PU&D Yard plume extent	12.9	5.9-10.9	UHSU/Qal	Geoprobe
02297	Building 779	D&D (Bldg. 779 IM/IRA)	Monitor any changes in groundwater quality that may result from D&D activities	15.0	7.1-12.0	UHSU/Qal	Geoprobe
02397	Building 779	D&D (Bldg. 779 IM/IRA)	Monitor any changes in groundwater quality that may result from D&D activities	13.0	6.1-11.0	UHSU/Qal	Geoprobe
02497	Building 779	D&D (Bldg. 779 IM/IRA)	Monitor any changes in groundwater quality that may result from D&D activities	18.0	6.0-11.0	UHSU/Qal	Geoprobe

Table 6-4 Groundwater Plume and Source Evaluation Monitoring Wells

Well Number	Location	Well Type	Siting Rationale	Total Depth (ft)	Screen Interval (ft)	UHSU Completion Interval*	Drilling Method
01097	Outside western edge of PU&D yard	Plume Characterization	Monitor quality of groundwater upgradient of PU&D Yard and define PU&D yard plume extent	53.5	19.8-39.8	Qal	Hollow Stem Auger
01197	Outside southern edge of PU&D yard	Plume Characterization	Monitor quality of groundwater between PU&D Yard and North Walnut Creek and define PU&D yard plume extent	31.0	13.0-28.0	Qal	Hollow Stem Auger
01297	Outside northern edge of PU&D yard	Plume Characterization	Monitor quality of groundwater between PU&D Yard and firing range and define PU&D yard plume extent	36.5	14.0-34.0	Qal	Hollow Stem Auger
01397	Outside eastern edge of PU&D yard	Plume Characterization	Monitor quality of groundwater immediately downgradient of PU&D yard and define PU&D yard plume extent	24.4	7.2-22.2	Qal, Kwbr	Hollow Stem Auger
01497	Northeast of PU&D yard	Plume Characterization	Monitor quality of groundwater between PU&D yard and Present Landfill and define PU&D yard plume extent	25.0	13.0-23.1	Qal	Hollow Stem Auger
01597	North of PU&D yard	Plume Characterization	Monitor quality of groundwater between PU&D yard and Present Landfill and define PU&D yard plume extent	31.6	14.6-29.6	Qal	Hollow Stem Auger
01697	East of PU&D yard	Plume Characterization	Define PU&D yard plume extent	29.0	18.5-28.2	Qal	Geoprobe
01797	East of PU&D yard	Plume Characterization	Define PU&D yard plume extent	30.0	12.0-22.0	Qal	Geoprobe
01897	East of PU&D yard	Plume Characterization	Define PU&D yard plume extent	34.0	13.0-22.8	Qal	Geoprobe
01997	East of PU&D yard	Plume Characterization	Define PU&D yard plume extent	14.8	7.0-12.0	Qal	Geoprobe
02097	East of PU&D yard	Plume Characterization	Define PU&D yard plume extent	14.0	7.0-11.9	Qal	Geoprobe
02697	Downgradient of Well 06091	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 06091	28.4	16.1-26.1	Qal	Hollow Stem Auger
02797	Downgradient of Well 06091	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 06091	43.6	31.3-41.4	Qal	Hollow Stem Auger
02897	Downgradient of Well 06091	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 06091	39.0	21.7-36.8	Qal	Hollow Stem Auger
05197	IHSS 118.1	Source Characterization	Define DNAPL source extent	28.0	17.7-28.0	Kwbr	Geoprobe
05397	IHSS 118.1	Source Characterization	Define DNAPL source extent	27.0	14.5-24.8	Qal, Kwbr	Geoprobe
05497	IHSS 118.1	Source Characterization	Define DNAPL source extent	27.0	17.2-22.4	Qal	Geoprobe
05697	IHSS 118.1	Source Characterization	Define DNAPL source extent	22.0	13.7-18.8	Qal	Geoprobe
05897	IHSS 118.1	Source Characterization	Define DNAPL source extent	22.4	17.2-22.3	Qal	Geoprobe
05997	IHSS 118.1	Source	Define DNAPL source extent	30.0	17.3-22.4	Qal, Kwbr	Geoprobe

Table 6-4 Groundwater Plume and Source Evaluation Monitoring Wells

Well Number	Location	Well Type	Siting Rationale	Total Depth (ft)	Screen Interval (ft)	UHSU Completion Interval*	Drilling Method
10197	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	16.5	12.5-16.5	Qal, Kwbr	Geoprobe
10297	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	14.0	9.6-13.4	Qal, Kwbr	Geoprobe
10397	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	23.0	18.6-22.6	Qal	Geoprobe
10497	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	9.0	6.3-8.3	Qal, Kwbr	Geoprobe
10597	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	14.2	6.0-10.0	Qal	Geoprobe
10697	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	12.0	8.0-12.0	Qal, Kwbr	Geoprobe
10797	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	15.5	13.5-15.5	Qal	Geoprobe
10897	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	10.0	2.2-8.2	Qal, Kwbr	Geoprobe
10997	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	12.0	7.4-12.0	Qal, Kwbr	Geoprobe
11097	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	11.0	2.0-6.0	Kwbr	Geoprobe
11197	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	10.3	6.3-10.3	Qal, Kwbr	Geoprobe
11297	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	14.0	12.0-14.0	Kwbr	Geoprobe
11397	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	15.6	9.2-13.2	Kwbr	Geoprobe
11497	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	12.0	4.8-8.8	Qal, Kwbr	Geoprobe
11597	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	14.2	8.5-12.5	Qal, Kwbr	Geoprobe
11697	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	30.5	26.5-30.5	Qal, Kwbr	Geoprobe
11797	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	15.0	3.5-7.5	Qal, Kwbr	Geoprobe
11897	North of Mound area near SW059	Characterization Plume Characterization	Define Mound plume extent for remediation design	18.0	6.9-11.0	Kwbr	Geoprobe
20197	Woman Creek south of Building 664	Characterization Plume Characterization	Define south IA plume extent	7.5	2.3-6.6	Kwbr	Geoprobe
20397	Woman Creek south of Building 664	Characterization Plume Characterization	Define south IA plume extent	12.0	2.1-6.6	Kwbr	Geoprobe
20597	Woman Creek south of Building 664	Characterization Plume Characterization	Define south IA plume extent	10.4	5.5-10.2	Kwbr	Geoprobe

Table 6-4 Groundwater Plume and Source Evaluation Monitoring Wells

Well Number	Location	Well Type	Siting Rationale	Total Depth (ft)	Screen Interval (ft)	UHSU Completion Interval*	Drilling Method
20697	Woman Creek south of Building 664	Plume Characterization	Define south IA plume extent	13.0	5.0-9.8	Qal	Geoprobe
20797	Woman Creek south of Building 664	Plume Characterization	Define south IA plume extent	12.0	3.6-8.6	Qal	Geoprobe
21097	Woman Creek south of Building 664	Plume Characterization	Define south IA plume extent	8.3	3.1-8.0	Kwbr	Geoprobe
21197	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	10.4	2.4-7.3	Kwbr	Geoprobe
21297	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	10.3	1.0-5.9	Kwbr	Geoprobe
21397	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	9.8	1.0-5.8	Kwbr	Geoprobe
21497	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	7.6	2.5-7.4	Kwbr	Geoprobe
21597	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	5.3	0.3-5.1	Kwbr	Geoprobe
21697	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	8.8	0.0-8.7	Kwbr	Geoprobe
21797	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	10.0	0.9-5.8	Kwbr	Geoprobe
21897	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	8.0	1.0-5.9	Qal	Geoprobe
21997	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	9.0	2.5-7.4	Qal	Geoprobe
22097	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	8.0	1.9-6.9	Qal	Geoprobe
22197	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	9.3	1.0-6.3	Kwbr	Geoprobe
22297	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	6.2	1.2-3.0	Kwbr	Geoprobe
22397	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	10.6	1.0-4.9	Kwbr	Geoprobe
22497	North Walnut Creek south of PU&D Yard	Plume Characterization	Define PU&D yard plume extent	9.0	1.0-5.9	Kwbr	Geoprobe
22597	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	26.2	14.3-26.0	Kwbr	Geoprobe
22697	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	20.0	6.2-17.9	Kwbr	Geoprobe
22797	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	14.0	6.8-13.6	Qal, Kwbr	Geoprobe

Table 6-4 Groundwater Plume and Source Evaluation Monitoring Wells

Well Number	Location	Well Type	Siting Rationale	Total Depth (ft)	Screen Interval (ft)	UHSU Completion Interval*	Drilling Method
22897	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	24.2	13.3-24.1	Kwbr	Geoprobe
22997	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	16.5	4.3-16.0	Qal, Kwbr	Geoprobe
23097	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	15.0	3.9-13.6	Qal, Kwbr	Geoprobe
23197	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	17.3	4.4-14.2	Kwbr	Geoprobe
23297	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	25.0	8.2-13.1	Qal, Kwbr	Geoprobe
23397	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	14.2	4.3-14.1	Qal, Kwbr	Geoprobe
23497	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	14.0	2.5-12.2	Kwbr	Geoprobe
23597	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	19.4	9.4-19.2	Kwbr	Geoprobe
23697	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	11.1	4.2-11.0	Qal, Kwbr	Geoprobe
23797	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	20.2	10.2-20.0	Qal, Kwbr	Geoprobe
23897	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	18.3	11.3-18.1	Qal, Kwbr	Geoprobe
23997	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	20.0	8.1-17.9	Qal, Kwbr	Geoprobe
24097	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	18.2	8.3-18.1	Kwbr	Geoprobe
24197	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	16.1	6.2-16.0	Qal, Kwbr	Geoprobe
24297	South Walnut Creek	Plume	Evaluate East Trenches plume with VOCs above Tier II	9.2	4.2-9.1	Kwbr	Geoprobe

Table 6-4 Groundwater Plume and Source Evaluation Monitoring Wells

Well Number	Location	Well Type	Siting Rationale	Total Depth (ft)	Screen Interval (ft)	UHSU Completion Interval*	Drilling Method
	south of B-Series Ponds	Characterization	at Well 23296				
24397	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	23.0	13.4-18.3	Kwbr	Geoprobe
24497	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	18.0	7.2-16.9	Kwbr	Geoprobe
25097	South Walnut Creek south of B-Series Ponds	Plume Characterization	Evaluate East Trenches plume with VOCs above Tier II at Well 23296	24.5	19.5-24.5	Kwbr	Geoprobe

* Qal = alluvium; Kwbr = weathered bedrock

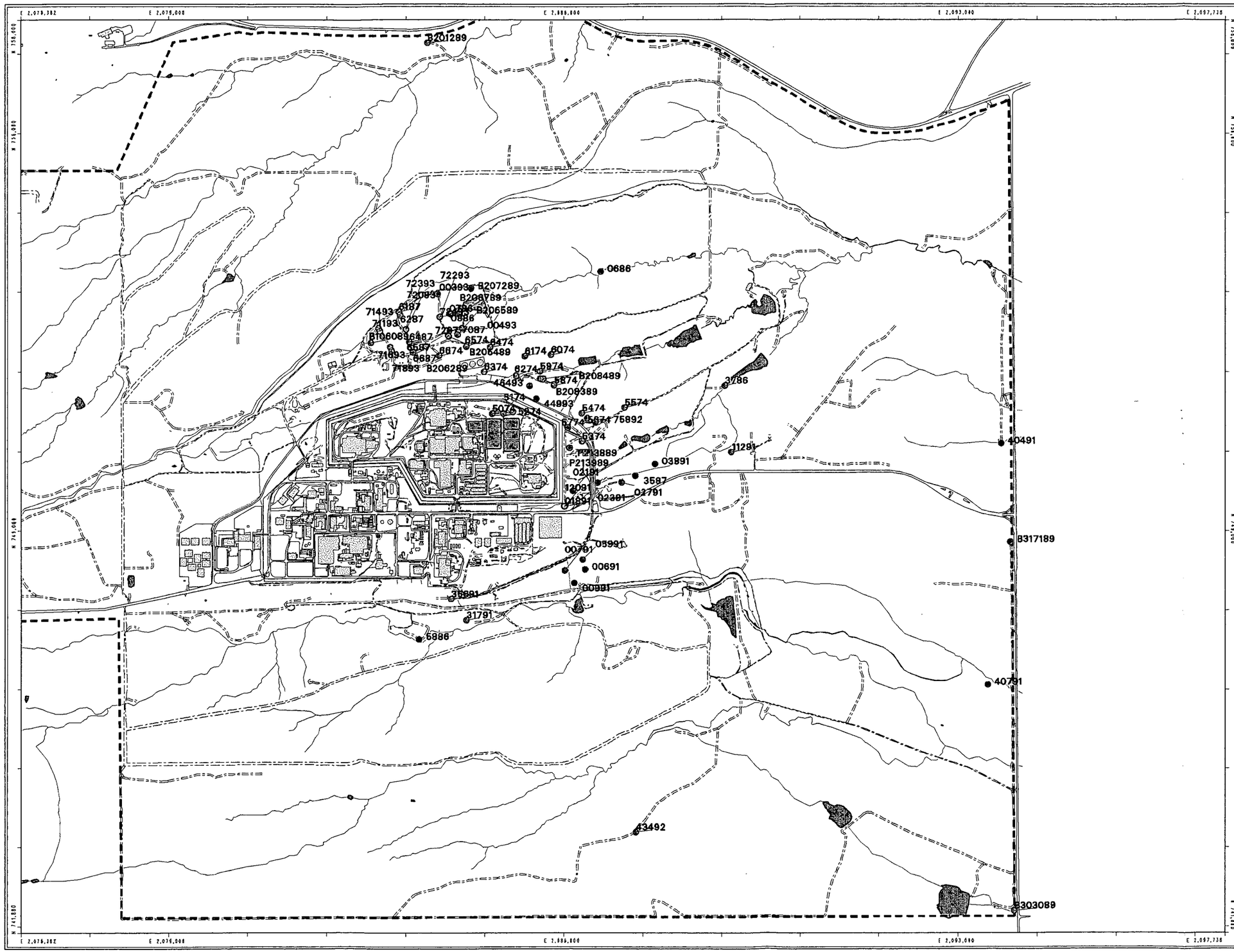

Figure 6-3
CY97 WARP
Well Abandonments

EXPLANATION

- Phase I Groundwater Monitoring Well Abandonments
- Phase II Groundwater Monitoring Well Abandonments

Standard Map Features

- Buildings
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 20800
1 inch represents approximately 1733 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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September 28, 1998

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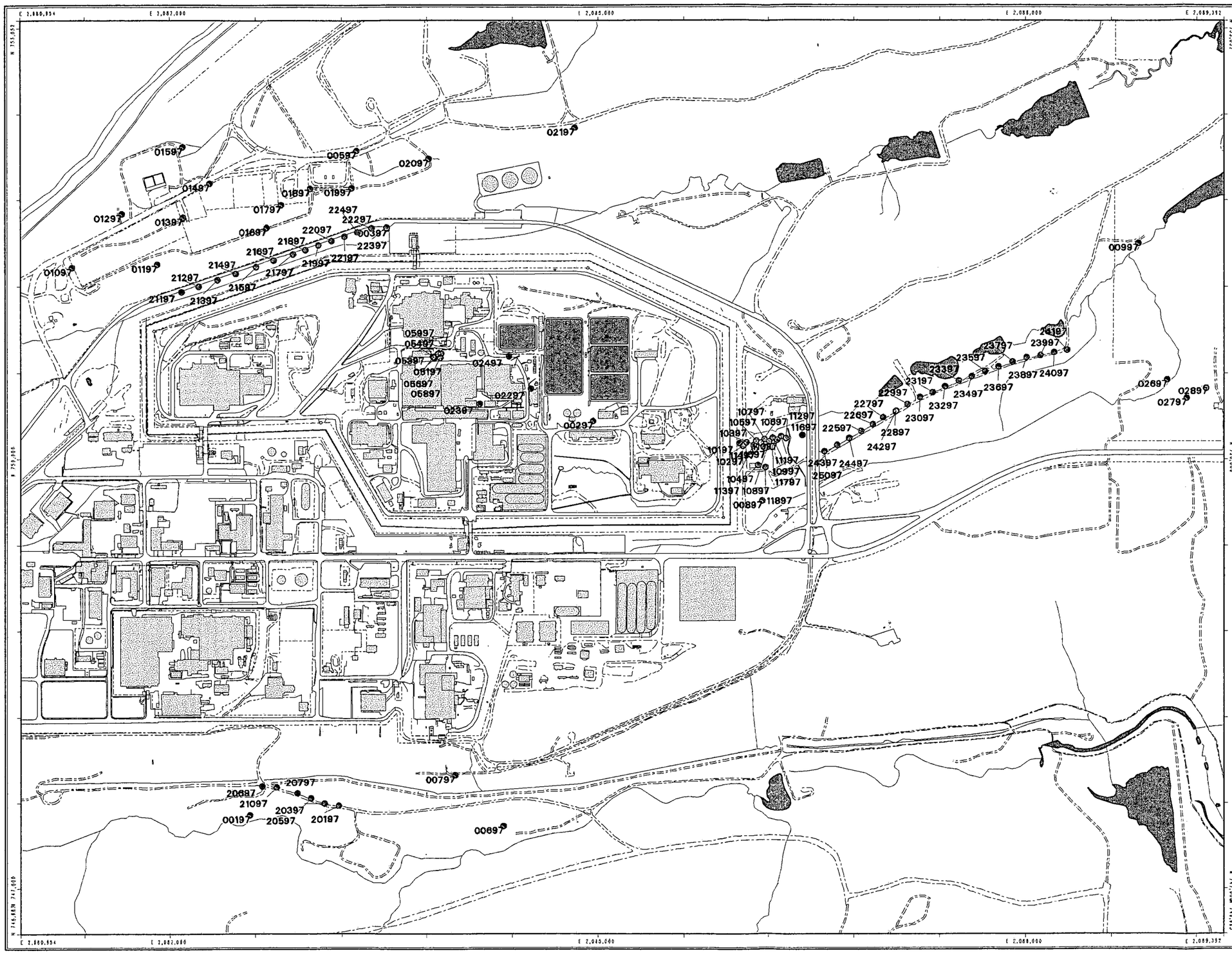

Figure 6-4
CY97 WARP
New Well Installations

EXPLANATION

- New Groundwater Monitoring Wells

Standard Map Features

- Buildings
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 8220
1 inch represents 685 feet

250 0 500 1000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: 97-0080

September 28, 1998

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Four new wells (00197 through 00397, and 02197) and four replacement wells (00597 through 00797 and 00997) support compliance with RFCA as defined by the proposed well monitoring list contained within the Draft IMP (K-H, 1997). The Draft IMP specified that additional plume-extent alluvial groundwater monitoring wells would be installed for characterization of groundwater plume boundaries associated with the perimeter of the IA and PU&D Yard. Four wells (00197 through 00397, and 02197), identified in Figure 6-4 and Table 6-3 were needed to supplement the RFCA groundwater monitoring network in tracking the movement of the contaminant plume front toward adjacent stream drainages. These locations include an area south of the IA on the north slope of Woman Creek; an area within the IA south of the SEPs; and areas south and east of the PU&D Yard along North Walnut Creek. In addition, four existing RFCA monitoring wells (6687, 31791, 35691, and 3786) were replaced by new monitoring wells (00597, 00697, 00797, and 00997, respectively) constructed to similar specifications as close as feasible to the existing wells. The replacement wells were required to remedy well damage or pond submersion problems (well 3786) that were judged to interfere with sample collection or affect sample integrity. Two wells originally planned in the FY97 WARP Work Plan, 00497 and 02597, were not installed because existing well coverages in the PU&D Yard and Building 779 areas were found to be satisfactory for long-term groundwater monitoring.

One well (00897) was installed near the Mound Site (IHSS 113) source removal area for monitoring the impact of remediation on local groundwater quality. Three additional Geoprobe wellpoints (02297 through 02497) were installed around Building 779 to support D&D monitoring efforts required by the IA IM/IRA.

Groundwater evaluations associated with recent data having values above Tier II action levels at wells 06091 and 23296, and inadequately characterized plumes, such as found at the PU&D Yard and south IA in the Woman Creek drainage, were the basis for numerous well installations. Most of these wells were installed to investigate plume extent and identify migration pathways to surface water. To evaluate the presence of VOC values above Tier II action levels in wells 06091 and 23296 in the East Trenches plume area, twenty-one (21) wellpoints (22597 through 25097) were installed in an east-west alignment upgradient of Ponds B-1, B-2, and B-3; and three wells (02697 through 02897) were installed downgradient from well 06091

Excluding well 02197 included with the list of RFCA wells above, twenty-five (25) wells and wellpoints (01097 through 02097 and 21197 through 22497) were installed to help define the pre-remediation nature and extent of the PU&D Yard plume. These wells were positioned around and

downgradient of the yard in areas of inadequate well coverage, particularly along suspected flow paths leading to the Present Landfill and North Walnut Creek. The type of well installed depended on the ability of the Geoprobe to reach bedrock.

In addition to GMP well installations, six (6) wellpoints were installed at IHSS 118.1 and eighteen (18) wellpoints were installed at the Mound site near SW059 in support of FY97 pre-remedial investigations undertaken by ER. These investigations are described in more detail in Sections 5.2 and 5.1 respectively.

All wells were completed in the upper UHSU that consists of Rocky Flats Alluvium, valley fill alluvium, and some underlying weathered bedrock. The wells were installed using the construction methods prescribed in OP, GT.06, *Monitoring Wells and Piezometer Installation*. For conventional wells, well construction materials consisted of 2-inch diameter, schedule 40 PVC riser and factory cut well screen, and 6-inch diameter steel surface protective casing with locking cap and lock. Geoprobe wellpoint installations consisted of ¾-inch diameter schedule 40 PVC riser and factory cut well screen, with no protective casing or lock.

7.0 CONCLUSIONS AND FUTURE ACTIVITIES

During CY97, the Site successfully complied with all RFCA requirements involving groundwater monitoring as specified in the IMP. Key accomplishments for the CY97 GMP are summarized as follows:

1) IMP semi-annual and quarterly sampling was conducted and completed at ninety-four wells during the year. With the exception of a slightly high ratio of combined QC to real samples for all analytes (1 to 22 actual versus 1 to 20 target), quality control requirements associated with laboratory analyses were met or exceeded.

2) Water levels were monitored in accordance with the monitoring schedule specified in the IMP. No areas of significant water level change attributable to Site operations are apparent from the CY97 data.

3) All RFCA reporting commitments were met, including the timely publication of quarterly and annual RFCA groundwater monitoring reports, an Annual IA IM/IRA report, and an Annual Present Sanitary Landfill groundwater monitoring report.

4) In accordance with IMP requirements, monthly confirmation sampling was initiated for wells containing analytes reported above Tier II groundwater action levels. The results of confirmation sampling will be presented in future quarterly reports. If elevated contaminant concentrations in any of these wells are confirmed, further action will be taken based on the decision logic specified for the particular IMP classification of the well.

5) Groundwater evaluations undertaken at three localities have further delineated VOC plume extent and potential impacts to surface water. These evaluations were initiated to investigate VOC concentrations above action levels in wells 23296 (South Walnut Creek drainage), 22796 and 22896 (North and South Industrial Area), and potential VOC contamination at the PU&D Yard (North Walnut Creek). In South Walnut Creek, current impacts to surface water were clearly documented by values above Tier I and Tier II for TCE and PCE in seep and surface water samples resulting from interception of the East Trenches VOC plume with the creek. In Woman Creek (South Industrial Area VOC plume) and North Walnut Creek (PU&D Yard VOC plume), no direct impacts to surface water are evident from the evaluations, but the plumes are generally more extensive than previously thought. An evaluation of North Industrial Area VOC plume pathways toward North Walnut Creek is being implemented in CY98.

6) Seventy-two wells were permanently abandoned as part of GMP efforts to maintain a high quality monitoring well network and manage well removal in accordance with planned Site closure activities. In addition, compliance with Office of the State Engineer, Rules and Regulations for Water Well Construction (2 CCR 402-2) was re-established through the permitting of 282 monitoring wells. Further improvement in monitoring system performance was achieved through the installation of dedicated bladder pumping systems in 23 high yield wells and design of a real time water level monitoring network for implementation in CY98.

7) A total of 91 new and replacement monitoring wells were installed in CY97 in support of the GMP and other projects. The majority of wells consisted of temporary, small diameter wellpoints installed for plume evaluation projects. Nine wells were added (excluding three replacements) to the GMP for long-term monitoring of plume extent, performance monitoring, and D&D activities as specified by the IMP.

Aside from routine groundwater monitoring and reporting functions, future GMP activities scheduled for CY98 involve interpretation and reporting of confirmation sampling data at wells with new values above action levels; completion of the North Industrial Area VOC plume evaluation; design, installation, and sampling of groundwater monitoring networks for D&D projects; and presentation and analysis of real-time water level monitoring data. The results of these activities will be summarized in future quarterly reports or the 1998 RFCA Annual Groundwater Monitoring Report, as appropriate.

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APPENDIX E.1

BOREHOLE LOGS

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 00197
Location - North: East:
Date: 091197
Geologist: F. Grigsby / J. Boylan
Drilling Equip.: Stratoprobe

Surface Elevation:
Area: Woman Ck.
Total Depth: 10.0
Company: RMRS/Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Grigsby DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					SM	0.0		Sandy silt ~~mixture~~ w/clay and gravel — very dark grayish brown (10YR 3/2). Rooted in top ~1.5'. Scattered gravels. Dry. Clay content increases below ~1.3' to sand-silt-clay mixture w/gravel.
	RUN 1: 0.0-4.0	3.0						1.0		
								1.8		
							CL	2.0		Silty clay w/sand and gravel — brown (10YR 4/3). Dry to sl. moist. Gravels rare, typically fine.
								3.0		NO RECOVERY 3.0-4.0'
	4.0	1.3						4.0		
	4.0 RUN 2: 4.0-8.0	4.0 1.8					GM/GC			Clayey, silty gravel w/sand mixture to clayey gravel sand & silt mixture — brown (10YR 4/3). Dry. Gravels fractured, shattered; rock flour common. Decreasing gravels below ~4.9'.
								5.0		
								5.2		Top of bedrock = 5.2' Claystone to silty claystone — grayish brown to light olive brown (2.5Y 5/2 - 5/3). Sl. moist. Fe-staining common, as pods, fracture fill, and dispersed. Trace carbonaceous flecks.
								5.8		
								6.0		NO RECOVERY 5.8-8.0'
								7.0		
	8.0	8.0						8.0		
	8.0 RUN 3: 8.0-10.0	8.0 1.5						9.0		Same as above, 5.2-5.8', but color is predominantly light olive brown (2.5Y 5/4). Fe-rich pods @ 6.0', 6.1', and fracture fill @ 9.4'.
								9.5		NO RECOVERY 9.5-10.0
10.0	10.0	10.0						10.0		TD = 10.0 (Measured TD = 10.4')

Box 1 of 1 0.0' - 10.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00297
Location - North: East:
Date: 08/19/97
Geologist: ~~J. Boylan~~ / F. Grigsby
Drilling Equip.: CME75-HSA

Surface Elevation:
Area: Bldg 910
Total Depth: 10.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Run No. 1 0.0'-2.0'	Rec. 0.0-1.2	Composite 0.0'-9.0' - VOA BH-00929RM; Composite 0.0'-9.0' - Metals BH-00930RM; Composite 0.0'-9.0' - Rads BH-00931RM; Composite 0.0'-9.0' Radionuclides BH-00932RM					GC	0.0		0.0'-1.2' - Clayey Gravel light yellowish brown (6/3) Gravel to 1"+. Black carbonaceous interval from 6.7' to 6.8'. Core dry - Pred. Non friable - weathered.
								1.0		1.2'-2.0' - NO Recovery
										2.0'-2.1' Silt or SAA
Run No. 2 2.0'-4.0	Rec. 2.0' 2.1						GC	2.0		2.1'-4.0' - NO Recovery
								3.0		
								4.0		4.0'-5.0' Center Bit Drilled NO Recovery
Center Bit Drilled	Rec. 0'									5.0'-5.3' - Clayey gravel with some Calcite
Run No 3 5.0'-7.0'	Rec. 1.7'						GC CL CL	5.0		5.3-6.0' Clay with some Calcite. Light olive gray (5Y. 6/1) with white N-9 Dry
								6.0		6.0'-6.4' - Sandy Clay - Reworked Bedrock. Dry.
										6.4' - Top of Bedrock
								7.0		~~6.9-7.0' No Recovery Claystone - yellowish gray (5Y 8/1) to Light gray (N-7) Dense - Indurated - Indications of some fractures~~
Run No 4 7.0'-9.0'	Rec. 1.6'							8.0		7.0'-8.6 Claystone. yellowish gray (5Y. 8/1) to Light gray (N-7). Dense. Indurated. Indications of some fractures. Dry
										8.6'-9.0' - No Recovery
Run No. 5 9.0'-10.0'	Rec. 1.0'							9.0		9.0'-10.0' - Claystone - Pred. light gray (N-7). Massive, Dense. - Dry
								10.0		*

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible:
(2) Core breaks cannot be matched, accurate footage measurements not possible.

* - Core mixed in box when core box fell from back of pick-up. Could not be reconstructed. Bedrock pick is good.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 00697
Location - North: _____ East: _____
Date: 081397
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation: _____
Area: WOMAN CREEK
Total Depth: 10.0
Company: Tierra Project No.: _____
Sample Type: continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					SM/SC	0.0		sandy silt + clay ~~mixture~~ w/ trace gravel - black (10YR 2/1), organic-rich, peaty, rooted. Sl. moist to moist.
	Run 1: 0.0-2.0	1.6						1.0		
								1.4		
							SM	1.6		Same as above 0.0-1.4 but less clay, organic - poor. Dry to sl. moist. Very dark grayish brown (10YR 3/2). Sand-silt mixture w/ trace gravel.
	2.0	2.0								NO RECOVERY 1.6-2.0
	2.0	2.0						2.0		Same as above, 1.4-1.6' w/ increased gravel @ 2.2-2.3'.
	Run 2: 2.0-4.0	1.5 incl. 0.2' stage		silty clay	—		CL	2.3		clay with silt, ~~sand~~ traces sand, gravel and caliche - Mottled mainly light yellowish brown (2.5Y 6/4) to light olive brown (2.5Y 5/6), w/ white caliche pods scattered throughout (caliche content possibly to "some"). Sl. moist. Abrupt color change to grayish brown (2.5Y 5/2) below 3.2'. All looks like reworked bedrock
								3.0		
								3.3		
								3.5		NO RECOVERY 3.3-4.0
	4.0	4.0						4.0		
	4.0	4.0						4.1		Same as above, 2.3-3.3 w/ color as described below 3.2'. ~~Color change to~~ Top of bedrock = 4.1'.
	Run 3: 4.0-6.0	1.6								Claystone w/ traces silt and caliche - olive gray (5Y 4/1), w/ Fe-stained area abruptly below 5.0' changing color to moderate yellowish brown (10YR 5/4-5/6). Sl. moist.
								5.0		
								5.6		
	6.0	6.0						6.0		Same as above, 4.1-5.6; color is dominantly olive gray (5Y 4/1) to dark grayish brown (2.5Y 4/2). Some portions laminated. Occasional Fe-healed fractures (mainly vertical, as at 6.3, 6.5) but also low-angle (6.9-7.1). Sl. moist.
	Run 4: 6.0-8.0	1.4						7.0		
								7.4		
	8.0	8.0						8.0		Same as above 4.1 ~~5.0~~ - 7.4. Coally fragments @ 9.0'. Sl. moist, increasing silt below ~ 9.5'.
	Run 5: 8.0-10.0	1.7						9.0		
								9.7		NO RECOVERY 9.7-10.0 T.D = 10.0'
10.0	10.0	10.0						10.0		

BOX 1 of 1 10.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00897
Location - North: _____ East: _____
Date: 073197
Geologist: J. Boylan
Drilling Equip.: CME 75 - HSA

Surface Elevation: _____
Area: MOUND
Total Depth: 31.3
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
	0.0	0.0						0.0		NO RECOVERY
	RUN 1:							1.0		0.0 - ~~12.0~~ 11.3 (JAB 073197)
										DID NOT
								2.0		CORE TOP
	0.0 TO ~~12.0~~ 11.3 (JAB 073197)	N/A						3.0		~~12~~ 11.3 (JAB 073197)
										FEET
		CENTER BIT						4.0		USED CENTER
								5.0		B.T.
								6.0		
								7.0		
								8.0		
								9.0		
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00897
Location - North: _____ East: _____
Date: 073197
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation: _____
Area: MOUND
Total Depth: 31.3
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	RUN 1, cont'd: 0.0-11.3	N/A: center bit						0.0		NO RECOVERY 0.0 – 11.3 NOTE: TOP OF BEDROCK IS SHALLOWER THAN 11.3' AT THIS LOCATION
	11.3 / 11.3	11.3 / 11.3						11.0 / 11.3		Bedrock — silty claystone, variegated w/lenses of siltier material in mainly clayey material. Color variable, mostly brownish yellow to yellowish brown (10YR 6/6 to 10YR 5/6). Silty zones laminated. Fe stained throughout. Occasional carbonaceous flecks, caliche granules. Slightly moist. Silty zones are moderately to very friable.
	Run 2: 11.3-13.3	1.7, incl. 0.1' slough						12.0		
	13.3 / 13.3	13.3 / 13.3						12.9 / 13.0 / 13.3		NO RECOVERY 12.9-13.3
	RUN 3: 13.3-15.3	2.0, incl. 0.5' slough						14.0		Same as above, 11.3-12.9, with increasing number of silty zones. Caliche pocket @ 14.3'. Still Fe-stained silty zones laminated. Has coarsened enough to be "silty claystone/clayey siltstone". Slightly moist.
	15.3 / 15.3	15.3 / 15.3						14.8 / 15.0 / 15.3		NO RECOVERY 14.8-15.3
	RUN 4: 15.3-17.3	2.0 incl. 0.1' slough						16.0		Same as above 13.3-15.3, w/caliche pockets or partially formed seam from 15.4-15.9'. Increased carbonaceous flecks. Still sl. moist, but some silty pockets to moist.
								17.0		
								17.2 / 17.3		NO RECOVERY 17.2-17.3
	RUN 5: 17.3-19.3	2.0 incl. 0.1' slough						18.0		Same as above, 13.3-15.3, but top 0.1' (which is slough, & damaged) contains some well-rounded medium sand. Moist to wet below ~18.8'. (Note: sand looks like 16-40 filter pack, which may be imported by auger rather than in-place. Because of its appearance I believe it to be slough, NOT intact core.) A little more clay-rich than above material, except below ~18.6, which is siltier.
								19.0 / 19.2 / 19.3		NO RECOVERY 19.2-19.3
	See next page							20.0		Same as above, 13.3-15.3. Very silty to 20.3 – this portion is clayey siltstone. Below 20.3, very strongly Fe stained (color is typically yellowish brown (10YR 5/4) here).

BOX 1 of 3: 0.0 – 20.2 (NO CORE 0.0-11.3)

(Descrip. cont'd next page)

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00993
Location - North: _____ East: _____
Date: 073197
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation: _____
Area: MOUND
Total Depth: 31.3
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
20.2 / 20.2	RUN 6: 19.3-21.3	2.0		1				20.0		High-angle Fe-healed fracture @ 20.5-21.0 (near vertical). Traces Fe-replaced plant debris. Sl. moist to moist (w/ siltstone portion ~~containing~~ representing most moisture). As above, siltstone is moderately to very friable.
	21.3 / 21.3	21.3						21.0		
	21.3 / 21.3							21.3		Same as above, 11.3-12.9'. Not as silty as the material immediately above. Pockets of fresher material (decreased Fe staining) present. Sl. moist. Fractures, Fe-healed, @ several points as indicated @ left, mainly clustered around 22-22.6' depth interval. Iron stone (incipient) grains @ ~22.4'.
	RUN 7: 21.3-23.3	2.0		1 1/2				22.0		
								23.0		
	23.3 / 23.3	23.3						23.3		
	23.3 / 23.3			1						Same as above, 11.3-12.9'. Trace rounded sand present in top 0.1' is imported by augers, NOT in-place. Occasional caliche granule, w/ thin silt-controlled seam @ 24.6'. Nice Mn streamers in silt (w/ traces caliche) ~ 23.7-23.5'. Sl. moist.
	RUN 8: 23.3-25.3	1.9						24.0		
								25.0		
	25.3 / 25.3	25.3						25.2 / 25.3		NO RECOVERY 25.2-25.3
	25.3 / 25.3									Same as above, 11.3-12.9. Caliche seam (poorly developed) @ 25.4', 1 granules/clasts @ 25.8', seam @ 26.4' @ 45° angle. Material below this seam appears fresh, unoxidized with only scattered traces of Fe staining. Color of fresh material is dark grayish brown (10YR 4/2) w/ laminae visible as gray banding. Sl. moist.
	RUN 9: 25.3-27.3	2.0						26.0		
								26.5		
								27.0		
	27.3 / 27.3	27.3						27.3		
	27.3 / 27.3									Same as above, 11.3-12.9, except fresh (as @ 26.5-27.3) to 27.6, and then to clayey siltstone below this. This siltstone interval is mostly Fe-stained. Increased clay below 29.1'. Sl. moist.
	RUN 10: 27.3-29.3	2.0						28.0		
28.7 / 28.7										
								29.0		
Box 3 of 3: 28.7-31.3	29.3 / 29.3	29.3						29.3		Same as above, 27.3-29.3, w/ siltstone from 30.4, fresh material 30.4-TD. (cont'd next page)
	see next page							30.0		

Box 2 of 3 . 20.2'-28.7'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00897
Location - North: _____ East: _____
Date: 073197
Geologist: J. Boylan
Drilling Equip.: CME 75-HSA

Surface Elevation: _____
Area: MOUND
Total Depth: 31.3
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3: 28.7-31.3 31.3	RW 29.3-31.3 31.3	2.0 31.3						30.0		Caliche seam @ 30.4, ~45° angle. Incipient ironstone @ 30.2-30.4'. SL moist.
								31.0		
								31.3		TD = 31.3'
								32.0		
								33.0		
								34.0		
								35.0		
								6.0		
								7.0		
								8.0		
								9.0		
								0.0		

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(1) Badly broken core, accurate footage measurements not possible.
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00997
Location - North: _____ East: _____
Date: 080497
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation:
Area: Walnut / B-5
Total Depth: 12.0
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					CL	0.0		Silty clay w/sand - very dark grayish brown (10YR 3/2). Hard, stiff. Slightly moist. Rooted. Occasional (sparse) caliche clast, more common @ 0.8 - 1.1.
	RUN 1: 0.0 - 2.0	1.1						1.0 / 1.1		NO RECOVERY 1.1 - 2.0'
	2.0 / 2.0	2.0 / 2.0						2.0		Same as above, but not as hard. Sl. moist. No longer rooted.
	RUN 2: 2.0 - 4.0	1.3						3.0 / 3.3		NO RECOVERY 3.3 - 4.0'
	4.0 / 4.0	4.0 / 4.0						4.0		Same as above, 2.0 - 3.3'
	RUN 3: 4.0 - 6.0	1.8, incl. 0.1' slough					CH	4.5 / 5.0 / 5.7		Clay - looks like bedrock claystone, but it isn't. May be slumped claystone. Dark grayish brown (2.5Y 4/2). Moist, malleable. Color is mottled - also some Fe-staining & Mn staining or organics. Occasional caliche speck. NO RECOVERY 5.7-6.0'
	6.0 / 6.0	6.0 / 6.0						6.0		Same as above, 4.5 - 5.7'. Moisture increases slightly w/depth, & clay becomes softer & more malleable. Gravel clast @ 7.2' (0.5", subrounded). Trace sand, trace to some silt.
	RUN 4: 6.0 - 8.0	2.0 incl. 0.6' slough						7.0 / 7.4		NO RECOVERY 7.4-8.0'
	8.0 / 8.0	8.0 / 8.0						8.0		Same as above, 6.0 - 7.4' w/increasing silt content. Sand content also increases, especially below 8.6' where it coarsens and becomes "trace to some". Finer-grained from 8.9 - 9.2, then coarsens again & includes trace gravel. Moist; to wet @ base (below ~ 9.4'). Silt & sands make for lowered plasticity, so those zones are "CL".
	RUN 5: 8.0 - 10.0	2.0 incl. 0.4' slough					CL / CH / CL	8.6 / 8.9 / 9.0 / 9.2 / 9.6		NO RECOVERY 9.6 - 10.0'
	10.0	10.0						10.0		

BOX 1 of 2: 0.0 - 10.4'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00997
Location - North: _____ East: _____
Date: 080497
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation: _____
Area: Walnut/B.5
Total Depth: 12.0
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑ 10.4	10.0	10.0					CL	10.0		Same as above, 8.0-9.6' and most similar to material @ 9.2-9.6'. Moist to wet.
10.4 Box 2 of 2: 10.4-12.0	RW 6: 10.0-12.0	1.8 incl. 0.3' slaff						10.5		TOP OF BEDROCK - claystone w/ silt to silty claystone — coarsest in bottom 0.2'. Light yellowish brown to light olive brown (2.5Y 6/4 to 2.5Y 5/3). Large (>1") gravel clast possible in from above. Some Fe staining throughout. Dry to slightly moist.
								11.0		
								11.5		NO RECOVERY 11.5-12.0'
12.0	12.0	12.0						12.0		TD = 12.0' (measured TD = 12.4')
								13.0		
								14.0		
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01097
Location - North: _____ East: _____
Date: 071497
Geologist: J. Boylan / R. Koehler
Drilling Equip.: ~~Geoprobe~~ CME 75

Surface Elevation: _____
Area: Upgradient PU&D
Total Depth: 53.5
Company: Tiga
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GM	0.0		Silty, sandy gravel with trace to some clay – dark grayish brown (10YR 4/2) to strong brown (7.5YR 5/6). Dry to slightly moist, abundant broken gravels. No hits (VOC or otherwise).
	Run 1: 0.0-2.0	1.4						1.0		
	2.0	2.0								NO RECOVERY 1.4-2.0
	2.0	2.0					GC	2.0		Clayey sandy gravel w/ trace to some silt – dark reddish brown (2.5YR 2.5/4). Slightly moist. No hits. Color is variegated but mainly as noted.
	Run 2: 2.0-4.0	2.0						3.0		
	4.0	4.0								
	Run 3: 4.0-5.0	1.6 (1.4 + 0.2 fill)						4.0		Same as above, 2.0-4.0'
	Run 4: 5.0-6.5	N/A (center bit)						5.0		NO RECOVERY 5.0-6.5'
	6.5	6.5						6.0		
	Run 5: 6.5-8.0	1.2						7.0		Same as above. 2.0-4.0, but color is mainly yellowish brown (10YR 5/4).
	8.0	8.0						8.0		
	Run 6: 8.0-9.5	N/A (center bit)								NO RECOVERY 8.0-9.5
	9.5	9.5						9.0		
	see next page							9.5		Same as above 2.0-4.0, with slightly less clay and more silt. Still no hits, still sl. moist.
								10.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01097
Location - North: _____ East: _____
Date: 07/4/97
Geologist: J. Boylan / Bob Kuehler
Drilling Equip.: ~~Geoprobe~~ CME75

Surface Elevation: _____
Area: Upgradient Pond
Total Depth: 53.5
Company: Tetra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 4 : 0.0 - 16.5'	RUN 7: 9.5-11.5	1.3					GC	10.0		see above, 9.5-10.0
	11.5 / 11.5	0.5 / 0.5						10.8		
	RUN 8: 11.5-13.5	0.8						11.0		NO RECOVERY 10.8-11.5'
	13.5 / 13.5	3.5 / 3.5						11.5		Same as above, 2.0-4.0, with mostly rock fragments and rock floor.
	RUN 9: 13.5-15.5	NA (CONTACT)						12.0		
	15.5 / 15.5	1.5 / 1.5						12.3		NO RECOVERY 12.3-13.5'
	RUN 10: 15.5-16.5	1.5						13.0		
	16.5 / 16.5	0.5 / 0.5						13.5		NO RECOVERY 13.5'-14.5'
Box 2 of 4 / 16.5-33.5'	RUN 11: 16.5-17.5	NA (CONTACT)						14.0		
	17.5 / 17.5	0.5 / 0.5						14.5		Same as above, 2.0-4.0'
	RUN 12: 17.5-19.5	2.0						15.0		
	19.5 / 19.5	2.5 / 2.5						16.0		
	see next page							16.5		NO RECOVERY 16.5-17.5'
								17.0		
								17.5		Same as above, 2.0-4.0' Slightly moist to moist. More fines than in last few runs, but still GC.
								18.0		
								18.5		
								19.0		
								19.5		Same as above, 2.0-4.0'
								19.6		NO RECOVERY, 19.6-22.0'
								20.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01097
Location - North: _____ East: _____
Date: 071497
Geologist: J. Boylan / R. Koehler
Drilling Equip.: ~~Geoprobe~~ CME 75

Surface Elevation: _____
Area: Uparadient Pond
Total Depth: 53.5
Company: Tetra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
	19.5	19.5						20.0		NO RECOVERY 19.5 - 22.0
	Run 13: 19.5-22.0	0.1'						21.0		
	22.0	22.0						22.0		
	22.0	22.0					GC			Same as above, 22.0-24.0'
22.0 - 53.5	Run 14: 22.0-24.0	0.7'						22.7		
								23.0		NO RECOVERY 22.7-24.0
	24.0	24.0								
	24.0	24.0					SC/CL	24.0		Clayey Sand to Sandy Clay. Pale Olive (5Y 6/3) Some Gravel. 0.1' of 2ft. sand + sandy silt at top, strong brown (7.5YR 4/6) 0.2' rock flour at base (24.0') Reworked bedrock below 24.2'. Slightly moist to moist.
	Run 24.0-26.0	1.0						25.0		
	26.0	26.0						26.0		
	26.0	26.0					GC			Clayey Sandy Gravel, Mottled Pale Olive (5Y 6/3) to strong brown (7.5 YR 4/6) one brown zone in middle very clayey (27.3'-27.4') Reworked bedrock with alluvial material. Slightly moist to moist.
B 2 of 4 16.5 - 53.5	Run 16 26.0-28.0	1.9						27.0		
	28.0	28.0						28.0		27.9 NO RECOVERY 27.9-28.0
	28.0	28.0								~~Same as above, 26.3-27.9 with reworked bedrock~~ JAB 071497
	Run 17: 28.0-31.5	N/A cont. 6"						29.0		NO RECOVERY 28.0-31.5
								30.0		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01027
Location - North: _____ East: _____
Date: 07/14/97
Geologist: J. Boylan / R. Koehler / W. Whiton
Drilling Equip.: ~~Sonic~~ CME 75

Surface Elevation: _____
Area: Upgradient PU&D
Total Depth: 53.5
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 4 / 16.5 - 33.5	Run 17 / 31.5 / 31.5	n/a (under bit)						30.0		NO RECOVERY 28.0 - 31.5'
	Run 18 / 31.5 / 33.5	2.0					GC	31.5		Same as above, 26.3-27.9. Reworked bedrock @ 31.5 - 32.3, light yellowish brown (2.5Y 6/3); below is not reworked bedrock and is strong brown (7.5YR 5/8). Wet. Some parts saturated @ 33.2' & below.
33.5 / 33.5	Run 19 / 33.5 / 35.5	1.2'					GM	33.0		Gravel-sand-silt mixture — mostly gravel but matrix is dominantly light yellowish brown (10YR 6/4). Saturated, mostly [illegible] Fractured, abundant rock flour [illegible] Bottom 0.1' Fine sand-silt [illegible] gravel is [illegible]
Box 3 of 4 / 33.5 - 46.5'	Run 20 / 35.5 / 37.5	1.4'						34.7		NO RECOVERY 34.7 - 35.5
								35.5		Same as above, 33.5 - 34.7, without fines @ base.
	Run 21 / 37.5 / 39.5	1.4'						37.5		NO RECOVERY 36.9 - 37.5
								38.9		Same as above 33.5-34.7, without fines at base. Some gravel is rotted. Moist to wet.
								39.5		NO RECOVERY 38.9 - 39.5
								40.0		SAME AS ABOVE 37.5-38.9'
	SEE NEXT PAGE									

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 5 OF 6

Borehole Number: 01097
Location - North: _____ East: _____
Date: 071597
Geologist: J. Boylan / R. Koehler / W. Wilton
Drilling Equip.: ~~Geoprobe~~ CME 75

Surface Elevation: _____
Area: Upgradient PU & D
Total Depth: 53.5
Company: Tierra
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF RUN INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run 22 39.5 41.5	1.7'					GM	39.0		SEE PREVIOUS PAGE
	41.5	41.5						41.0		
								41.2		NO RECOVERY 41.2'-41.5'
	41.5	41.5						41.5		
	Run 23 41.5 43.5	1.5'						42.0		Same as above, 33.5-34.7 except that top 0.2' appears to be subangular to subrounded very coarse sand to fine gravel, wet to saturated. [illegible]
								43.0		No Recovery 43.0'-43.5'
	43.5	43.5						43.5		
	43.5	43.5								NO RECOVERY 43.5 - 44.5
	Run 24 [illegible]	N/A (empty)						44.5		
								45.0		SAME AS ABOVE 41.5-43.0 RPK 071597
	Run 25 44.5 46.5	2.0'						45.5		
							SM/SC	45.4		Sand Silt Clay, Dark Brown (7.5YR 4/6) RPK 071597 MOIST TO WET POSSIBLE HEALED FRACTURE HEALED WITH FE STAIN, MAY BE ALARMIN A ALSO!
								46.0		
	46.5	46.5						46.2		SAME AS ABOVE 41.5-43.0
	46.5	46.5					GM	46.5		Same as above [illegible]
	RUN 26 46.5 48.5'	1.9'						47.0		
							SM/SC	47.0		SAME AS ABOVE 45.4' - 46.2'
								48.0		
	48.5	48.5						48.3		No Recovery 48.3 - 48.5
	48.5	48.5						48.5		
	Run 27 48.5 To 50.5'	1.9' (includes 0.7 slough)								Same as above, 45.4'-46.2' [illegible]
								49.0		
								49.5		TOP OF BEDROCK [illegible]
								50.0		~~TOP OF BEDROCK 49.8' (see next page)~~ - JAS

Run 1 33.5 - 41.5'
Run 2 41.5 - 46.5
Run 3 46.5 - 53.5

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01097
Location - North: _____ East: _____
Date: 071597
Geologist: J. Boylan / R. Fochler / W. Weston
Drilling Equip.: ~~Geoprobe~~ CME75

Surface Elevation: _____
Area: Uparatment PU-D
Total Depth: 53.5
Company: Tetra
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 4 of 4 46.8 - 53.5	see previous page 50.5	50.5					Pattern should be to NO RECOVERY	50.0		NO RECOVERY 50.0 - 50.5
	50.5	50.5						50.5		~~No recovery 50.0 - 50.5~~
	Run 28 50.5 To 52.5	2.0' (Included 0.5' Slough)						51.0		SAME AS ABOVE 49.4' - 50.0
	52.5	52.5						52.0		No Recovery 52.0' To 52.5'
	52.5 Run 29 52.5 - 53.5	52.5 N/A (center bit)						52.5		No Recovery 52.5 - 53.5
53.5	52.5	53.5						53.0		
								53.5		TD = 53.5
								54.0		
								55.0		
								56.0		
								57.0		
								58.0		
								59.0		
								60.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01197
Location - North: _____ East: _____
Date: 07/17/97
Geologist: ~~Bryan~~ R. KOEHLER 07/17/97
Drilling Equip.: ~~Geoprobe~~ HSA - CME 75

Surface Elevation: _____
Area: UPGRADIENT PUMP YARD
Total Depth: 31.0'
Company: Tierra
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dingley DATE 6-8-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Sandy Gravel (Fill)
0.0	0.0	0.0					GC	0.0		Gravel with sand and minor clay. Dark red (fines) (2.5YR 2.5/4). Clasts angular, fragmented, quartzite and granitics, some root hairs at top DRY
	0.0 Run #1 0.0-	0.0 Recovered 1.0'						1.0		NO VOC HITS
										No Recovery 1.0-2.0'
	2.0	2.0						2.0		
	2.0 Run 2 2.0-4.0	2.0 Recovery 0.8' 0 bots/wash						2.2		AS ABOVE 0.0-1.0' NO ROOTS EXCEPT IN SLOUGH
										No Recovery 2.0-4.0
								3.0		
	4.0	4.0						4.0		
	4.0 CENTER BIT ROCK	4.0 N/A								No RECOVERY 4.0-5.0
	5.0	5.0						5.0		Clayey Gravel (Fill)
Box 1 of 3 0.0 to 14.0 ft	5.0 Run 3 5.0-7.0	5.0 Recovery 2.0-					GC	6.0		GRAVEL, SILT, SAND, CLAY OLIVE (5Y 5/4) Angular broken (RPE strong) rock fragments. Quartzites + Granitics. Rock Flour, Dry No VOC Hits
	7.0	7.0								
	7.0 Run 4 7.0-9.0	7.0 Recovery 1.4'					GC	7.0		AS ABOVE 5.0-7.0' Mottled colors reddish brown (2.5YR 4/4) to strong brown (7.5YR 5/8) to olive (5Y 5/4) Bottom 0.0' slightly moist, No VOC Hits
	9.0	9.0						8.0		
								8.4		No RECOVERY 8.4-9.0
	9.0 Run 5 9.0-10.0	9.0 Recovery 2.0-						9.0		RPK 7/17/97 ~~Sand~~ AS ABOVE 5.0-7.0' Not as much gravel, Mostly Brownish yellow (10YR 6/8), slightly moist. No VOC Hits.
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01197
Location - North: East:
Date: 07-17-97
Geologist: ~~J. Boylan~~ R. KOEHLER 07/17/97
Drilling Equip.: ~~Gregory~~ CME-75
Surface Elevation:
Area: UPGRADIENT PLED YARD
Total Depth: 31.0
Company: [illegible]
Project No.:
Sample Type: [illegible]

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Bridgley DATE 6-5-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0-14' Box 1 of	SEE PREVIOUS PAGE 11.0	11.0					GC	10.0		SEE PREVIOUS PAGE
	11.0 Center Bit Auger 12.0	11.0 NA						11.0		No Recovery 11.0-12.0
	12.0 Run 6 12.0-14.0	12.0 Recovery 2.0'					SC	12.0		Clayey Sand (SC) Sand Silt Clay, Mostly brownish yellow (10YR 6/3), Trace gravel, moist. No VOC hits. RPK 7/17/97
14.0	14.0	14.0					GC	13.0		Clayey Gravel (GC) ~~No Recovery 14.0-15.0~~ RPK 07/17/97 Gravel Sand Silt Clay, Mottled Olive (5Y 5/4) to Brownish Yellow (10YR 6/8), Angular gravel, Moist. No VOC hits.
14.0	14.0	14.0				RPK 07/17/97		14.0		No Recovery 14.0-15.0
	15.0 Center Bit Auger 15.0	15.0 NA						15.0		As Above 9.0-11.0'
14.0-24.6 ft. Box 2 of 3	15.0 Run 7 15.0-17.0	15.0 Recovery 2.0'						16.0		
	17.0 Run 8 17.0-19.0	17.0 Recovery 1.0'					CL	16.7 17.0		Clay with sand/silt and trace gravel, pale olive (5Y 6/3) to strong brown (7.5YR 5/8), moist. No VOC hits. AS ABOVE 16.7-17.0'
							GC	17.2		AS ABOVE 13.0-14.0'
								18.0		No Recovery 18.0-19.0'
	19.0 Run 9 19.0-20.0	19.0 Recovery 2.0'					CL	19.0		AS ABOVE 16.7-17.0'
	20.0	20.0					GC	19.6 20.0		AS ABOVE 13.0-14.0'

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01197
Location - North: _____ East: _____
Date: 071797
Geologist: ~~J. Barton~~ R. KOEHLER 071797
Drilling Equip.: ~~Geoprobe~~ HSA- CME75

Surface Elevation: _____
Area: UPGRADIENT PUMP YARD
Total Depth: 31.0 ft.
Company: Tiga
Project No.: _____
Sample Type: ~~Continuous core~~

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dwigby DATE 6-9-95

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
	SEE PREVIOUS PAGE	SEE PREVIOUS PAGE					GC	20.0		SEE PREVIOUS PAGE
	21.0 / 21.0	21.0 / 21.0						21.0		Clayey Gravel (F.G.) Gravel, sand silt clay, No VOC hits. As Above ~~AA~~ 13-14' RPK 071797
Box 2 of	Run 10 21.0-23.0	Recovery 2.0'						22.0		
	23.0 / 23.0	23.0 / 23.0						23.0		AS ABOVE ~~AA~~ 21.0-23.0 RPK 071797 WET GRAVEL SUBROUND, No VOC hits.
	Run 11 23.0-25.0	Recovery 1.8					CL	23.4		Sandy ~~Silty~~ Clay Some silt A Trace Gravel, Mottled brownish yellow 10YR 6/8 to olive (5Y 5/4) Very moist to wet. 0.1' of Fine sand/silt at base. No VOC hits
24.6 / 24.6	25.0 / 25.0	25.0 / 25.0						25.0		No Recovery 24.8-25.0
Box 3 of 3 24.6-31.0'	Run 12 25.0-27.0	Recovery 2.0'			Change to SC Symbol	~~FG~~	SC	26.0		Clayey ~~Sd~~ ~~Sandy silt~~ Gravel (CG) Sand Silt Gravel Clay, yellowish red (5YR 5/8) Subround gravel, some fractured rocks (drilling) micaceous in part, moist. No VOC hits. From Rock fragment.
	27.0 / 27.0	27.0 / 27.0				FC		27.0		Sandy Clay Some Silt (CG) Sand Silt Clay, strong brown (7.5YR 5/6) Saturated. No VOC hits.
	Run 13 27.0-29.0	Recovery 1.4'			Change to CL Symbol	Change to CL	ML / CL	27.3		Sandy Clay, Micaceous, Trace gravel, strong brown (7.5YR 5/6) Moist to saturated. No VOC hits.
	29.0 / 29.0	29.0 / 29.0						28.0		TOP OF BEDROCK, CLAYSTONE, Light olive gray (5Y 6/2) to brownish yellow (10YR 6/6), poss. carbonaceous mottling. No VOC hits.
	Run 14 29.0-31.0	Recovery 2.0'						28.4		NO RECOVERY 28.4-29.0
	30.0 / 30.0	30.0 / 30.0						29.0		AS ABOVE 28.0-28.4 Trace Gravel/Sand slough at top of core. No VOC hits.
								30.0		

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01197
Location - North: _____ East: _____
Date: 07 18 97
Geologist: ~~J Burton~~ R. KOEHLER
Drilling Equip.: ~~Geoprobe~~ CME 75

Surface Elevation: _____
Area: UPGRADIENT PUTD YARD
Total Depth: 31.0 ft.
Company: Tetra
Project No.: _____
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 6-9-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
See Previous Page								30.0		
31.0		31.0								
31.0	31.0	31.0						31.0		
								2.0		
								3.0		
								4.0		
								5.0		
								6.0		
								7.0		
								8.0		
								9.0		
								9.0		

NOTES. General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01297
Location - North: _____ East: _____
Date: 072197
Geologist: ~~[illegible]~~ R. KOEHLER 072197 RPK
Drilling Equip.: ~~[illegible]~~ CME-75 HSA RPK 72197

Surface Elevation: _____
Area: UPGRADIENT PUMP YARD
Total Depth: 36.5 ft
Company: [illegible] Project No.: _____
Sample Type: ~~[illegible]~~

EG&G LOGGING SUPERVISOR
APPROVAL: F. Bright DATE 6-23-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0								SILTY Gravel (FG)
Box 1 of 3 0.0-13.2 ft.	Run 1 0.0-2.0	Recovery 1.3'					GM	0.0		Gravel, sand, silt, unconsolidated, crushed rock, Lt gray (7.5YR 7/0) to Brown (7.5YR 5/2), trace roots, dry, no VOC hits. Minor roots at top.
	2.0	2.0						1.0		No Recovery 1.3'-2.0'
	Run 2 2.0-4.0	Recovery 1.8' include 0.5 spalled					GC	2.0		Silty Gravel (F.G) Gravel, sand, silt, clay, subrounded gravel, Yellowish brown (10YR 6/8) to Strong brown (7.5YR 5/6) Very slightly moist, no VOC hits.
	4.0	4.0						3.0		
	Run 3 4.0-6.0	Recovery 2.0' (0.2 spalled rock)						4.0		AS ABOVE 3.0-3.3' Much crushed rock (quartzite), some mica.
	6.0	6.0						5.0		
	CENTER BIT AUGER	N/A						6.0		No Recovery 6.0-8.0
	8.0	8.0						7.0		
	Run 4 8.0-10.0	Recovery 2.0'						8.0		Gravel, sand, silt clay, mostly lt olive gray (5Y 6/2) with 0.1' at top of Dark yellowish brown (10YR 3/4) Broken quartzite as, some subrounded gravel as, top 0.1' slightly more moist than lower part, lower part slightly moist. No VOC hits
	10.0	10.0						9.0		
								10.0		

NOTES. General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01297
Location - North: _____ East: _____
Date: 07-21-97
Geologist: ~~J. Boyton~~ R. Koehler 7-21-97
Drilling Equip.: ~~Geoprobe~~ CME-75 HSA RPK 7/21/97

Surface Elevation: _____
Area: UPGRADIENT PU&D YARD
Total Depth: 36.5'
Company: Tetra
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 6-23-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Sandy Clay (SC)
	10.0	10.0					CL	10.0		Silty Sandy Gravelly Clay, pale olive (5Y 6/3) moist, no VOC hits
Box 1 10.30-13.2'	Run 5 10.0-12.0	Recovery 0.4'						10.4		No recovery 10.4-12.0
	12.0 / 12.0	12.0 / 12.0						11.0		
								12.0		As Above 10.0-10.4'. More sandy down hole, rotted granitic gravel-trace
13.2 / 13.2	Run 6 12.0-14.0	Recovery 1.9'						13.0		
	14.0 / 14.0	14.0 / 14.0					SC	13.9		No recovery 13.9-14.0'
							SC	14.1		As Above 10.0-10.4'
										As Above 2.0-3.3' some limonite stainings
								15.0		
Box 2 of 3 13.2-28.5'	Run 7 14.0-16.0	Recovery 1.5'						15.4 / 15.5		Fractured Fountain Fm cobble, (2.5YR 5/6)-Red siltstone? No recovery 15.5-16.0'
	16.0 / 16.0	16.0 / 16.0						16.0		No recovery 16.0-18.0. Augered through rocky zone.
	CENTER BIT AUGER	N/A						17.0		
	18.0 / 18.0	18.0 / 18.0						18.0		As Above 2.0-3.3', sands look rounded
	Run 8 18.0-20.0	Recovery 1.1'						19.0 / 19.1		No recovery 19.1-20.0'
	20.0 / 20.0							20.0		

NOTES. General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 4

Borehole Number: 01297
Location - North: East:
Date: 072197
Geologist: R. KOEHLER
Drilling Equip.: CME-75 HSA

Surface Elevation:
Area: UPGRADIENT PU&D YARD
Total Depth: 36.5 ft.
Company: Tetra Tech
Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 6-23-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey Sand (CE)
Box 2 of 3 13.2-28.5	20.0	20.0					SC	20.0		Top 0.1' As Above 2.0-3.3' Saturated Rest is: Sandy silty clay, occ. gravel, pale olive (5Y 6/3) moist.
	Run 9 20.0-22.0	Recovery 1.5						21.0		
	22.0	22.0					GC	21.2		Clayey Gravel - some sand GCD. Gravel, sand silt, clay, pale olive, fractured gravel, gravel rounded. Wet (5Y 6/3)
								21.6		
	Core Catcher Sample	N/A						22.0		No Recovery
	22.0	22.0								
								23.0		As Above 21.2-21.6. Some discrete gravel/crs sand laminae, wet to moist.
	Run 10 23.0-25.0	Recovery 1.7						24.0		
	25.0	25.0						24.3		No recovery 24.3-25.0
	25.0	25.0						25.0		As Above 21.2-21.6. At 25.0 turns brownish yellow (10YR 6/8) below (was pale olive above). Does so below a large quartzite fragment.
	Run 11 25.0-27.0	Recovery 1.3						26.0		
	27.0	27.0						26.3		No recovery 26.3-27.0
								27.0		Sandy Gravel to 27.6. 27.6 to 28.8 (GD) As Above 25.0-26.3 Clay poor especially at top. Top 0.3' may be water layed crs sand and/or gravel. Wet. (Is sand layer due to coring process?)
	Run 12 27.0-29.0	Recovery 1.8						28.0		
	29.0	29.0						28.5		
								28.8		No Recovery 28.8-29.0'
Box 3 of 3 28.5-36.5	Core Catcher Sample	N/A						29.0		No Recovery 29.0-30.0'
	30.0	30.0						30.0		
								32.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01297
Location - North: East:
Date: 072197
Geologist: ~~[illegible]~~ R. KOEHLER RPK 72197
Drilling Equip.: ~~Geoprobe~~ CME-75 HSA RPK 72197
Surface Elevation:
Area: UPGRADIENT PUMP YARD
Total Depth: 36.5
Company: Tiera
Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 6-23-97

TOP/BOTTOM OF CORE BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3 28.5–36.5'	30.0	30.0						30.0		As Above 27.0–28.8'
	Run 13 30.0–32.0	Recovery 1.7'						31.0		
	32.0	32.0						31.7		No Recovery 31.7–32.0
	32.0	32.0						32.0		As Above 27.0–28.3
	Run 14 32.0–34.0	Recovery 0.8'						32.8		RPK 7-21-97
	34.0	34.0						33.0		No Recovery 32.8–34.0
	34.0	34.0				SW		34.0		At bottom a well sorted sand (or rock fragment?) white (10YR 8/2) – 0.1'
	Run 15 34.0–36.5'	Recovery 2.0'						34.1		Crs Sand to Fine Gravel, no clay, mottled quartzites and granitics, wet.
								35.0		Top of Bedrock claystone, mottled olive yellow (2.5Y 6/6) – 0.2', very dark grayish brown (2.5Y 3/2) – 0.4' RPK 72197 grading down to light yellowish brown (2.5Y 6/4) to light olive gray (5Y 6/2) – 1.3' at bottom, saturated, No VOC hits
36.5	36.5	36.5						36.0		
36.5	36.5	36.5						36.5		TD = 36.5'
								37.0		
								38.0		
								39.0		
								40.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01397
Location - North: _____ East: _____
Date: 072897
Geologist: J. Boylan
Drilling Equip.: ~~Geoprobe~~ CME75

Surface Elevation: _____
Area: PU&D
Total Depth: 24.0
Company: Tiga
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dougherty DATE 6-9-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE AZIMUTH	BEDDING AZIMUTH	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
										~~Silty, Gravel, Sandy Sand~~
0.0	0.0	0.0					GM/GC	0.0		Silty, sandy gravel to clayey, sandy gravel — Dark brown (10YR 3/3) in top 0.2'; below is clayeyer, strong brown (7.5YR 4/6) to dark brown (7.5YR 3/4). Dry to sl. moist. To 15 ppm on PID in top few inches. Grades to GC below ~0.5
	RUN 1: 0.0-2.0	1.2					GC	0.5		
								1.0		
								1.2		NO RECOVERY 1.2-2.0
	2.0	2.0						2.0		
	2.0	2.0								Same as above, 0.5-1.2'. Colors include mottling, incl. light yellowish brown (2.5Y 6/3).
	RUN 2: 2.0-4.0	1.8 (incl. 0.3' slough)					GC	3.0		
								3.5		NO RECOVERY 3.5-4.0
	4.0	4.0						4.0		
	4.0	4.0								Same as above, 0.5-1.2, also mottled w/oranges and pinks (Fe-staining, broken gravels w/feldspars). To 80 ppm on PID. Sl. moist to moist. Siltier than 0.5-2.0 almost GM. ~~Gravelly Sand, Some Silt (GS)~~
	RUN 3: 4.0-6.0	2.0 (incl. 0.2' slough)						5.0		
							SM			Gravelly, silty sand with clay — yellowish brown (10YR 5/6).
	6.0	6.0						6.0		
	6.0	6.0					GC GM			Same as above, ~~0.5-1.2~~ 0.0-0.5 w/mottled coloration (mainly browns, also pinks, strong browns). Sl. moist to moist. No hits.
	RUN 4: 6.0-8.0	1.7						7.0		← change pattern to GM
								7.7		NO RECOVERY 7.7-8.0
	8.0	8.0						8.0		
	8.0	8.0								NO RECOVERY 8.0-10.0
	RUN 5: 8.0-10.0	N/A center bit						9.0		
								10.0		

Box 1 of 2 : 0.0-12.0

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 01397
Location - North: East:
Date: 072897
Geologist: J. Boylan
Drilling Equip.: CME 75

Surface Elevation:
Area: PU & D
Total Depth: 24.0
Company: EG&G
Project No.:
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL Fred G. Bridgely DATE 6-9-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
BOX 1 of 2 0.0-12.0	10.0	10.0					GM	10.0		Same as above, 6.0-7.7, Color mainly strong brown (7.5YR 5/6), Moist. No hits.
	RUN 6: 10.0-12.0	2.0						11.0		
							SM			Same as above, 5.0-6.0, but strong brown (7.5YR 5/6), Moist to wet. No hits.
12.0	12.0	12.0						11.9		
12.0	12.0	12.0					GM	12.0		Same as above 6.0-7.7. Color-mainly strong brown (7.5YR 5/8), Saturated. No hits.
	RUN 7: 12.0-14.0	1.6						13.0		
								13.6		NO RECOVERY 13.6-14.0
	14.0	14.0								
Box 2 of 2 : 12.0-24.0	14.0	14.0						14.0		Silty clay w/sand & gravel to silty sandy clay w/gravel, and 0.1'-thick clayey sandy gravel lens @ 18.1'-18.2'. Light gray (2.5Y 7/2) to pale yellow (2.5Y 7/3). Saturated. Stiff. Occasional gravel clasts mixed in. No hits.
	RUN 8: 14.0-17.0	N/A center bit						15.0		
								16.0		NO RECOVERY 14.0-17.0
	17.0	17.0						17.0		
	17.0	17.0					CL			
	RUN 9: 17.0-19.0	2.0						18.0		
	19.0	19.0						19.0		
	19.0	19.0								NO RECOVERY 19.0-20.0
	RUN 10: 19.0-20.0	N/A - center bit								
	20.0	20.0						20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01397
Location - North: East:
Date: 072897
Geologist: J. Boylan
Drilling Equip.: ~~Geop.~~ CME75

Surface Elevation:
Area: PU&D
Total Depth: 24.0
Company: Tierra
Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C Dingley DATE 6-9-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2: 12.0'-24.0'	20.0 RUN 11: 20.0-22.0	20.0 1.8 (incl. 0.2' slough)					SM	20.0		Same as above 11.0-11.9', with increased gravel content. No hits. Wet to saturated.
							CH	20.6		Reworked bedrock claystone - sand @ top, sand w/ gravel in 0.05' lens @ bottom. See below for description.
								20.9		TOP OF BEDROCK = 20.9
								21.0		Claystone w/ silt to silty claystone - mainly light gray (5Y 7/1), with streaks of Fe staining. Wet. Occasional flecks of carbonaceous material. Some to abundant silt. No hits.
	22.0	22.0						21.6		NO RECOVERY 21.6-22.0
	22.0	22.0						22.0		
	RUN 12: 22.0-24.0	1.6 (incl. 0.1' slough)						23.0		
								23.5		
	24.0	24.0						24.0		TD = 24.0'
								25.0		
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

NOTES: General: USCS is modified for this log as follows:
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01497
Location - North: East:
Date: 072297
Geologist: Bryan R Koehler 72297
Drilling Equip.: CME-75 HSA RPK 72297
Surface Elevation:
Area: DOWN GRADIENT PUMP YARD
Total Depth: 25.0
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL Fred [illegible] DATE 6/19/98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					~~GC~~ SM	0.0		(Gravel, Silt-Sand-Sd & Cl. (?-G)
	Run #1 0.0-2.0 ft	Recovery 1.2 ft		Change to SM symbol (1)				1.0 1.2		Gravel, silt, sand, clay, brown (10YR 5/3), abundant root hairs at top. Dry, crumbly.
	2.0	2.0						2.0		Silty Gravel, sandy Cl.
	Run #2 2.0-4.0 ft	Recovery 1.0 ft		~~Sand~~ Change to SM symbol (2)				3.0		As Above 0.0-1.2. In addition to brown A.A. also mottled Yellow (10YR 8/6) to dark yellowish brown (10YR 4/4) (several) pieces of crushed rock (quartzite). No Recovery 3.0-4.0 ft
	4.0	4.0						4.0		No Recovery 4.0-7.0 ft
	Center Bit Auger 4.0-7.0 ft	N/A						5.0 6.0		
	7.0	7.0						7.0		Silty Gravel - sandy Cl.
	Run #3 7.0-9.0 ft	Recovery 2.0 ft.						8.0		Gravel, silt, sand, clay, more clay rich than above, does not crumble as easily. Light yellowish brown from 7.0-7.8 (2.5Y 6/4), pale olive 7.8-9.0 (5Y 6/4). Rock fragments continue, sand rounded, slightly moist.
	9.0	9.0						9.0		No Recovery 9.0-10.0
	Center Bit Auger 9.0-10.0	N/A						10.0		

Box 1 of 2 0.0 to 16.3'

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 01497
Location - North: East:
Date: 072297
Geologist: ~~J. Boyton~~ R Koehler 7.2297
Drilling Equip.: ~~Sampson~~ CME-75 HSA

Surface Elevation:
Area: Down Gradient Pad Yard
Total Depth: 25.0
Company: Tiera
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Knight DATE 6-19-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2: 0.0-16.3'	10.0 Run #4 10.0/12.0-12.0 ft	10.0 Recovery 2.0 ft					GC	10.0		As Above 7.0-9.0 ft 10.0-10.4 brownish yellow (10YR 6/6 to 6/8) 10.4-10.7 crushed quartzite 10.7-11.0 rotten granite 11.0-11.5 crushed quartzite mostly 11.5-12.0 pale olive clayey as above (5Y 6/4) moist. Rest is slightly moist to dry.
	12.0 Run #5 12.0-14.0 ft	12.0 Recovery 2.0 ft						11.0 12.0		As Above 7.0-9.0 ft Broken rock fragments and 1 piece subrounded gravel. OK AS IS RPK 7.2297
	14.0 Run #6 14.0-15.0 ft	14.0 N/A	Sandy clay some gravel in top 2.0 ft of entire interval				CL	13.0 14.0		Sandy Silty Clay, pale olive (5Y 6/4) to strong brown (7.5YR 5/8). Moist. ~~13.0-14.0 As Above 7.0-9.0 ft~~ RPK 7.2297 No Recovery 14.0-15.0 ft. Center bit drilled. (Need block in box) 15.0
16.3	15.0 Run #6 15.0/15.0-17.0 ft	15.0 Recovery 2.0 ft					GC	15.0 16.0 16.3		Gravel silt sand clay As Above 10.0-12.0 ft brownish yellow (10YR 6/6 to 6/8)
16.3	17.0 Run #7 17.0/17.0-19.0 ft	17.0 Recovery 2.0 ft					CL	17.0 18.0 19.3		Sandy Clay As Above 13-14.0 ft. Mostly strong brown (7.5YR 5/8) Trace gravel.
	19.0 Run #8 19.0-21.0	19.0 Recovery 2.0 ft					GC	19.0 20.0		As Above 7.0-9.0 ft. As Above 7.0-9.0 Mottled yellowish brown (10YR 5/6) to Yellow (10YR 8/6). Rotten glauconite (?) at 19.3 (0.1' thick).

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01497
Location - North: _____ East: _____
Date: 072297/072397
Geologist: J. Boylan / R. KOEHLER
Drilling Equip.: ~~Geoprobe~~ RK 072297 CME-75 #SA

Surface Elevation: _____
Area: DOWNGRADIENT PUEBLO YARD
Total Depth: 25.0
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 6-19-95

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 16.3' to 25.0	See Previous Page 31.0	21.0					GC	20.0		See previous page
	21.0	21.0						21.0		NO RECOVERY 21.0-22.0
	center Bit 22.0	22.0						22.0		Same as above, 7.0-9.0, but wet to saturated, strong brown (7.5YR 5/6).
	22.0	22.0						22.5		TOP OF BEDROCK
	RUN 9: 22.0-24.0	1.5'						23.0		claystone - heavily Fe-stained, brownish yellow (10YR 6/8) with streaks of grayish brown (2.5Y 5/2). Moist. Scattered traces carbonaceous material
								23.5		NO RECOVERY 23.5-24.0
	24.0	24.0						24.0		Same as above 22.5-23.5, except dominantly light brownish gray (2.5Y 6/2) with Fe mottling. Browner @ bottom 0.1'.
	24.0	24.0								
	RUN 10: 24.0-25.0	1.5 (incl. 0.3' gap)								
25.0	25.0	25.0								
								25.0		TD = 25.0'
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 4

Borehole Number: 01597
Location - North: _____ East: _____
Date: 072397
Geologist: J. Boylan
Drilling Equip.: ~~Geoprobe~~ CME 75 HSA

Surface Elevation: _____
Area: PU&D
Total Depth: 32.0
Company: [illegible] Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0 RUN 1: 0.0-2.0	1.6					GM	0.0		Sandy, silty gravel w/clay — brown (10YR 4/3) in top 0.4'. Below this, most fines are rock flour. Small pockets of clayey gravel present below 0.4'. Dry. Almost entirely composed of rock flour and fragmented gravels. Lightly rooted.
	2.0	2.0						1.0		
								1.6		NO RECOVERY 1.6-2.0
	2.0	2.0						2.0		
	2.0 RUN 2: 2.0-3.0	N/A (cuttings bit)								NO RECOVERY 2.0-3.0
	3.0	3.0					GC	3.0		Clayey, sandy gravel - strong brown (7.5YR 4/6) at top to olive gray (5Y 4/2) below 3.6', then back to same strong brown @ base. Gravel-poor clay-rich lens @ 3.7-4.0'. Slightly moist.
	3.0 RUN 3: 3.0-5.0	1.7						4.0		
								4.7		NO RECOVERY 4.7-5.0
	5.0	5.0						5.0		Same as above, 3.0-4.7. Same color change from brown to olive w/brown only in top 0.1'. Balance is olive. Similar clay lens @ 6.1-6.5'. Sl. moist.
	5.0 RUN 4: 5.0-7.0	1.6						6.0		
								6.6		NO RECOVERY 6.6-7.0
	7.0	7.0						7.0		
	7.0 RUN 5: 7.0-8.0	N/A (cuttings bit)								NO RECOVERY 7.0-8.0
	8.0	8.0						8.0		Same as above, 3.0-4.7, without color changes or clay lens. Color is from strong brown (7.5Y 5/6) to yellowish brown (10YR 5/6). Slightly moist.
	RUN 6: 8.0-10.0	0.8						9.0		
	10.0	10.0						10.0		

BOX 1 OF 3: 0.0-13.2

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01597
Location - North: East:
Date: 072497
Geologist: J. Boylan
Drilling Equip.: ~~Geoprobe~~ CME 75 HSA

Surface Elevation:
Area: PU&D
Total Depth: 32.0
Company: Tetra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3: 0.0-13.2	10.0 RUN 7: 10.0-12.0	2.0					CL	10.0		Sandy, silty clay — mottled, mainly strong brown (7.5YR 5/6) and light yellowish brown (2.5Y 6/3) scattered carbonaceous flecks, traces gravel. Increasing gravel w/depth. Slightly moist. Gradual transition to underlying material.
	12.0 / 12.0	12.0 / 12.0					GC	11.0		Same as above, 3.0-4.7, with more clay. Colors mottled strong brown (7.5YR 5/6) and light brownish gray (2.5Y 6/2). Slightly moist.
	RUN 8: 12.0-14.0	2.0						12.0		Same as above, 3.0-4.7. Sl. moist.
13.2 / 13.2								13.0		
	14.0	14.0						13.5		Gravelly, clayey sand — strong brown (7.5YR 4/6), sl. moist. Sand is vfg to coarse.
	RUN 9: 14.0-15.0	N/A center bit					SC	14.0		NO RECOVERY 14.0-15.0'
	15.0	15.0						15.0		Same as above, 13.5-14.0, with less gravel except for scattered pieces @ base of interval. Moist to wet. Shattered gravels, 15.6-15.8, too thin to break out.
Box 2 of 3: 13.2-26.0	RUN 10: 15.0-17.0'	2.0					CL	15.6		Sandy, silty clay w/ traces gravel — pale olive (5Y 6/3). Moist to wet.
	17.0 / 17.0	17.0 / 17.0						16.9		
	RUN 11: 17.0-19.0	1.7					GC	17.0		Same as above, 3.0-4.7. Moist to wet. Not quite as gravelly — more sand & silt.
								18.0		
	19.0	19.0						18.7		NO RECOVERY 18.7-19.0
	RUN 12: 19.0-20.0	N/A center bit						19.0		NO RECOVERY 19.0-20.0
								20.0		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01597
Location - North: _____ East: _____
Date: 072497
Geologist: J. Boylan
Drilling Equip.: ~~Geoprobe~~ CME 75

Surface Elevation: _____
Area: N of PU&D
Total Depth: 32.0
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3: 13.2-26.0	20.0	20.0					GC	20.0		Same as above, 3.0-4.7. Saturated in top ~1' wet in rest of interval. Not as gravelly as 3.0-4.7, instead being richer in sand and silt.
	RUN 13: 20.0-22.0	1.6						21.0		
								21.6		NO RECOVERY 21.6-22.0
	22.0	22.0						22.0		
	RUN 14: 22.0-24.0	1.1						23.0		Same as above, 3.0-4.7, w/clay lens @ 22.4-22.7'. Saturated, Sandier than @ 3.0-4.7.
								23.1		NO RECOVERY 23.1-24.0
	24.0	24.0						24.0		
	RUN 15: 24.0-26.0	1.6						25.0		Same as above 3.0-4.7, but sandier; mottled w/reds & oranges from rotting Ftn & Dakota gravels, but mainly light yellowish brown (10YR6/4). wet.
								25.6		NO RECOVERY 25.6-26.0
26.0	26.0	26.0						26.0		
Box 3 of 3: 26.0-32.0	RUN 16: 26.0-28.0	N/A center bit						27.0		NO RECOVERY 26.0-28.0
	28.0	28.0						28.0		
	RUN 17: 28.0-30.0	2.0 (incl. 1.3' saturated cuttings NOT BORED)						28.4		Same as above, 24.0-25.6'.
								28.7		TOP OF BEDROCK - see next page for description
								29.0		NO RECOVERY 28.7-30.0
	30.0	30.0						30.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 4 OF 4

Borehole Number: 01597
Location - North: _____ East: _____
Date: 072497
Geologist: J. Boylan
Drilling Equip.: ~~Geoprobe~~ CME 75

Surface Elevation: _____
Area: PU&D
Total Depth: 32.0
Company: Tetra
Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3: 26.0-32.0	30.0	30.0						30.0		Claystone — light brownish gray (2.5Y 6/2) to grayish brown (2.5Y 5/2). Scattered carbonaceous flecks, Fe staining. Occasional Fe-healed fractures (high-angle ~30.4-30.5, ~45° @ ~~30.~~ ~31.7'. Moist to wet.
	RUN 18: 30.0-32.0	2.0 (each 0.3' slough)		1				31.0		
				/				31.7		
32.0	32.0	32.0						32.0	X	NO RECOVERY 31.7-32.0

TD = 32.0'

NOTE: Well 01597 set in offset hole located 6.5' WSW of hole from which core was obtained.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 01697
Location - North: East:
Date: 082597
Geologist: J. Boylan
Drilling Equip.: ~~CME75 HSA~~ Geoprobe

Surface Elevation:
Area: PU'D yard
Total Depth: 29.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GM	0.0		Gravel/sand & silt mixture — very dark grayish brown (10 YR 3/2). Dry. Rooted.
	RUN 1: 0.0 - 4.0	3.4						1.0		
							GC	1.1		Clayey gravel - some ~~Gravel sand - clay~~ silt ~~mixture~~ — beautiful dark red (2.5YR 3/6) in upper part, becoming mottled & lighter below ~2.0' (to, on average, yellowish red, 5YR 4/6) to light yellowish brown (10 YR 6/4). Slightly moist. Decreased gravel at 3.0 - 3.4'. Gravels typically fractured; rock flour common.
								2.0		
								3.0		
								3.4		NO RECOVERY 3.4 - 4.0
	4.0 / 4.0	4.0 / 4.0						4.0		Same as above, 1.1-3.4, w/ mottled coloration like 2.0-3.4'. Sl. moist.
	RUN 2: 4.0 - 7.0	3.5 (incl. 0.3' slough)						5.0		
								6.0		
								6.5		← Replace pattern w/ GC ~~NO RECOVERY~~ ~~6.5 - 7.0~~
	7.0 / 7.0	7.0 / 7.0						7.0		Same as above, 4.0 - 7.0. Colors still mottled, but mainly strong brown (7.5YR 5/6) and pale olive ~~(5Y~~ (5Y 6/3). Slightly moist to moist.
	RUN 3: 7.0 - 9.0	2.8 (incl. 0.8' slough)						8.0		
8.3 / 8.3										
see next page	9.0 / 9.0	9.0 / 9.0						9.0		Same as above, 7.0 - 9.0', w/ gravel-poor zone (clayey) @ 10.1 - 10.7' (increased sand also present in this zone). Sl. moist to moist.
	RUN 4: 9.0 - 11.0	3.1 (incl. 0.9' slough)						10.0		

BOX 1 of 6 : 0.0 - 8.3'

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: ~~082197~~ 01697
Location - North: East:
Date: ~~082197~~ 082597, 082697
Geologist: J. Boylan
Drilling Equip.: ~~CME 75 - HSA~~ Geoprobe

Surface Elevation:
Area: ~~East of~~ PU&D yard
Total Depth: 29.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigaly DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 6 : 8.3-13.6' (082597)	See previous page 11.0	See previous page 11.0					GC	10.0		see previous page
	11.0 / Run 5: 11.0-13.0	11.0 / 3.5 (incl. 1.5' slough)						11.0		Same as above, 4.0-7.0. Gravel poor, sandy. Zone @ 12.1-12.9' is strong brown (7.5YR 5/6 to 5/8). Sl. moist to moist. Rotting gravels cause some of the mottling.
	13.0	13.0						12.0		
	13.0 / Run 6: 13.0-15.0	13.0 / 4.0 (incl. 1.4' slough)						13.0		Same as above, 4.0-7.0', w/ rotted gravels common. Sl. moist to moist. Underlying contact approximately located due to extra recovery.
13.6 / 13.6								14.0		
Box 3 of 6 : 13.6-18.9'	15.0	15.0					CL	14.2		~~Silty~~ sandy clay to clay w/silt & sand predominantly strong brown (7.5YR 4/6). Moist. Gravels rare. Occasional pods of light olive gray (5Y 6/2) material.
	15.0 / Run 7: 15.0-17.0	15.0 / 3.9 (incl. 1.0' slough)						15.0		Same as above, 14.2-15.0. Moist. Some gravel (to ~2") at base.
	17.0	17.0						16.0		
	17.0 / Run 8: 17.0-19.0	17.0 / 4.0 (incl. 1.7' slough)					CH	17.0		Sandy Clay. Very similar to above 14.2-15.0, but higher plasticity, occasional streamers & flecks of carbonaceous material. Looks very much like bedrock claystone except for traces sand (quartz plus feldspar). Color is mottled mainly Fe-stained yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2). Moist.
18.9 / 18.9								18.0		
	19.0	19.0						19.0		Same as above, 17.0-19.0
see next page	Run 9: 19.0-20.0	3.1 (incl. 1.8' slough)						20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01697
Location - North: ____ East: ____
Date: 082697, 082797
Geologist: J. Boylan (JAB)
Drilling Equip.: ~~EMERGE HSA~~ Geoprobe

Surface Elevation: ____
Area: P(1)&(1) yard
Total Depth: 29.0'
Company: Tierra Project No.: ____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL: [signature] DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 4 of 6 (18.9-22.0')	20.0 RUN 10: 20.0-21.0	20.0 2.5 (incl. 1.2' slough)					CH	20.0		(17.0-19.0) Same as above, becoming increasingly sandy & silty below 20.6'.
	21.0 RUN 11: 21.0-22.0	21.0 2.4' (incl. 0.8' slough)						21.0		Same as above, 17.0-19.0', but w/silty to silty and sandy zones, as at ~21.0-21.6'. Well-rounded pebble (~4 mm) @ ~21.6'. Otherwise, looks much like bedrock. Moist.
22.0	22.0	22.0						22.0		
082697 / 082797	22.0 RUN 12: 22.0-23.0	22.0 2.8' (incl. 1.5' slough)					CL/SM	22.4		Interlayered clay, clay with sand and silt, and sand-silt mixture w/clay — predominating colors are light olive gray (5Y 6/2) for clays and strong brown (7.5YR 5/6) for sand-silts. Most of run is the coarser material w/clay zones @ ~22.6-22.8'. Moist to wet.
Box 5 of 6: 22.0-27.0	23.0 RUN 13: 23.0-25.0	23.0 3.0 (incl. 0.6' slough)					SM	23.0		Silty sand mixture w/trace to some gravel and clay — Same as coarse zones in 22.1-23.0, w/increased gravel. Strong brown (7.5YR 5/6). Wet.
	25.0 RUN 14: 25.0-27.0'	25.0 2.4' (incl. 0.3' slough)						24.0		
								25.0		Same as above 23.0-25.0'. A few coarser gravel clasts present, especially @ 25.3' ~~27.3'~~ where they are accompanied by pod of gray clay. Wet.
								26.0		
27.0	27.0	27.0						27.0		
Box 6 of 6: 27.0-29.0	27.0 RUN 15: 27.0-29.0	27.0 3.4' (incl. 1.4' slough)					CL			Same as above, but much finer-grained: clay-silt-sand mixture. Saturated to wet. Portions are SM, but most is CL. Occasional gravels. Abrupt lower contact.
								28.0		TOP OF BEDROCK = 28.0' Silty, clayey sandstone to clayey, sandy siltstone — mottled due to variable Fe-staining, w/average color light yellowish brown (2.5Y 6/4). Wet @ top, slightly moist to moist @ bottom. Decreasing grain size w/depth.
29.0	29.0	29.0						29.0		TD = 29.0'
								30.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH18897 (aka 01797)
Location - North: _____ East: _____
Date: 9/2/97
Geologist: M. Wood
Drilling Equip.: CME-75

Surface Elevation: _____
Area: PU+D, IHSS 170
Total Depth: 22
Company: RMRS
Project No.: BD320FN
Sample Type: SS

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
		1.4/2.0					GM	1	1350	0.0-1.4 silty gravel, gm w/clay, grayish brown (5YR3/2) f-c gravel, f-c sand, sl moist, sl plastic clay matrix, trace roots at 0.0-0.2, dense 9 8 13 17
										No Recov 1.4-2.0
		7.0/7.0					GC	2 3	1358	2.0-4.0 clayey gravel, GC, moderate brown (5YR3/4), f-c gravel, f-c sand, sl moist, sl plastic clay matrix, very dense 17 23 34 34
		0.5/0.9					GC	4 5	1411	4.0-4.5 same as 2.0-4.0 30 50 for 5 in BH17044RM was 4.0-4.5 No Recov 4.5-6.0
		2.0/2.0					GC	6 7	1424	6.0-8.0 cont same as 2.0-4.0, trace caliche 17 21 23 17
		1.6/2.0					GC	8 9 10	1430	8.0-9.6 same as 2.0-4.0 18 19 12 15 No Recov 9.6-10.0

NOTES General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible
(2) Core breaks cannot be matched, accurate footage measurements not possible

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH18897
Location - North: _____ East: _____
Date: 9/2/97
Geologist: M. Wood
Drilling Equip.: CME-75

Surface Elevation: _____
Area: PU+D IHSS 170
Total Depth: 22
Company: EMRS Project No. CB0320DN
Sample Type: SS

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
		2.0/2.0					SC	10	1433	10.0 – 11.8 same as 3.0-4.0 24 24 22 11
								11		BH17045RM 11.0-11.5 11.8 – 12.0 sandy clay (CL)
		0.6/2.0					CL	12	1504	mod brown (5YR 4/4) to pale olive (10Y 6/2) f-m sand, moist, plastic 12.0 – 12.6 same as 11.8-12.0 6 6 9 10
								13		No Recov 12.6 – 14.0
		2.0/2.0					CL	14	1512	14.0 – 16.0 same as 11.8-12.0 3 5 7 7
								15		BH17046RM 15.0-15.5 von
		2.0/2.0						16		16.0 – 17.0 same as 11.8-12.0 4 8 12 16
								17		17.0 – 18.0 clayey sand (SC) w/ trace gravel, light brown (5Y 2.5/1) moist, f-c sand mdm density, plastic clay matrix
							SC			
								18		18.0 – 20.0 sandy clay, CL, f-m sand, plastic, stiff to very stiff 3 4 7 11
		2.0/2.0					CL			increase in sand 19.8'
								19		
								20		

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Materials amounts are estimated by % volume instead of % weight
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH18397
Location - North: East:
Date: 9/2/97
Geologist: M. Ward
Drilling Equip.: CME-75

Surface Elevation:
Area: PU+D, IHSS 120
Total Depth: 22
Company: RMRS
Project No.: CB0320IN
Sample Type: SS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
		2.0/2.0					CL	20		20.0-21.3 same as 18.0-20.0
										5 6 9 11 21.3-22.0 same as 17.0-18.0 wet-sat.
								21		
							SC			BH17047RM voa 20.5-21.0
								22		TD = 22.0
										E06315RM
										SS2 BP17021RM 0-22.0
								23		9/3/97 0905 water at 20.51
										GW17009RM voa 0930
										sl brown/turbid
								24		drill boring over to WARP to install monitoring well
								25		
								26		
								27		
								28		

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1 /4 of

Borehole Number: 01797 (BH18897, Mark Woods*)
Location - North: _____ East: _____
Date: 09-03-97
Geologist: R. KOEHLER
Drilling Equip.: CME-75 Auger

Surface Elevation: _____
Area: PU&D YARD
Total Depth: 30.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS SPLIT SPOON 2"

EG&G LOGGING SUPERVISOR
APPROVAL T. Dingly DATE 6-22-98

* WARP-97 TAKING OVER HOLE FROM MARK WOODS AT 22.0 ft

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
								20.0		
								21.0		UPPER WELL LOGGED BY MARK WOODS. 0905 TIME DATE 090397 20.51 INITIAL WATER DEPTH
22.0	22.0	22.0						22.0		Top of Bedrock effectively 22.0
Box 1 of 1 22.0-30.0 ft.	22.0-23.1 Run #1	23.1 Recovery 0.2 ft						22.1 23.1		Fine to Medium Sand, Clayey Trace gravel (Sdstn-Ss) at bottom, mottled lt olive gray (5Y-6/2) to yellowish brown (10YR 5/6), fine moist, gravel contains limonite rotten material. ← Gravel, Sand, Silt Clay
								24.0		No Recovery 23.1-24.0
	24.0-26.0 Run #2	24.0 Recovery 2.0 ft						25.0		As Above 22.0-23.1 RK 24 24 Limonite gravel, 22.2, 23.4, 24.9-25.1 (or Manganese oxide) Less moist below 25.0 Sand generally Fine Grained except adj to gravel.
	26.0-27.0 Run #3	26.0 Recovery 1.0 ft						26.0		Clayey Sand As Above 22.0-22.9 only slightly moist, discs greater but itself, qtzite cobble 26.3 ft.
	27.0-28.0 Run #3	27.0 Recovery 0.5 ft						27.0		27.0 RK 26.5-27.0 No Recovery and slough.
	28.0 NO SAMPLE	28.0						28.0		No Sample 27.5-28.0 Augered past this interval.
	28.0-30.0 Run #4	28.0 Recovery 1.3 ft (Finishing fill unit)						29.0		Sample deformed in barrel, badly chewed up. Includes Clayey Sand and Clay (First core run fell out of barrel, recovered the same interval) 29.3-30.0 No Recovery
								30.0		TD 30 ft
30.0	30.0	30.0								

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Note - 22.0-30.0 - generally Clayey Sdstn & Sandy Clay stn. - some Fe stn nuggets to ± 25.0 - Quartzite at 26.3 ± Probably ~~shaft sheet~~ slough of top of run. - F.C.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01897
Location - North: _____ East: _____
Date: 08/07/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE MACROCORE

Surface Elevation: _____
Area: EAST OF PU&D YARD
Total Depth: 24.0 FT
Company: TIERRA Project No.: _____
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FINAL LINE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.0		Gravel, sand, silt, clay, mottled light brown (5YR 5/6) and pale yellowish orange (10YR 8/6) trace pale olive (10Y 6/2), massive does not breakup easily, gravel subrounded, dry to slightly moist, caliche (or rock flour?) in lower 0.6ft, moist in top 0.2ft. No fractures. No VOC's
0.0–8.5 ft.	Run #1 0.0–4.0 ft	Recovery 4.0 ft						1.0		
								2.0		
								3.0		
	4.0	4.0						4.0		As above 0.0–4.0 ft. 0.1 ft of slough at top core with bentonite marker (bentonite added to mark top core) No VOC's
Box 1 of 1	Run #2 4.0–7.0 ft	Recovery 4.0 ft						5.0		
								6.0		"Rotten" igneous rock at approx 6.0 ft.
	7.0	7.0						7.0		As Above 0.0–4.0. No Pale olive, gravel content declines below 8.5 ft, but still present at 9.0 ft (large rounded Ig Rock frags)
	Run #3 7.0–10.0 ft	Recovery 4.0 ft. 0.4 ft slough						8.0		
8.5								8.5		No VOC's
8.5								9.0		To Sandy Clay (RPK 08/11/97)
Box 2 of 8.5							F/CL			Clayey Sand, mottled dark yellowish orange (10YR 6/6) to Pale olive (10Y 6/2), massive does not breakout easily, slightly moist. No VOC's
10.0	10.0	10.0						10.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: ~~0807~~ RPK 01897
Location - North: _____ East: _____
Date: 080797 — 08/11/97 - 8/12/97 - 8/13/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE MACROCORE

Surface Elevation: _____
Area: EAST OF PU&D YARD
Total Depth: 24.0 ft
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 8.5-12.6 ft.	10.0 / 13.0	2.0 ft incl. 0.7 ft slough; Recovery 4.0 ft.					SC/CL	10.0		As above 9.0-10.0 ft. Sandy intervals at 11.0, 11.7 to 11.9, 12.6 to 12.7 (approximate). Very stiff. No VOC's
								11.0		
								12.0		START 08/12/97
	13.0 / 15.0	13.9 / 3.1 slough; Recovery 4.0 ft incl. 3.1 slough	Slough not put in core box - semi liquid					13.0		AS ABOVE 9.0-10.0 ft Trace crs sand or gravel (individual grains)
								13.9 / 14.0		Slough - Gravel/Sand/Clay 13.9-15.0 Semi liquid not put in core box
	15.0 / 17.0	15.0 / 2.0 slough; Recovery 4.0 ft incl. 3.0 slough					SC	15.0		Clayey Sand with 0.1 ft of Gravel/Sand/Clay in cutting shoe at bottom. Sand content increases down, coarsens down, colors As Above 9.0-10.0 ft. massive, stiff, moist, No VOC's
							GC	15.9 / 16.0		Fountain Fm Gravel matrix Dark yellowish orange 10YR 6/4 moist. Slough As Above 13.9-15.0
	17.0 / 17.6	17.0 / 4.0 slough; Recovery 4.0 ft incl. 1.8 slough	Slough not put in core box				SC	17.0		Clayey Sand, Med-Fine grained, Greenish gray (5GY 6/1), stiff, moist, no VOC's.
							GC	17.5		Gravel, Sand, Clay (as in 15.9-16.0), Dark to Pale yellowish orange (10YR 6/4 to 8/6), heavily limonite stained, gravel black and rounded to sub rounded, also feldspathic, stiff, moist, no VOC's
							CH	18.3		Clay, greenish gray, massive, stiff, moist.
Box 3 of 3 17.6-24.0	17.6 / 19.0	1.0 ft incl. 1.8 slough; Recovery 4.0 ft incl. 0.5 slough					GC	18.5		As Above 17.5-18.3 ft. (5GY 6/1)
								19.0		19.0 Start 08/13/97
	19.0 / 20.0	19.0 / 4.0 of 1.0 slough						19.6		NO RECOVERY 19.0-19.6 All Slough
								20.0		See next page.

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01897
Location - North: East:
Date: 08-13-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE MACROCORE

Surface Elevation:
Area: EAST OF PUMP YARD
Total Depth: 24.0
Company: TIERRA Project No.: VARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								20.0		
Box 3 of 3 (2.0 ft Recovery)	20.0	20.0					SC	20.1		AS ABOVE 17.5-18.3
							SC	20.3		AS ABOVE 17.0-17.5 Lt. Olive Gray (5Y 6/1) to Dark yellowish orange (10YR 6/6)
							GC			AS ABOVE 17.5-18.3
								21.		
								21.4		
							SC			AS ABOVE 17.0-17.5
								21.7		
							GC	21.7		
								22		No Recovery 21.7-22.0 (represents 2.1 ft gravelly slough)
							SC			
										AS ABOVE 17.0-17.5, many clay pellet grains in addition to sand (qtz) and gravels. More clayey than above.
								23		
								23.8		TOP BEDROCK 23.8 ft.
								7		Claystone, Light Olive Gray (5Y 6/1) occ. mottled with Dark yellowish brown (10YR 6/6), dry, hard, carbonaceous.
24.0	24.0	24.0						24		
24.0	24.0	24.0								T.D. = 24.0 ft.
								25		
								26		
								27		
								28		
								29		
								30.0		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01997
Location - North: East:
Date: 08-14-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: East of PU&D Yard
Total Depth: 28.0
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL F. Bridgley DATE 11-17-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0.0		Clayey Silt - Some
0.0	0.0	0.0					GC	0.3		Gravel & Sand, ~~Silt~~ ~~Clay~~, Grayish brown (5YR 3/2) ~~---~~, Roots and plant debris, moist
Box 1 of 2 0.0 ft to 4.0 ft	Run #1 0.0 ft to 4.0 ft.	Recovery 4.0 ft.						1.0		Clayey ~~Some~~ Gravel & Sand & Silt, ~~Clay~~ mottled Lt Brown (5YR 5/6) Lt. olive gray (5Y 6/1), dark greenish gray (5GY 4/1) moist to slightly moist.
								2.0		Gravels fractured by drilling, Rock ~~floor~~ RPK floor common.
								3.0		Colors for reds and oranges not really represented in rock color chart.
	4.0							4.0		As Above 0.3-4.0
	4.0	4.0						5.0		
	Run #2 4.0 to 7.0 ft	Recovery 4.0 ft with 0.3 ft rock					SC	5.2		Clayey Silt ~~Sand~~ ~~Some~~ w/minor gravel, lt. brown (5YR 6/4) to lt. olive gray (5Y 6/1), massive, moist
								5.8		
							GC	6.0		As Above 0.3-4.0
								6.3		As Above 5.2-~~6.3~~ 5.9 RPK Lt. brown (5YR 5/6) to DK Yellowish orange (10YR 6/6)
							SC	6.8		
	7.0	7.0					GC	7.0		As Above 0.3-4.0
	7.0	7.0								As Above 0.3-4.0 ft.
7.0								7.0		
7.0								8.0		
								8.2		
Box 2 of 7 7.0 ft to 10.0 ft	Run #3 7.0 to 10.0 ft	Recovery 4.0 ft including 0.7 ft rock					SC/CL	9.0		Clayey sand to sandy clay, silt to coarse sand, moderately sorted, subangular, lt. olive gray (5Y 6/1) to DK Yellowish orange (10YR 6/6), massive, firm, moist. Includes, qtz, qtzite, claystone, rock chips as sand origin
								10.0		
10.0	10.0	10.0								

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01997
Location - North: East:
Date: 08-14-97
Geologist: K. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: East of P & and D Yard
Total Depth: 28.0 ft.
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL F. Bragly DATE 11-17-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	2.0					GC	10.0		As Above ~~0.3-4.0~~ RPK 8-14-97 0.3-4.0 OK Pale yellowish orange 10YR 8/6 to Dark yellowish orange (10YR 6/6) More orange actually
11.0								11.0		omit
11.5								11.5		TOP OF BEDROCK RPK 8/30/97 * Page 3 ~~FC~~ ~~sandy silt~~, medium to fine sand, quartz/feld, grayish orange (10YR 7/4) to dk. yellowish orange (10YR 6/6), moist, firm, massive. sandy clay ~~stone~~ FC
12.0	12.0	2.0						12.0		As Above 11.5 to 12.0 ft
13.0	12.0	1.0						13.0		11.5' to 13.0' - Possible reworked Bedrock. - Contact may occur at ±13.0' (J.D.) Lower 0.5 ft more sandy slightly drier breaks into pieces
13.5								13.5		
14.0	14.0	1.0						14.0		As Above 11.5-12.0. Sand content varies so firmness varies too. More sand equals tendency to crumble. Probably corresponding upward. sandy unit appears bleached. (J.D.)
16.0	16.0	2.0						16.0		As Above, wet, semi fluid in barrel 11.5-12.0
16.5								16.5		Sandy Clay to Clayey Sand, fine sand to silt, quartz-feldspathic, mottled, pale yellowish brown 10YR 6/2, dk yellowish orange (10YR 6/6), pale yellowish orange (10YR 8/6), stiff/firm, massive moist to slightly moist.
18.0	18.0	1.5						18.0		As Above 16.5-18.0 Except silty clay ~~clay~~ FC Lower 0.2 ft mottled Lt to med Lt grey (N7-N6) to Dk yellowish orange (10YR 6/6)
18.5								18.5		
20.0	20.0	2.0						20.0		

Run #1 Recovery 4.0 ft incl. 1.2 ft slough
Run #4 Recovery 4.0 ft incl. 1.0 ft slough
Run #5 Recovery 4.0 ft incl. 1.0 ft slough
Run #6 Recovery 4.0 ft incl. 1.0 ft slough
Run #7 Recovery 4.0 ft incl. 0.5 ft slough
Run #8 Recovery 4.0 ft incl. 1.5 ft slough
Slough, semi liquid not part of core box

Fig. 56
Clay to sandy clay
sandy - clay
clayey sand
sand - clay
clay - sand
FC 55/6
sandy clay mix
silty clay FC

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01997
Location - North: East:
Date: 08-14-97
Geologist: R KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: East of PU+D Yard
Total Depth: 28.0
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-17-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								20.0		16.5-18.0 RPK 08/14/97
20.0	20.0	20.0					SC/CL			As Above, gray tends to be sandier, sandier 21.0 to 22.0 ft
Box 4 of 5: 18.5-26.7	Run #9 20.0-22.0 ft	Recovery 4.0 ft (1 broken piece, 1.8 ft slab)	5 broken pieces not part of core box					21.0		
	22.0	22.0						22.0		
	Run #10 22.0-24.0 ft	Recovery 4.0 ft 5 pieces, 2 all					GW	23.0		Gravel and Sand, minor clay, matrix mud grayish orange (10YR 7/4), unconsolidated, wet, don't know if this is slough or actual sediment (double checked drillin and we did go to 24.0 ft) Gravel rounded
	24.0	24.0						23.9		
							SH	24.0		Clay, dk yellowish orange (10YR 6/8), Massive, firm moist.
	24.0	24.0					GC/SC			3 separate pieces in barrel, Gravel, Sand, Silt Clay, grayish orange (10YR 7/4), firm, moist. gravel rounded.
	Run #11 24.0-26.0 ft	Recovery 0.8 ft pieces						24.8		No Recovery 24.8-25.0
	26.0	26.0						25.0		Soil [illegible] sandier than [illegible]
								26.0		~~Top of bedrock 26.0 ft~~ RPK 08/20/97 *
	26.0	26.0								Claystone, dk yellowish orange (10YR 6/6) to lt olive gray (5Y 6/1), ~~mo~~ mottled, massive, trace carbonaceous material, firm to stiff, moist, ~~Pecent~~ Top of Bedrock CONT ON - [illegible]
26.7								26.7		
Box 5 of 5: 26.7-28.0 ft	Run #12 26.0-28.0 ft	Recovery 1.6 ft						27.0		
								27.6		No Recovery 27.6-28.0 ft
28.0	28.0	28.0						28.0		
								29.0		
								30.0		

* In consultation with John Boylan and Fred Grigsby top of bedrock moved to 11.5 ft. 8/20/97 RPK

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 02097
Location - North: _____ East: _____
Date: 081897
Geologist: J. Boylan
Drilling Equip: ~~EG&G HSA~~ Geoprobe

Surface Elevation: _____
Area: E of PU&D
Total Depth: 14.0
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Earl C. Bingsby DATE 6-5-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC/GM	0.0		~~Silty Gravel~~ ~~Gravelly Silt~~ - Some Clay, (CL-GC) gravel-silt-clay mixture w/sand - very dark brown (10YR 2/2) at top grading to dark brown (10YR 3/3) below ~0.9'. Avg gravel ~ 3/4-1" diam. and larger. Slightly rooted @ top. Slightly moist to moist (it's been raining and 02097 is in low spot). Abrupt lower contact.
	RUN 1: 0.0-4.0	2.7						1.0		
							GC/GM	1.5		Calcareous (caliche-rich) gravel-sand-silt-clay mixture — same as above, but color is white (10YR 8/2) to very pale brown (10YR 8/3), grading to light gray (2.5Y 7/2) below ~2.5'. Moist. Increased sand content relative to overlying material.
								2.0		
								2.7		
								3.0		NO RECOVERY 2.7-4.0
	4.0 / 4.0	+.3 / 4.0						4.0		Same as above, 1.5-2.7', with gravel zone (or single shattered boulder) at 4.4-4.9'. Moist. Abrupt lower contact. Abundant rock flour in gravel zone.
	RUN 2: 4.0-7.0	3.4 incl. 0.1' slough						5.0		
							GC/GM	5.3		~~Gravelly~~ Sandy Gravel - Some Silt/Clay (GC) Gravel-sand-silt-clay mixture — very similar to above, 1.5-2.7, but without the abundant caliche. Rotted gravels common. Moist. Gravels are finer than in overlying materials, averaging ½" or smaller. Mottled colors due to rotted gravels; predominantly light olive brown (2.5Y 5/3).
								6.0		
	7.0 / 7.0	7.0 / 7.0						7.0		
								7.2		Same as above, 5.3-7.0.
	RUN 3: 7.0-10.0'	4.0 incl. 1.0' slough					CH	8.0		Clay to clay w/silt — light brownish gray (2.5YG 6/2) w/ scattered orange Fe-staining. Silty zone, w/trace to some vf sand, @ 8.2-8.5'. Color changes to brown above contact w/underlying material (strong brown, 7.5YR 5/6 ~9.3-9.5'). Moderate to high plasticity. Scattered carbonaceous flecks. Moist.
8.9 / 8.9								9.0		
							GC/GM	9.5		Same as above, 5.3-7.2', but color is mottled i predominant yellowish brown (10YR 5/4). Moist to wet.
	10.0	10.0						10.0		

BOX 1 OF 3 : 0.0 - 8.9'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02097
Location - North: East:
Date: 081897, 081997
Geologist: J. Boylan
Drilling Equip: ~~Emerson-USA~~ Geoprobe

Surface Elevation:
Area: E of PU&D
Total Depth: 14.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 6-5-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
8.9	10.0	10.0					GC/GM	10.0		Same as above, 9.5-10.0. Saturated.
	RUN 4: 10.0-12.0	2.0' (incl. 0.2' slough)					CL/SC	10.2		Clay to clay w/silt to clay-silt-sand mixture — mottled, predominant colors are yellowish brown (10YR 5/4) to grayish brown (2.5Y 5/2). Rare gravel clasts. Some areas to high plasticity. Grain size variations in lenses and pockets of coarser material (to fine sand) in finer matrix. Wet to saturated.
	12.0	12.0						11.0		
	12.0	12.0						11.7		TOP OF BEDROCK — interfingered sandstone, claystone, siltstone, and mixtures of these end-members. Color is variegated, mostly brownish yellow (10YR 6/6) to yellowish brown (10YR 5/6) from Fe staining, with some areas light gray (2.5Y 7/2). Streaks of carbonaceous material also present. Some laminations present. Sand is subang. to well rounded, quartz, generally w/ trace to some clay and silt. Sand layers most developed at 11.7-12.1' and especially at 13.7-14.0'.
	RUN 5: 12.0-13.5	4.0 (incl. 2.9' slough)						11.8		NO RECOVERY 11.8-12.0
								12.0		
								13.0		
	13.5	13.5						13.1		
13.9 Box 3 of 3	RUN 6: 13.5-14.0	4.0 (incl. 3.2' slough)								
14.0	14.0	14.0						14.0		TD = 14.0'
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

Box 2 of 3: 8.9-13.8

081897 | 081997

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02197
Location - North: East:
Date: 082197, 090997
Geologist: J. Boylan
Drilling Equip.: ~~CME75 HSA~~ Geoprobe, CME75 HSA
Surface Elevation:
Area: E of PU&D
Total Depth: 12.9
Company: Tierra
Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Bingaly DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GM	0.0		Gravel-sand-silt mixture - very dark brown (10YR 2/2). Dry. Road gravel may constitute some of sample. Light rounding. Gravels fractured mostly, w/a few showing some rounding. ~~Clayey Gravel-Sand mixture~~
	RUN 1: 0.0-4.0	3.7					GC	0.5		~~Gravel and Clayey Silt~~ / Silt - beautiful dark reddish brown (5YR 3/4) to dark red (2.5YR 3/6), then to dark brown (7.5YR 4/4) below ~3.0'. Slightly moist. Caliche grains present in some portions.
								1.0		
								2.0		
								3.0		
								3.7		NO RECOVERY 3.7-4.0
	4.0 / 4.0	4.0					GM	4.0		Silty Gravel Same as above 0.5-3.7, but less clay and more silt, less gravel and more sand (on average). Colors vary, but generally light yellowish brown (10YR 6/4) to brownish yellow (10YR 6/6). Moist below ~5.5'. sl. moist above. Core is mostly loose, broken up.
	RUN 2: 4.0-7.0	4.0 Circ. (0.5' slough)						5.0		
								6.0		
7.1	7.0 / 7.0	7.0						7.0		Same as above, 4.0-7.0. Core is sl. moist to moist - may have been dried by heat generated during lengthy hammering.
7.1	RUN 3: 7.0-8.5	2.1 Circ. (1.0' slough)						8.0		
	8.5	8.5						8.1		NO RECOVERY 8.1-8.5
	8.5 / 8.5	8.5						8.5		Same as above 4.0-8.1: gravel-sand-silt mixture w/clay, and some portions to gravelly, silty sand. Moist. Pod @ 9.6-9.8 is gravel-sand-silt-clay mixture, w/the clay in chips and chunks; below is more gravelly.
	RUN 4: 8.5-10.0	1.6						9.0		
	10.0	10.0						10.0		

BOX 1 OF 2: 0.0-7.1

BOX 2 OF 2: 7.1-12.9'

NOTES: General: USCS is modified for this log as follows:
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02197
Location - North: _____ East: _____
Date: 090997
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation: _____
Area: E. of PU&D
Total Depth: 12.9
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigsby DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑	10.0 RUN5: 10.0-12.0	10.0 2.0					GM	10.0		Same as above, 4.0-8.1'. Moist. Abrupt, sharp lower contact.
								10.2		TOP OF BEDROCK = 10.9'
								11.0		Claystone to claystone w/silt — mottled w/Fe-staining & traces carbonaceous material & caliche. Predominantly lighter yellowish brown (2.5Y 6/4). Moist.
Box 2 of 2: 7.1-12.9'	12.0	12.0						12.0		Same as above, 10.2-12.0.
	12.0-12.9 RUN6:	1.2 (incl. 0.2' slough)								
12.9	12.9	12.9						12.9		
								13.0		T.D. = 12.9'
								14.0		
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02297
Location - North: East:
Date: 09-25-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: Building 779
Total Depth:
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred Quigley DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey Gravel - Some
0.0	0.0	0.0						0.0		
0.0-10.0 ft	0.0 Run #1 4.0 ft	3.5 ft Recovery					GC	1.0, 2.0, 3.0, 3.5		~~Clay~~ Silt & Sand, ~~Gravel~~ FG, mottled - grayish orange (10YR 7/4), dark yellowish orange (10YR 6/6), moderate yellowish brown (10 YR 5/4), pale yellowish brown 10YR 6/2); gravel - fractured to subround sand - very fine to very coarse, subangular to subround; gravel - quartzite and granitic rock fragments, sand - quartz; well graded, slightly plastic, moist especially the top 0.3 ft. No VOC's No RADS
								3.5		No Recovery 3.5-4.0 ft.
	4.0	4.0						4.0		
Box 1 of 2	4.0 Run #2 7.0 ft.	3.3 ft Recovery including trace sloughs						5.0		As Above 0.0-3.5 ft. No VOC's No Rads
							GM	6.0		~~Silt~~ Sandy Gravel, some silt, minor clay, dusky yellow (5 Y 6/4) with abundant caliche - very pale orange (10YR 8/2) FG most gravel fractured quartzite, disaggregates, moist No VOCs No Rads
	7.0	7.0						7.0		
	7.0-10.0 ft. Run #3	3.3 ft Recovery including 0.3 ft of sloughs						8.0		As Above 6-7.0 ft slightly more clay but not as much as 0.0-6.0 ft. Light brown to dark yellowish orange 5YR 5/2 10 YR 6/6 No VOCs No rads
								9.0		
	10.0	10.0						10.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02297
Location - North: East:
Date: 09-25-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: Building 779
Total Depth: 15.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	10.0						10.0		As Above 6.0-7.0 ft, color and clay amount similar to 1.0-10.0 ft. 5 ppm VOC (erratic readings) in lowest 1.3 ft. No rads.
Box 2 of 2 10.0-15.0 ft.	Run #4 10.0-13.0 ft	2.8 ft including 0.3 ft of slough Recovery						11.0		
								11.3		Top of Bedrock.
								12.0		Claystone; light olive gray (5Y 6/1) to dark yellowish orange (10YR 6/6), non porous, soft in top half, firmer and crumbly in bottom; lower half heavily and plastic carbonaceous (probably leached out of top half, where limonite staining is heaviest), top moist, bottom slightly moist, no VOC No Rad.
								12.6		No recovery 12.6-13.0 ft.
	13.0							13.0		Claystone As Above 11.3-12.6, all soft all slightly plastic, not particularly carbonaceous
	Run #5 13.0-15.0 ft	3.1 ft including 0.1 ft of slough Recovery						14.0		Silty Claystone with horizontal caliche zone at top. Colors as in claystone 11.3-12.6, firing crumbly.
15.0	15.0	15.0						15.0		
15.0	15.0	15.0								T.D. = 15.0 ft.
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #08397
Location - North: _____ East: _____
Date: 09-29-97
Geologist: R KOEHLER
Drilling Equip.: GEOPROBE — MACROCORE

Surface Elevation: _____
Area: Building 779
Total Depth: 13.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred Haigh DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.0		Some: Clay & Silt, Sandy Gravel; mottled dark yellowish brown (10YR 4/2), moderate yellowish brown (10YR 5/4), dark yellowish orange (10YR 6/6), light olive gray (5Y 6/1); gravel – quartzite and granitic rock fragments, fractured to subround; sand – v fine to very coarse, subangular to subround, clayey sections slightly plastic, generally firm, massive, slightly moist, No VOC, No Rad. Changes to Clayey Gravel from 1.7' to 9.0'
Box 1 of 2 0.0-8.3 ft.	Run #1 0.0-4.0 ft.	Recovery 4.0 ft						1.0		
								2.0		
								3.0		
								4.0		
	Run #2 4.0-7.0 ft.	Recovery 3.5 ft including 0.8 ft slough		Change with Sym.			Cl.			~~As Above 0.0-4.0~~ Gravelly Clay Moderate reddish brown 10 R 4/6 with clay dominant, little gravel 4.5-5.0 ft.
								5.0		
							~~GM~~ GC			Dark yellowish orange (10 YR 6/6) dominant 5.0-6.7 ft. This interval dominated by sand and gravel, little or less clay. No Rads, No VOC's
				Change with symb				6.0		
								6.7		Sandy Gravel – some clay
										No Recovery 6.7-7.0 ft.
	7.0							7.0		
	Run #3 7.0-10.0 ft.	Recovery 4.0 including 0.3 ft slough								As Above 0.0-4.0 Dark yellowish orange dominant 10 YR 6/6 Pale yellowish orange (10 YR 8/6) at 8.6-8.8 ft. Sand zone at 8.6-8.8 also. No Rads, No VOC's Sand and gravel dominant
								8.0		
8.3	8.3							8.3		
Box 2 of 2 8.3-13.0 ft.								9.0		
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02397
Location - North: _____ East: _____
Date: 09-29-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation: _____
Area: Building 779
Total Depth: 13.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigsby DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 8.3-13.0 ft	10.0 Run #4 10.0-13.0 FT	0.3 ft Recovery 4.0 ft. including 0.3 ft slough						10.0 10.2 11.0 12.0 13.0		As Above 8.0-9.0 Soil and gravel. TOP OF BEDROCK Interbedded Clayey Sandstone with trace claystone and sandstone. Fine grained, quartz and mafics, subangular to subround, well sorted, uncemented, massive, sand friable, rest is firm, trace crumbly (claystone). Light blue gray (5 PB 5/1) mottled by dark yellowish orange (10 YR 6/6). Poorly cohesive as moved. Slightly porous(?) Slightly moist to moist. No Roots No Rocks. Manganese cement into pl ft.
13.0	13.0	13.0						14.0 15.0 16.0 17.0 18.0 19.0 20.0		T.D = 13.0 ft.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02497
Location - North: East:
Date: 09-26-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: Building 779
Total Depth: 18.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey Gravel - some
0.0	0.0	0.0					GC	0.0		~~Clay~~, Sand, Silt, ~~Gravel~~ moderate brown (5YR 3/4) FG gravel - dominantly quartzite w/ some granitic rock fragments, fractured to subrounded; v. fine to v. coarse sand, quartz dominant with feldspar and granitic rock fragments, subangular to subrounded, well graded, disaggregated to firm, moist, No VOC's, No Rads. Clayey zones slightly plastic
0.0-10.0 ft.	0.0-4.0 ft.	2.3 ft.		Correct USCS symbols				1.0		
								2.0		
								2.3		No Recovery 2.3-4.0 ft (Large gravel lodged in cutting shoe.)
								3.0		
Box 1 of 3	Run #1	Recovery						4.0		As Above 0.0-2.3
	4.0-7.0 ft.	3.5 ft including 0.5 ft of slough						4.5		Clayey Sand to Sandy Clay; mottled - pale yellowish brown (10YR 6/2), dark yellowish orange (10YR 6/6), pale olive (10Y 6/2); very fine to v. coarse sand, subangular to subrounded, quartz and granitic fragments, well graded, non porous, plastic, firm, moist, no VOCs, no Rads.
							CL	5.0		
								5.5		
	Run #2	Recovery				FG.	~~SAN~~			~~Clay~~, Sandy ~~Silt~~, Gravel as above 0.0-2.3 ft. ~~clay~~
							GW	6.0		Higher Gravel content, less clay. Mottled pale olive (10Y 6/2), grayish olive (10Y 4/2) moderate orange pink (5YR 8/4)
	7.0-10.0 ft.	3.7 ft including 0.7 ft of slough						7.0		~~Clay~~, Sandy ~~Silt~~, Gravel as above 0.0-2.3 ~~some clay & silt~~ Gravel content and colors as in 5.5-7.0 ft. "Orange" more dominant than green.
	Run #3	Recovery					GM	8.0		
								9.0		
								10.0		
	10.0	10.0								

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02497
Location - North: East:
Date: 09-26-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: Building 779
Total Depth: 18.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dingly DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
										H = heavily limonite staining
10.0	10.0	0.0						10.0		Clay Sand [illegible] as above 10.0-10.2 ft.
								10.2		TOP WEATHERED BEDROCK
										Sandy ~~Clay~~ Claystone; light olive gray (5Y 6/1) to light brown (limonite - 5YR 5/6), fine quartz and matrix, subangular to subround, well sorted, firm slightly plastic, moist, no VOC no rad.
								11.0		
								11.1		← Heavy limonite at contact
										Claystone; silty at top and bottom (?), light olive gray with limonite stains (5Y 6/1) (limonite lt brown (5YR 5/6));
								12.0		Silty Sandstone - some clay
										~~Slightly Clayey Sand~~; lt olive gray (5Y 6/1) with limonite stains lt. brown (5YR 5/6), trace calcite, fine quartz and matrix sand, subangular to subround, porous, some fine sand disaggregates proportional to clay content?, clay content increases up; ~~sdty~~ moist, No VOC No Rad
								13.0		
								13.2		Clayey ~~Sand~~ shavings as above. Shavings cutup in core tube and cutting shoe. 18.0-13.0 ft.
								14.0		13.2-16.0 No Recovery
								15.0		
								16.0		
								16.2		Clayey Sand cutup in shoe as above 13.0-13.2 ft.
										16.2-18.0 no Recovery
								17.0		
								18.0		
18.0	18.0	18.0								T.D. = 18.0 ft.
								19.0		
								20.0		

Box 2 of 2 10.0-18.0 [Run #4 10.0-13.0 ft.] Recovery 4.0 ft including 0.5 ft slough

Run #5 13.0-16.0 ft Recovery 1.1 ft including 0.5 ft slough

Run #6 16.0-18.0 ft Recovery 2.64 including 0.44 ft slough

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 02697
Location - North: East:
Date: 092797
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation:
Area: East Buffer Zone
Total Depth: 28.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. [illegible] DATE 5-26-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					CL	0.0		Silty clay w/ sand; trace gravel – dark brown (10YR 4/3, 3/3). Sl. moist. Rooted @ top. Hard, stiff. Gravels rare, typically <0.5", but present.
	RUN 1: 0.0-2.0	1.6	BH00853 RN1 - VOA - Composite 0-28.0 BH00953 RN1 - Reds - Composite 0-28.0 BH00953 RN1 - Metals - Composite 0-28.0 BH00953 RN1 - Rad Screen - Composite 0-28.0					1.0		
								1.6		NO RECOVERY 1.6-2.0
	2.0 / 2.0	2.0						2.0		
0.0 24.0	Reamed w/center bit – No Recovery 2.0-5.0							3.0		NO RECOVERY (center bit; not coring) 2.0-5.0
								4.0		
	5.0 / 5.0	5.0						5.0		Same as above 0.0-1.6, w/increased silt & sand; color now strong brown (7.5YR 4/6). Sl. moist.
	RUN 2: 5.0-7.0	1.6						6.0		
								6.6		NO RECOVERY 6.6-7.0
	7.0 / 7.0	2.0						7.0		
BOX 1 OF 2	Reamed w/center bit – No Recovery 7.0-10.0							8.0		NO RECOVERY (center bit) 7.0-10.0
								9.0		
	10.0 / 10.0							10.0		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02697
Location - North: East:
Date: 09 27 97
Geologist: J. Boylan
Drilling Equip.: CME 75 - HSA

Surface Elevation:
Area: East Buffer Zone
Total Depth: 28.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 5-26-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑	10.0	10.0					CL	10.0		Same as above, 5.0-6.0. Sl. moist to moist.
	RUN 3: 10.0-12.0	1.9						11.0		
	12.0	12.0						11.9 / 12.0		NO RECOVERY 11.9-12.0
	12.0	12.0								NO RECOVERY (center bit) 12.0-15.0
	Reamed w/center bit - No Recovery 12.0-15.0							13.0		
								14.0		
	15.0	15.0						15.0		
	15.0	15.0	See Page 1				GC			Clayey gravel - sand mixture - strong brown (7.5YR4/6). Sl. moist to moist. Gravels mostly fractured by drilling, contains rock flour and gravel shards. Gravels > 2".
	RUN 4: 15.0-17.0	0.9 (incl. 0.5' sluff)						15.6		
								16.0		NO RECOVERY 15.6-17.0
	17.0	17.0						17.0		
	17.0	17.0								NO RECOVERY (center bit) 17.0-200
	Reamed w/center bit - No Recovery 17.0-20.0							18.0		
								19.0		
↓	20.0	20.0						20.0		

BOX 1 of 2 0.0 - 24.0

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 02697
Location - North: East:
Date: 092797
Geologist: J. Boylan
Drilling Equip.: CME75-HSA

Surface Elevation:
Area: East Buffer Zone
Total Depth: 28.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 5/26/98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										F.G. Sandy Gravel - Sense
	20.0	20.0					GM	20.0		F.G. Gravel-sand-silt ~~mixture~~ w/ ~~clay~~ - mottled due to abundance of rotting gravels (~~[illegible]~~ metamorphics) - ~~some~~ mainly quartzites & schists. Moist. matrix (sand-silt) is reddish yellow (7.5YR 6/6).
1 of 2: 0.0-24.0	RUN 5: 20.0-22.0	1.8						21.0		
	22.0	22.0						21.8		NO RECOVERY 21.8-22.0
	22.0	22.0						22.0		Same as above 20.0-21.8, but wet. Clayey lens @ 23.9 (<0.1' thick) is sticky & soft, overlays completely decomposed olive brown gravel.
	RUN 6: 22.0-24.0	2.0						23.0		
	24.0	24.0						24.0		
	24.0	24.0						24.0		Same as above, 22.0-24.0. Wet.
			See Page 1					24.8		TOP OF BEDROCK
	RUN 7: 24.0-26.0	1.3						25.0		Silty claystone/clayey siltstone w/trace v.f.g. sand - fines gradually w/depth. Mottled w/Fe-staining - grayish brown (2.5Y 5/2) to yellowish brown (10YR 5/6). Sl. moist.
								25.3		NO RECOVERY 25.3-26.0
	26.0	26.0						26.0		Same as above, 24.8-25.3 but finer-grained: claystone/silty claystone. Color freshens below 26.4', gradually changing to mottled dark gray to grayish brown (10YR 4/1 to 5/2). Sl. moist. Fe-staining decreases sharply below 26.4'.
Box 2 of 2: 24.0-28.0	RUN 8: 26.0-28.0	2.2 (incl. 0.2' slough)						27.0		
	28.0	28.0						28.0		
								29.0		TD = 28.0'
								30.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02097
Location - North: _____ East: _____
Date: 09-24-97
Geologist: E. Grigsby
Drilling Equip.: CME 75

Surface Elevation: _____
Area: E. of OU-2
Total Depth: 43.0'
Company: Tierra Project No.: _____
Sample Type: Continuous Core/Cuttings.

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3	Run No. 1 0.0'-2.0'	Rec. 1.6'	02 00949-RM - V019 - Composite 0'-23.0' 02 00950-RM - Fields - Composite 0'-23.0' 02 00951-RM - Metals Composite 0'-23.0' 02 00952-RM - Rad Screen Composite 0'-23.0'				CL	0		0'-0.5' - Silty Clay - Tr. Gravel & Sand - Dusky Yellowish Brown (10YR-2/2) Abundant Roots - Friable, Sl. Damp Top Soil. -
							GC	1		0.5'-1.6' - Clayey Gravel - Some Sd. & Silt - dry, wx - Mod Well Cemented - Matrix Moderate Orange Pink (5YR 8/4)
								2		1.6'-2.0' - No Recovery
	Reamed & Drilled 0.0'-5.0'	No Core Rec.						3		2.0'-5.0' - Center Bit drilled - Cuttings - Indicate Clayey gravel.
							GC	4		5.0'-7.0' Clayey Gravel - Some Silt & Sd. Some Top Soil Stuff at Top of Core. - Matrix Grayish Orange Pink (5YR-7/2) to very Pale Orange (10YR-8/2) Gravel Pred. Quartzite - Pred. 1/2 - 3/4 inch - Some broken during drilling - Core Mod Cemented to Friable - Now Dry.
								5		
Box 1 of 3	Run No. 2 5.0'-7.0'	Rec. 2.0'					GC	6		
								7		7.0'-10.0' Drilled Out - No Description
	Drilled & Reamed 5.0'-10.0'	No Core Rec.						8		
								9		
								10		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02797
Location - North: East:
Date: 09-24-97
Geologist: F. Grigsby
Drilling Equip.: CME 75

Surface Elevation:
Area: E. of OU-2
Total Depth: 43.0'
Company: Tierra Project No.:
Sample Type: Continuous Core/cuttings

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3	Run No. 3 10.0'-12.0'	Rec. 1.5'	See Page 3				GC	10, 11, 12		10.0 - 11.5' - Clayey Gravel - Same as 5.0 - 7.0' - Some Top Soil Stuff at top of Core - Core could be Sl. Calcareous (No acid?). 11.5-12.0' - No Recovery
	Drilled & Reamed 10.0'-15.0'	No Core Rec.						13, 14		12.0'-15.0' - Drilled - No Description of Cuttings. 15.0'-16.0' Sandy Gravel - Some Silt & Clay. Some Top Soil Stuff at top of interval. Matrix Light Brown (5YR 6/4) Graded Quartzite - Some Shale & Feldspar Clast. - Sand Pred. f.G. - angular quartz - Weakly Cemented. Dry. Trace FeO Coatings on grains.
Box 1 of 3	Run No. 4 15.0'-17.0'	Rec. 1.0'					GM	15, 16		16.0'-20.0' No Recovery - Drilled out.
	Drilled From 15-20'	No Core Recovery						17, 18, 19, 20		20.0'-20.2 - Clayey Sand - Some Small gravel - Matrix Light Brown (5YR 6/4 to 5YR 5/6) Sand Poorly graded - Pred f.G. quartz, Subrounded to Subangular. Mod Well Cemented (Siliceous.)

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02797
Location - North: East:
Date: 09-24-97
Geologist: F. Grigsby
Drilling Equip.: CME 75

Surface Elevation:
Area: E. of OU-2
Total Depth: 43.0'
Company: Tierra Project No.:
Sample Type: Continuous Core/Cuttings

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3	Run No. 5 20.0'-22.0'	Rec. 0.2'	See Page 1				SC	20		20.2'-21.5' - No Recovery
								21		21.5'-25.0' - Drilled - No Sample Description.
	Drilled From 21.5'-25.0'	No Core Recovery						22		
								23		
								24		
Box 2 of 3	Run No. 6 25.0'-27.0'	Rec. 1.5'					GM	25		25.0'-26.2' - Sandy Gravel - Some Clay and Silt - Matrix Light Brown (5YR 6/4) ~~Gore~~ Gravel Well graded. Some broken ~~cobble~~ Cobble Clast Pred. Quartzite. - Sand Pred. f.G. but well graded. Typically sub rd. to subangular Quartz. Mod. well Cemented (Argillaceous) Core Wx. - Dry.
								26		
								27		
	Drilled to 30.0'	No Core Recovery						28		26.2'-30.0' - Drilled Out - No Sample Descriptions.
								29		
								30		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02797
Location - North: East:
Date: 9-24-97, 9-25-97
Geologist: E. Grigsby
Drilling Equip.: CME 75

Surface Elevation:
Area: F. of OU-2
Total Depth: 43.0'
Company: Varra Project No.:
Sample Type: Continuous Core/Cuttings.

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3	Run No. 7 30.0'-32.0'	Rec. 2.1'	See Page 1	30° 60°			GM SC	30 31 32		30.0'-31.3' - Sandy Gravel - Some Clay and Silt - Some DS 25.0'-26.2' except Shear Zone from 30.3' to 30.7' (visible in whole core) From 30.7 To 31.3 core extremely broken. Estimated fracture ∠s = 30° & 60°
	Drilled to 35.0'	No Core Recovery				should be GM symbol		33 34		31.3'-32.1' Sand - some Clay and Silt - Friable - weakly Cemented (Argillaceous). ~~Sandz~~ Light brown (5YR 6/4) Sand Poorly graded - Pred. f.g. Pred. quartz. Angular to subangular some Feldspar & Mica. Well defined Upper and lower Contacts. Lower 0.1' of core shows distinct change to Clayey sand with Tr. gravel, with distinct Color Change to very Pale Orange (10YR 8/2) Interval Dry.
Box 2 of 3	Run No. 8 32.0'-35.0'	Rec. 2.0'					GM GC	35 36		32.1-35.0' - Drilled out - No Sample Description
Box 2 of 3	Run No. 9 35.0'-39.0'	Rec. 1.3'					SC	37 38		35.0'-35.7' - Sandy Gravel - Some Clay and Silt Matrix Light Brown (5YR 6/4) Interval Badly broken - Gravel Clasts ~~orie~~ in upper portion of Core indicates Shear Zone. Core dry
Box 2 of 3	Run No. 10 39.0'-40.0'	Rec. 2.2'						39 40		35.7'-36.7' Clayey Gravel - Some Sand and Silt Matrix Grayish Orange (10YR 7/4) Interval Sheared - with indicated Shears on upper & Lower Contacts. Interval Dry

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02797
Location - North: East:
Date: 09-25-97
Geologist: F. Grigsby
Drilling Equip.: CME 75

Surface Elevation:
Area: E. of OU-2
Total Depth: 43.0'
Company: Tierra Project No.:
Sample Type: Continuous Core/Cuttings

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3	Run No. 10 39.0'-41.0'	Rec. 2.2'						40		36.7-38.3' - Clayey sand - some gravel. Pale Yellowish Brown (10YR 6/2) - sand well graded, angular to sub angular quartz, ~~sand~~ some feldspars. (Some altered) - gravel quartzite - Entire Interval coarsens downward. Clayey zone from 37.7 to 38.3' - ~~Clay~~ - Interval ~~is~~ was wet when recovered
Box 3 of 3	Run No. 11 41.0'-43.0'	Rec. 2.2'		Hor & Low angle				41		
								42		
								43	TD	38.3-39.0' - No Recovery
Reamed hole to 43.6'			See Page 1						Reamed TD	39.0-39.8' - Top of Bedrock (Note - Sand at top of interval is considered stuff from above. Core blocks should be adjusted accordingly) Silty Claystone yellowish gray (5Y 8/1) to very pale orange (10YR-8/2), with designated intervals of Grayish orange (10YR 7/4) staining. Interval was damp when ~~reading~~ recovered.
										39.8-40.9' - Sandy Claystone ~~Very Clay~~ F.G. Finer grained and higher clay content in upper 0.4' of core. - sands become coarser with depth. - Color from very pale orange (10YR-8/2) to Pinkish gray (5YR 8/1) with some grayish orange (10YR-7/4) mottling - Core well cemented (degassing) at top - friable at bottom Upper contact appears possible shear
										40.9-43.0' - Claystone - Pale yellowish brown (10YR-6/2) at top to light brownish gray (5YR-6/1) at bottom (color when slightly damp) - Numerous low angle fractures with dark yellowish orange (10YR 6/6) limonitic coatings - Core dense & indurated - breaks along fractures

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02897
Location - North: _____ East: _____
Date: 9-22-97
Geologist: F. Grigsby
Drilling Equip.: CME 75

Surface Elevation: _____
Area: _____
Total Depth: 39.0'
Company: Terra
Project No.: _____
Sample Type: Continuous Core/Cuttings

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2	Run No 1 0'-2.0'	2.0'	Composite 0'-39': VOA - BH00945 Composite 0'-39': Rad - BH00946 Composite 0'-39' Metals - BH00947 Composite - Radiation BH00948				ML GM GC	0 1 2 3 4 5 6 7 8 9 10		0-0.4' Gravelly Silt - Top Soil Grayish Brown (5YR-3/2) Slightly damp, Gravel to 1" - well graded - Low plasticity 0.4'-2.0' Silty Gravel - Some Clay - Cobble cemented - gravel to cobble size (broken) well graded. ~~Clay~~ Color pred. moderate orange Pink (5YR 8/4) some very Pale Orange (10YR - 8/2) - Interval dry. - wx. 2.0'-5.0' - Drilled out - No Core - Clayey Gravel - Sl. damp. Grayish Orange (10YR - 7/4) & Dark yellowish Brown (10YR-4/2) 5.0-6.0' - Clayey gravel - Sat - Color Light Brownish Gray (5YR 6/1) in top half & Pale yellowish Brown (10YR - 6/2) in lower half. Sl. damp. more cohesive wx. 6.0'-10.0' - Clayey gravel (Drilled) Pred. med. ~~Yellowish~~ Brown (5YR-4/4) Med plasticity - Sl. Damp.
Box 1 of 2	Run No 2 5.0'-7.0'	1.0'								
Box 1 of 2	Drilled from 5.0'-10.0'	No Recovery					GC			

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02897
Location - North: _____ East: _____
Date: 09-22-97
Geologist: F. Grigsby
Drilling Equip.: CME 75

Surface Elevation: _____
Area: _____
Total Depth: 39.0
Company: Terra- Project No.: _____
Sample Type: Continuous core / Cuttings

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Run No 3 Box 1 of 2	10.0'-12.0'	Rec. 2.0'						10		10.0'-12.0' - Clayey Gravel - Very pale orange (10YR 8/2) with some dark yellowish orange (10YR-6/6) clay - Med plasticity. Dry - Gravel becoming larger - Contains numerous broken cobbles.
	Reamed & Drilled 10'-15'	No Core No Recovery					GC	11		
								12		12.0'-15.0' - Clayey Gravel - Drilled out same as above. (Cuttings only)
								13		15.0'-17.0' - Clayey gravel - same as 10.0'-12.0'. Red. quartzite clast but some granite clast with both alt. & fresh feldspar. Dry - wx -
								14		
Run No. 4 Box 1 of 2	15.0'-17.0'	Rec. 2.0'						15		17.0'-20.0' Drilled out - Transition from clayey gravel (15.0'-17.0') to sandy clay (20.0'-21.0')
								16		20.0'-21.0' - Sandy Clay with some gravel - Light brown (5YR-5/6) - Slightly damp ~~Some Gravel~~ fig.
								17		~~Fig.~~ 21.0'-21.5' - ~~Clayey~~ Sandy gravel - Some clay - Matrix Light Brown (5YR-6/4) mod well cemented. - Poss. bly Calcareous (No acid) Lost cutting shoe in hole.
	Reamed & Drilled 15.0'-20.0'	No Core Recovery						18		
							CL	19		21.5'-25.0' - Drilled out. Sand gravel as above.
								20		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02897
Location - North: East:
Date: 09-22-97 / 09-23-97
Geologist: E. Gregsby
Drilling Equip.: CME-75

Surface Elevation:
Area: E-OU-2
Total Depth: 39.0'
Company: Tierra Project No.:
Sample Type: Continuous Core/Cuttings

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2	Run No. 5 20.0'-22.0'	Rec. 2 ft.					CL	20		
	Reamed & Drilled 20.0'-25.0'	No Core Recovery					GM	21, 22, 23, 24		
Box 2 of 2	Run No. 6 25.0'-27.0'	1.1 ft Rock - ~~No Recovery~~ 0.2' = Core Rec.					CL	25, 26, 27		25.0'-25.2' - ~~Gravelly Clay~~ Sandy Gravel Sl. Damp - Light Brown (5YR-5/6) Hit Cobble at Bottom of interval - 25.2'-30.0' - Gravelly Clay - SAA. 30.0'-30.2' - Gravelly Clay - SAA 30.2-31.8 - Sandy Gravel - Predominately Broken Cobbles. Matrix grayish Orange (10YR 7/4) at top - to Very light gray (N8) at Bottom of interval (Rock Dust) - Dry.
	Reamed & Drilled 25.0'-30.0'	No Core Recovery						28, 29, 30		31.8-32.0 - No Recovery

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 02897
Location - North: _____ East: _____
Date: 09-22-97
Geologist: F. Gregsby
Drilling Equip.: CME 75

Surface Elevation: _____
Area: E. & OU-2
Total Depth: 39.0'
Company: Tetra Project No.: _____
Sample Type: Continuous Core/Cuttings

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	Run No. 7 30.0'-32.0'	Rec. 1.8'					CL / GM	30 / 31		32.0'-35.0' - No Core - Drilled Out - Grades from Cobbles To Gravelly Clay, Moderate ~~Yellowish~~ Brown (5YR 4/4)
	Reamed & Drilled 32.0'-35.0'	No Core Recovery						32 / 33 / 34		35.0'-35.4' - Gravelly Clay - Some Sand - Moderate Brown (5YR 4/4) - Sl. damp - Gravel to ± 3/4"
										35.4'-35.6' - Broken Cobble - Jammed Cutting Shoe
										35.6'-37.0' - No Recovery
Box 2 of 2	Run No. 8 35.0'-37.0'	Rec. 0.6'					CL / GW	35		37.0'-~~35.0~~ 37.3' FC. Gravelly Clay - Some Sand - Mod. Yellowish Brown (10YR 5/4) Sl. Damp. Med. plasticity -
								36		37.3'-38.3' - Claystone - Top of Bedrock - Light olive gray (5Y 6/1) with Dark yellowish orange (10YR 6/6) Stained streaks - Minimal structure (small healed fractures) Some Mn. staining - Claystone is Dense & Sl. Damp. Bedrock - Alluv. contact well defined.
Box 2 of 2	Run No. 9 37.0'-39.0'	Rec. 2.0'					CL	37		
								38		38.3-39.0' - Silty Claystone - Very Pale orange (10YR 8/2) at Top - grades to Pale yellowish Brown at Bottom of Interval. - Some Pale yellowish orange (10YR 8/6) stained streaks. Mod. friable - Poor Permeability.
								39		
							FL	~~40~~		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05197
Location - North: 750734 East: 2083902
Date: 091697
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: LHSS 118.1
Total Depth: 28.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-13-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0	0.0				GC	0.0		Gravelly clay to clayey gravel w/sand and asphalt - dark yellowish brown. Dry to sl. moist. No hits. Increasing clay w/depth. Asphalt only in top ~1-3".
	RUN 1: 0.0-4.0	3.6								
							CL	1.0		Clay w/traces sand, caliche - mottled w/Fe i caliche staining. Avg. color is light olive brown (2.5Y 5/3) to brown (10YR 4/3) sl. moist. No hits.
								1.4		
								1.8		BH10114RM (rads)
								2.0		BH10117RM (rad scn)
								2.3		BH10118RM (VOC)
								2.5		BH10111RM (rad scn)
								2.8		BH10112RM (VOC)
								3.0 3.1		BH10113RM (VOC dup)
								3.4		
								3.6		NO RECOVERY 3.6-4.0
	4.0 / 4.0	4.0 / 4.0					CL/GC	4.0		Same as above, 1.0-3.6'. Increasing sand below 4.2', and trace to some gravel: some zones to GC, so call it CL/GC.
	RUN 2: 4.0-8.0	3.3								
								5.2		BH10119RM (rad scn)
								5.4		BH10120RM (VOC)
								5.7		
								6.0		
								6.4		BH10115RM (RS)
								6.7		BH10116RM (VOC)
								7.0		
								7.3		NO RECOVERY 7.3-8.0
	8.0 / 8.0	8.0 / 8.0						8.0		Same as above, 4.0-7.3. ~~moist to~~ wet to saturated. Color to very dark gray (10YR 3/1) and black (10YR 2/1).
	RUN 3: 8.0-12.0	1.4						9.0		
								9.1		BH10121RM (RS)
								9.4		BH10122RM (VOC)
								10.0		NO RECOVERY 9.4-12.0

Box 1 of 2: 0.0-16.0

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05197
Location - North: 750734 East: 2083902
Date: 091697
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: LHSS 118.1
Total Depth: 28.0
Company: Tetra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Bingly DATE 11-13-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2: 0.0-16.0	see page 1							10.0		NO RECOVERY 9.4-12.0
	12.0 / 12.0	12.0 / 12.0					SM	12.0		Gravel-sand-silt-clay mixture — brown (10YR 5/3, 4/3). Saturated. Increased gravel @13-13.6'.
	RUN 4: 12.0-16.0	3.1						13.0		Appears to be bedrock contact. Material above can be fill, while the silty claystone below appears very similar to that in 42592-F.B.
							CL/CH	13.6 / 13.8 / 14.0 / 14.3 / 14.6 / 14.9 / 15.1		Reworked claystone to silty claystone — Fe stained over much of it. Color ranges from yellowish brown (10YR5/8) where stained to a bleached white (10YR8/1), most often light yellowish brown (10YR6/4). Slightly moist to wet. Heavily Fe-stained sand, and a few gravels, present at 18.9-19.3' (most of sand consumed by samples). Some zones look more like alluvial clays than bedrock clays, judging mainly by color. Occasional Fe-stones (e.g., lens @ 17.2'), and Fe-healed fractures are common (various orientations). Fe staining is patchy. Clean, well-rounded med-coarse frosted quartz sand lens at 18.8-18.9'. Below 18.9' is return to alluvium, some of which was retained for core as an example.
										BH10125RM (RS); BH10126RM (Vol); BH10124RM (Vol); BH10123RM (RS); NO RECOVERY 15.1-16.0 — Claystone. Same as above, 13.6-15.1
16.0	16.0	16.0						16.0		
Box 2 of 2: 16.0-28.0	RUN 5: 16.0-20.0	4.3 (incl. 1.0' sloughs)						17.0		
								17.6 / 17.8 / 18.0 / 18.1		BH10127RM (RS); BH10128RM (VOC)
								18.8 / 19.0 / 19.1 / 19.3		BH10129RM (RS); BH10130RM (VOC); NO RECOVERY 19.3-20.0
	20.0	20.0						20.0		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05197
Location - North: 750734 East: 2083902
Date: 09/16/97
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 28.0
Company: Tetra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-13-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
	20.0	20.0						20.0		Same as above, 13.6-19.3; again, mostly claystone to silty claystone; again, have well rounded frosted qtz sand lens. Lens is @ 20.4-20.6, w/several gravel clasts (to ~½") at 20.3-20.4:
	Run 6: 20.0-24.0	3.7 (incl. 20' slough)						21.0		BH10132RM (21.1-21.4) (VOC)
								21.4		BH10131RM (RS)
								21.6		43592 contains some sand with Fe staining nodules below 17.0 – These intervals may correlate
								21.7		NO RECOVERY 21.7-24.0
								22.0		
								23.0		
	24.0	24.0						24.0		
	24.0	24.0								MIXED CUTTINGS: SLOUGH + CORE (Explanation: core barrel was overpacked & core could not be removed. Had to use hand drill w/ long auger-like bit to clear it, causing the material to be heavily damaged and mixed.)
	Run 7: 24.0-28.0	4.3						25.0		
								26.0		BH10134RM ~ 26-26.5 (VOC)
										BH10133RM ~ 26-27 (RS)
								27.0		
								27.2		TOP OF BEDROCK
										Claystone w/silt – light olive brown (2.5Y5/4) mostly, w/ some zones more or less Fe-stained. Heavily damaged. Occasional coally fragments. Sl. moist.
28.0	28.0	28.0						28.0		TD = 28.0'
								29.0		
								30.0		

Box 2 of 2: 16-28.0

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05397
Location - North: 750733 East: 2083854
Date: 091897
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5987
Area: LHSS 118.1
Total Depth: 27.0
Company: Tetra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigaly DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0	SEE LOG COLUMN				SW/GM	0.0		Silt-sand-gravel mixture w/ asphalt – dry. Yellowish brown (10YR 5/4). No hits.
							CL	0.3		Sandy clay w/ gravel to sandy gravelly clay – dark yellowish brown (10YR 4/4) overall, but mottled. Scattered traces caliche. Sl. moist to moist. No hits.
	Run 1: 0.0-4.0	2.7						1.0		
								1.8		
								2.0		BH10152RM (rads)
								2.2		BH10150RM (VOC)
								2.5		BH10151RM (rad scan)
								2.7		NO RECOVERY 2.7-4.0
								3.0		
	4.0	4.0						4.0		
	4.0	4.0								Same as above, 0.3-2.7'. Moist. Color to brown (10YR 4/3) and yellowish brown (10YR 5/4), w/ Fe-staining common. Traces black coally material @ 6.6'. No hits.
	Run 2: 4.0-8.0	3.5					CL	5.0		
								6.0		
								7.0		
								7.3		BH10153RM (VOCs)
								7.5		BH10154RM (RCs)
										NO RECOVERY 7.5-8.0
	8.0	8.0						8.0		
	8.0	8.0								Same as above, 0.3-2.7'. Moist. Color as 4.0-7.5, w/ zone below 9.8' being very dark grayish brown to very dark brown (10YR 3/2 to 2/2). No hits. Dark zone also sandier + siltier. Saturated @ base of run.
	Run 3: 8.0-12.0	2.9					CL	9.0		
								10.0		

Box 1 of 2: 0.0-13.9

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05397
Location - North: 750733 East: 2083851
Date: 091897
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5987
Area: IHSS 118.1
Total Depth: 27.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2: 0.0-13.9'	See previous page	See previous page	SEE LOG column				CL	10.0		See previous page
								10.3		BH10156RM (voc, real)
								10.5		BH10155RM (VOC dup)
								10.7		BH10157RM (rs)
								10.9		NO RECOVERY 10.9 - 12.0
	12.0 / 12.0	12.0 / 12.0						12.0		Same as above, 0.3-2.7. Saturated. Mottled, as previous intervals, w/ predominant color being v. dark grayish brown (10YR 3/2). Below 13.3', color typically light olive brown (2.5Y 5/4) w/ Fe-staining common. No hits.
	RUN 4: 12.0-16.0	2.7						13.0		
								14.0 / 14.1		BH10159RM (rs)
								14.4		BH10158RM (VOC)
								14.7		NO RECOVERY 14.7 - 16.0
								15.0		
Box 2 of 2: 13.9-27.0'	16.0 / 16.0	16.0 / 16.0						16.0		
						GW/SW		16.4		Sandy gravel to gravelly sand - saturated. No hits. Matrix color difficult to determine due to minor matrix - may be yellowish brown (10YR 5/4). Some washout is likely.
	RUN 5: 16.0-20.0	2.1						17.0		
								17.6		
								17.8		BH10161RM (rs)
								18.0		BH10160RM (VOC)
								18.1		NO RECOVERY 18.1 - 20.0
								19.0		
	20.0	20.0						20.0		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 05397
Location - North: 750733 East: 2083854
Date: 091897
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5987
Area: IHSS 118.1
Total Depth: 27.0
Company: Tetra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Grigsby DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	20.0	20.0					Gravel/SW	20.0		Same as above, 16.4-18.1.
	RUN 6: 20.0-24.0	1.9	SEE LOG COLUMN					21.0		
								21.2		BH10163RM (RS)
										BH10162RM (VOC)
								21.5		TOP OF BEDROCK
								21.9		claystone (to silty claystone) — light yellowish brown (2.5Y6/4). No hits. Fe-staining common. Trace to some silt, sl. moist to wet.
								22.0		
										NO RECOVERY 21.9-24.0
								23.0		
	24.0 / 24.0	24.0 / 24.0						24.0		
								24.25		~~Same as above 21.5-21.9~~ BH10164RM (RS)
								24.5		BH10165RM (VOC)
	RUN 7: 24.0-27.0	2.8 (some stones included - unable to tell, assume included in samples)						25.0		Same as above 21.5-21.9, but wet to saturated (possibly from overlying water); unable to peel & check internal condition, color, etc. of core due to VOC hits to ≥140 ppm (PID). External colors include Fe-staining & fresher grays. Occasional traces sand - for example, sand laminae (med., frosted qtz) included in samples.
								26.0		
								26.3		BH10167RM (VOC)
								26.5 / 26.6		
								26.9		BH10166RM (RS)
27.0	27.0	27.0						27.0		NO RECOVERY 26.8-27.0
										TD = 27.0'
								28.0		
								29.0		
								30.0		

Box 2 of 2: 13.9'-27.0'

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 05497
Location - North: 750709 East: 2083851
Date: 092597
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: LHSS 118.1
Total Depth: 27.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dougherty DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0	SEE LOG COLUMN				GM/SM	0.0		Sandy Gravel - some ~~Gravelly sand~~ - silt mixture w/clay - brown (10YR 4/3). Sl. moist. No hits.
	RUN 1: 0.0-5.0	2.4					GC/CL	0.7		Sandy Gravel - some ~~Gravelly sandy~~, silt + clay mixture — yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/4) to brown (10YR 4/3). No hits. Sl. moist. Some zones to gravelly, sandy, silty clay
								1.5		BH 10229RM (Gads)
								1.9		BH 10227RM (VOC)
								2.2		BH 10228RM (rad screen)
								2.4		NO RECOVERY 2.4-5.0
								3.0		
								4.0		
	5.0	5.0								
	5.0	5.0					GC	5.1		Same as above 0.7-2.4'. Wet & sticky. No hits. Decreasing gravel + sand, more + more like CL.
	RUN 2: 5.0-8.0	1.2						5.8		10241RM (LAB)
								6.0		BH ~~10228RM~~ (VOC)
								6.2		BH 10230RM (RS)
								7.0		NO RECOVERY 6.2-8.0
	8.0	8.0								
	8.0	8.0					CL	8.0		Same as above, 0.7'-6.2 but less sand & gravel. No hits. Wet, and saturated below ~9'.
	RUN 3: 8.0-13.0	1.6						9.0		
								9.3		BH 10231RM (VOC)
								9.6		BH 10232RM (RS)
								10.0		NO RECOVERY 9.6-13.0

Box 1 of 2: 0.0'-25.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 05497
Location - North: 750709 East: 2083851
Date: 092597
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 27.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigsby DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
BOX 1 OF 2: 0.0'-25.0'	RUN 3: 8.0-13.0	1.6	SEE LOG COLUMN					10.0, 11.0, 12.0		NO RECOVERY 9.6-13.0
	13.0 / 13.0	13.0 / 13.0					CL	13.0		Same as above, 8.0-9.6, w/ increased sand & gravel. Saturated, goopy. No hits.
								13.2		BH10234RM (RS)
								13.4		
								13.7		BH10233RM (VOC)
	RUN 4: 13.0-17.5	0.7						14.0, 15.0, 16.0, 17.0		NO RECOVERY 13.7-17.5'
	17.5 / 17.5	17.5 / 17.5					GC	17.5		Clayey sand & gravel w/ some silt & mixture. Color is somewhat homogenized due to damaged core; presence of fluid - is light olive brown (2.5Y 5/3). Saturated. "Hits" off core barrel to 186 ppm (PID), but Ø off core. Lots of saturated slurry.
	RUN 5: 17.5-21.5	2.5						18.0, 19.0, 19.5, 19.8, 20.0		BH10235RM (VOC) BH10236RM (RS)

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05497
Location - North: 750704 East: 2083851
Date: 092597
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 27.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑	↑ see previous page	↑	SEE LOG COLUMN					20.0		NO RECOVERY 20.0-21.5
	21.5 / 21.5	21.5 / 21.5					GC	21.5		Same as above, 17.5-19.5: Saturated. No hits, but driller reports an odor.
BOX 1 OF 2: 20.0-25.0'	RUN 6: 21.5-25.0	2.9		= /				22.0 / 22.1		Top of bedrock = 22.1'. claystone - mottled w/Fe staining, predominantly light yellowish brown (2.5YR 6/4 to 6/3), w/fresher zones grayish brown (2.5Y 5/2). Occasional Fe-healed fractures, especially @ 23.7' where brief detections to 7ppm found. Several gravel clasts pushed in from above. Moist @ top to slightly moist towards base.
								23.0		
								23.9 / 24.0		BH 10237RM (VOC)
								24.2		BH 10238RM (RS)
								24.4		NO RECOVERY 24.4-25.0
25.0 / 25.0	25.0 / 25.0	25.0 / 25.0						25.0		
BOX 2 OF 2: 25.0-27.0	RUN 7: 25.0-27.0	2.6' (incl. 1.4' slough)		/ / /			25.7-26.0 BH10239RM (VOC) 26.0-26.2 BH10240RM (RS)	25.7 / 26.0 / 26.2		Same as above, 22.1-24.4', but most is fresher color (less Fe staining) and traces carbonaceous material present. Rapidly-dissipating hits to 7ppm; to 159 ppm off emptied core tube. Slightly moisty, though slough and external surfaces of core are saturated. A few low angle fractures, healed, present.
27.0	27.0	27.0						27.0		NO RECOVERY 26.2-27.0 (replace claystone symbol w/no recovery symbol)
								28.0		TD = 27.0'
								29.0		
								30.0		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05697
Location - North: 750712 East: 2083844
Date: 092497
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 22.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Gregory DATE 11-7-97

Top/Bottom of Core in Box	Top/Bottom of Interval	Feet of Core in Interval (Field Measurement)	Sample Number	Fracture Angle	Bedding Angle	Grain Size Distribution	USCS Symbol	Depth in Feet	Soil/Lithologic Log	Sample Description
0.0	0.0	0.0	SEE LOG COLUMN				~~GM~~ SM	1.0		Sandy Silt with some clay & gravel, gravel-sand-silt mixture w/clay — brown (10YR4/3). Wet (most, likely from heavy rains past several days). Clayey towards base, possibly to CL but sample consumed by samples so unable to log. No hits. Traces asphaltic clasts.
	RUN 1: 0.0-4.0	1.9						0.8		
								1.0		BH10218RM (gads)
								1.4		
								1.7		BH10216RM (voc)
								1.8		BH10217RM (radsweep)
								2.0		NO RECOVERY 1.9-4.0
								3.0		
	4.0 / 4.0	4.0 / 4.0						4.0		Gravel-sand-silt-clay mixture — same as above (0.0-1.9) but w/increased clay. Color slightly mottled, predominantly yellowish brown (10YR5/4). Wet, sticky. Hits to 18 ppm off hole, but Ø off core. To CL below 4.4' which is "same as above" but less sand, gravel. Containing traces asphaltic material.
							CL	4.8		
	RUN 2: 4.0-8.0	1.2						5.1		BH10219RM (voc)
								5.2		BH10220RM (RS)
								6.0		NO RECOVERY 5.2-8.0
								7.0		
	8.0 / 8.0	8.0 / 8.0						8.0		Silty FG-Clay ~~Silt~~, traces sand and gravel — as above, yellowish brown (10YR5/4), wet to saturated, sticky. Traces asphaltic material, especially @ 8.9-8.9'. No hits, despite asphalt.
	RUN 3: 8.0-12.0	1.1						8.6		BH10221RM (voc) (contains ~1" clast of asphaltic material)
								8.8		BH10222RM (RS)
								9.0 / 9.1		NO RECOVERY 9.1-12.0
								10.0		

Box 1 of 2: 0.0-22.0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05697
Location - North: 750712 East: 2083844
Date: 092497
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 22.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Brigsby DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑	see previous page		See Log Column					10.0		NO RECOVERY 9.1-12.0
								11.0		
	12.0 / 12.0	12.0 / 12.0					CL	12.0		Same as above, 8.0-9.1, w/ increased sand and fine gravel. Saturated. No hits. Abrupt lower contact.
	RUN 4: 12.0-16.0	1.4					CH	12.8 / 13.0 / 13.1 / 13.4		BH10223RM (VOC) (12.8') BH10224RM (RS) Reworked bedrock - not logged as it was consumed by samples. Looked like silty claystone, light Fe-staining. No hits. Call it CH, because bedrock clay is typically more plastic.
								14.0		NO RECOVERY 13.4-16.0
								15.0		
	16.0 / 16.0	16.0 / 16.0						16.0		NO RECOVERY 16.0-16.8 sandy clay
	RUN 5: 16.0-18.0 (w/ piston tip)	1.2					SC/SP	16.8 / 17.0		Sand w/clay and silt to clayey sand w/silt to clayey, silty sand — brownish yellow (10YR 6/6), w/ some areas (16.8-17.0, 17.8-18.0) more heavily Fe-stained. Trace to some fine gravel (to ~1/4", sub-rounded to well-rounded) in top 0.2', along w/coarse sand. Elsewhere, sand is sub-rounded, very fine to medium, quartz, frosted, fairly clean. No hits. Saturated.
	18.0 / 18.0	18.0 / 18.0						18.0		NO RECOVERY 18.0-18.8
	RUN 6: 18.0-20.0	1.1						18.8		Top of bedrock = 18.8'
								19.0		Clay, tan - light yellowish brown (2.5Y 6/4) to grayish brown (10YR 5/2), moist. Scattered carbonaceous streaks. Several subhorizontal, Fe-healed fractures @ 19.4-19.5, pix low-angle @ 19.1'. Trace to some silt. No hits.
								19.5 / 19.7		BH10225RM (VOC) BH10226RM (RS)
	20.0 / 20.0							20.0 / 19.9		NO RECOVERY 19.9-20.0

Box 1 of 2: 0.0-22.0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05697
Location - North: 750712 East: 2083844
Date: 092497
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 22.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-2-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2: 0.0-22.0	20.0	20.0						20.0		NO RECOVERY 20.0-20.8
	RUN 7: 20.0-22.0	1.2						20.8 / 21.0		Same as above, 18.8-19.9'. High-angle, Fe-healed fractures @21.2-21.8. Thick Fe/Mn oxides lead one @21.6'; this portion of core showed up to 93 ppm (PID), which rapidly fell off to background. Low angle fracture @ 21.0, also Fe-healed. Increased carbonaceous flecks @21.9-22.0'. Moist.
	22.0	22.0						22.0		
										TD = 22.0'
										OFFSET LOCATION "05697A" TO RE-CORE 13-19'
	RUN 1: 13.0-14.5	0.0			NO RECOVERY 13.0-14.5			13.0 / 23.0		
	14.5	14.5						14.0 / 24.0		OFFSET DESCRIPTIONS
14.5					CH/CL			14.5 / 24.5		Clay w/silt to silty clay sand — light gray (2.5YN7/) to light olive brown, 2.5Y 5/4. Sandy below ~15.1'. Saturated. No hits.
					SC/SP			15.0 / 25.0 / 15.2		Same as on p.2 of 3, 16.8-18.0. Pebbles scattered among sand — found one to ½" diam. Therefore, this is fill, NOT the #1 sand.
Box 2 of 2: 14.5-19.0' (offset hole)								16.0 / 26.0		
								17.0 / 27.0		
								18.0 / 28.0		
								18.7 / 28.7		Mixed sand, Fe-oxide clasts, claystone (reworked)
19.0								19.0 / 29.0		Top of bedrock = 18.9' — see descrip p.2 of 3; TD of offset = 19.0
								30.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 05897
Location - North: 750707 East: 2083895
Date: 092097
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 24.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dougherty DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0	SEE LOG COLUMN				CL	0.0		Clay w/ sand and trace gravel to gravel-clay mixture - finer portion (which is most common) is mottled w/ Fe-staining, averaging dark yellowish brown (10YR 4/2). Matrix in coarser zones (@0.0-0.4, and portions of sampled intervals 1.6-2.7) is dark brown (10YR 4/3 to 3/3). Trace to some silt also present throughout. No hits. Sl. moist to moist.
	RUN 1: 0.0-4.0	2.7						1.0		
								1.6		
								2.0		BH 10185RM (rads)
								2.2		
								2.5		BH10183RM (VOC)
								2.7		BH10184RM (rad screen)
								3.0		NO RECOVERY 2.7 - 4.0
	4.0 / 4.0	4.0 / 4.0						4.0		Same as above 0.0-2.7, w/ reduced coarser intervals. Color is dark grayish brown (2.5Y 4/2). Wet to saturated. Hits to 1.5 ppm (PID).
	RUN 2: 4.0-8.0	2.3						5.0		
								5.6		BH10188RM (VOC dup)
								5.8		
								6.0		BH10186RM (VOC)
								6.3		BH10187RM (RS)
								7.0		NO RECOVERY 6.3-8.0
	8.0 / 8.0	0.0 / 0.0					SM/SC	8.0		Clayey sand, some silt ~~Sandy silty clay~~ mixture w/ gravel - brown (10YR 5/3). Saturated.
								8.2		No hits.
	RUN 3: 8.0-12.0	0.6'						8.4		BH10190RM (RS) (8.2-8.4') } replace SM/SC pattern w/ ⊠ for samples
								8.6		BH10189RM (VOC) (8.4-8.6')
								9.0		NO RECOVERY 8.6-12.0
								10.0		

Box 1 of 1 : 0.0 - 24.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 05897
Location - North: 750707 East: 2083895
Date: 092097
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: LHSS 118.1
Total Depth: 24.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-3-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
BOX 1 OF 1: 0.0-24.0'	See previous page		See LOG COLUMN					10.0		NO RECOVERY 8.6-12.0'
	12.0 / 12.0	12.0 / 12.0						11.0		
	RUN 4: 12.0-16.0	1.6					SM	12.0		Silty sand, some gravel ~~Sand-gravel-silt mixture~~ — loose, saturated.
							GW	12.3		Very well graded (in sedimentological sense), w/fines @ top, progressively coarsening w/increasing depth — sample may have been washed & sorted to some extent during drilling. ~~Brown~~ Dark gray to very dark gray (10YR 4/1 to 3/1). No hits. VOC from fines, RS from gravels w/ trace to some sand. ("Fines" = sand, silt, clay w/ trace gravel) Boundary between SM, GW is very approximate and may not reflect actual down-hole conditions. Gravels to ~1".
								12.5 / 12.6		
								13.0		12.3-12.6: BH 10191RM (VOC)
								13.4 / 13.6		BH 10192 RM (RS)
								14.0		NO RECOVERY 13.6-16.0
								15.0		
	16.0 / 16.0	16.0 / 16.0						16.0		Same as above 12.5-13.6, w/fine section @ top (16.0-16.3, clay-silt mixture w/sand). Call top section CL, bottom GW.
							CL	16.3		
							GW	16.5 / 16.7		BH 10193RM (VOC) / BH 10194RM (RS) } replace GW pattern w/ ~~[illegible]~~ for samples
								17.0		
	RUN 5: 16.0-20.0	1.0						18.0		NO RECOVERY 17.0-20.0
								19.0		
	20.0	20.0						20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 05897
Location - North: 750707 East: 2083895
Date: 092097
Geologist: J. Boulan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 24.0
Company: Tierra
Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL F. Smigly
DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑	20.0	20.0	SEE LOG COLUMN				GM/SC	20.0		Gravel-sand-silt-clay mixture — not examined closely due to presence of free product, collection for samples.
	RUN 6: 20.0-24.0	3.3						20.4		Saturated. Hits to 7 ppm (PID) below sample interval. (No free product seen outside sample intervals.)
								20.7		BH10195RM (VOC)
								21.0		BH10197RM (VOC dup)
								21.4		Top of bedrock
								22.0		Claystone to clay stone w/silt - grayish brown (2.5Y 5/2). Several near-horizontal fractures (v. thin, minor) @ 21.8' not self-healed in core. No free product evident.
								23.0		
								23.3		BH10196RM
24.0	24.0	24.0								NO RECOVERY 23.3-24.0
								24.0		TD = 24.0'
								25.0		
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

BOX 1 OF 1: 0.0-24.0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 05997
Location - North: 750704 East: 2093853
Date: 092297
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 30.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigsby DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0	See LOG COLUMN				GC	0.0		Clayey gravel to clay-silt-sand-gravel mixture - most consumed by samples; not closely examined. Remaining core (0.0-0.2) is silt or and sandier than balance. Sl. moist. Color of top 0.2' is dark yellowish brown (10YR 3/4). No hits.
	RUN 1: 0.0-4.0	1.8						0.2		BH10201RM (rad dup)
								0.8		
								1.0		BH10200RM (rad)
								1.4		BH10198RM (voc)
								1.6		BH10199RM (rad screen)
								1.8		
								2.0		NO RECOVERY 1.8-4.0
								3.0		
	4.0	4.0						4.0		sandy Clay w/silt, ~~sand~~ GG; gravel to sandy gravelly clay w/silt — mottled predominantly brown (10YR 5/3). Moist to wet (@ base of run). Scattered traces caliche, pods of variously colored clays, areas of Fe staining. No hits. Softest @ base.
	4.0	4.0					CL			
	RUN 2: 4.0-8.0	2.3						5.7		
								5.9		
								6.0		BH10202RM (voc)
								6.1		BH10203RM (RS)
								6.6		
								7.0		NO RECOVERY 6.3-8.0
	8.0	4.0						8.0		Same as above, 4.0-6.3; w/ moisture & softness of base of overlying run. No hits. (Wet, but no free water yet evident.)
	8.0	3.0								
	RUN 3: 8.0-12.0	1.6						9.0		
								9.1		BH10204RM (voc)
								9.4		BH10205RM (RS)
								9.6		
								10.0		NO RECOVERY 9.6-12.0'

BOX 1 OF 2 : 0.0 - 28.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 5

Borehole Number: 05997
Location - North: 750704 East: 2083853
Date: 092297
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 30.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dingly DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
↑	↑ See previous page	↑	SEE LOG COLUMN					10.0		NO RECOVERY 9.6-12.0'
								11.0		
	12.0 / 12.0	12.0 / 12.0						12.0		Same as above, 4.0-6.3, but saturated, goopy-soft.
	RUN 4: 12.0-16.0	1.4						12.5		
								13.0 / 13.1		BH10206RM (VOC)
								13.4		BH10207RM (RS)
								14.0		NO RECOVERY 13.4-16.0
								15.0		
	16.0 / 16.0	16.0 / 16.0						16.0		
							SM/GW	16.2		Same as above, 12.0-13.4
								16.7		silt-sand-clay mixture grading w/depth to sand-gravel mixture to gravel — saturated. Very well graded (sedimentologically) w/fines at top & progressively coarsening w/depth. Some of this sorting may be due to washing during drilling. No hits. Boundary between SM & GW is approximate. Coarsest gravel recovered is ~½-¾" diam.
								17.0		BH10208RM (VOC)
								17.3		BH10209RM (RS)
	RUN 5: 16.0-19.5	1.3						18.0		NO RECOVERY 17.3-19.5
								19.0		
	19.5 / 19.5	19.5 / 19.5					SM/GW	19.5		Same as above, 16.2-17.3, again w/fines @ top grading to gravels below. Sharp contact w/underlying material; hits @ contact to 49 ppm (not sustained). No free product observed.
	See next page							20.0		(Cont'd next page)

Box 1 of 2 : 0.0-20.0'

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 05997
Location - North: 750704 East: 2083853
Date: 092297
Geologist: J. Boylan
Drilling Equip.: STRATAPROBE

Surface Elevation: 5986
Area: IHSS 118.1
Total Depth: 30.0
Company: Tierra Project No.:
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2: 0.0-28.0'	Run 6: 19.5-24.0	1.9						20.1		Several black clasts present @ base - look more like asphalt than coal.
								20.2		BH 10212RM (VOC) (Possible backfill wash ?)
										Top of bedrock = 20.3
										Claystone - light yellowish brown (2.5Y 6/4) to light brownish gray (2.5Y 6/2), the former due to Fe-staining. Carbonaceous streaks common. Fe-cemented fractures, low angle, @ 20.8'. Moist to wet. Hits to 6 ppm.
								21.1		
								21.2		BH 10210RM (VOC)
								21.3		BH 10211RM (RS)
								21.4		NO RECOVERY 21.4-24.0
								22.0		
								23.0		
	24.0 / 24.0	24.0 / 24.0						24.0		Possible Top of Bedrock ??
										Same as above, 20.3-21.4'. Color darkens below 24.7' to very dark gray (10YR 3/1). Several near horizontal fractures @ 24.5'.
								24.7		
	Run 7: 24.0-28.0	2.7 (incl. 1.7' slough)						25.1		BH 10214RM (RS)
										NO RECOVERY 25.0-28.0 (BH10213RM, VOC; BH10215RM, VOC dup) } slough
								26.0		
								26.7		~~BH10216RM (RS)~~ (ND)
										NO RECOVERY 25.0-28.0 ~~26.7~~ (ND)
								27.0		
	28.0 / 28.0	28.0 / 28.0						28.0		
								28.3		Same as above, 20.3-21.4'.
Box 2 of 2: 28.0-30.0'	Run 8: 28.0-30.0	4.3' (incl. 4.0' slough)								NO RECOVERY 28.3-30.0
								29.0		
	0.0 / 30.0	30.0						30.0		TD = 30.0

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10197
Location - North: _____ East: _____
Date: 3-10-97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 16.0'
Company: Terra Eng. Project No.: —
Sample Type: Posh-Core.

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0-10.0	Run No 1 0'-4.0'	Rec 3.3'					CL	1, 2, 3		0-3.3 (1.3) Silty Clay - Pred. Dark yellowish orange (10YR-6/6) Damp - well wx - Trace gravel. 1.3'-3.3' Gravelly Clay - some silt interbedded Dark yellowish Brown (10YR-4/2) & Dark yellowish orange (10YR-6/6) - Slightly damp - well wx. gravel (0 +) inch - Pred. gray quartzite. 3.3-4.0' - No Recovery -
	Run No. 2 4.0'-6.0'	Rec 1.3'					CL	4, 5, 6		4.0'-5.0' Gravely Clay - Dark yellowish Brown (10YR-4/2) - SAA. 5.0'-5.3' - Silty Clay - Dark yellowish orange (10YR 6/6) SL. Damp (cavity Entered) - well wx. 5.3-6.0 - No Recovery
	Run No. 3 6.0'-8.0'	Rec 1.8'					CL	7, 8		6.0'-7.8 - Silty Clay - Tr. Sand & Gravel - Pred. Dark yellowish Orange (10YR 6/6) with Light Olive gray (5Y-5/2) mottling & lens of clay - Damp & Pliable - Med plasticity - well weathered. 7.8-8.0' - No Recovery.
	Run No. 4 8.0'-10.0'	Rec. 2.3'					CL	9		8.0-10.0 - Recovered Core from Prev. Run - Silty Clay - changing to Sandy Clay Grades from Dark yellowish orange (10YR-6/6) to Grayish orange (10YR-7/4) & Moderate yellowish Brown (10YR-5/4) in Sandy Section. Trace of Gravel throughout.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 10197
Location - North: _____ East: _____
Date: 3-10-97
Geologist: E. GRIGSBY
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 16.0'
Company: I.E.C. Project No.: _____
Sample Type: Push-core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 10'-16'	Run No 5 10.0'-12.0' Rec. 0.5'						CL.	11		8.0'-10.0' - Cont. - Clay, damp & pliable - some free moisture in sandy section. 10'-10.3' - sandy clay - same as above - damp & pliable. Fragments of Cu metal in core.
			VOA BH09997RM					12		10.3'-12.0' - NO Recovery. 12.0'-12.5' - Silty Clay - Damp same as above. - Some Cu frag. Took VOA sample at 12.0'-12.25'. ~~12.5'-14.0' - NO Recovery~~ FG.
	Run No 6 12.0'-14.0' Rec. 0.5'		Rad Sample. BH09998RM					13		Top of Bed Rock at 13.7'.
			Rad Screen BH09996RM					14		14.0'-16.0' - Recovered Lost Core from above. Top of Bedrock at 13.7' based on Quartzite Pebbles at that Depth. - ~~12.5'~~ FG. ~~13.7~~ FG.
	Run No 7 14.0'-16.0' Rec. 0.0'							15		
								16	TD	12.5'-13.7' - Silty Clay - SAA. - Some Cu fragments. 13.7-16.0' - Claystone - Light olive gray (5Y-5/2) with Dark Yellowish Orange (10YR-6/6) mottling (FeO) - Lower portion appears brecciated. 13.5-13.6 - Rad screen sample. BH09996RM. 12.0'-12.25' - VOA - BH09997RM ~~13.5~~ FG. 12.5-13.7. Rad sample. BH09998RM. ~~13.5~~ FG. 12.5'-13.7' - Metals Comp. BH09999RM

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 10297
Location - North: _____ East: _____
Date: 3-6-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 14.01'
Company: Tierra Env. Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-12.0'	Run No 1 0'-2.1'	Rec 2.1'					CL	0, 1, 2		0'-2.1' - Silty Clay - Grayish orange (10YR-7/4) with mod. yellowish Brown (10YR 5/4) mottling - Consist of fill material to 1.8' - Some quartzite Gravel to 2.1'.
	Run No 2 2.1'-4.0'	Rec. 1.8'						3		2.1' - 3.9' - Silty Clay - SAA - Calcitic at 2.9'-3.1' - (very) light gray (N-8) - Colluvium below 3.1' - Pred. Grayish orange (10YR-7/4) - well ox - Very sl. damp -
	Run No. 3 4.0'-6.0'	Rec. 2.0'					CL	4, 5		3.9'-4.8' Silty Clay - SAA - ~~Fe~~ Fe. - 4.8'-5.0' - Light gray quartzite Cobbles)
	Run No. 4 6.0'-8.0'	Rec 1.5'			Gr 20% Clay 80%		CL	6, 7		5.0'-6.0' - gravelly Clay - Gravel to 3/4" - Pred. gray quartzite. - Very slightly damp Matrix - Color Pred. Mod. yellowish brown (10YR-5/4) Gravel < 25%
	Run No 5 8.0'-12.0'	Rec 1.0'					CL	8, 9		6.0'-7.5' - Gravelly Clay - Dark yellowish Brown (10YR 4/2) & Dark yellowish ~~Brown~~ Fe. orange in fractures (FeOx) Gravel to ± 3/4" - Pred. gray quartzite - Some sand at top of interval - Wood fragment Blocking Cutting head - Interval sl. Damp. 7.5-8.0 - No Recovery

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10297
Location - North: _____ East: _____
Date: _____
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 14.0'
Company: Tierra Env. Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-12'	Run No 5 8.0'-12.0'							11		8.0'-9.0' - Clay - Tr. Gravel & Wood trash (Natural) - Sl. damp - Dark Yellowish Brown in top 0.5' - (10YR 5/4) 0.3 of 0.4. Greenish Gray (5G 4/1) Rest of core Mixture of above - Some Calcite filling fractures in green clay - Some roots.
Box 2 of 2 12.0'-14.0'	Run No 6 12.0'-14.0'	Rec 2.0'					CL	12		9-12' - No Recovery
								13		12.0'-12.4' - Sandy Clay - Same as bottom of above (Mixture clay (green) & some sand -
								14	TD	12.4-14.0' - Top of Bedrock - Claystone - Good Contact - Distinct Color change of Light Olive gray (5Y-5/2) to to bluish green (?). Abundant Grayish Orange (10YR-7/4) oxidized zones & Fractures - Bedrock Weathered Sl. damp - Gravel fragment just above Contact.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10397
Location - North: _____ East: _____
Date: 3/19/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: ~~1.7~~ 2.3'
Company: IEC Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3 0'-9.9'	Run #1 0.0'-2.0'	Rec. 1.7'					GM			0-.5' - Silty Gravel - Moderate Yellowish Brown (10YR-5/4) - Dry
								1		0.5' - 1.7' - Silty Clay - Some Sand, Tr. Gravel - Pred. Dark Yellowish ~~Brown~~ Orange (10YR-4/2) Very ~~Slightly~~ Damp - Friable - Silt to 40% (estimated)
							CL			
							GC	2		
	Run No 2 2.0'-4.0'	Rec. 1.6'								1.7' - 2.3' - Clayey Gravel - Top half of interval - contains Cobble size Quartzite & granite clast with silty clay matrix as above - Dark yellowish orange (10YR-6/6). Lower half consist of smaller quartzite gravel and clayey matrix - Dark yellowish Brown (10YR-4/2) - Some carbon material - Sl. Damp - Friable to non friable
							CL	3		
								4		
	Run No. 3 4.0'-7.0'	Rec. 3.0'								2.3' - 3.3' - Sandy Clay - Pred. ~~Clay~~ Clay in top half - Dark Yellowish Brown (10YR-4/2) - Grades to very sandy in lower half. - Pale Yellowish Brown (10YR-6/2) and Grayish Orange (10YR-7/4) - Sl. Damp - Non friable to friable - Some gravel at bottom.
								5		
							GC			
								6		
								7		
							GW			3.3 - 4.0' NO Rec.
	Run No 4 7.0'-11.0'	Rec. 3.9'								4.0' - 7.0' - Clayey Gravel - Some Sand - Dark Yellowish Orange (10YR-6/6) to approx. 6 ft. - Changes to Pale Yellowish Brown (10YR-6/2) in bottom foot - Sl. Damp. Hard Friable - Gravel to Cobble size - Pred Quartzite Avg size 1" or less
								8		
							GC			
								9		
							GC	10		7.0-7.3 Granite Boulder.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10397
Location - North: _____ East: _____
Date: 3-19-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: ~~11.0'~~ 22'
Company: IEC Project No.: _____
Sample Type: Push-Core.

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box-2 of 3 9.7-17.0	Run No 5 11.0-15.0	Rec. 3.2'	VOA BH-10016 BH-10015				GC GW GC CL CL GC	10 11 12 13 14		9.3'-9.5'- Sandy Gravel - some clay - Grayish Orange (10YR-7/4) Gravel fnd. quartzite. Poorly graded fnd. 1/2" & smaller - friable Sl. Damp - wx - 9.5'-10.9'- Clayey Gravel some sand. More clayey matrix than above - Color grades to - Pale Yellowish Brown (10YR 6/2) to Dark Yellowish Brown in Lower foot of interval Core friable at top - mod friable at Bottom - Sl. Damp. 11.0'-11.2'- Quartzite Cobble. Part of cobble at bottom of previous run. Recovered .25' of Stuff above this interval.
	Run No 6 15.0-17.0	Rec. 2.2'	VOA BH-10017				CL GC CL SP	15 16 17		11.2-11.6'- Clayey Gravel - Brownish Black (5YR 2/1) to Grayish Brown (5YR 3/2) Possible fossil Soil horizon - Contains Carbon fragments. 11.6-12.2'- Taken as sample - Clay - 12.2'-12.7'- Clay - Olive Gray (5Y-3/2) - Stiff - Dense Pliable - Quartzite cobble in middle of interval. 12.7'-14.2'- Clayey gravel - Matrix - Pale Yellowish Brown (10YR-6/2) to Dark Yellowish Orange (10YR-6/6) - some Disseminated Fe O staining - Clay sl. damp - Pliable.
	Run No 7 17.0-21.0	No Rec.						18 19		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10397
Location - North: _____ East: _____
Date: 3-20-99
Geologist: E. Gregsby
Drilling Equip.: GeoProbe

Surface Elevation: _____
Area: SW-59
Total Depth: ~~17.0'~~ 23'
Company: TEC Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
20x 3 of 3 21.0'-23.0'	Rubble 21.0'-23.0'	Rec. 4' of stuff						21 22 23	TD.	14.2'-15.0'-No Recovery 15.0'-15.3'-Clay Some Sand. - Dusky Yellowish Brown (10YR-2/2). Sl. Damp. Mod-friable. 15.3'-16.4'-Clayey Gravel Some Sand. Pale Yellowish Brown (10YR-6/2). Quartzite Cobbles & Pebbles - Clay Sl. damp. - Non friable - Sandy from 15.5' to 16.0' 16.4'-16.9'-Clay Pale Brown (5YR-5/2)- Dense Sl. Damp. Non friable. Bottom 2 inches becomes sandy (1 grain clast) and changes to Dary Yellowish Orange (10YR-6/6). 16.9'-17.0'-Sand - Some Clay Poorly graded - fine. F.G. - Pale Yellowish Brown (10YR-6/2). friable Sl. damp 17.0'-21.0'- NO Recovery - Piston did not release - Wet 21.0'-23.0'- Sand from above interval - Wet

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10497
Location - North: _____ East: _____
Date: 3/25/97
Geologist: E Gregory
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 9 ft.
Company: IEC Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1 0'-9.0'	Run No 1 0.0'-4.0'	Rec. 2.9'					GC			0.0'-0.3' Clayey Sand - Some Gravel - Moderate Brown (5YR-4/4) to Moderate Red (5R-5/4) - Heavy Fe Oxide Coating on Sand grains - Mod - Abundant Biotite/Muscovite in matrix - Sand poorly Sorted - Sl. damp - friable m. grained - sub rd. rord.
							CL	1		
							CL	2		
								3		0.3'-1.3' - Silty Clay - Some gravel - abundant roots - Mod. yellowish Brown (10YR-5/4) to Dark yellowish Brown (10YR-4/2) Sl. damp when recovered.
								4		1.3'-3.0' - Clay - Some Silt Tr. Sand & Gravel - Cobbles at Top of interval - Dark yellowish Brown (10YR-4/2) at top (approx 0.7') and Moderate yellowish Brown in lower part of int. - Possible paleo Soil Moist. Clay Very Dense - Non friable.
	Run No 2 4.0'-6.0'	Rec. 1.8'					CL	5		
							SP	6		3.0'-4.0' - No Rec.
	Run No 3 6.0'-9.0'	Rec 3.5'						7		4.0'-5.7' Silty Clay - Some Silt from above in Top 0.2' - Gravelly at top - Becomes sandy in lower. 0.7' of interval. Varies from Pale yellowish Brown (10YR 6/2) and
								8		Grayish orange (10YR-7/4). Varies from Non friable to mod. friable. 5.7-5.8' - Clayey Sand - Sand Poorly graded, f.G. - Damp
								9	TD	Grayish Orange (10YR-7/4) 6.0'-6.8' - Clay - Pale yellowish Brown (10YR-6/2) and Grayish Orange (10YR-7/4) saturated - Sticky and pliable - Roots 6.8-9.0' - Top of Bedrock - Claystone olive gray (5Y-4/1) and Med. Dark Gray (N-4) - Highly reworked - Varies from Sticky & pliable to Mod. Indurated - Saturated -

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10597
Location - North: _____ East: _____
Date: 3/26/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: ~~14.0'~~ 14.3'
Company: DEC Project No.: _____
Sample Type: Dash-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0'-10.0'	Run No. 1 0.0'-4.0'	Rec. 1.6'					CL CL	1 2 3		0.0'-0.6' Gravelly Clay - Dark Yellowish Brown (10YR 4/2) Quartz Pebbles & Cobbles - Appears to have pushed cobble ahead of cutting head for a few inches. - few roots - Clay sticky & Pliable. - Damp 0.6'-1.6' - Clay - Some gravel - Mottled Pale Yellowish Brown (10YR 6/2) with Grayish Orange (10YR 7/4) Fe stained zones. - Grave - Pred Quartzite - Some Granite Chips. Clay sticky & Pliable - Changes to Dark Yellowish Brown (10YR 4/2) at approx 1.4' with Granite Cobble & Carbonaceous material. Clay damp.
	Run No. 2 4.0'-6.0'	Rec. 2.0'					CL	4 5		1.6'-4.0' - No Rec except for Stuff.
	Run No. 3 6.0'-8.0'	Rec. 2.2'		40°				6 7 8		4.0'-9.6' Clay - some sand & Fr. Gravel - Granite clast at Top. - Pred. Brownish Gray (5YR 4/1) Damp - Pliable stuff. - Some roots. - Possible landslide slip plane at approx 8.1' Dip ≅ 35-40°. Interval below plane contains gravel - more in sediments above.
	Run No 4 8.0'-10.0'	Rec. 2.7'					CL	9		9.6'-10.0' - Sandy Clay - Some Gravel - Dark Yellowish Brown (10YR 4/2) - Gravel fragments may include some Arapahoe S.S. clasts - Collowan.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10597
Location - North: _____ East: _____
Date: 3/26/97
Geologist: F. Gragsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 14.3'
Company: IEC Project No.: _____
Sample Type: Rock-Core.

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 10 10.0'-14.0'							CL	11		10.0'-12.8' - Colluvium - Same as above (9.6'-10.0') - Grades to predominately reworked Claystone Clast. -
								12		
								13		Inferred Top of Bedrock 12.8-14.0' - Claystone - Transitional contact with apparent colluvium above.. Dark Yellowish Brown (10YR-4/2) in upper half of interval, grading to Pale Yellowish Brown (10YR-6/2) in lower half of interval. - Mottled with Dark Yellowish Orange (10YR-6/6) Fe O Coated Clast. - Entire Interval appears to consist of brecciated recemented Claystone (argillaceous cemented) - No well define Bedrock Contact. Core dry when recovered.
								14		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10697
Location - North: _____ East: _____
Date: 3-11-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 12.0
Company: TEC Project No.: —
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1 0'-12.0'	Run #1 0'-4'	Rec. 3.9'					CL	1, 2, 3		0'-4' Clay - Tr. Sd. & Gravel - Mod. yellowish Brown (10YR-5/4) Med. Plasticity - Damp - Pliable Occasional Quartzite pebbles. Top 0.4' - Grayish Brown (5YR-3/2) Topsoil/Grass. - Heavy FeO (Dark yellowish orange 10YR-6/6) in lower foot of interval - invert fractures & tubes
	Run #2 4.0'-8.0'	Rec. 3.15'					CL	4, 5, 6, 7		4.0'-7.1' Clay - Pale yellowish Brown (10YR-6/2) Core recovered wet. Very Damp & Pliable after setting - Organic debris on top 0.3' - Some Cut ~~fragments~~ slivers Hair interval. - Interval has sandy texture as interbedded zone - Some quartzite sand size fragments (sparse) 7.1-8.0' - No Rec. on initial run - Rec. 2.0' on pick up run. Interval silty clay - saturated & runny - Light olive gray (5Y-5/2) - found small quartzite pebbles spread throughout interval. Bottom core samples consist of claystone fragments - ~~Fine~~ predom. Dark Gray (N3) with Dark yellowish orange (10YR-6/6) Fe oxidized lens & fracture faces - Prob. Top of Bedrock at 10.0'
	Run #3 8.0'-10.0'	Rec. 2.0'	BH-10003RM BH-10002RM BH-10001RM	BH10002RM			CL	8, 9		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10697
Location - North: _____ East: _____
Date: 3-11-97
Geologist: F. Gregsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 12.0'
Company: TEC Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Push 10.0-12.0'	Rec. 0'						11		10.0' - 12.0' - No Recovery - Small Piece of Claystone at 10.0' on Previous run.
								12.0		TD.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10797
Location - North: _____ East: _____
Date: 3/27/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 15.0'
Company: TEC Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	BOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-10.0' - Cut 2' clay from above	Run No 1 0.0'-4.0'	Rec. 1.6'					CL / GC	1, 2, 3		0-1.1 - Silty clay - some sand and trace of gravel. Color grades from Pale yellowish brown (10YR-6/2) to Dark yellowish orange (10YR-6/6) - Slightly damp when taken - Mod friable, weathered - many roots. - 1.1-1.6' - Clayey gravel - some sand and silt. - Matrix moderate yellowish brown (10YR-5/4) black (N-1) and grayish black (N-2) asphaltic type material occurring as fragments and coating occurring in knuddled interval.
	Run No 2 4.0'-6.0'	Rec. 0.7'					CL	4, 5		1.6'-4.0' - No Recovery. 4.0'-6.0' - Recovered approx 1.3' of material - Top 0.6' is sluff from above. Next 0.7' consists of stiff FC stick & friable clay composed of reworked claystone, color varies from pale yellowish brown (10YR-6/2) to grayish orange (10YR-7/4) some heavy Fe Ox. in streaks and lenses. Clay very dense, sl. damp, non-friable.
	Run No 3 6.0'-8.0'	Rec. 1.9'						6, 7		~~6.0'-8.0'~~ FC. 6.0'-13.0' - Clay - Colluvium consisting of reworked bedrock claystone with some silt and some sand. Light brownish gray (5YR-6/1) and dark yellowish orange (10YR-6/6) bands. Clay sl. damp, very dense, non-friable - Recovery very difficult. - Descriptions are based on ~~cut~~ recovered core, and from sluff, ~~and~~ ~~...~~
	Run No. 4 8.0'-10.0'	Rec. 2.5'					CL	8, 9		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10797
Location - North: East:
Date: 3/27/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation:
Area: SW-59
Total Depth: 15.0'
Company: TEC Project No.:
Sample Type:

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN-SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
SW 59 ~~Run 1 10.0'-12.0'~~ 8.5'-10.0'	Run No 5 10.0'-12.0'	Rec: 2.0'					CL	1		13-15 - Initial run failed because Piston did not retract. Second attempt with open barrel & core catcher recovered clay as in previous interval, and a wet sandy clay with gravel (quartzite) in lower 0.5' of interval. ~~May have recovered~~ 1'-6'. This interval is saturated. - Initial water encountered on first attempt to advance from 13.0' to 15.0'. Run Terminated at ±13.2' with plugged cutting head.
	Probe 12.0'-13.0'							10		
SW 59 13.0'-15.0'	Run No 6 13.0'-15.0'	Rec. 1.5'						12		
								13		
								14		
								15		TD

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 10897
Location - North: _____ East: _____
Date: 3-13-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 10.0'
Company: ZEC
Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
BOX 1 0'-10.0'	Run #1 0'-2.0'	Rec 1.9'	BH-10005RM; BH-10006RM; BH-10007RM				CL; GC	1; 2		0'-1.1' - Silty Clay - Some Sand - Pred. Dark Yellowish Brown (10YR-4/2) Top Soil with grass, Roots throughout. Calcareous. 1.1-2.4 ~~Clayey Sand~~ Gravelly Sand - Some Clay - Light Brown (5YR-6/4) when recovered (Saturated) Gravel pred quartzite - Some cobble size clast - Sand f.-c. to v.f.c. - Overall interval well graded high enough clay content to form soil binder with low plasticity - Calcareous
	Run #2 2.0'-6.0'	Rec. 0.5'						3; 4; 5		2.4-6.0' - No Recovery
	Run #3 6.0'-8.0'	Rec. 1.2'	BH-10004RM					6; 7		6.0'-6.2' - SAA (1.1-2.4) 6.2'-7.2' - Claystone - Top of Bedrock ≅ 6.2' Olive gray (5Y-4/1) fractures with Fe Ox - Dark Yellowish Orange (10YR-6/6) occur along interval - ~~No pred fract~~ f.c. Appears to consist of broken fragments and clast. - Sl. damp. Non friable. - Sl. plastic, Sl. Calcareous
	Run #4 8.0'-10.0'	Rec. 2.0'						8; 9		7.2-8.0 - No Recovery 8.0'-10.0' - Claystone - Same as 6.2'-7.2' - Vertical - Fe Ox ~~Co~~ coated fractures. - Designated MnO Claystone becomes more competent with depth. - Sl. Calcareous.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 10997
Location - North: East:
Date: 3/12/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation:
Area: SW-59
Total Depth: 12.0'
Company: TEC Project No.:
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-2.6'	Run No 1 0.0'-4.0'	Rec. 3.55'					CL	1, 2, 3		0'-3.5' Silty Clay - Some gravel & Sand - Color grades from Dark Yellowish Brown (10YR 4/2) in topsoil to Moderate Yellowish Brown (10YR 5/4) & Pale Yellowish Brown (10YR 6/2) in lower Interval - Some quartzite cobbles & pebbles throughout. Calcareous 3.5-4.0' - No Recovery
	Run No 2 4.0'-6.0'	Rec. 1.8'			Change to Claystone symbol from 4 to 9.0'			4, 5, 6		Top of Bedrock 4.0' - 6.0' ~~5.8'~~ FG Claystone - granite Cobble at top of interval Caliche nodules & alt. feldspar nodules throughout interval - Color varies from Dark yellowish orange (10YR 4/6) to Light olive gray (5Y 5/2) - Very Sl. damp - dense - Weathered - Sl. plastic - Med plasticity. Calcareous ~~5.8~~ FG
	Run No 3 6.0'-8.0'	Rec. 2.3'						7		6.0-8.0' - Clayst-stone - Pred. Light Olive gray (5Y 5/2) Appears to consist of Claystone fragments & Clast. - possibly some felsic FG. altered Feldspar clast. (~~Reworked bedrock~~) FG (Alluvium?) Sl. Damp - Mod. Plastic. Fe Oxides in healed fractures
	Run No 4 8.0'-10.0'	Rec. 2.3'						8, 9		8.0'-9.0' - Claystone - Distinct Color change to Dusky yellowish Brown (10YR 4/2) - Some Mod. - More competent & indurated. - Sl. Damp when

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10997
Location - North: _____ East: _____
Date: 3/12/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 12.0'
Company: IEC
Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.6'-12.0'	Run. No. 5 10.0'-12.0'	Rec. 2.4'						11 12	TD.	8.0'-9.0'- Cont. recovered. Becomes slightly sandy at bottom of interval & grades to Pale Yellowish Brown (10YR-6/2) - Some Fe Oxidation along fractures - Grayish orange (10YR 7/4) to Dark yellowish orange (10YR-6/6) Non friable to friable, mod. sandy interviews 9.0'-12.0'- Sandy Claystone - Pale Yellowish Brown (10YR-6/2) Dry - friable - Grades to Grayish Orange (10YR-7/4) in lower - 3 feet of interviews

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 11097
Location - North: _____ East: _____
Date: 3/28/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 11.0'
Company: IEC Project No.: _____
Sample Type: Push-Core.

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0-8.4'	Run No. 1 0.0'-4.0'	Rec. 2.2'		45° at 1.8			CL. GC	1 2		0.0'-0.4'- Silty clay - Some gravel at bottom of interval - Topsoil with grass & roots. - Sl. damp. - Sl. friable. - Mod. yellowish brown (10YR-5/4) - Calcareous 0.4'-1.8' Sandy Gravel - Some clay - Dominate Color of matrix is light Brown (5YR-5/6) - Sl. Damp - friable - well graded - weathered - Gravel pred. quartzite - Some cobbles Apparent 45° shear at bottom of interval (Cuts quartzite cobble) Some calcitic.
	Run No. 2 4.0'-6.0'	Rec. 2.2' Repeated	Run No. 2 - Repeated Offset 2.0'-6.0' Rec. 3.1'				CL	3 4		1.8'-2.0'- Clay - Pale Yellowish Brown (10YR-6/2) and Dark yellowish orange (10YR-6/6) (Fe stained) - Sl. Damp - friable - Non friable - Wx - Appears to be Composed of reworked Claystone fragments.
	Run No3 6.0'-8.0'	Rec. 2.5'						5 6 7		2.0'-2.3' (offset hole) - Sandy Gravel as in 0.4'-1.8' above - Calcareous. 2.3'-4.8 - Clay - Calcitic at Top of interval (to 3.0') - Sand & Gravel in lower 6 inches - Clay, Moderate Yellowish Brown (10YR-5/4), Calcitic Very Pale Orange (10YR-8/2) - Entire interval (of core) - Clay Sl. Damp - Mod. friable - zone of heavy FeO at 3.2' - Dark yellowish orange (10YR-6/6) - Sandy
Box 2 of 2 8.4'-11.0'	Run No4 8.0'-11.0'	Rec. 4.0'						8 9		Gravel interval occurs above bedrock contact. 4.8'-9.2' - Claystone - TOP of Bedrock - Some Silt. - Dark Yellowish Brown (10YR-4/2) to approx 6.0' - Grades to Moderate Yellowish Brown (10YR-5/4) Below 6 feet. Some Calcitic

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 11097
Location - North: _____ East: _____
Date: 3/28/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 11.0'
Company: TEC
Sample Type: Push-Core
Project No.: _____

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
8.7-11.0'								10		4.8' - 9.2' cont. filled fractures, and numerous FeO coated healed fractures (60°-90°) throughout interval. Fe coatings are Dark yellowish ~~Brown~~ Fe. Orange (10YR 6/6) Clay Sl. Damp where recovered, mnd at 8.7' Sl. friable, weathered
								11		9.2' - 11.0' - sandy clay - contact well defined. clayey lens are dark yellowish brown (10YR 4/2) sandy lens are Grayish Orange (10YR 7/4) Either wet and dry. Clay wetter and dense & indurated sandy ~~zone~~ Fe lens are friable. Dark yellowish Orange (10YR 6/6) Fe oxide staining throughout.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 11197
Location - North: _____ East: _____
Date: 3/12/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 10.0'
Company: TEC
Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1 0'-10.0'	Run No 1 0.0'-4.0'	Rec. 2.6'						1		0'-0.2' Top Soil - Dark yellowish Brown (10YR 3/2) Grass - Roots -
										0.2'-0.5' Quartzite Cobble -
										0.5'-2.6' Clay - Reworked Zone - Some Gravel - Cobble at 1.2'-1.4' ±
								2		30° Shear below Cobble
										Color Mod. Yellowish Brown (10YR 5/4) in Clay & Very Pale orange (10YR 8/2) in Cobble Small Cobble nodules approx 2.3 - 2.4
								3		
								4		
	Run No 2 4.0'-6.0'	Rec. 2.2'					C1			at 2.6' - Roots at 2.6' Entire interval appears highly reworked Alluv
										2.6'-4.0' - No Recovery
								5		4.0 - 4.7' - Clay - Tr. gravel & sand. pale yellowish brown (10YR 6/2) with light Olive gray (5Y 6/2) & Dark yellowish Orange (10YR 6/6) - Trace quartzite gravel & sand (in place). 30° shear at bottom of interval.
								6		
	Run No. 3 6.0'-8.0'	Rec. 1.8'						7		
										4.7 - 6.0' - Clay - Tr. quartzite sand - Reworked Bedrock & alluvium - Slightly friable - Composition probably Silty Clay Color Pred. Pale Yellowish Brown (10YR 6/2) Subtle oxidation banding at ±45°
								8		
	Run No. 4 8.0'-10.0'	Rec. 2.0'						9		
								10		6.0'-7.3' - Clay - ~~Sand~~ SAA - 7.3-10.0 - Claystone - Top of TD: Bedrock. Very transitional. Some Silty intervals - tonal. Pale Yellowish Brown (10YR 6/2) to Grayish Orange (10YR 7/4). Entire core Dry.

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11297
Location - North: _____ East: _____
Date: 4-1-97
Geologist: F. Grigsby
Drilling Equip.: GeoProbe

Surface Elevation: _____
Area: SW-59
Total Depth: 14.0'
Company: TEC Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0' to 9.15	Run No 1 0.0'-4.0'	Rec. 2.8'					CL			0.0'-0.4' - Silty Clay - Some Gravel - Moderate Brown (5YR-4/4) Top Soil/Grass & roots - Wx - Dry - Calcareous
							CL	1		0.4'-2.0' - Clayey Gravel - Some Sand & Silt - Gravel - Pred. Quartzite - up to Cobble Size - Clay Sl. Damp - Dusky Yellow Brown (10YR-4/2) - Non friable - Med. Plasticity - Weathered - Calcareous.
								2		2.0'-2.8' - Clay - Colluvium consisting of rounded Claystone fragments - Moderate Yellowish Brown (10YR-5/4) and Dark Yellowish Orange (10YR-6/6) Some Med. heavy FeO - & Calcite -
								3		2.8'-4.0' - No Recovery.
	Run No. 2 4.0'-6.0'	Rec. 2.2'					CL	4		4.0'-5.1' - Clay - Some Calcite - Large rounded approx 4x3' - Colluvium - Bound in bedded quartzite Rebore at approx 5.0' - Color Pred. Pale Yellowish Brown (10YR-6/2) with White (N9) and Dark Yellowish Orange (10YR-4/6) - Dense - Non friable - Consist pred of rounded Claystone fragments.
								5		
								6		
	Run No. 3 6.0'-8.0'	Rec. 2.0'								5.1'-10.0' Top of Bedrock - Claystone.
								7		Pale Yellowish Brown ~~10YR~~ (10YR-6/2) to 6 feet, grading to Grayish Orange (10YR-7/4) to approx 6.6' - Heavily FeO stained interval from 6.6'-7.6' - Dark Yellowish Orange (10YR-6/6) - to Pale Yellowish Brown (10YR-6/2) to
								8		
	Run No 4 8.0'-10.0'	Rec. 2.8'						9		10.0' - Some FeO in lower 6 inches of interval - Some vert. hairline fractures in upper half of interval - Some MnO above & below the FeO stained interval. Interval Dry

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 11297
Location - North: East:
Date: 4/1/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation:
Area: SW-59
Total Depth: 140'
Company: TEC Project No.:
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 2-0'-14.0'	Run No. 5 10.0'-12.0'	Rec. 3.8'						11		10'-12.0' silty Claystone - some sand - Pale yellowish Brown (10YR 6/2); core badly broken - Claystone fragments mod indurated - some mod heavy Fe O staining along bedding planes (Partings) - [Dark yellowish Orange (10YR 6/6)] - Interval is Dry
	Run No. 6 12.0'-14.0'	Rec. 3.5'						12		
								13		12.0'-14.0' - Silty Claystone same as above - but may have more sand.
								14		TD.

Note: Extra Core Recovery is the result of Core being extensively broken while hammering. - Measure TD was 12.3' at end of 10.0 to 12.0' run.

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 11397
Location - North: _____ East: _____
Date: 4/9/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 15.6
Company: TEC
Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-5.5'	Run No.1 0.0'-4.0'	Rec. 3.0'					CL	1		0.0-1.3' Gravelly Clay - some silt - Dark yellowish Brown (10YR-4/2) and Dusky Yellowish Brown (10YR-3/2) - Gravel ~~to~~ broken cobbles, to 1/4 inch ±. - well graded. Pred. quartzite. - Core sl. damp. - dense - Non plastic. Calcareous. - Roots throughout interval - weathered -
								2		
							CL	3		1.3'-3.3' - silty Clay - some sand - Dusky yellowish Brown (10YR-4/2) - some Very Pale Orange (10YR-8/2) mottling from calcite or calcareous material - Core Dry, indurated - Non friable.
	Run No.2 4.0'-6.0'	Rec. 2.8'						4		
							CL	5		3.3'-5.5'. Silty Clay - some small sand, trace gravel.. Pred. moderate yellowish Brown (10YR-5/4) with very pale orange (10YR-8/2) calcite and calcareous material. - Core sl. damp - mod. friable - Med-low plasticity - wx. some organic material.
							CL	6		
	Run No.3 6.0'-8.0'	Rec. 0.6'					CL	7		5.5-6.0' - Silty Clay - Same as above - but with some Dark stuff intermixed on sides of core. 6.0'-7.1 - Sandy Clay - moderate Brown (5YR-4/4) and light Brown (5YR-5/6) in upper 0.4' of interval - Grayish Orange (10YR-7/4) in ~~upper~~ rest of interval. - friable - Calcareous - weathered.
								8		
	Run No.4 8.0'-9.0'	Rec. 2.8'						9		
Run No.5 9.0'-11.0'	Rec. 2.8'									7.1-7.9 - Clay - some gravel and sand - Dark yellowish Orange (10YR-6/6) with Pale Yellowish Brown (10YR 6/2) layers or lens - Very sl. Damp - Med plasticity - wx.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11397
Location - North: _____ East: _____
Date: 9/9/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 15.6'
Company: IEC Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.0'-15.6'		Run No. 6 11.0'-13.6'	Rec. 3.7'					11 12		7.9-8.0': Calcrete layer. Very Pale orange (10YR-8/2) 8.0-8.8': Claystone - Top of Bedrock, Alternating bands of pale yellowish Brown (10YR-6/2) and Dark yellowish Orange (10YR-6/6) claystone - Orange zones Fe O stained. Calcrite nodule at approx. 8.3'
		Run No 7 13.6'-15.6'	Rec. 3.8'					13 14 15		8.8-10.3 Sandstone with interbedded claystone - S.S. Grayish orange (10YR-7/4) F.G. - unconsolidated - well sorted - wet. Claystone Pale yellowish Brown (10YR-6/2) interbedded with S.S. -
									TD	10.3'-13.6': Claystone - some sand. - Interbedded Pale yellowish Brown (10YR-6/2) and Dark yellowish orange (10YR 6/6) Claystone - Consist predominantly of Brecciated Claystone fragments that are recemented (argillaceous) some sandy interval. - Fresh breaks are sl. damp. - Mod. Indurated 13.6'-15.6': No Recovery sand slurry only.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV.. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 11497
Location - North: _____ East: _____
Date: 4-9-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 12.0'
Company: TEC
Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-10.0'	Run No. 1 0.0'-4.0'	Rec. 2.2'					CL	1		0.0'-2.2' - Clay - Tr. gravel - Grayish Brown (5YR-3/2) from surface to ±1.0' - Grades to Pale Yellowish Brown (10YR-6/2) and Dark Yellowish Orange (10YR-6/6) Sticky Clay. - Interval Sl. Damp. Non friable to friable - Weathered sticky interval - High plasticity Roots in top 3 inches.
							CH	2		
								3		2.2'-4.0' - No Rec
	Run No. 2 4.0'-5.0'	Rec. 0.8'					CL	4		4.0'-4.8' - Clay - Some silt & sand Moderate Yellowish Brown (10YR-5/4) in top half of interval, changing to light olive gray in lower half of interval - Sticky & friable.
	Run No. 3 5.0'-6.0'	Rec. 1.1'						5		
	Run No. 4 6.0'-8.0'	Rec. 1.7'					CL	6		4.8'-6.0' - Clay - Some silt & sand. Top may be stuff. - Color pred. Pale Yellowish Brown (10YR-6/2) Some Grayish Orange (10YR-7/4) staining in top 0.5' (Stuff?) Interval damp - Mod friable to sticky & friable.
								7		
	Run No. 5 8.0'-10.0'	Rec. 2.2'						8		6.0'-7.3' - Top of Bedrock Claystone - Brecciated (Extensive) Pale Yellowish Brown (10YR-6/2) to Dark Yellowish Brown (10YR-4/2) with abundant Dark yellowish orange (10YR-4/6) Fe/Mn coating on fracture planes. - Some MnO
								9		7.3'-8.0' - No Recovery

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(1) Badly broken core, accurate footage measurements not possible.
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11497
Location - North: _____ East: _____
Date: 4/9/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 12.0'
Company: IEC Project No.: _____
Sample Type: Push-core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
8.0'-12.0' Run No. 6 10.0'-12.0'		Rec. 2.5'						11 12		8.0'-12.0' claystone - Dark Yellowish Brown (10YR-4/2) Some carbonaceous material - some MnO - 70° fracture between 9.0' & 10.0' - Vertical fracture with slickensides between 11.0 & 12.0'. Dark Yellowish Orange (10YR-4/6) FeO coating on fracture planes. - Interval brecciated and/or disturbed through approx 11.0' Massive below 11.0'. Interval sl. damp.

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 11597
Location - North: _____ East: _____
Date: 4/8/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 14.2'
Company: TEC Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0'-10'	Run No 1 0.0'-4.0'	Rec. 3.5'					CL	0, 1, 2, 3, 4		0-~~5.6'~~ 4.1' - Clay - Some silt and Calachie. Color Pred. Dark Yellowish orange (10YR 6/6) with Very Pale orange (10YR-8/2) calachie to 2.5' - Roots throughout interval. Color change to Pale Yellowish Brown (10YR-6/2) with Trace of Calachie and Grayish orange (10YR 7/4) FeO staining. Interval Sl. Damp - Weathered, Nonfriable - Med to low plasticity
	Run No.2 4.0'-6.0'	Rec. 1.7'						5, 6		4.1'-10.0' - Clay - Pale Yellowish Brown (10YR-6/2) with Dark Yellowish Orange (10YR-6/6) FeO staining and Coating on some fracture. Some Carbonaceous intervals. - 45° fracture at approx 7.5'. Interval Consist primarily of Claystone fragments Disturbed that are well cemented with Clay - Some Very heavy FeO staining in places. Clay grades to Dusky Yellow (5Y-6/4) from 9.4 to 9.8'
	Run No.3 6.0'-8.0'	Rec. 1.7'		45°			CL	7, 8		
	Run No.4 8.0'-10.0'	Rec. 2.0'						9		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 11597
Location - North: _____ East: _____
Date: 4/8/97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 14.2'
Company: ZEC
Project No.: _____
Sample Type: Push-Core.

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 10'-14.2'	Run No. 5 10.0'-12.0'	Rec. 2.2'					CL	11		10-11.8' - Clay - SAA - Color Change to Dark yellowish Brown (10YR 4/2) in lower 0.8' of interval.
	Run No. 6 12.0'-14.0'	Rec. 3.0'						12		11.8'-14.2'. Top of Bedrock Claystone - Color pred. Brownish Gray (5YR 4/1) Breaks on parting planes - but pred. massive. No dominant fractures. - Trace (sporadic) FeO
								13		
								14	TD	

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 11697
Location - North: _____ East: _____
Date: 3-14-97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: -
Area: SW-59
Total Depth: ~~26.0'~~ 30.0'
Company: TEC
Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 5 0.0'-9.7'	Run No. 1 0.0'-4.0'	Rec. 2.9'	Red Screen BH1 0.0-8.RM				CL	1		0'-0.9' - Clay - Some Gravel Dark yellowish Brown (10YR-4/2) Top Soil grading to alluvium. Damp. - Pliable -
							CL	2		0.9'-2.9' - Gravelly Clay - Pale Brown (5YR-5/2) grades to pale yellowish Brown (10YR-6/2) Some Dark yellowish Orange (10YR-6/6) Fe O in lower half foot of interval. Gravel pred. Quartzite - to 1 inch in size. - Some Silt, interval. - Some calcite
								3		2.9'-4.0' - No Recovery
	Run No. 2 4.0'-6.0'	Rec. 2.1'						4		4.0'-4.3' - Gravelly Clay - SAA Possible slough.
							CL	5		4.3'-8.0' Clay Colluvium - Pale yellowish Brown (10YR-6/2) & Grayish Orange (10YR-7/4) - Composed of Claystone fragments & Clast. - Found isolated small quartz and quartzite pebble within core. - Core Sl. Damp Pliable. - some calcite - Interval Calcareous.
	Run No. 3 6.0'-8.0'	Rec. 2.0'						6		
								7		
	Run No. 4 8.0'-12.0'	Rec 1.7'						8		8.0'-9.1' - Clay - Same as above.
							GC	9		9.1'-9.7' Gravel, Clay - Olive Gray (5Y-4/1) and Brownish Black (5YR-2/1) - Quartzite Cobble at Contact of interval - Clay: Dense Sl. Damp & Pliable. - Sl. Calcareous

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11697
Location - North: _____ East: _____
Date: 3-14-97 3-17-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe.

Surface Elevation: _____
Area: SW-59
Total Depth: ~~860'~~ 30 Dft.
Company: TEC Project No.: _____
Sample Type: Push Core.

EG&G LOGGING SUPERVISOR Offset Original hole. 1 ft to West.
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
BOX 2685 9.7'-17.0'	Run No 4 8.0'-12.0'	Rec. 1.7	Run No 5 9.7'-12.0' Rec 2.8'				CL	9 10 11 12		9.3'-12.0 Clay - Some sand - Some gravel - Colluvium. - Pale yellowish brown (10YR-4/2) to Brownish Gray (5YR-4/1) with zones of Dark yellowish orange (10YR-4/6) Fe Oxide staining. Cobble size quartzite at Top of interval. and from 11.8'-12.0' some isolated sandy intervals with small Pebbles - Interval appears to be grad. composed of reworked claystone fragments (calcareous) with clay. - Int. sl. damp - Mod. friable - Med. plasticity - Some calcite & calcareous
	Run No. 6 (Offset) 12.0'-14.0'	Rec. 2.6'	Offset Hole				CL	13 14		12.0'-13.4' clay - Some gravel - Some sand - Appear to have push gravel fragment along outside of core to approx. 12.6'. Clay very dense - sl. damp - Light Olive gray (5Y-6/1). Moderate yellowish Brown (10YR-5/4) sandy lense at ±12.9' with some carbonaceous material - Clay has high plasticity - sl. friable - Fractured Cobble at Top of interval - Smeared fine rock fragment/sand or silt below cobble. - Isolated gravel & cobbles throughout interval. (calcareous)
	Run No. 7 14.0'-16.0'	Rec. 2.4'					CL	15 16		
	Run No. 8 16.0'-18.0'	Rec 2.3'						17		
	Run No 9 18.0'-20.0'	Rec. 2.7'	By/carbonaceous By/carbonaceous					18 19		13.4'-14.0' ~~Date~~ Soil horizon - (5Y 2/1) Olive Black - Carbonaceous roots. - Fred Silty Clay. 14-16.0' Silty Clay Top Soil - Uniform Dark yellowish Brown (10YR 4/2) - Some Sand, Roots - sl. Damp - sl. friable. sl. calcareous

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11697
Location - North: _____ East: _____
Date: 3-17-97, 3-18-97
Geologist: E. Grigsby
Drilling Equip.: GeoProbe

Surface Elevation: _____
Area: SW-59
Total Depth: ~~26.0'~~ FC 30.0'
Company: TEC Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 5 17.0'-24.0'	Run No. 10 20.3'-22.0'	Rec 2.3'	BH-100132 BH-100142				CL	20		16.0'-18.0' Silty Clay - SAA - color Dark Yellowish Brown (10YR 4/2) - Becomes sandier in lower 0.5' - Calcitic Nodule at 17 feet
			BH-100152 BH-100162				CL	21		18.0'-20.3' (Corrected TD - see daily log) - Sandy Clay - Pale Yellowish Brown (10YR-6/2) - Some zones and lens of Fe Oxidation - Dark Yellowish
	Run No. 11 22.0'-24.0'	Rec: 2.0'					CL	22		Orange (10YR. 6/6) - Possible channel fill material. Some occassional quartzite pebbles. Si. Damp - friable
			BH-100172 BH-100182				CL	23		20.3'-21.5' SAA. - Occassional quartzite pebbles - Some Calcitic & some mica fragments visible under Microscope
	Run No. 12 24.2'-26.0'						CL	24		21.5'-22.0' Clay - Moderate Yellowish Brown (10YR 5/4) Very dense & stick - Contains quartzite pebbles.
							CL	25		22.0'-24.2' - Sandy Clay - Same as interval at 18.0'-20.3'. Approx.
Box 4 of 5 24.2'-28.5'	Run No 13 26.0'-28.0'	Rec. 2'						26		One foot of Recovered core (3' rec.) is Clay & gravel Push down from above. Disregarded with respect to Description.
								27		24.2-25.6' FC Colluvium - Consist of reworked bedrock fragments - Pale Yellowish Orange (10YR-8/6) and Pale Yellowish Brown (10YR-6/2)
	Run No 14							28		25.6-26.0 - Destroyed cleaning sample barrel - but appear to be SAA
								29		

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Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

~~* Include with description of 18.0' 2nd Interval. FC~~

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11697
Location - North: _____ East: _____
Date: 3-14-97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 30.0'
Company: TEC
Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 5 of 5 28.5'-30.0'	Run 5 28.0'-30.0'	Rec. 3.1'						29		26.1 - 30.0' - Top of Bedrock, Claystone. - Olive Gray (5Y 4/1) Changing to Pale Yellowish Brown (10YR 6/2) in bottom 1.5' of interval. Desiminated Dark Yellowish Orange (10YR 6/6) FeO Coating on Parting Planes and indicated fractures. Some Fe6 finely desimated Calcite. Most of interval Consists of disturbed Claystone fragments. Fine laminations occur in bottom foot of interval. -
								30	TD	

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 11797
Location - North: _____ East: _____
Date: 4/3/97, 4/7/97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: _____
Company: TEC Project No.: _____
Sample Type: Flush-Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0'-10.2'	Run No 1 0.0'-4.0'	Rec. 3.2'					CL	1, 2, 3		0.0'-3.2' - Clay - some Silt, Dark Yellowish Orange (10YR-6/6) for top 0.6' of Interval - with some Carbonaceous material at top - Roots throughout. - Color change to Pale Yellowish Brown (10YR-6/2) with Dark Yellowish Orange (10YR-6/6) mottling - Interval Sl. Damp. Becomes silty to possibly sandy with depth - Appears to be fred. made up of reworked claystone fragments; weathered.
	Run No 2 4.0'-8.0'	Rec. 3.8'					CL	4, 5, 6, 7		3.2'-6.5' - Silty Clay - some sand - Trace gravel (small) - Moderate Yellowish Brown (10YR-5/4) with Pale Yellowish Brown (10YR-6/2) silty lens - Some Dark Yellowish Orange (10YR-6/6) Fe O Mottling. Found small gravel fragments in lower part of Interval. - Int. Sl. Damp Mod friable - Clay Mod plastic, - weathered same Mn-O
	Run No 3 8.0'-11.0'	Rec. 3.2'						8, 9		6.5'-11.0' - Top of Bedrock (?) Claystone - some thinly laminated - Most Brecciated. - Verticle Fe O filled fractures from 6.5' to approx 9.0' FG Light Olive Gray (5Y-6/1) Changing to Brownish Gray (5YR-4/1) in lower 2 ft of interval. - Dark Yellowish Orange (10YR-6/6) to approx 10.5' - Trace MNO to That Depth - Core Sl. Damp.

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 1797
Location - North: _____ East: _____
Date: 4/7/97
Geologist: F. Gregory
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: _____
Company: IEC
Project No.: _____
Sample Type: Push-Core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 10.2'-12.0'										6.5'-11.0' See page 1.
								11		11.0'-12.0' Claystone -
								12		12.0' 15.0' No Recovery - Jammed Barrel - could not recover core intact.
	Run No. 4 11.0'-15.0'	Rec. 4'						13		
								14		
								15		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 11897
Location - North: _____ East: _____
Date: 4/11/97
Geologist: F. Gingstey / John Bayless
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-59
Total Depth: 18.0
Company: TEC Project No.: _____
Sample Type: Push - Core

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0							0.0		
							CL	0.4		Silty clay w/sand and gravel — ~~10YR 2/2~~ 5YR 2/2 dusky brown. Some organics. Low plasticity. Slightly moist.
							CL	1.0		Silty clay — grayish brown to moderate brown (5YR 3/2 to 5YR 3/4). Trace sand, occasional gravel clast. Slightly moist.
	RUN 1	3.3'						1.6		
							ML	2.0		Silty clay to clayey silt with ~~sand and gravel~~ trace to some sand — moderate yellowish brown (10YR 5/4). Slightly moist to dry. Crumbly.
								3.0		
								3.3		Slough, 3.3-4.0
	4.0									
	4.0							4.0		
							ML			Same as 1.6 to 3.3 but with increased gravel and sand content. Color varies from moderate yellowish brown to moderate brown (5YR 4/4) with occasional reddish streaks and pockets. Dry to slightly moist. Crumbly except where more brown/red — these areas contain more clay.
BOX 1 OF 2	RUN 2	1.0'						5.0		
	6.0							6.0		Slough, 5.6-6.3
	6.0							6.3		Top of bedrock — Mottled, weathered; dominant color is pale yellowish brown (10YR 6/2) to light olive gray (5Y 5/2). Claystone to silty claystone w/trace to abundant iron oxides. Sl. moist. Occasional caliche clasts. Silty claystone present in lenses, pockets. Occasional carbonaceous flecks.
	RUN 3	2.4'						7.0		
	8.0							8.0		
	8.0									
	RUN 4	2.7'						9.0		Sandy siltstone — heavy Fe-staining. Sl. moist. Dark yellowish orange (10YR 6/6).
9.3								9.4		
9.3										Clayey siltstone/silty claystone — mostly Fe-stained 10YR 6/6, some dusky yellow (5Y 4/4). Sl. moist.
	10.0							10.0		

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 11997
Location - North: _____ East: _____
Date: 4/11/97
Geologist: J. Boylan
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: SW-54
Total Depth: 18.0'
Company: TEC
Project No.: _____
Sample Type: Push-core

EG&G LOGGING SUPERVISOR APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	10.0							10.0		Occasional sub-vertical fractures, healed Fe/Mn oxides. Below 10.2' pockets of unweathered/unstained material present, occasionally as laminae. Still an occasional siltier layer, generally <½" thick. Silt layers, laminae, pockets increase below 11.9' but not enough to be a "siltstone". Several large (½" to >1") caliche clasts below 13.3' (measuring back from 14.0'). Slightly moist to moist.
	Run 5	1.9'						11		
	12.0									
	12.0							12		
	Run 6	2.5'						13		
	14.0									
	14.0							14 14.0		14.0-14.6': slough
	Run 7	0.6'						14.6 15		
	16.0									
	16.0							16 16.0		16.0-16.6' - slough w/ several gravel fragments (pushed from above) to 1" diam.
	Run 8	2.1'						16.6 17		Same as above, w/ increased carbonaceous flecks, Fe/Mn-oxide healed fractures. Much less weathering below 17.0' - color dominantly pale yellowish brown (10 YR 6/2) w/ occasional pockets of Fe-staining. Dry to slightly moist.
18.0	18.0							18		TD = 18.0'
								19		
								20		

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 20197
Location - North: _____ East: _____
Date: July 22 1997
Geologist: William M White
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: WOMAN CREEK
Total Depth: 7.5'
Company: TIERRA Project No.: _____
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dougherty DATE 8-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0'	0.0'	0.0						0.0'		0.0 - 0.2' Gravel @ surface w/ some organic debris
	Run # 1	3.5' ~~Wet~~ ~~Moist~~ ~~0.4~~ ~~Slight~~ 7-22-97					CL	1.0		CLAYSTONE 0.2' to 1.4' DARK YELLOWISH BROWN (10YR 4/2) with ~~sand~~ occasional gravel inclusions (reworked bedrock) Very Slightly moist to dry. No visable fracturing No visable Fe staining
	0.0' To 4.0'						ML	2.0		CLAYEY SILTSTONE 1.4' to 2.4' Pale yellowish brown (10YR 6/2) Very slightly moist to dry no visable fracturing No Fe staining
										TOP of Bedrock 2.4'
							CL	3.0		CLAYSTONE 2.4 to 3.5' MODERATE YELLOWISH Brown (10YR 5/4) Very slightly moist No visable Fracturing. Traces of calcite
								3.5'		Fe staining noticable from 3.3' to 3.5' & Slightly fractured
										No Recovery 3.5' to 4.0'
	Run # 2	3.5' Wet 0.3' Slight						4.0'		CLAYSTONE 4.0 - 7.5' Greenish Gray (5GY6/1)
Box 1 of 1	4.0' To 7.5'						CL	5.0		Very Slight Moisture content No visable Fracturing MINOR Fe staining. Some minor calcite 4.7' to 5.5'
								6.0		NO VISABLE ORGANIC MATTER
										NO VOC's detected by minicam
								7.0		
7.5'	7.5'	7.5'						7.5'		TD AT 7.5'
								8.0'		
								9.0'		
								10.0'		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

(4011-930-0134-930)(Form GT.1A(03/01/92))

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 20397
Location - North: _____ East: _____
Date: July 21 1997
Geologist: William Milliton
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: _____
Total Depth: _____
Company: TERRA ENV Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL: [signature] DATE 6-29-98

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0		0.0			OL	0.0		ORGANIC SILTY CLAY 0.0-0.4' DARK YELLOW BROWN (10YR 4/2) with gravel at bottom of interval very slightly moist REWORKED bedrock
	Run # 1	3.7						0.4		0.4 to 1.7' Silty DARK Yellow Brown (10 YR 4/2) very slightly moist, very little iron staining no visable fracturing some occasional gravel
	0.0'						CL	1.0		
	4.0'				Change			1.7		1.7' to 3.7' Top of Bedrock CLAYSTONE. moderately yellowish brown (10 YR 5/4) occasionally dusky yellowish brown (10YR 2/2) and more silty and increasing iron staining with depth and some ironstone
					To Clayst Symbol from 1.7 to 7.9		CL	2.0		
								3.0		
	4.0	4.0						3.7		No Recovery 3.7' to 4.0'
	4.0	4.0						4.0		4.0' to 7.9' CLAYSTONE as above from 1.7' to 3.7' except much more iron staining and a slickenside fracture from 6.1' to 6.2'
	Run # 2	4.0'						5.0		
	4.0' To 8.0'	1.9' Sloughy					CL	6.0		
								7.0		7.4' to 7.5' Fe stained permeated layer
	8.0	8.0						7.9		
	8.0 Run # 3	8.0						8.0		7.9' to 8.0' No recovery
	8.0 to 12.0	4.0 0.4' Sloughy					CL	9.0		8.0' to 12.0 SAME as above 4.0 to 7.9'
Box 2	12.0	12.0'		10.0'				10.0'		

Box 1 of 2

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20397
Location - North: _____ East: _____
Date: July 21, 1997
Geologist: William M. Whitson
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: _____
Total Depth: _____
Company: Tierra Env Project No.: _____
Sample Type: Continuous CORE

EG&G LOGGING SUPERVISOR
APPROVAL F. Dwiggly DATE 6-29-98

TOP/BOTTOM OF CORE INBOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	0.0'						10.0		Same as above 4.0' - 7.4'
Box 2 of 2 4.7' to 12.0'	Run #3 12.0'	4.0' in liners 0.4' Slough					CL	11.0'		8.0' - 12.0'
										@ 10.2' AND 10.7' Fe stained vertical thin fractures
12.0'	12.0'	12.0'						11.6'		11.6' - 12.0 No Recovery
								12.0'		
								NMW 7-21-97		

NOTES: General: USCS is modified for this log as follows:
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 20597
Location - North: _____ East: _____
Date: July 18, 1997
Geologist: William M Whiton
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: _____
Total Depth: _____
Company: TIERRA Project No.: _____
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		ORGANIC SANDY SILTSTONE Dark yellow brown (10 YR 4/2) very slightly moist Trace Fe Stain friable Trace of caliche no VOC's detected with minirae 0.0 to 1.7'
	RUN #						SM	1.0		
								1.7		
	1 0.0' to 4.0'	3.5'					CL	2.0		1.7' to 3.5' Silty Clay with only a trace of organics Brownish gray (5YR 4/1) Fissile to Blocky* very slightly moist Trace of Fe Staining. No VOC's detected w/ minirae
								3.0		
								3.5'		*Break up when dry
	4.0	4.0								NO RECOVERY 3.5' TO 4.0'.
	4.0	4.0						4.0		
							OL	4.5		4.0'-4.5' GRAVELY SILTSTONE with Trace organics olive gray (5YR 4/1) fissile breaks up when dry. very slightly moist
	Run # 2 4.0 to 8.0	4.0'						5.0		Silty Claystone bedrock 4.5 to 8.0 Light olive gray (5Y 6/1) very slightly moist no visable weathering and no visable fracturing Trace of caliche Low plasticity some Fe staining
								6.0		
							CL	7.0		
	8.0	8.0						8.0		
	8.0	8.0						8.2'		Same as above 4.5' to 8.0' except very fissile
	Run # 3 8.0 to 10.4	2.4'						9.0		SAME as above 4.5' to 8.0' except color is Greenish Gray (5GY 6/1) and less Fe staining
10.0								10.0		

Box 1 of 2 0.0' to 10.0'

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Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20597
Location - North: _____ East: _____
Date: July 18 1997
Geologist: William M. Whitton
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: _____
Total Depth: _____
Company: TIERRA Project No.: _____
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE HEBOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAINSIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
[illegible] Box [illegible]	[illegible] Box3 [illegible]	[illegible] [illegible]	[illegible] [illegible]				CL	10.0 [illegible]		SAME AS ABOVE 4.5' to 5.0' EXCEPT COLOR IS Greenish Grey (5GY 6/1) AND LESS Fe Staining

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #20697
Location - North: East:
Date: 09-02-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: WOMAN CREEK
Total Depth:
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS 2 inch Dia.

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dingley DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.0		GRAVEL SAND, SILT-CLAY, Mottled V. Dark Gray (10YR 3/1) to Brownish Yellow (10YR 6/6), Well Graded (?), Subrounded to Angular Low Plasticity, Root Hairs and vegetation common, dry to very slightly moist
Box 1 of 2 0.0-9.2 ft.	Run #1 0.0-4.0 ft.	Recovery 3.7 ft.					SC	0.5		
								1.0		Fine to Med Clayey Sand, Top half Brown to Dk Brown (10YR 4/3), bottom half Brown (10YR 5/3), Poor grading, rounded to subrounded, slightly plastic, quartz, clay clasts(?) feldspar, massive w/o fractures, slightly moist, Root hairs throughout some limonite rotted grains also Trace caliche
								2.0		
								2.9 3.0		Fine to Med Clayey Sand - Higher sand content than above, Yellowish Brown (10YR 5/6) to Strong Brown (7.5YR 5/6 to 5/8), slightly coarser than above more rotten limonite, Pebble gravel at 3.4 ft. angular to sub rounded, well graded, massive, slightly moist
								3.4		
	4.0	4.0								NO RECOVERY 3.7-4.0 ft
	4.0	4.0						4.0		Fine to Medium Clayey Sand Reddish Yellow (7.5YR 6/8), Poor Grading, Subangular, slight plastic, rock frags, feldspar, quartz, massive, moist, trace root hairs
								5.0		Bentonite Marker DP core
	7.0	3.0					GC	5.5		As Above with some angular gravel 4.0-5.5 ft. May be more clay rich.
	Run #2 4.0-7.0 ft	Recovery 3.0 ft.						6.0		
								7.0		As Above 5.5-7.0 ft.
	7.0	2.0						7.9		2 clay intervals 7.7-8.0 and 8.9-9.2 ft. Clays Lt. Yellowish Brown (2.5Y 6/3) to Dark Yellow (10YR 6/6), Poor grading, Plastic, Massive, Moist, Trace carbonaceous material in lowermost.
								8.0		
								8.9		May be composed of fine sand sized clay pellets
9.2								9.0		TOP OF BED ROCK
9.2 Not to scale	Run #3 7.0-10.0 ft	Recovery 2.7 ft including 0.5 ft of sludge						9.2		No RECOVERY + SLOUGH 9.2-10.0 ft.
	10.0	10.0						10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20697
Location - North: East:
Date: 09-02-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: WOMAN CREEK
Total Depth: 13.0 ft
Company: TERRA Project No.: WARP-97
Sample Type: CONTINUOUS 2 INCH

EG&G LOGGING SUPERVISOR
APPROVAL Fred Wrigley DATE 12-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	0.0						10.0		
10.0 Box 2 of 2 10.0-13.0 ft 13.0	10.0 Run #4 10.0-13.0 ft 13.0	0.0 Recovery 4.0 ft 13.0						11.0 12.0 13.0		~~Input~~ RK 09/02/97 Claystone, mottled Pale Olive (5Y 6/3) to Brownish Yellow (10YR 6/6) well sorted 1 Pebble about 11.1 ft. (definitely in middle of core), massive, plastic, moist Trace carbonaceous material. Pebble may be "rotten" sandstone.
13.0	13.0	13.0						14.0 15.0 16.0 17.0 18.0 19.0 20.0		T.D. = 13.0 ft.

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20797
Location - North: _____ East: _____
Date: July 17 1997
Geologist: William M. Whitain
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: _____
Total Depth: _____
Company: TIERRA Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL Paul C. Dingley DATE 6-8-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0'	0.0		0.0				0.0		ORGANIC SILT Friable moderately yellow brown (10YR 5/4) very slightly moist. occasional quartzitic inclusions 0.0' to 2.0
	Run 1 0.0 to 4.0'	3.5'					OL	1.0		Large ROSE and Milky Quartz Gravel at ~~very~~ surface WMW 9-17-97
							GM	2.0		Silty Gravel with some sand friable moderate olive brown (5Y 4/4). DRY FROM 2.0 TO 2.3
							SM	2.3 3.0		SILT SAND ~~SILT~~ PALE OLIVE (10Y 6/2) DRY some Fe staining with trace ~~Fe~~ more Fe staining
	4.3	4.0'						3.5		No Recovery 3.5'-4.0'
	4.3	4.0					GW	4.0		Gravel well graded clean, quartzitic, dry 4.3 to 4.3
	Run 2 4.0 to 9.0	3.9'					GW	4.3 5.0		SAND with large Angular Gravel mixed moderately yellow brown (10YR 5/4) Friable 4.3' to 6.8' DRY to 5.6' slightly moist starting at 5.7' all the way to 6.6 becoming more moist very moist from 5.9' to 6.0' some silt
							SP	6.0		
	8.3	8.0						6.8 7.0		CLAY Pale olive (10Y 6/2) to Dark yellowish ORANGE (10YR 6/6) Friable to Blocky (Break up when dry out) DRY 6.8'-7.9'
	8.3	8.0					CL	7.9 8.0		No RECOVERY 7.9' to 8.0
	Run 3 8.0' to 12.0'	4.0'			Change		SM	8.5		SILTY SAND moderately yellow brown (10YR 5/4) friable very slightly moist grading to clay @ 8.5'
							GW	8.6		GRAVEL SAND medium grey 8.5' to 8.6' WELL Graded (NS)
					To Change Symbol.			9.0		SILTY ~~CLAY~~ BED 8.6' TO 12.0' moderate olive brown (5Y 4/4) with vertical Fe stained fractures no inclusions of rock, no visable signs of weathering beyond the thin fracturing that is Fe stained DRY
10.0								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20797
Location - North: _____ East: _____
Date: July 17 1997
Geologist: William M. Whiton
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: _____
Total Depth: _____
Company: TIERRA Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dugsby DATE 6-8-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	10.0		10.0				10.0		SAME AS ABOVE 8.6 TO 10.0' DRY
Box 2 of 2	RUN 3	4.0					CL	11.0		
	8.0 TO 12.0									
12.0	12.0	12.0						12.0		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: ~~01797~~ 21097
Location - North: _____ East: _____
Date: ~~082397~~ 082997
Geologist: J. Boylan
Drilling Equip.: ~~CME75-HSA~~ Geoprobe

Surface Elevation: _____
Area: ~~PU+D yard~~ Woman Creek
Total Depth: 8.0
Company: Tierra Project No.: _____
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dingsley DATE 11-6-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					CL	0.0		Silty clay w/sand and gravel, dry to sl. moist, slightly rooted, dark yellowish brown (10YR 4/4).
	Run 1: 0.0-4.0'	4.0'						0.2		Top of bedrock = 0.2'. Silty claystone. Claystone ~~silty and~~ Fe-stained @ top to yellowish brown (10YR 5/6); below 0.6, color is light olive brown (2.5Y 5/3) to brown (10YR 5/3), w/carbonaceous & Fe oxide flecks & streaks and light gray streaks. Slightly moist. Claystone below 1.7, silty claystone above. Color lightens to light brownish gray (2.5Y 6/2) below 2.0'. Fe oxide seam @ 1.9'.
								1.0		
								2.0		
								2.1		Sandy siltstone ~~with sand~~ with some clay - light brownish gray (2.5Y 6/2). Very quartz sand. Sl. moist. Bottom contact transitional.
								2.5		Clayey siltstone - light brownish gray (2.5Y 6/2) w/Fe staining below 3.7'. Occasional caliche clast, to ½" diam. Sl. moist. Fe oxide & carbonaceous flecks scattered throughout.
								3.0		
	4.0	4.0						4.0		Same as above, 2.5-4.0, w/Fe staining more prevalent. Grades to silty claystone below ~4.5'; very gradual shift. Fines to claystone below ~5.2', w/color darkening to light olive brown (2.5Y 5/3). Heavy Fe staining @ 6.1' and below, to 6.6'. Carbonized plant remains present below this. Sl. moist.
	Run 2: 4.0-8.0'	3.7' (incl. 0.2' slough)						5.0		
								6.0		
										Select hearing line
								7.0		
8.0	8.0	8.0								NO RECOVERY 7.5-8.0
								8.0		TD = 8.0
								9.0		
								10.0		

Box 1 of 1: 0.0-4.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21197
Location - North: East:
Date: 08/06/97 – 08/07/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE MACROCORE

Surface Elevation:
Area: WALNUT CREEK
Total Depth: 10.5
Company: TIERRA Project No.: WARD
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1 0.0 – 10.5 ft.	Run #1 0.0 – 4.0 ft.	Recovery 4.0 ft.		1?			GC	0.0		Gravel, Sand, Silty Clay, Dark Yellowish Brown (10YR4/2) Wet, Grass Weeds Roots Abundant
								0.6		Top of Weathered Bedrock(?)
								1.0		Silty Clay with Clay chip Gravel, Dark Yellowish orange (10YR 6/6), clay chips dark yellowish brown (10YR 4/2), some limonite stained fracture at 0.5 ft. with gravel (quartzite) Blocky plastic, moist, possible Vocs (rainbow meter)
								2.0		Fine Sandy (RPK) Silty Clay; Greenish gray (5G 6/1), some limonite mottling without obvious fractures, higher sand content 2.4-2.5 ft and 3.9-4.0 ft, moist. Possible Voc hits as above (0.6-2.0 ft).
								3.0		
	4.0	4.0						4.0		As Above 2.0-4.0 ft. Core very wet may have flowed into core barrel. Wet. No voc. Lower 0.3 ft Sandy clay – Clayey sand. (Preservation by cutting shoe.)
	Run #2 4.0 – 6.0 ft	Recovery 4.0 ft incl. 3.2 ft slough	Slough semi liquid not sample in core box					4.8		
								5.0		No Recovery 4.8 – 6.0. Semi liquid slough was not put in core box.
	6.0	6.0						6.0		
	Run #3 6.0 – 8.0 ft.	Recovery 4.0 ft incl. 2.1 ft slough	Slough not in core box.					7.0		Clayey Sand, fine grained, greenish gray (5G 5/1) massive, some limonite mottling 6.0-7.0 ft, wet, no voc hits. Mottling not contain clay fragments. RPK
	8.0	8.0						8.0		← Represents 0.8 ft semi liquid slough As Above 6.0 – 7.9 ft. No clay or limonite stains as above (6.0 – 7.9).
	Run #4A RPK 8.0 – 10.5 ft	Recovery 1.4 ft incl. 0.9 slough						9.0		
								9.2		No Recovery 9.2 – 10.5 ft.
10.0	10.0	10.0						10.0		No second sheet T.D. = 10.5 ft.

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Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 31297
Location - North: _____ East: _____
Date: 08/06/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: WALNUT CREEK
Total Depth: 10.0 ft.
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS — MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE AREA	BEDDING AREA	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.0		Clay, Sandy Silt, Gravel, Moderate Yellowish Brown (10YR 5/4) Abundant Rootes Vegetation, Wet.
								0.3		Top Weathered Bedrock.
										Silty(?) Claystone; Mottled Pale Yellowish Brown (10YR 6/2); Grayish Orange (10YR 7/4); Dark Yellowish Orange (10YR 6/6). Gravel (rounded) in clay 1.2 to 1.3 ft. No good fractures, Root hair at 1.3 ft. Moist.
								1.0		
								1.3		
								2.0		Does not crumble, sticks together breaks in blocks if forced. Slightly carbonaceous
								3.0		Low Mini Rae hit (65ppm) 3.0 to 3.0 ft. Dissapated in 10 min.
Box 1 of 3	0.0 - 8.0 ft.									Lower 0.3 ft matches below.
	Run #1	0.0 - 4.0 ft						4.0		Silty Claystone to Claystone; Pale yellowish brown (10YR 6/2) to 5.5 ft, Dark yellowish orange to 6.0 ft. Trace limonite fractures. Fractures hairline, most below 5.5 ft. Still breaks into blocks but slightly more crumbly than above. only slightly moist. Slightly carbonaceous.
		Recovery 4.0 ft								
	Run #2	4.0 - 6.0 ft						5.0		
		Recovery 2.0 ft.						6.0		As Above 4.0-6.0 ft. 0.3 ft of Dark Yellowish orange (10YR 6/6) at top. Rest Pale Yellowish brown (10YR 6/2). Trace limonite stain at 7.0 ft without obvious fractures.
	Run #3	6.0 - 8.0 ft						7.0		
		Recovery 2.0 ft.						8.0		As Above 4.0-6.0 ft. Light limonite stains about 8.0 ft without obvious fractures. Blocky to ~~8.~~ 9.5 ft. Crumbly to pieces below that. Some limonite at base.
8.0	8.0	8.0								
Box 2 of 2 8.0-10.0 ft	Run #4	8.0 - 10.0 ft.						9.0		
		Recovery 1.7 ft.						10.0		Total Depth = 10.0 ft. Measured with steel tape at 10.3 ft.
10.0	10.0	10.0								

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21397
Location - North: East:
Date: 08/05/97
Geologist: R. ROEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: WALNUT CREEK
Total Depth: 9.8ft
Company: TIERRA Project No.: UARP
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.0		Gravel, Sand, Silt, Clay, Light Brown (5YR 5/6) to Dark Yellowish Orange (10YR 6/6), more clay than in other holes in this line, some rootholes, moist.
								0.7		TOP WEATHERED BEDROCK
Box 1 of 2 0.0-7.3ft.	Run #1 0.0-4.0ft	Recovery 4.0 ft		—	2.5ft		CL	1.0		Claystone; Pale yellowish brown (10YR 6/2) to Dark Yellowish orange (10YR 6/6) mottled with limonite stains (Pale yellowish orange (10YR 8/6)), contains more silty material at 2.0 and 4.0ft. Horizontal limonite stained fractures 2.5-4.0ft, moist.
				—	3.1ft			2.0		
				—	3.6ft			3.0		VOC hit (65ppm PID) at approx. 3.0 ft dissipated in 10 min.
				—	3.8ft					
	4.0	4.0						4.0		Lowest 0.1 ft as below 4.0-5.3 ft.
	Run #2 4.0-6.0ft	Recovery 3.5ft						5.0		Silty Claystone; Light Bluish Gray (5B 7/1) to Medium Bluish Gray (5B 5/1) to Grayish orange (10YR 7/4). 4.0-5.0 Pale yellowish brown (10YR 6/2). Crumbles to flat flakes (fissile?), very slightly moist. No VOC's. No obvious limonite. Crumbling is spontaneous.
	6.0	6.0						6.0		As Above 5.0-6.0 (i.e. bluegrays). No VOC's. Dry. Silt content increases downhole.
	Run #3 6.0-8.0ft	Recovery 3.7ft including 0.4ft slough						7.0		
7.7								7.7		
7.3								7.6		No Recovery - slough 7.6-8.0ft
Box 2 of 2 7.3-9.7	6.0							8.0		As Above 6.0-7.6 ft. Medium to Dark Gray (N5 to N3). Very Carbonaceous. Slightly moist (more so than above).
	Run #4 8.0-9.7 Refusal	Recovery 3.0ft including 1ft slough						8.7 9.0		No Recovery - slough 8.7-9.7 ft.
							9.7			(Measured 9.8ft with tape, RPK 08/05/97)
9.7	9.7	9.7						10.4		TRIED TO GO BEYOND 9.7 But Could Not. Recovered 0.5ft of Slough. Put in core box.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21497
Location - North: _____ East: _____
Date: 08/04/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: WALNUT CREEK
Total Depth: 7.3 ft.
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE BARREL	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.6	0.0					GC	0.4		Gravel, Sand, Silt, Clay, Dark yellowish brown (10YR 4/2), some root hairs, crumbly to plastic, slightly moist to moist, No VOC.
Box 1 of 1 0.0—7.3 ft	Run #1 0.0-4.0 ft	Recovery						1.0		Top of Bedrock (0.4 ft.) (Silty?) Claystone; Pale yellowish brown (10 YR 6/2) with occasional limonite staining Dark yellowish orange (10YR 6/6), plastic break into blocks, fracture with limonite 1.7 and 2.3 ft., carbonaceous, moist, No VOCs
				—				1.7 2.0 2.3		
								3.0		
	4.0	4.0						4.0 4.3		As Above 0.4-4.0 ft, Pale yellowish brown to 4.3 ft; then medium dark gray (N4) to Dark yellowish brown (10YR 4/2), fracture with limonite at 4.2 ft.
	4.0	4.0		—				5.0		
	Run #2 4.0-6.0	Recovery 2.5 ft						6.0		
	6.0	6.0						6.3		AS ABOVE 4.0-6.0 (Silty?) RPK 8/14/97 Claystone; Dark gray (N3), crumbly to fissile, dry, No VOC's, some limonite staining 6.3 to 6.8 ft dark yellowish orange (10YR 6/6)
7.3	Run #3 6.0-7.3	Recovery 1.3 ft.						7.0 7.3		
7.3	7.3	7.3						8.0		Refusal at 7.3 ft. TD = 7.3 ft.
								9.0		
								10.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21597
Location - North: East:
Date: 08/04/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: WALNUT CREEK
Total Depth: 5.3 ft.
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.3		Gravel, Sands, Silt, Clay; Pale brown (5YR 5/2) to Dark yellowish orange (10YR 6/6), moist, No VOC. Some Root Hairs.
Box 1 of 1 0.0 — 5.3 ft.	Run #1 0.0 — 4.0 ft.	RECOVERY 4.0 ft.		1				1.0		Silty Clay to Clayey Silt, Pale yellowish brown (10YR 6/2) to Dark yellowish orange (10YR 6/6), crumbly to blocky fracture 0.3 — 2.3 ft, dry to that point, 2.3-4.0 slightly moist more plastic, horizontal fractures at 2.3 and 3.0 ft. with limonite staining, No VOC.
								2.0		↑ Top BEDROCK 0.3 ft.
								3.0		
	4.0	4.0						4.0		Clayey Silt, Light olive gray (5Y 6/1), crumbly, dry, no VOC
	Run #2 4.0-5.2 Refusal	Recovery 2.9 ft. includes 0.2 slough						4.5		As Above 4.0-4.5, Light gray (N7) to Medium bluish gray (5B 5/1), some limonite stain Dark yellowish orange (10YR 6/6), possibly along fractures but too crumbly to tell.
								5.0		No Recovery 5.0-5.2
	5.3							5.2		
	Run #3 5.2-5.3 ft Refusal!!	Recovery 0.6 ft all slough.						5.3		No recovery 5.2-5.3 (all slough)
								6.0		
								7.0		
								8.0		
								9.0		
								10.0		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 21697
Location - North: East:
Date: 08/01/97
Geologist: R. KOEHER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: WALNUT CREEK
Total Depth: 8.5 ft.
Company: TIERRA Project No.: WARD
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.2		GRAVEL SAND SILT CLAY, DARK YELLOWISH BROWN (10YR 4/2) ABUNDANT ROOT HAIRS, SLIGHTLY MOIST
										TOP WEATHERED BEDROCK
								0.6		SILTY CLAY, PALE YELLOWISH BROWN (10YR 6/2), BREAKS INTO BLOCKS, ABUNDANT ROOT HAIRS, SLIGHTLY MOIST, NO VOC.
								1.0		CLAYEY SILT, PALE YELLOWISH BROWN (10YR 6/2) CONTAINS VERTICAL(?) SILT FILLED FRACTURE (DARK YELLOWISH ORANGE 10YR 6/6) GRADES
								1.6		TO SILTY CLAY, MORE BLOCKY, LIMONITE ON FRACTURES, TRACE CARBONACEOUS ROOT HAIRS FOLLOW FRACTURE, DRY TO V. SLIGHTLY MOIST
								2.0		
								2.7		NO VOC HIT AT ALL.
								3.0		Heavy Limonite 2.7-3.7 ft.
								3.7		CLAY
								4.0		
								4.2		AS ABOVE (SILTY CLAY 0.6-4.0)
								4.6		Clayey Silt, Pale Yellowish Brown (10 YR 6/2) CRUMBLES EASILY, LIMONITE STAINED FRACTURE. V. SLIGHTLY MOIST, NO VOC.
								5.0		
								5.6		← HARD LIMONITIC/RUSTY LAYER AT BASE.
								6.0		FINE SAND, SILT, CLAY, DARK YELLOWISH ORANGE (10 YR 6/6), LOOKS CEMENTED, BREAKS INTO FLAT PLATES, DRY, NO VOC
								6.6		
								7.0		Clayey Silt AS ABOVE 4.2-5.6 Not competent for fractures, V. Slightly moist, no VOC
										— 7.4 Heavy Limonite stains — 7.8
								8.0		AS ABOVE 6.6-8.0 ft. No Limonite stainings.
								8.5		
								9.0		
								10.0		

Box 1 of 2 0.0-8.0 ft

Run #1 0.0-4.0 ft RECOVERY 4.0 ft

Run #2 4.0-5.6 ft RECOVERY 2.4 ft

Run #3 5.6-8.0 ft RECOVERY 3.7 ft.

Box 2 of 2 8.0-8.5 ft

Run 4 8.0-8.5 Recovery 1.8 ft including 0.9 ft slough

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 21797
Location - North: _____ East: _____
Date: 08/01/97
Geologist: R KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: WALNUT CREEK
Total Depth: 10 ft.
Company: TIERRA Project No.: WARP
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 0.0-8.0 ft.	0.0	0.0					GC	0.1		CLAY, SAND, GRAVEL, SILT & Dark Yellowish Brown (10YR 4/2) ABUNDANT ROOT HAIRS, MOIST, NO VOC.
							ML	0.5		~~TOP WEATHERED BEDROCK~~ CLAY, SILT, DARK YELLOWISH BROWN AT TOP GRADES DOWN TO DARK YELLOWISH ORANGE (10YR 6/6) AT BOTTOM, SOME ROOT HAIRS, MOIST, NO VOC
							CL	1.0		
	RUN #1 0.0 – 4.0 ft	RECOVERY 4.0 ft			45°			1.5		RPC ~~CLAY/SILT~~ ~~SILT CLAY~~ VERY PALE ORANGE (10YR 8/2) TO PALE YELLOWISH BROWN (10YR 6/2), SOME FRACTURES, FRACTURES LIMONITE STAINED, DRY, BREAKS INTO BLOCKS, NO VOC
								2.0		
								2.3		RPC ~~SILTY CLAY~~ ~~CLAY SILT~~. COLORS AND FRACTURES AS ABOVE 0.5-2.3 ft. SLIGHTLY MOIST, POSSIBLY CARBONACEOUS. DOES NOT BREAK INTO BLOCKS. NO VOC
								2.5		
								2.8		
								3.0		
					30°			3.3		CALICHE
	4.0	4.0						4.0		AS ABOVE 2.3-4.0 ft. PERCENT CLAY/SILT VARIES. NO VOC.
	RUN #2 4.0-6.0 ft	RECOVERY 2.7 ft						5.0		
								5.2-5.3		
								5.6		
	6.0	6.0						6.0		RPC ~~CLAYEY SILT~~ TO ~~SILTY CLAY~~ ~~SILT CLAY~~ AS ABOVE 0.5-2.3 ft. DOES NOT BREAK INTO BLOCKS, DRY TO SLIGHTLY MOIST, CRUMBLES NO VOC.
	RUN #3 6.0-8.0 ft	RECOVERY 3.2 ft.						6.5-6.8		
								7.0		
Box 2 8.0-10.0 ft.	8.0	8.0						8.0		AS ABOVE 6.0-8.0 ft. CRUMBLES, PIECES PLATEY.
								8.5		
	RUN #4 8.0-10.0 ft	Recovery 3.6 ft.						9.0		GRADES TO DARK GREY (N3) BELOW 8.5 ft.
	10.0	10.0						10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

T.D. at 10.0 ft, Measured with steel tape.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 21897
Location - North: _____ East: _____
Date: 07-31-97
Geologist: F. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: _____
Total Depth: 8.0'
Company: Merra Project No.: _____
Sample Type: Continuous Core.

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Run No. 1 - 0.0'-3.0'	Rec. 3.0'			45 vertical	iron		CL	0 1 2 3 4 5 6 7 8 9		0-0.3' - Clay - Trace Gravel - Dark yellowish Brown (10YR-4/2) Roots, Sl. Damp. 0.3-2.3' - Top of Bedrock Silty Claystone - Pale Yellowish Brown (10YR-6/2) with Dark Yellowish Orange (10YR 6/6) Limonite lens. - Some Mn O. Core friable to mod. friable - No Sig. Structure - Indicated iron. ~~bedding~~ (5-21-98). 2.3-8.0' - Claystone - Some Silt (- Core dry - indicated.) Color light olive gray (5Y-6/1) in top 0.3 ft. of interval and lower 2.0' of interval. Center portion grades to yellowish gray (5Y-7/2) with Grayish Orange (10YR-7/4) Limonite zones flec. and coated fractures. (interval appears bleached). Vertical fracture from 3.5' ≅ 3.5' - Heavy Limonite/Iron oxide coating - Some Heavy Mn O on of fracture surface underlie coating - 45° fracture with Fe O coating at 4.2' - other multiple fractures with Fe O coatings or stainings within interval. From 6.0'-7.0' core appears disturbed & recemented. - Organic debris in lower 2 ft.
Run No. 2 3.0'-6.0'	Rec. 2.0									
Run No. 3 6.0'-8.0'	Rec. 2.3'								TD	

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21997
Location - North: _____ East: _____
Date: 07-31-97
Geologist: F. Gregory
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: Walnut Creek
Total Depth: 9.0'
Company: Terra Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1							CL	0		0.0-0.2' Gravelly clay - Probably fill (road bed) material. Dark yellowish brown (10YR-4/2) Sl. damp - friable.
					Hor.			1		0.2'-2.2' Top of bedrock - Silty claystone - some v.f.g. S.S. Mod-friable. Indicated horizontal bedding color varies from zones of pale yellowish brown (10YR-6/2), Grayish orange (10YR-7/4) to Dark yellowish orange (10YR-6/6) Unknown iron staining mat. abund. - Appears to be mod. permeable in some intervals.
Run #1 0.0'-4.0'	Rec. 4.0'							2		
					Hor.			3		
								4		2.2'-4.0' - Silty claystone - Some S.S. - Sand more abundant than above, with some sandy claystone interval. Color varies as above - appears more permeable. Some heavy ~~stain~~ FeO (Hematite/Limonite) coated planar fractures or bedding planes. No sig. structure
Run 2:	Run 2: 4.0-6.0	4.2						5		
								6		4.0-6.0: Silty claystone some S.S. Approx 0.4' compacted clay/silt at top of interval. Rest of core contains abundant induced horizontal fractures accounting for excess recovery. Core same as above (2.2-4.0) except more clayey & less sand
	Run 3: 6.0-8.0	4.0						7		
								8		6.0'-7.5'± Clayey siltstone grad. Pale yellowish brown (10YR-6/2) with interbedded sediments that are Dark yellowish orange (10YR-6/6) [FeO stained]. Core very friable - very sl. damp.
	Run 4: 8.0-9.0	4.0						9		
	TD = 9.0'							10		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21997
Location - North: _____ East: _____
Date: 07-31-97
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: Walnut Creek
Total Depth: _____
Company: Tierra Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										7.5'–9.0' ~~7.5'–8.0'~~ Siltstone Med. light gray N-6 Last run of 1.0' recovered 4.0' of Core. - lower foot of core assume to be in place. Less Fe O staining than in above interval - Decreasing silt content with depth.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22097
Location - North: _____ East: _____
Date: 07-29-97
Geologist: E. Gregory
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: Walnut Creek
Total Depth: 8.0'
Company: Tierra Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Run No. 1 0-4.0' Open	0	Rec. 4.0'		70°	Hor. Fe		GC	0		0.0-0.4' Sandy Gravel - Some clay & silt - Dry - Dusky yellowish brown (10YR-2/2) Topsoil zone in top half of core - Dark yellowish orange (10YR-6/6) weathered interval in lower half. - Sediments well sorted - Gravel fred quartzite - Some broken.
	4.0-7.0			30°				1		0.4'-1.2'- Top of Bedrock Silty claystone - Dark yellowish orange (10YR 6/6) and Pale yellowish brown (10YR 6/2)
Run No. 2	6.0'	Rec. 2.0'			Hor.			2		Interval very friable - Abundant Fe Ox staining. Trends toward Horizontal bedding. Dry
								3		1.2'-4.0'- Claystone - Some silt.
								4		Dark yellowish orange (10YR 6/6) with Pale yellowish brown (10YR 6/2) mottling. Open fracture (~70°) extending from 1.6' to 2.3'
								5		30° fracture at approx 3'
								6		Good contact between silty claystone at 1.2'. Int. Dry
								7		Weathered - Abundant Fe Ox. Mod. friable. Bottom of interval contains more silt. Fe.
								8		4.0'-5.0'- Silty claystone - Interminged Pale yellowish brown (10YR-6/2) and Grayish orange (10YR-7/4). Mod. friable to
	TD = 8.0'							9		
								10		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22097
Location - North: _____ East: _____
Date: 7-29-97
Geologist: E. Brigsby
Drilling Equip.: Geoprobe

Surface Elevation: _____
Area: Walnut Creek
Total Depth: 8.0'
Company: Tierra Project No.: _____
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL _____ DATE _____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										4.0'-5.0'-Cont. To very friable - Some abund. Fe Ox. - Well weathered. Hor. bedding
										5.0'-6.0'- Claystone - Some silt. - Color change to pale yellowish brown (10YR. 6/2) to Dark yellowish brown (10YR. 4/2) Some very finely laminated intervals. Very heavy limonitic coatings and staining - Some MnO. - ~~60%~~ Extra core recovery Probably due to induced fracturing. - Very hard to split.
										6.0'-7.0'±. Claystone. Same as above except becomes alternating ~~w~~ Fe. olive gray ~~ex~~ (5Y 4/1) and Dark yellowish Orange ~~beds~~ (10YR. 6/6) beds. Breaks in horizontal plane - Mod to very friable.
										7.0'-8.0'- Silty Claystone - Same as above except all olive gray (5Y. 4/1). Induced Horizontal breaking (Accounts for ~~extra~~ ~~bone~~ ~~etc.~~ excess core recovery.)

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 22197
Location - North: _____ East: _____
Date: 07/28/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: WALNUT CREEK
Total Depth: 9.3 ft.
Company: TIERRA Project No.: WARP97
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

Top/Bottom of Core in Box	Top/Bottom of Interval	Feet of Core in Interval (Field Measurement)	Sample Number	Fracture Angle	Bedding Angle	Grain Size Distribution	USCS Symbol	Depth in Feet	Soil/Lithologic Log	Sample Description
0.0	0.0	0.0					GM	0.1		Gravel, Sand, Silt, Clay, Dark Yellowish Brown (10YR 4/2), Moist, Roots, No VOC Hits
							SC	0.5		Gravel, Sand, Silt, Clay, Light Brown (5YR 5/6) Dry TOP BEDROCK - No VOC Hits
	Run #1 0.0-2.0 ft.	Recovery 2.2 ft.						1.0		Fine Sand, Silt, Clay, Dark yellowish orange (10YR 6/6) to Grayish orange (10YR 7/4), fissile fracturing, RPK 7/28/97 some ~~occasional~~ limonite stains, carbonaceous, very slightly moist, No VOC hits
2.0	2.0	2.0						2.5		As As above. 0.5 to 2.0 ft.
Box 1 of 2 0.0-6.0 ft	Run #2 2.0-4.0 ft	Recovery 2.4 ft. (Slough) (Inclusion)						3.0		
								3.5		No Recovery 3.5-4.0 (Slough)
	4.0	4.0						4.0		As Above 0.5 to 2.0 ft. May be more clayey than above. Pale yellowish brown (10YR 6/2) to Dark yellowish orange (10YR 6/6)
	Run #3 4.0-6.0 ft.	Recovery 3.9 ft. incl. 0.8 slough						5.0		
6.0								5.2		No Recovery 5.2-6.0 (Slough)
6.0	6.0	6.0						6.0		As Above 4.0-5.2 ft.
Box 2 of 2 6.0-9.3	Run #4 6.0-7.3 ft	Recovery 2.9 ft. incl. .5 slough						7.0		
								7.3		As Above 4.0-5.2 ft.
	7.3	7.3						8.0		
	Run #5 7.3-9.3	Recovery 3.8 incl. 0.8 slough						8.5		No Recovery 8.5-9.3 (Slough)
7.3	9.3	9.3						9.0		
9.3	9.3	9.3						9.3		TD = 9.3 ft.
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22297
Location - North: East:
Date: July 24, 1997
Geologist: William M. White
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: WALNUT CREEK
Total Depth: 6.2'
Company: TIERRA Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GW	0.0		0.0 to 0.4' Gravel sand mixture moderate yellowish brown (10YR5/4) friable dry
	Run # 1 0.0' to 2.0'	2.0'					SM	1.0		SANDY Siltstone with some clay (moderate yellowish brown) (10YR 5/4) very friable, heavily Fe stained 0.0' to 1.4'
										Top of Bedrock 1.4'
	2.0	2.0								SANDY SILTSTONE, light olive gray (5Y 5/2) with some clay and very heavy Fe staining. DRY
	2.0	2.0						2.0		
Box 1 of 1	Run # 2 2.0' to 4.0'	2.0'					Sm	3.0		SANDY SILTSTONE, 2.0' TO 4.0', light olive gray (5Y 5/2) with some vertical Fe staining dry. NO VISABLE FRACTURING Beyond That indicated by very thin vertical and horizontal Fe staining. No visable organics Slightly plastic
	4.0	4.0						4.0		
	4.0	4.0								SAME AS ABOVE 2.0 - 4.0'
	Run # 3 4.0' to 6.2'	2.0'						5.0		
6.2'	6.2'	6.2'						6.0		
								6.2'		6.2' TD Boring
								7.0		
								8.0		
								9.0		
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22397
Location - North: East:
Date: July 23, 1997
Geologist: William M. White
Drilling Equip.: GEOPROBE
Surface Elevation:
Area: Walnut Creek
Total Depth: 10.6'
Company: TIERRA Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		Gravel SAND Silt mixture, 0.0' - 0.7' Dark Yellow brown (10 YR 4/2) clay with minor organic debris
Box #1 of 2 0 to 7.9	Run #1 0.0' to 4.0'	3.8'					GM			Top of Bedrock 1.0'
							ML	1.0		CLAYEY SILTSTONE, 0.7' to 3.8' Light olive Gray (5Y 5/2) with abundant Fe staining, some of which is vertical and some horizontal. DRY. No visable fracturing beyond that indicated by the thin Fe stain. No visable organics
								2.0		
								3.0		
	4.0'	4.0'						3.8'		
	4.0'	4.0'						4.0		4.0 - 5.5' logged from offset
	Run #2 4.0 to 7.0 (and Run #6)	Run #2 7-23-97 First attempt 1.5' offset recovered Add'l 1.5'					ML	5.0		SAME AS ABOVE 0.7 to 3.8' Light olive gray (5Y 5/2) w Th Fe staining
								5.5'		
								6.0		SAME AS ABOVE 0.7 to 3.8' except less Fe staining and grading to a silty clay at 7.0'
	7.0	7.0						7.0		
	Run #3	~~Run #3~~ MW 7-23-97						8.0		SANDY SILTSTONE, Brownish Gray (5YR 4/1) from 7.0' to 8.0' and light olive gray (5Y 6/1) from ~~8.0' to~~ MW 7-22-97 8.0' to 9.0' Some very thin horizontal Fe staining. VERY friable especially 8.5' to 9.0' No indication of fracturing (except iron staining)
Box 2 of 2 7.9 to 10.6'	7.0' to 9.0	2.0'								
	9.0	9.0						9.0		
	9.0 Run #5 9.0-10.6'	9.0 2.6'					SM			SAME AS ABOVE 7.0' to 9.0' was light olive gray (5Y 6/1) 9.0'-10.6'
10.6	10.0	10.0						10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22397
Location - North: East:
Date: July 23, 1997
Geologist: William M. Wilt
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: Walnut Creek
Total Depth: 10.6'
Company: TIERRA Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR

APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0 Box #2 10.6	0.0 Run #5 10.6	0.0 10.6					SM	0.0		SAME AS ABOVE 7.0' TO 9.0 WAS light olive GRAY
								10.6'		TD @ 10.6'
								11.0		
								12.0		
								13.0		
								14.0		
								15.0		
								16.0		
								17		
								18		
								19		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22497
Location - North: _____ East: _____
Date: 07/28/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: WALNUT CREEK
Total Depth: ~~[illegible]~~ 9.0'
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR

APPROVAL _____ DATE _____

Top/Bottom of Core in Box	Top/Bottom of Interval	Feet of Core in Interval (Field Measurements)	Sample Number	Fracture Angle	Bedding Angle	Grain Size Distribution	USCS Symbol	Depth in Feet	Soil Lithologic Log	Sample Description
0.0	0.0	0					OL	0.1		Sandy silt clay, Grayish Brown (5YR 3/2), abundant root hairs, moist, NO VOC HITS
	Run #1 0.0-2.0ft	Recovery 2.0'					GC			Gravel, sand, silt, clay, Dark yellowish orange (10YR 6/6) *VOC HIT at bottom dissipated to 0.0 in 5 min.
							GW	1.0		Gravel, quartzite, Light Gray (N7), angular. NO VOC HITS
							SC	1.2		TOP BEDROCK Fine sand, silty clay, Dark yellowish orange (10YR 6/6) to Light Brownish gray (5YR 6/1), crumbly to fissile. slightly moist. NO VOC HITS.
	2.0	2.0						2.0		As Above 1.2-2.0', (about 0.1' sloughed at top).
0-7.5ft	Run #2 2.0-4.0ft	Recovery 2.5'						3.0		
	4.0	4.0		1						Carbonaceous material 3.5-4.0 Vertical fractures, limonite fill. Horizontal fracture, limonite stain
	4.0	4.0						4.0		As Above 1.2-2.0ft.
Box 1 of 2	Run #3 4.0-6.0ft	Recovery 2.7ft						5.0		still carbonaceous. Occ fractures with variety of orientations with limonite fill or deposits.
	6.0	6.0						6.0		As Above 4.0-6.0ft
	Run #4 6.0-8.0ft	Recovery 3.1ft						7.0		Mostly Lt. brownish gray (5YR 6/1) to pale yellowish brown (10YR 6/2) Fracturing declines in amount down hole. (Core intervals accurate, core expanding in barrel a lot.)
7.5								7.5		
	8.0	8.0						8.0		As Above 4.0-6.0ft Mostly medium grey (N5), Minor Dark yellowish orange (10YR 6/6) 0.2ft slough at top (bentonite used to mark core top)
Box 2 of 2 8-10.0ft	Run #5 8.0-10.0ft	Recovery 2.0ft						9.0		
10.0	10.0	10.0						10.0		T.D = 10.0ft. (*)

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

(*) Note: Measured depth with steel tape = 9.0ft Driller realized he had only drilled to 9.0ft for run #5.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22597
Location - North: East:
Date: 09-12-97
Geologist: R KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 260 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dingly DATE 11-20-97

Top/Bottom of Core Index	Top/Bottom of Interval	Feet of Core in Interval (Field Measurement)	Sample Number	Fracture Angle	Bedding Angle	Grain Size Distribution	USCS Symbol	Depth in Feet	Soil Lithologic Log	Sample Description
								0.0		Clayey Sand
0.0	0.0	0.0					GC			Clay, silty sand (v. fine), occasional gravel, moderate brown (5YR 3/4), well graded, gravel subround, sand angular, disaggregates immediately and completely, massive, dry, no VOCs. Root hair common
								0.3		TOP OF BEDROCK (WEATHERED)
								1.0		Clayey siltstone to very fine sandstone, moderate yellowish brown (10YR 5/4) from 0.8-1.4 ft then grayish orange (10YR 7/4) to light gray (N7) to 4.0 ft, quartz, mafics, possibly some caliche, subangular, massive, crumbles easily, dry, root hairs to 1.6 ft. Top foot of interval may be reworked bedrock and/or colluvium.
								2.0		
0.0-9.1 ft.	0.0-4.0 ft.	Run #1 Recovery 3.0 ft.						3.0		No Recovery 3.0-4.0 ft.
13 of 10 of 44	4.0	4.0						4.0		
	4.5	4.0								As Above 0.8-3.0 ft.
								4.4		Unconsolidated (silt to very fine) sandstone, light gray (N7) with limonitic stains (4.4, 5.5, 6.0-6.4 ft) dark yellowish orange (10YR 6/6), angular quartz and mafics, well sorted, uncemented to subangular, poorly, falls apart on touch, dry, no VOC's
								5.0		
	4.0-8.0	Run #2 Recovery 4.0 ft.						6.0		
								6.4		As Above 0.8-3.0 ft, olive gray (5Y 4/1), limonite stain lower 0.2 ft, appears to be randomly fractured with possible caliche development along fractures, very slightly moist, firm, no VOC's
								7.0		
								7.4		Sandstone as in 4.4-6.4 No VOC's
	8.0	8.0						8.0		Clayey Silt-V. Fine Sandstone as in 6.4-7.4 ft. No VOC's
	8.0-11.0 ft.	Run #3 Recovery 3.9 ft. Including 0.4 of sloughed								Sandstone as in 4.4-6.4 ft. Silt - Fine sized grains. Clayey interval 9.1-9.3 with limonitic stains. Other thinner, less well developed clayey zones present, dominantly friable sandstone. Very slightly moist, No VOC's
9.1								9.0		
Bit Drt 9.1-11.0 ft.								9.1		
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22597
Location - North: East:
Date: 09-12-97
Geologist: R. Koehler
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 26 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-25-97

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 4 9.8-16.0	Run #4 11.0-14.0 ft. 41.0	Recovery 4.0 ft in 3.0 ft 0.5 ft slough						10.0		Sandstone See previous page.
								10.3		Vertical fracture with caliche 10.3-10.9 ft.
								10.9		
								11.0		4.4-6.4 RPK 9/15/97 Sandstone as in ~~Lit 7.4~~ ft. No obvious caliche, very slightly moist, no VOC's. silt to fine grained.
								12.0		Clayey (silt to fine grained) Sandstone, mixed grayish orange (10YR 4/4), light gray (N 7), and dusky yellow (5Y 6/4), heavier limonitic stained zones at 13.0, 13.4, 13.8 ft, quartz and matrix, subangular to angular, well sorted, not porous but limonite suggests open horizontal fractures, mixed friable, firm to slightly plastic, slightly moist. no VOC's.
								13.0		
								13.4		
								13.8		
	14.0	14.0						14.0		Clayey ~~Silt~~ Sandstone As Above 12.0-14.0 ft. Clay clasts or clay dominant 14.0-14.8, 15.7-15.5 ft. Softer more plastic, less crumbly than above. Limonitic stains 14.0-14.5 ft, 15.2-16.0 ft. General color moderate yellowish brown (10YR 5/4) to dark yellowish orange (10YR 6/6)
	Run #5 14.0-16.0 ft	Recovery 3.0 ft including 0.7 ft. slough						15.0		
	16.0	16.0						16.0		
Box 3 of 4 16.0-30.0 ft	Run #6 16.0-18.0 ft. 18.0	Recovery 3.6 ft including 0.8 ft slough						16.0		Clayey ~~Silt~~ Sandstone As Above 12.0-14.0 ft. May be very fine as opposed to fine grained sand. Prominent clay zone 16.3-16.4, prominent limonite zone 17.7 ft. more crumbly than plastic (compared to 14.0-16.0) slightly moist, no VOC's. General color as in 14.0-16.0 ft interval.
								17.0		
								17.7		
								18.0		
	Run #7 18.0-30.0 ft	Recovery 4.0 ft including 1.7 ft slough						19.0		Clayey ~~Silt~~ Sandstone As Above 12.0-14.0 ft. May be slightly coarser (silt to fine grained) from 18.5-19.0 ft. Heavy limonitic stains at 18.1 and 18.4 ft. Seems to be slightly more moist than above. General color as in 14-16.0 ft. interval.
								20.0		

Amount Clay Decreases

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22597
Location - North: East:
Date: 09-12-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 26.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-25-97

TOP/BOTTOM OF CORE BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENTS)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION	
20.0	20.0 Run #8 22.0	Recovery 2.6 ft. Including 1.3 ft short (1)						20.0		As Above 12.0-14.0 ft. Clayey Silt-Sandstone. Probably less clay than above, core liner wet, some clay lumps especially 20.5 ft., limonite concretion at 21.5 - approx 1 cm long. soft, very moist, no UOCs.	Relatively Clean (Least Clay)
Box 4 of 4 20.0-26.0 ft.	22.0 Run #9 24.0	22.0 Recovery 2.0 ft.						21.0			
	24.0 Run #10 26.0	24.0 Recovery 2.0 ft.						22.0		As Above 20.0-22.0 ft. (Clayey Silt-Sandstone) Relatively clean, silt to very fine grained, soft to firm, moist. Color as above between moderate yellowish brown (10YR 5/4) and dark yellowish orange (10YR 6/6)	
26.0								23.0			
								24.0		As Above 20.0-22.0 ft. more clayey than 22.0-24.0 ft. Especially clayey 24.9-25.5 ft. with heavy limonite stain at top and bottom of this interval.	More Clay
								25.0			
								26.0		T.D. = 26.0 ft.	
								27.0			
								28.0			
								29.0			
								30.0			

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22697
Location - North: East:
Date: 09-17-97 8PR 09/18/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE
Surface Elevation:
Area: B-PONDS
Total Depth: 20.0ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		
Box 1 0.0-10.0ft	0.0 Run#1 0.0-4.0ft	2.5ft Recovery			Top of Bedrock		GC	1.0		Clay, Silt, Sand, Gravel, dark yellowish brown (10YR 4/2), well graded, gravel angular-fractured, not plastic, gravel composed of granite and quartzite, massive, dry, disaggregated, no VOC's, root hairs throughout.
								1.6		
							GW	1.9		Gravel, up to 3cm, angular, fractured, quartzite, fine medium gray (N5), dry, disaggregated.
								2.0		Clayey sandstone, dark yellowish orange (10YR 6/6), silty fine sand, angular to subangular, well sorted, not porous, not cemented, breaks into soft blocks, slightly moist, no VOC's
								2.5		
								3.0		No Recovery 2.5-4.0ft
	4.0	4.0						4.0		Top of Bedrock
	4.0 Run#2 4.0-7.0ft	3.0ft Recovery including 0.3ft sparsh.						5.0		Clayey sandstone as above 1.9-2.5, semi horizontal fractures with caliche common, suspect clay clasts but these difficult to see, possibly mm size, limonite stains 4.1, 4.8, 5.7, 6.4ft, prominent slightly moist, no VOC's root hairs 4.0-4.3ft. Quartz, metamorphic frags, quartz ±22)
								6.0		
	7.0	7.0						7.0		As Above 1.9-2.5 and 4.0-7.0ft. Less prominent caliche and limonite stains, still soft, friable. may be "bleached" out in lowest 0.3ft (very light gray, N8), no VOC's
	7.0 Run#3 7.0-10.0ft	3.0ft Recovery including 0.3ft sparsh.			30°			8.0		
								8.5		Claystone, light olive gray (5Y 6/1) to moderate yellowish brown (10YR 5/4), well sorted, firm, 30° fractures with caliches, slightly moist, no VOC's
								8.9		
								9.0		Sandstone As Above 1.9-2.5ft and 4.0-7.0ft.
10.0								10.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22697
Location - North: East:
Date: 09-15-97 and 09-16-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 20.0 ft
Company: TERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL F. Dingley DATE 11-5-97

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FOLIATION ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	10.0						10.0		
Box 2 of 3 10.0-16.3	Run #4 10.0-13.0 ft	13.0				Wet		10.7		Clayey Sandstone, silt to fine grained, light olive gray (5Y 6/1) mottled with limonite (dark yellowish orange (10YR 6/6)), well sorted, angular-subangular, non porous, firm, massive, slightly moist, No VOCs.
								11.0		(*) Clayey Sandstone, silt to medium grained, clay clasts, heavy limonitic staining, light brown (5YR 5/6) to dark yellowish orange (10YR 6/6), sand subrounded to rounded qtz sand, sand unconsolidated, may be crs sand in subvertical fractures in clay to clayey fine sandstone, slightly moist, no VOCs.
								11.3		
								12.0		Clean, silt to medium sandstone, light olive gray (5Y 6/1) & limonitic - light brown (5YR 5/6) to dk yellowish orange (10YR 6/6), unconsolidated/friable, quartz, trace qtzite, tr ironstone nodule, massive, moist, no VOCs.
								12.1		
								12.8		Clayey Sandstone (silt-v. fine) to silty sandy clay, Light olive gray (5Y 6/1), firm, massive, non porous, slightly moist
								13.0		Clay clasts in Sand as in 11.3-12.1.
								13.4		As above, unconsolidated, moist, Quartz + mafic RF. 13.8-13.0 Med Sand, Qtz and mafics, rounded.
								13.7		Medium to Crs Sandstone, some pebbles and clay clasts, heavy limonite stain - moderate brown (5YR 4/4), rounded,
								14.0		Med SS, clay clasts to cm, Mod. Yellish Brown, poor sorting, unconsolidated, wet, porous, No VOCs.
								14.1		Silt to Fine SS, Trace clay, Pale (10 YR 5/4), unconsolidated, porous, quartz and mafics, rounded, wet, no VOCs.
								14.7		yellowish brown (10YR 6/2) to limonitic dark yellowish orange (10 YR 6/6), quartz + mafics, subangular, firm, moist, No Recovery 14.1-15.0
								15.0		limonite on fractures at base no VOCs
								16.0		Silt to Fine Sandstone, pale yellowish brown (10YR 6/2) to limonite stained (dark yellowish orange 10 YR 6/6), possibly clayey, well sorted, subangular, quartz and mafics, firm, crumbly to slightly plastic, non porous, slightly moist, No VOCs.
16.3	Run #5 15.0-17.0 ft	4.0 ft						16.1		Clay clasts to Clayey Sandstone, very fine, colors as 15.0-16.1, subangular, well sorted, firm, slightly plastic,
16.3		Recovery including 1.2 ft of sand						16.3		limonite or magnesite filled fracts, slightly moist, no VOCs.
										Clayey Sandstone as in 15.0-16.1
								17.0		No Recovery 17.0-19.0. Hole probably caved in and we over cored several pieces of surface gravel. These caught in core liner, fractured liner.
								18.0		Some slough saved in core box. Medium unconsolidated sand, some clayey pieces also.
Box 3 of 3 16.3-20.0 ft.	Run #6 17.0-19.0 ft	0.0 ft Recovery 0.0 ft Sand bag retrieved						19.0		
	Run #7 19.0-20.0	Recovery 0.0 ft no slough						20.0		Sandy Claystone, pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2) with limonite stains, dark yellowish orange (10YR 6/6), silt to very fine sand, well sorted, subangular (?), non porous, firm, quartz, moist, no VOCs.
20.0	20.0	20.0								

(*) Sand (medium grained) injected up into fine grained clayey sandstone ?? sandy clay...

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: #22797
Location - North: East:
Date: 10/22/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-Ponds
Total Depth: 14.0
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - 2"

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dougherty DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0.0		Clayey Sand, some silt
0.0 ft.	0.0	0.0					SC			~~Clay, silt~~, Very fine sand; very dark brown (10YR 2/2), moist, root hairs, worms, massive, soft
								0.5		~~Clay, silt~~ Silty Clay
								1.0		~~Clay, silt~~, Very fine to medium sand; grades from very dark brown (10YR 2/2) at top to dark yellowish brown (10YR 4/6) at bottom; poor grading; subangular to subround, hard at top grades down to soft and slightly plastic at bottom, breaks into ~~coins~~ stacked coins (1"), massive, dry at top moist at bottom, contains some clasts composed of well sorted medium quartz sand, well rounded and cemented with limonite. Composition: quartz, granite RF, mica, mafics. Root hairs to 2 ft. Minor gravel 0.5-0.7 and 2.7-2.9 ft. quartzite and concretions
	Run #1 0.0-04.0 ft.	Recovery 3.0 ft					CL			
								2.0		
								3.0		No Recovery 3.0-4.0 ft.
	4.0	4.0						4.0		
0.0 ft.	4.0-7.0 ft	Recovery 2.5 ft.					CL	5.0		As Above 0.5-3.0 ft. Dark yellowish brown (10YR 4/6). Occasional quartzite gravel (4.0-4.3, 6.0-6.5 ft especially), generally moist, soft, slightly plastic, some limonite or manganese coating on some sand grains. May be slightly porous. Clay content decreases down.
	Run #2							6.0		
								6.5		No Recovery 6.5-7.0 ft.
	7.0	7.0						7.0		As Above 0.5-3.0 ft and 4.0-6.5 ft. Clay content decreasing rapidly, wet, soft, gravel at 7.3 and 7.7 ft
Box 1 of	Run #3 7.0-11.0 ft	Recovery 3.5 ft including 0.2 ft shale					CL	8.0		Top Bedrock
								9.0		Sandstone; light gray (10YR 7/2) to light brownish gray (10YR 6/2) with some limonite staining (brownish yellow 10YR 6/8); medium grained well sorted subround to round, mostly quartz with trace mafics; unconsolidated, wet, porous.
								10.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #22797
Location - North: East:
Date: 10-22-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B - PONDS
Total Depth: 14.0
Company: TERRA Project No.: WARP-97
Sample Type: CONTINUOUS - 2"

EG&G LOGGING SUPERVISOR
APPROVAL Paul C. Dingley DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								10.0		
Box 1 of 2	Run #3	See Prev Page						10.3		See Above (previous page)
										No recovery 10.3 - 11.0 ft.
								11.0		
								11.3		As above 8.0-10.3 ft. May be slightly clayey 12.5-13.5 ft. Porous, wet, unconsolidated
								12.0		
								13.0		
Box 2 of 2 11.3-14.0 ft.	Run #4 11.0-14.0 ft.	Recovery 4.0 ft.						14.0		Claystone, possibly silty; light olive brown (2.5Y 5/3) to grayish brown (2.5Y 5/2) with some limonitic staining associated with sand (olive yellow 2.5Y 6/8), massive, firm but slightly plastic, lens of limonitically stained clasts in middle med. sand sized, no obvious fractures though does break into irregular flat sided pieces.
								15.0		
								16.0		
								17.0		TD = 14.0 ft
								18.0		
								19.0		
								20.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22897
Location - North: East:
Date: 09-08-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 24.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dwiggins DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0.0		Silty Clay - some
0.0	0.0	0.0					GC			Fine sand ~~silt, clay~~ with occasional gravel, gravel angular to subround, quartzite(?); dark brown (7.5YR 3/2); friable, dry, root hairs throughout, vegetation at top; no VOC's.
								1.0		TOP OF BEDROCK (WEATHERED) — Transitional/ Claystone grading down to siltstone/sandstone below; Silty to fine sandy, quartz, mafics, mica(?), some rotten limonitic grains (larger? may be coated root hair) well sorted, subround(?), firm, massive, very slightly moist, root hairs common. No VOC's.
								2.0		Dark yellowish brown (10YR 4/4) Possibly clay clasts - coarser than other sands.
								2.7		RPK
								3.0		Fine sandstone, ~~occ~~ occasional silt or medium sand, all clayey, grades up, light brownish gray (10YR 6/2) to grayish brown (10YR 5/2), grain composition as above - 23, well sorted, well rounded, massive, friable and dry, occ. roots, No VOC
								3.6		No Recovery 3.6-4.0 ft.
8.0	4.0	4.0						4.0		Fine sandstone, occasional silt or medium sand, clayey; quartz, mafics, feldspar(?); subround to round; well sorted light olive gray (5Y 6/2) mottled by limonitic stains (10YR 5/8), caliche(?) outlines small nodules (4.7-5.0 ft.) hollow limonitic concretion ≈ 5mm x 20mm at 5.5 ft, rare root hairs. No VOC's. slightly moist
				4.7 Nodular 5.0				5.0		
								5.5		
								6.0		As Above 4.0-6.0 ft. Less clayey, gray (10YR 6/1) to limonitic mottled - brownish yellow (10YR 6/8) no obvious nodules, caliche, or concretions, slightly moist, no VOC's.
								7.0		
8.0	8.0	8.0						8.0		Gravel, round to subround, 1 spindly up to 3 cm, most 1 cm, quartzite in sand matrix, slightly moist.
						↓ well wet		8.2		
								9.0		RPK 9/8/97 Claystone, light brownish gray (2.5Y 6/2) to grayish brown (2.5Y 5/2), occasional limonite staining without organized fractures, black carbonaceous material common, crumbles easily, slightly moist, massive, no VOC's.
								10.0		No Recovery 9.7-10.0 ft.

Box 1 of 3 0.0 - 8.0 ft.
Box 2 of 3 8.0 - 17.9 ft.

Run #1	0.0-4.0 ft.	Recovery 3.6 ft.	
Run #2	4.0-6.0 ft.	Recovery 2.6 ft.	including 0.3 ft slough
Run #3	6.0-8.0 ft.	Recovery 2.4 ft.	including 0.4 ft slough
Run #4	8.0-10.0 ft.	Recovery 2.5 ft.	including 0.6 ft. slough

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22897
Location - North: East:
Date: 09-08-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 24.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Bingley DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0 / 12.0 ft. Run #5 10.0-12.0 ft.	10.0 / 0.0 ft. Recovery (prob. fell out)						10.0		No Recovery 10.0-12.0 ft (suspect wet core slid out of core liner)
Box 2 of 3 8.0-17.9 ft.	12.0 / 12.0 / 13.0 ft. Run #6 12.0-13.0 ft	12.0 / 1.0 ft. Recovery						11.0		
								12.0		Claystone as above 3.0-9.9 ft, grades down, lacks carbonaceous material, drier than above, harder
								12.5		Silty/Fine Sandy Claystone (Possibly Clayey Siltstone/Sandstone - too fine to see clearly), lt. brownish gray (2.5 Y 6/2) to grayish brown (2.5 Y 5/2), random healed (limonite) fractures occasional, massive, well sorted, hard no vocs
	13.0 / 13.0-15.0 ft. Run #7 13.0-15.0 ft	13.0 / 1.2 ft. Recovery						13.0		
								14.0		As Above 12.5-13.0 ft
								14.2		
	15.0 / 15.0-17.0 ft. Run #8 15.0-17.0 ft	15.0 / 3.0 ft. Recovery						15.0		As Above 12.5-13.0 ft.
								16.0		
	17.0 / 17.0-19.0 ft. Run #9 17.0-19.0 ft	17.0 / 2.2 ft. Recovery						17.0		As Above 12.5-13.0 ft.
17.9								18.0		
17.9 / Box 3 of 3 17.9-24.0 ft.	19.0 / 19.0-21.0 ft. Run #10 19.0-21.0 ft	19.0 / 2.1 ft. Recovery		30 / 30	Limonite (stain)			19.0		Begin 09/09/97 Silty-Fine Sandy Claystone to Clayey Siltstone/Sandstone As Above 12.5-13.0 ft. Possible limonite healed fracture at 19.5 other random orientation. Limonite fractures present
								20.0		
20.0	20.0	20.0								

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22897
Location - North: East:
Date: 09-09-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 24.0 ft.
Company: TERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACRO CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Bragby DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
20.0	Run #10 19.0-21.0 ft.	Recovery 2.1 ft.						20.0		See Above
21.0		21.0						21.0		21.0-21.1 AS ABOVE 12.5-13.0, probably sandier.
								21.1		Claystone, minor silt, darkens downward from dark yellowish brown (10YR 4/2) to moderate brown (5YR 3/4); well sorted, ~~some~~ small amount carbonaceous material, hard to crumbly, some immobile limonite filled fractures, slightly ~~[illegible]~~ moist to dry.
Box 3 of 3 19.9-24.0 ft.	Run #11 21.0-24.0 ft.	Recovery 3.0 ft.		10° 1.6°				22.0		
								23.0		
24.0		24.0						24.0		T.D. 24.0 ft.
								25.0		
								26.0		Geologic Logging Completed 09/09/97
								27.0		Well Installed/Completed 09/10/97
								28.0		
								29.0		
								30.0		

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22997
Location - North: East:
Date: 10-23-97
Geologist: R. Koehler
Drilling Equip.: Geoprobe - Macrocore

Surface Elevation:
Area: B-Ponds
Total Depth: 16.5
Company: Tierra Project No.: Wayp 97
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL Fred Bright DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey sand - some
0.0	0.3	0.0					SC	0.0		Silt, ~~Sandy Clay~~, with occasional Gravel, Dark olive brown (2.5Y 3/3), fine quartz, granitic matic sands, poorly graded, angular to subround, dry, breaks into coin shaped pieces, hard, root hairs throughout.
								1.0		
								2.0		Clayey sand - some
								2.2		Silt, ~~Sandy Clay~~, Sand clasts, Trace gravel (3.5 ft) grayish brown (10YR 5/2), brownish yellow (10YR 6/8), very pale brown (10YR 7/4) - mottled, mostly fine sand - quartz, granitic, matics, some medium well rounded frosted sands appear to be from clasts or some material common sand - subangular; poorly graded, firm, dry, Trace root hairs
								3.0		
								3.5		
										No Recovery 3.5-4.0 ft.
								4.0		As Above 2.2-3.5 ft. More medium sand grains mixed in, clean medium sand intervals at 4.7-5.0 ft and 5.3-5.6 ft. Gravels (quartz, quartzite, granitic) 4.3, 4.6, & 9 ft. slightly moist to dry, firm, unconsolidated sands collapse. Iron stains heavy at bottom.
								5.0		
								5.75		Top Bedrock?
								6.0		Sand, variably clayey; very pale brown (10YR 3/4) to light gray (2.5Y 7/2), fine, subangular to rounded, quartz and matics, well sorted, variably porous, unconsolidated, moderately friable to friable, massive, slightly moist to moist. Porosity probably controlled by fine size more than clay content. Clay content probably low. Iron oxide concretions, 1 gravel clast as marked.
								7.0		
								8.0		As Above 5.75-9.0 ft. Wet, high content of subround to round grains. Clean little clay. Unconsolidated
								9.0		
								9.3		
								10.0		

Box 1 of 2 0.0-9.3 ft.

0.0	4.0	Run #1 0.0-4.0 Recovery	3.5 ft.
4.0	8.0	Run #2 4.0-8.0 ft Recovery	4.0 ft.
8.0	9.3	Run #3 8.0-11.0 ft Recovery incl. 0.7 ft slough	3.1 ft

OK

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22997
Location - North: East:
Date: 10-23-97
Geologist: R. Koehler
Drilling Equip.: Geoprobe - Macrocore

Surface Elevation:
Area: B-Ponds
Total Depth: 16.5 ft
Company: Tierra Project No.: WARP-97
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 9.3-16.5 ft.	Run #3 10.0-11.0	See Previous Page						10.0		See Previous Page
								10.4		No Recovery 10.4-11.0 ft.
	Run #4 11.0-14.0 ft.	11.0-14.0			oops! Not clayey			11.0 RPK 10/23/97		As above 5.75-8.0 wet, unconsolidated.
								11.7 12.0		Clayey Sandstone, light yellowish brown (2.5Y 6/3) to brownish yellow (limonite stained) (10YR 6/8), very fine sand, quartz and mafics, subangular to subround, well sorted, slightly porous, uncemented, friable, massive, wet to moist.
								13.0		
	14.0	14.0						14.0		
	14.0 Run #5 14.0-16.5 ft	14.0 Recovery 4.0 ft incl. 2.0 ft slough								Sandstone (unconsolidated may be slough), light gray (2.5Y 7/2), very fine to fine, quartz and mafics, subangular to round, frosted, porous, wet.
								15.0		Claystone, dark gray (5Y 4/1), well sorted, non porous non cemented, trace carbonaceous matter, heavy limonite stain on fractures, massive
16.5								16.0		16.0-16.5 No recovery
16.5	16.5	16.5						16.5		TD = 16.5 ft.
								17.0		
								18.0		
								19.0		
								20.0		

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(1) Badly broken core, accurate footage measurements not possible.
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23097
Location - North: _____ East: _____
Date: 10-23-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation: _____
Area: B-Ponds
Total Depth: 15.0
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey Gravel - some.
0.0	0.0	0.0					GC	0.0		~~Clay~~, silty sand ~~[illegible]~~ brown (10YR 5/3), granitic and quartzite gravel, quartz, granitic, mafic, quartzite sands, crumbles, friable, dry, root hairs throughout. Gravel rounded to fractured.
								1.0		
							CL	1.2		Clay with some sand and gravel olive gray (5Y 4/2), quartz, granitic, chert gravel, caliche, well graded, angular to rounded gravel and sand, firm
								1.6		
							SC	2.0		Clayey sand with gravel at bottom (trace), dark brown at top (10YR 3/3) mottled and grading down to light brownish gray (2.5Y 6/2) with limonite stains at bottom, very fine sand, subangular to subrounded, quartz mafics granitic 1.6-2.1 dry, rest very slightly moist, top 0.5 crumbles, rest firm to hard, root hairs
								3.0		
								4.0		
Box 1 of 2 0.0-9.0 ft.	Run #1 0.0-4.0 ft	Recovery 3.8 ft.								
	4.0	4.0		/				5.0		Clayey Sand with trace gravel as marked, generally light brownish gray (10YR 6/2), some limonite staining in top 0.5 ft, caliche in top 1.0 ft and in lower 0.5 ft., moist, firm, massive,
								6.0		
								6.3		Top of Bedrock sandstone
	Run #2 4.0-8.0 ft	Recovery 4.0 ft.						7.0		~~Fine Sand~~ (less clayey or not clayey than above 4.0-5.2) one gravel as marked, light brownish gray (2.5Y 6/2) with limonite staining, fine possibly medium sand (esp at bottom), subangular to rounded, well sorted, porous, wet, caliche appears on drying, possibly crossbedded,
								8.0		
	8.0	2.0								
9.0	Run #3 8.0-11.0 ft	Recovery 3.8 ft incl. 0.7 ft slough.						9.0		Sandstone (unconsolidated), light gray (N7) to light yellowish brown (2.5Y 6/3), fine some medium sand, quartz mafics (or dark chert), possibly some clay clasts? (1 cm), clay clast may contain caliche, soft, moist, friable, in bottom 0.5 ft some limonite or manganese coated grains. Limonite stain heavy right at top, decreases down
								10.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23097
Location - North: _____ East: _____
Date: 10-
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE-MACROCORE

Surface Elevation: _____
Area: B-Ponds
Total Depth: 15.0
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL: [signature] DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
B 2 of 2 9.0-15.0 ft.	Run #3 8.0-11.0 ft	Recovery See Prev. page						10.0		See previous page
	Run #4 11.0-13.0 ft	Recovery 4.0 ft incl. 2.0 ft of slough	slough not saved					11.0		Fine to medium grained sand as above 8.0-11.0 ft. Ironstone concretions at 11.6 ft, possibly clayey or clay clast about 12.8 ft.
	13.0	13.0						12.0		
	13.0	13.0		Material inside BOX may be slough Material was soupy wet sand in spots Cor bound				13.0		? Unconsolidated sand as above 8.0-11.0 ft.
	Run #5 13.0-15.0 ft	Recovery 4.0 ft 0.9 ft of 3 slough						14.0		
15.0								14.1		Clayey Sandstone Gray (light gray (N6-N7), mottled with reddish yellow (5YR 6/8), very fine sand, opaque, dark gray, firm, moist, not porous, ~~some~~ carbonaceous material, massive TRACE
15.0	15.0	15.0						15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

T.D. = 15.0 ft.

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23197
Location - North: East:
Date: 09-19-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 17.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS — MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Brigsby DATE 11-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0.0		
Box 1 of 2 0.0 — 9.3 ft.						GC				Clay, Silt, Sand, Gravel; dark yellowish brown (10 YR 4/2) Gravel - angular (fractured) to subangular, quartzite, granitic and mafic rock fragments, fine angular to subangular sand, disaggregated, dry, no VOCs. Trace Rootlets
								1.0		
							SC			Clayey Sand with occasional gravel, grades down from dark yellowish brown (10 YR 4/2) to dusky yellowish brown (10 YR 2/2) to moderate yellowish brown (10 YR 5/4), angular to subround gravel, sand fine grained to medium quartz, mafics, feldspar, non-porous, hard, very slightly moist, no VOCs. ● = Gravel, angular • = Sand
								2.0		
								3.0		
								3.7		NO RECOVERY 3.7-4.0 ft.
	4.0 Run #1 0.0-4.0 ft.	4.0 Recovery 3.7 ft.						4.0		Clayey Sand As Above 1.0-3.7 ft.
	4.0	4.0		Top of Bedrock				4.3		Unconsolidated Medium sandstone, Subround, quartz mafics some frosted, uncemented, porous, slightly moist, moderate yellowish brown (10 YR 5/4) with trace limonite staining (dark yellow orange (10 YR 6/6)
								4.5		Claystone to Sandy Claystone (rare), pale yellowish brown (10 YR 6/2)
								5.0		
								5.4		Clayey Sandstone, pale yellow brown (10 YR 6/2) with limonite stains (dark yellow orange (10 YR 6/6), silt to fine sand, subangular to subround, quartz and mafics, well sorted, irregular fracture some with limonite cement, non-porous, firm, ironstone concretion as marked, slightly moist, No VOCs. Silt to clay fine sand, quartz?, subangular?, firm to hard, possibly clay clasts, irregular fracture around clasts with Caliche, slightly moist, No VOCs.
								6.0		
								7.0		
								7.3		NO RECOVERY 7.8-8.0 ft.
	4.0 Run #2 4.0-8.0 ft.	4.0 Recovery 4.0 ft including 0.2 ft shale						8.0		Clayey Sandstone As Above 5.4-7.8 No VOCs, slightly moist. More Clay Less Clay
	8.0	8.0						8.4		Claystone to Sandy Claystone As Above 4.5-5.4 ft. No caliche, slightly carbonaceous, soft to firm slightly moist, no VOCs
								9.0		
9.3								9.2		← Clean Fine Sand Laminae 0.02 ft thick
9.3	8.0-11.4 ft Run #3	3.4 ft Recovery including 0.2 ft shale						9.3		Clayey Sandstone As Above 5.4-7.8 (main caliche?) cemented fracture at bottom More Clay
								10.6		OVER/NEXT PAGE Less Clay

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23197
Location - North: _____ East: _____
Date: 09-19-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: B-PONDS
Total Depth: 17.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Dingley DATE 11-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.3-17.0 ft.	Run #3 8.0-11.0 ft.	Recovery 3.4		—				10.0		Color more mottled, some fractures and patches of very light gray (N8) = calicle?), possibly some manganese cement. Nodular/irregular fracture. Small VOC's that vented!
	11.0							11.0		Clayey Sandstone As Above 5.4-7.8 ~~No obvious~~ obvious fractures, much limonite staining does not appear less clayey at bottom more clayey at top. Small VOC hits from upper 1.0 ft. Fractures has limonite or Mn cement.
	Run #4 11.0-14.0 ft.	Recovery 3.8 ft including 0.4 ft slough.		—				12.0		
	12.9							12.9		
								13.0		Claystone, pale yellowish brown (10YR6/2) to dark yellowish brown (10YR4/2), firm, slightly plastic, irregular breakage, non-porous, slightly moist, No VOC's
	14.0							14.0		
	Run #5 14.0-17.0 ft.	Recovery 4.4 ft including 1.0 ft slough.						15.0		Claystone as above 10.9-14.0 ft. has some sandy intervals 14.8-14.9 ft, 15.1-15.2, 15.8-15.9 with heavy Carbonaceous (rare) Limonite stains slightly moist, No VOC's
								16.0		
17.0	17.0	17.0						17.0		
17.0								18.0		TD = 17.0 ft.
								19.0		
								20.0		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23297
Location - North: _____ East: _____
Date: 09-10-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation: _____
Area: B-PONDS
Total Depth: 23.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0.0		Clayey ~~Some Silt~~
0.0 - 9.6 ft. Box 1 of 4	Run #1 0.0-4.0 ft	Recovery 3.6 ft.					SC	0.6		~~Silt~~, Sand (Fine), ~~Clay~~, Trace gravel; Moderate Brown (5YR 3/4), well graded, gravel subround to angular, nonplastic, dry, root hairs abundant. No VOC's
								1.0 / 1.1		Silt, Sand (Fine to Coarse), Clay, Trace gravel, clay clasts common to abundant, dusky brown (5YR 2/2), well graded, C. sand & gravel subrounded to subangular, rock frags, quartz, clay clasts, massive, v. slightly moist, some root hairs. Moderately firm
								2.0		Clayey ~~Some Silt~~ ~~Silt~~, Sand (Fine to Coarse) ~~Clay~~, Trace to Some Gravel (more and coarser than above), clay clasts up to 2cm. (more common and coarser than above), dark yellowish brown (10YR 4/2) mostly, mottled with grayish olive (10Y 4/2) and dark yellowish orange (10YR 6/6) = limonite, firm, massive, as it dries shows caliche powder (specially in gravel horizons. Gravel subround to subangular, Crumbles easily. No VOC's.
								3.0		
								3.6		No Recovery 3.6-4.0 ft.
								4.0		As Above 1.1-3.6 ft. Dusk brown at bottom (5YR 2/2), may be cleaning up. No VOC's.
	Run #2 4.0-7.0 ft	Recovery 2.7 ft.						5.0		
								6.0		
								6.7		No Recovery 6.7-7.0 ft.
								7.0		As Above 1.1-3.6 ft. Color varies in range above, clay clasts less prominent though material is still clayey.
	Run #3 7.0-10.0 ft	Recovery 3.3 ft.						7.0		
								9.0 / 9.1		TOP OF BEDROCK (Nonfractured) Sandstone, dark yellowish orange (10YR 6/6), medium grained, well rounded, quartz, trace mafic and feldspar, well sorted, possible clay clasts/lumps up to cm sized, porous, not cemented, massive, crumbles easily, patches of limonite cement in 5% of rock.
9.6 / 9.6 Box 2								9.6		
								10.0		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23297
Location - North: East:
Date: 09-10-97
Geologist: R. Kochler
Drilling Equip.: Geoprobe

Surface Elevation:
Area: B-Ponds
Total Depth: 25.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: Continuous macrocore

EG&G LOGGING SUPERVISOR
APPROVAL Fred C Dingley DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	0.0						10.0		
Box 2 of 4 9.6-16.0 ft.	Run #4 10.0-13.0 ft	3.4 ft Recovery						10.2		10.0-10.2 SEE ABOVE Sandy Claystone, dark yellowish brown (10YR 4/2) mottled with dark yellowish orange (10YR 6/6), clay clasts up 1 cm(?) in sandstone, possibly Roots or burrows filled by sand in clay, probably lag deposit, poor sorting, med. quartz well rounded, trace coarse sand to gravel, some limonite cemented horizons and "chips". ~~Some sandy interval~~
								11.0		
								11.3		
								12.0		Silty, ~~very fine sandy~~ Claystone (to?) Clayey siltstone ~~to Sandstone~~, light olive gray (5Y 6/1) (not great color match) with trace limonite stain, trace limonitic clasts and gravel, well sorted, not porous, massive moist. Roots at bottom! Soft. Trace calcite at top.
								13.0		
	13.0-16.0 ft	4.0 ft Recovery								As Above 11.3-13.0 Limonitic stains disappear 14.9 ft. Carbonaceous through 14.9 ft Very slightly moist, cuts easily with knife and crumbles. Clay looks pelleted or clast like through 14.9 ft. May still be below that but must be finer grained pellets/clasts. No Roots
								14.0		
								15.0		
16.0	16.0	16.0						16.0		Begin 09/11/97
16.0	Run #6 16.0-18.0 ft	Recovery 4.0 ft including 1.6 ft slough		30/ ? slickensides?						As Above 11.3-13.0 ft. Slightly carbonaceous ~~Lower~~ Limonite stain 17.4-17.6 ft Limonite cement on random fractures throughout. Crumbles and cuts easily v. slightly moist.
Box 3 of 4 16.0-23.0 ft								17.0		
	18.0	18.0								As Above 11.3-13.0 ft.
	Run #7 18.0-21.0 ft	Recovery 3.5 ft						19.0		
								19.2		Claystone, dark yellowish brown (10YR 4/2), well sorted, firm - cuts easily and crumbles easily, massive, slightly carbonaceous, v. slightly moist. No Roots
		20.0						20.0		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23297
Location - North: East:
Date: 09-11-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 25 ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dingley DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
	18.0 Run #7 18.0-21.0 ft	18.0 Recov. 3.5 ft						18.0		SEE Above Claystone
	21.0	21.0						21.0		Claystone As Above 19.2-21.0 ft. No VOC's 21.0-22.0 dark yellowish brown (10YR 4/2) 22-23.0 dusky yellowish brown (10YR 2/2) some healed fractures
RPK Box 4 of 4	21.0 Run #8 21.0-23.0 ft	21.0 Recovery 3.1 ft.						22.0		
	23.0	23.0						23.0		Claystone As Above 19.2-21.0 ft. dusky yellowish brown (10YR 2/2) bottom 0.3 ft of core slightly more damp than above, moisture core liner.
	23.0 Run #9 23.0-25.0 ft	23.0 Recovery 3.6 ft.						24.0		
25.0	25.0	25.0						25.0		T.D. = 25 ft.
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23397
Location - North: _____ East: _____
Date: 10-27-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE – MACROCORE

Surface Elevation: _____
Area: B-Ponds
Total Depth: 14.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: 2" – CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					SC GC	0.0		Clayey sand, some silt. Clay, silty, sandy gravel; dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3), well graded, mostly clay to very fine sand, subangular gravel, plastic, moist, grass and root thinos.
								0.6		
							SC	1.0		Clayey sand, some silt and ~~clay, silt, sand~~, trace gravel; gray (10YR 5/1) to (limonitic) brownish yellow (10YR 6/8), clay and silt through medium sand, some clay clasts up to 5 mm, sand composed of quartz, subangular to rounded, poorly sorted, well graded, soft to firm, slightly plastic, slightly moist to moist, caliche appears on drying (reddish yellow) (7.5YR 7/3).
								2.0		
0.0 – 11.0 ft.	Run #1 0.0 – 4.0 ft	Recovery 2.8 ft						2.8		
								3.0		No Recovery 2.8 – 4.0 ft.
								4.0		
Box 1 of 2	4.0	4.0								As Above 0.6 – 2.8 ft. Gravel at 4.3, 5.5 ft.
	Run #2 4.0 – 8.0 ft.	Recovery 2.9 ft. including 0.2 ft slough						5.0		
								5.5		Top of Bedrock
								6.0		Sandstone; grayish brown (2.5Y 5/2) to (limonitic) brownish yellow (10YR 6/8), quartz and matrix, subangular to rounded (finer grained than angular), moderately well sorted, porous, uncemented, ~~non~~ RPP 10/28/97
								6.7		
								7.0		Contains clayey zones, mod friable, looks massive, moist. Coarser sand frosted
										No Recovery 6.7 – 8.0 ft. (Approx No.)
	8.0	8.0						8.0		Sandstone, very pale brown (10YR 7/4), fine to medium, subangular to rounded, frosted, completely disaggregates, dry, porous, heavy limonite stain at top.
	Run #3 8.0 – 11.0 ft	Recovery 2.8 ft including 0.3 ft slough						8.8		
								9.0		Claystone with sandstone zones as above (8.0 – 8.8) olive gray (5Y 4/2) with some limonite stains, non porous, sandy clay very discrete, clay firm, slightly moist, slightly plastic. (upper clay unit only, below 10.0 more sand and silt)
								10.0		some caliche in clay

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: # 23397
Location - North: _____ East: _____
Date: 10-27-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation: _____
Area: B-Ponds
Total Depth: 14.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2	Run #3 8.0-11.0 ft	Recovery 3.8 incl. 0.34 slough						10.0		See previous page
								10.5		Quartzite gravel frag, sub round
										No Recovery 10.5-11.0 ft.
								11.0		
11.0	11.0							11.2		As Above (Claystone, sandy) 8.8-10.5 ft.
Box 2 of 2 11.0-14.0	11.0-14.0 ft	Recovery 3.6 ft in 4 0.75 ft slough						12.0		Sandy Claystone; grayish brown (2.5Y 5/2) to light olive gray (5Y 6/2), some limonite staining brownish yellow (10YR 6/8), very fine sand, quartz, subangular to subround, non-porous soft, crumbles into blocks, massive, slightly moist
								13.0		
14.0	14.0	14.0						14.0		No Recovery 13.9-14.0 ft
										T.D. = 14.0 ft.
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23497
Location - North: East:
Date: 10-28-97
Geologist: ROBERT KOEHLER
Drilling Equip.: GEOPROBE MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 14.0
Company: TIERRA Project No.: WARP-97
Sample Type: 2" CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey, some silt.
0.0	0.0	0.0				FG	~~GC~~ SC	0.0		~~Clay, silt~~, Sand, trace Gravel; mottled grayish brown (10YR 5/2) to lt. yellowish brown (10YR 6/4) grading down to very dark brown (10YR 2/2) at bottom; well graded, fine to coarse sand, angular to subround, top half more clayey and plastic, bottom half less clayey, more crumbly, moist top half, slightly moist bottom, gravel is quartzite - fractured, root hairs to about 1 ft.
0.0 – 8.6 ft.	0.0 – 4.0 ft Run #1	3.9 ft Recovery		Undrained sample			SC	1.5		
						RPK 10/28/97	SC	2.0		
								2.4		~~Top Subsoil~~ RPK 10/30/97 Sandy Clay to clayey sand; very dark brown at top grading down to yellowish brown (10YR 2/2 down to 10YR 5/4) at bottom, more clayey at top, sandy at bottom, fine to medium sand, sub rounded to round, well sorted, quartz and mafics, soft to firm, slightly plastic, non porous, moist to slightly moist, massive
								3.0		
								3.9		No Recovery 3.9-4.0 ft.
	4.0	4.0						4.0		Sandy Clay to clayey sand As above 2.4-3.9 ft. Yellowish brown (10YR 5/4) throughout Sandy zones ~~porous~~ probably porous RPK 10/28/97
Box 1 of 2	4.0 – 8.0 ft Run #2	4.0 ft incl. 0.4 ft slough Recovery						5.0		Becomes more clayey up.
								6.0		↑ Sandy
								6.2		↑ Becomes more clayey up.
								7.0		Sandy Top of Bedrock RPK 10/30/97 Sandstone, yellow (10YR 7/8) to dark reddish brown (2.5YR 2.5/3) = rust/heavy limonite, fine to medium quartz and mafics, subround to round, possible clay laminae, slight plastic to easy friable, porous no cement, slightly moist massive
								7.6		No Recovery 7.6-8.0 ft
	8.0	8.0						8.0		(*) As Above 7.0-7.6 ft
8.6								8.1		Sandstone, clean to slightly clayey; grayish brown (2.5Y 5/2) to brownish yellow (limonite stained) (10YR 6/8); fine grained quartz and mafics; subangular to subround, well sorted, no cement, friable, plastic if clayey, massive, moist.
8.6	8.0 – 11.0 ft. Run #3	3.7 ft Recovery incl. 0.7 ft slough						9.0		
Box 2 of 2								10.0		

NOTES: General: USCS is modified for this log as follows:
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(*) 2 pieces of quartzite gravel, rounded at this position, do not know whether they are part of slough or actually at base of coarser sand above bulk of finer sands.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23497
Location - North: East:
Date: 10-28-97
Geologist: ROBERT KOEHLER
Drilling Equip.: GEOPROBE-MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 14.0
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dingly DATE 12-7-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 8.6-14.0 ft	Run #3	Recovery 3.3 ft 0.7 ft short						10.0		See Previous Page
	11.0	11.0						11.0		Sandstone As Above 8.1-11.0 ft
	Run #4 11.0-14.0 ft	Recovery 4.0 ft incl. 0.6 ft of slough						11.5		Sandstone; light gray (10YR 7/2) to brownish yellow (limonite) (10YR 6/8), fine to medium-grained, sub-angular to rounded, well sorted, porous, may be ~~layey~~ clayey, friable, massive, slightly moist.
								12.0		Claystone; light brownish gray (2.5Y 6/2) to grayish brown (2.5Y 5/2), well sorted, non-porous, firm, plastic, moist.
								13.0		
14.0	14.0	14.0						14.0		
14.0	14.0	14.0								T.D. = 14.0 ft.
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23597
Location - North: East:
Date: 09-16-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 14.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		
0.0–9.6 ft	0.0–4.0 ft Run #1	Recovery 3.3 ft					GC	1.0		Clay, silt, sand, some gravel; dark yellowish brown (10 YR 6/2) at top grades down to grayish brown (5 YR 3/2) at base, well graded, gravel subangular, not plastic at top, slightly plastic below 0.6 ft. (dry 0–0.6, slightly moist 0.6–1.6 ft.) quartzite and granitic gravels, quartz sand (some rounded and medium sand size) Roots in top 0.6 ft.
								1.6		Top of Bedrock
								2.0		Sandy Claystone; grayish brown (5 YR 3/2) at top, grades down to moderate yellowish brown (10 YR 5/4) with limonite stains (dark yellowish orange (10 YR 6/6), silt to fine sand, trace medium sand and gravel in top 0.6 ft., angular to subangular, sand, well sorted, non porous, firm to hard, quartz matrix, possibly micas, slightly moist, trace roots to 3.0 ft. No VOCs
								3.0		
								3.3		No Recovery 3.3–4.0 ft.
	4.0	4.0						4.0		
	4.0–7.0 ft Run #2	Recovery 2.8 ft including 0.2 ft sludge						5.0		As Above Sandy ~~silty~~ clayey; Light olive gray to olive gray (5 Y 6/1 to 5 Y 4/1) with limonite stains dark yellowish orange (10 YR 6/6); clean unconsolidated sand at intervals – 4.2–4.3, 5.4–5.5, 5.7–6.0 ft., rest is firm, massive, random fractures with a slick 6.0–6.6 ft. dries quickly, no VOCs
								6.0		
								6.6		No Recovery 6.6–7.0 ft.
	7.0	7.0						7.0		
	7.0–9.6 ft Run #3	Recovery 3.5 ft with 0.5 ft clay (sludge)						8.0		Sandy Claystone as above (1.6–3.3) and 4.0–6.6 (4.0–6.6 for color) Sand unconsolidated 8.9–9.0, 9.2–9.3 and 9.8–10.0 ft. Heavy limonite stains 7.2, 7.6, 8.0–8.2, 9.5 Generally firm to hard, slightly moist dries quickly, no VOCs
								9.0		
9.6								9.6		
	9.6	10.0	10.0					10.0		

Box 1 of 3

NOTES: General: USCS is modified for this log as follows:
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23597
Location - North: East:
Date: 09-17-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 19.0ft
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred [illegible] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
9.6-15.5ft. Box 2 of	10.0 / 13.0 Run #4	2.0ft / Recovery 4.0ft including 0.5ft of clay						10.0 11.0 12.0 13.0		Clayey Sandstone to Sandstone; Pale yellowish brown (10YR 6/2) with limonite zones - dark yellowish orange (10YR 6/6); silt to fine sand, sub angular, well sorted quartz, mafics, feldspar (?), firm generally crumbles easily, some random fractures with healed limonitic zones, 1 piece possibly carbonaceous. Slightly moist, not obviously porous. Unconsolidated sandy zones 10.9-11.0, 11.3-11.5, 11.7-11.8, 11.9-12.1, 12.4-12.5ft. Heavy limonitic stains 10.3-10.8ft, 12.3-12.6ft. No VOCs
	13.0 / 15.0ft Run #5	1.5 / Recovery 2.1ft including 0.6ft of slough			Wet Slough			13.0 14.0 15.0		Interbedded Clayey Sandstone - Sandstone As Above 10.0-13.0ft. Some very light gray patches (N8) in sandstone. Claystone, Pale yellowish brown (10YR 6/2), firm breaks with fracture, fractures have carbonaceous material or limonite cement, 13.2-13.3ft, 13.6-13.7ft, 14.7-15.0ft., slightly moist. No VOCs. Unconsolidated sandstone; 13.0-13.1, 13.4-13.5, 13.7-13.8, 14.3-14.6 (alternating Clay, Ss, Clayey Ss). Unconsol. Fine Sandstone as above
15.5 / 15.5-19.0ft Box 3 of 3	15.0-17.0ft Run #6	1.5 / Recovery 3.4ft including 0.7ft slough						15.1 15.5 16.0 17.0		Claystone; Dark yellowish brown (10YR 4/2), firm, slightly plastic, breaks into blocks, occasional sub vertical fractures with limonite or manganese stain, slightly moist, carbonaceous. Unconsolidated fine sandstone 15.8-16.8ft, sandy claystone 16.4-16.9ft. Very pale orange 10YR 8/2
19.0	17.0-19.0ft Run #7	1.0 / Recovery 3.4ft including 0.7ft slough						18.0 19.0 20.0		Claystone As Above 15.1-17.0ft. Prominently carbonaceous
	19.0	19.0								T.D. = 19.0ft.

Clayey Sandstone Obvious tow 5Y4/1

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23697
Location - North: East:
Date: 10-28-97
Geologist: ROBERT KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 11.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Bingley DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0								~~Clay, silt~~, Sand, trace gravel; brown to dark brown (10YR 4/3) except for bottom 0.5 ft - dark yellowish brown (10YR 4/6) to lt. yellowish brown (10YR 6/4); silt to medium sand, angular to rounded, poor grading, hard/brittle, breaks into rainlike pieces, quartz mafics, granitics, dry, roots throughout.
Box 1 of 1 0.0 - 11.0 ft.	Run #1 0.0-4.0 ft	Recovery 2.5 ft.				~~HGC~~	SC	0.0		
				Change symbol				1.0		
								2.0		
								2.5		
								3.0		No Recovery 2.5-4.0 ft.
								4.0		
	Run #2 4.0-8.0 ft	Recovery 3.7 ft incl. 0.1 ft slough			Change symbol		SC	5.0		As Above 0.0-2.5 ft. dark yellowish brown (10YR 4/6) to brownish yellow (10YR 6/8), hard, rainlike breakage. gets sandier downhole. No roots, but caliche which may follow old root (25%).
								5.7		Top of Bedrock
								6.0		Sandstone, yellowish brown (10YR 5/4), very fine to fine, subangular to subround, well sorted, friable, not cemented, porous, massive dry.
								6.4		Claystone, light olive brown (2.5Y 5/3) with limonite patches - olive yellow (2.5Y 6/8) randomly fractured, pieces cemented with caliche, massive, hard, very slightly moist.
								7.0		
								7.6		No Recovery 7.6-8.0 ft.
	Run #3 8.0-11.0 ft	Recovery 3.3 ft incl. 0.3 ft slough						8.0		Claystone as above 6.4-7.6, light yellowish brown (10YR 6/4) to brownish yellow (10YR 6/8) in addition to olive brown above), non porous, hard, massive, very slightly moist, caliche vary below 8.5 ft. Lower 1.5 ft has some fine sandy parts quartz/mafics, subangular to subround, not porous.
								9.0		
								10.0		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23697
Location - North: East:
Date: 10-28-97
Geologist: ROBERT KOETHER
Drilling Equip.: GEOPROBE-MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 11.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: 2"- CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dobyle DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1	Run #3	See Previous Page						10.0		See Previous Page. Claystone with some sandy claystone.
11.0	11.0	11.0						11.0		T.D. = 11.0 ft.
								12.0		
								13.0		
								14.0		
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23797
Location - North: East:
Date: 10-29-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 20.0 ft
Company: TIERRA Project No.: WAAP-97
Sample Type: 2" CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey Gravel - Some sand & silt.
0.0	0.0	0.0					GC	0.0		~~Clay, silt, sand, gravel~~; dark brown (10YR 4/3), fine to med sand, quartz, mafics, granitics, subangular to subround, quartzite and granitic gravel, subround to fractured, crumbles easily, dry, root hairs throughout, massive
								1.0		
								1.4		~~Top Bedrock (2)~~ RPK 10/30/97
							SC			Clayey Sand to Sandy Clay; dark yellowish brown (10YR 3/4); fine sand, quartz, mafics, granitics, subangular to subround, firm to hard, top 0.5 ft crumbles, rest slightly plastic, massive, to 0.5 ft dry, rest very slightly moist. Trace root hairs to 3.2 ft.
								2.0		
								3.0		
								3.2		
Box 1 of 3 0.0-9.7 ft	Run #1 0.0-4.0 ft	3.2 ft Recovery								No Recovery 3.2-4.0 ft
								4.0		As Above 1.4-3.2 ft. Yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/6), traces of caliche, caliche on roots, caliche along old rotted roots through about 7.0 ft. Some limonite and manganese stained grains. Slightly plastic. Firm, very slightly moist
	4.0	4.0						5.0		
								6.0		
	Run #2 4.0-8.0 ft	4.0 ft, no slough Recovery						7.0		← 1, 1cm rounded gravel
								8.0		As Above 4.0-8.0 Remarkably monotonous. Slightly moist, firm to slightly plastic. No caliche/No roots
	8.0	1.0						9.0		
9.7	Run #3 8.0-9.7 ft	Recovery 1.7 ft, no slough 0.4 ft Pebble						9.7		
								10.0		

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23797
Location - North: East:
Date: 10-29-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 20.0
Company: TIERRA Project No.: WARP-97
Sample Type: 2" CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-22-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENTS)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 9.7-17.0 ft.	Run #3 9.7-11.0	SEE PREVIOUS PAGE					SC	10.0		See Previous Page
								10.5		7-10mm gravel 2 pieces
								11.0		
	Run #4 11.0-14.0 ft	Recovery 4.0 ft incl. 0.5 ft of sand						12.0		As above 4.0-8.0 and 8.0-11.0 Monotonous. ← 0.05 ft Sand fine grained quartz/matrix. Noticed micas and more Manganese which was present above. Coated grains
								13.0		← Small gravel
						RPR 10/31/97		14.0		1-2cm Granite Gravel in cuttings shoe!
							GW	14.3		Gravel in coarse clayey sand, gravel rounded,
	Run #5 14.0-17.0 ft	Recovery 3.6 ft incl. 0.6 ft of sand					SC	14.9		Sandstone particles part clayey, grayish brown (10YR 5/2) with limonite stains - yellowish red (5YR 5/8) fine to medium sand, quartz, micas, granitic, subangular to sub-r sand, poor sorting → cross beds, Manganese coating, firm, massive, slightly moist.
							GC	15.0		Gravel in clayey sand
							SC			
								16.0		Clayey Sand to Sandy Clay as above 4.0-8.0 and 8.0-11.0 ft
17.0								17.0		Top of Bedrock
Box 3 of 3 17.0-20.0 ft	Run #6 17.0-20.0 ft.	Recovery 4.0 ft incl. 0.3 ft clay		Random with Limonite				18.0		Silty Claystone grading to claystone at bottom, grayish brown (2.5Y 5/2) with limonite stains yellowish brown (10YR 5/6) well sorted, firm, massive, slightly plastic to plastic, moist.
								18.7		
								19.0		Claystone: dark to very dark grayish brown (10YR 4/2 to 3/2) with ~~manganese~~ limonite(?) stained fracture zone yellowish red (5YR 5/8), crumbly to slightly plastic, trace carbonaceous matter, breaks irregularly, moist.
								20.0		

NOTES: General: USCS is modified for this log as follows: 20.0 ft = TD
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23897
Location - North: East:
Date: 10-30-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-POND
Total Depth: 12 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: 2" CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
										Clayey Sand & Silt
0.0	0.0	0.0				SC	~~GM~~	0.0		Silty sand/gravel; brown (10YR 5/3); 2-4 cm sized gravel, quartz, granitics, angular to subround, unconsolidated, friable, massive, slightly moist. grass at top
				Change symbol			SC	0.5		Clayey Sand to Sandy Clay; Very dark brown (10YR 2/2) 0.5-2.0 ft then grades to yellowish brown (10YR 5/4); dominantly fine grained occasional medium, quartz, granitics, subangular to subround, well sorted, non porous, very hard to firm, massive, dry. Trace root hairs top 1.5 ft. Caliche 0.0-2.3 ft.
								1.0		
								2.0		
								2.7		
								3.0		No Recovery 2.7-4.0 ft.
0.0-8.0 ft.	Run #1 0.0-4.0 ft.	Recovery 2.7 ft.						4.0		
	4.0	4.0						4.0		Clayey Sand to Sandy Clay; yellowish brown (10YR 5/4); occasional gravel as marked gravel = granitic, subround; very fine to fine sand; subangular to subround, quartz, mafics, granitics, mica, manganese coated, caliche along vertical fracture, hard 4.0-4.5 ft, firm below-out, not plastic, massive, non porous, 4.0-5.5 ft dry, below that v. slightly moist.
				Vertical				4.5		
								5.0		
								5.5		5.5 RPK
								6.0		
Box 1 of 3	Run #2 4.0-7.0							6.5		Caliche cemented sand nodules.
	REDRILL*							7.0		
	7.0	7.0								As Above (4.0-7.0 ft.) No obvious caliche except at about 9.6 ft. Gravel as marked. Micas more prominent.
								8.0		
Box 2 of 3 8.0-15.34	Run #3 7.0-10.0 ft	Recovery 4.0 ft incl. 0.4 ft of clunks						9.0		
								9.6		More clayey less sandy. Possibly some laminations, prominent limonitic stains,
	10.0	10.0						10.0		Caliche cemented sand nodules

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

*Original Run #2 recovery only 0.9 ft., pushed a rock ahead of cutting shoe. Moved hole over 0.5 ft North and redrilled. Backfilled aborted hole with bentonite.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #23897
Location - North: East:
Date: 10-30-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-BONDS
Total Depth: 18.0 ft
Company: TIERRA Project No.: WARP-97
Sample Type: 2" CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dougherty DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 8.0-13.3 ft	Run #4 10.0-13.0 ft	Recovery 4.0 ft incl. 0.4 ft of slough					SC	10.0		As Above 4.0-7.0 ft Gravel as marked
								11.0		
								12.0		
								12.5		Top of Bedrock
	13.0	13.0						13.0		Sandstone (ft. brownish gray (2.5Y 6/2) to limonitic olive yellow (2.5Y 6/8), very hard, fine, rounded, uncemented, porous, wet, quartz and abundant magnetite or heavy minerals, top RPK.
	13.0	13.0								Sandstone as above 12.5-13.0
	Run #5 13.0-16.0 ft	Recovery 4.0 ft incl. 0.8 ft slough						14.0		some small clayey zones, wet throughout, heavy limonitic staining on top of underlying clay.
								15.0		
15.3								15.3		
15.3-18.0 ft								15.3		Claystone as below 16.0-16.9
	16.0	16.0						16.0		Claystone: grayish brown (10YR 5/2) to very dark gray (10YR 3/1) (Top to bottom), massive, hard to firm, non porous, sticky, wet. Top 0.3 ft random fractures with limonite stains. Blocky irregular breakage.
Box 3 of 3	Run #6 16.0-18.0 ft	Recovery 4.0 ft incl. 0.4 ft slough too wet to save.						16.9		
								17.0		No recovery 16.9-18.0
								18.0		
18.0	15.0 10/30/97 RPK	18.0 3.1 ft of slough								TD = 18.0 ft
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23997
Location - North: East:
Date: 09-17-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 20.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS — MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL F. Dregely DATE 11-17-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					GC	0.0		Clayey Silt Sand Gravel, dark yellowish brown (10 YR 4/2) to dusky yellowish brown (10 YR 2/2), gravel subangular, quartzite and granitic fragments 0-0.5 dry, 0.5-1.0 ft slightly moist, crumbles easily. Sand: silt to fine sized, subangular, No VOCs
Box 1 of 3 0.0 - 8.8 ft.	Run #1 0.0-4.0 ft.	Recovery 4.0 ft.						1.0		Clayey Sand, dusky yellowish brown (10 YR 2/2), silt to coarse sand, rare rounded to subangular gravel, sand is subangular to subround, poorly sorted, massive, hard, breaks into "stacked coins", very slightly moist, non-porous, No VOCs. Root hairs rare but present to 3 ft. • = gravel + = caliche I = ironstone
							SC	2.0		
								3.0		
								4.0		Clayey Sand as above 1.0-4.0 ft. 1 ironstone concretion, 1 cm, and gravel
	Run #2 4.0-7.0 ft.	Recovery 3.6 ft including 0.4 ft of slough.						4.6		Clayey Sand with rare gravel; pale yellowish brown (10 YR 6/2), grayish orange (10 YR 7/4), moderate yellowish brown (10 YR 5/4), silt to fine sand, subangular, quartz and mafics, gravel subround, quartzite, RPK vertical fracture with caliche, slightly moist, hard. 4.6-5.0 poor sorting, wide size range (silt-fine) 5.0-6.5 well sorted mostly fine size, (silt-fine) 6.5-7.0 poor sorting wide size range (silt-fine)
								5.0		5.0-6.5 breaks into "coins"
								6.0		1.6 VOCs
								7.0		
	Run #3 7.0 ft-10.0 ft	Recovery 3.3 ft including 0.3 ft of slough.						8.0		Clayey Sand As Above 4.6-7.0 ft. Looks mottled as if composed of sedimentary clasts, clay clasts, sand clasts, etc. Quartzite cobble at approx 8.3'
Box 2 of 3 8.8-16.0 ft.								8.8		top of Bedrock (EG)
								8.9		Clean Sandstone, grayish orange (10 YR 7/4) to dark yellowish orange (10 YR 6/6), silt to fine grained, subangular to subround, well sorted, uncemented, some clay in middle (not much) slightly moist, disaggregates, no VOCs
10.0								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 23997
Location - North: East:
Date: 09-17-97 / 09-18-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 20.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-17-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	0.0						10.0		Sandstone As Above, 8.9-10.0 ft.
Box 2 of 3 8.8-16.0 ft.	Run #4 10.0-13.0 ft.	Recovery 3.4 ft including 0.5 ft of slough						10.6		Clayey Sandstone; pale yellowish brown (10YR 6/2), grayish orange (10YR 7/4), moderate yellowish brown (10YR 5/4), silt to fine sand, quartz and matrix, subangular, in part carbonaceous, trace caliche and ironstone nodules. Firm crumbly
								11.0		
								11.3		
								12.0		Sandstone As Above 8.9-10.0 ft., moist, no VOCs (caliche in clayey zone) in addition to above colors; part light brown (5YR 5/6)
								12.3		Clayey Sandstone As Above 10.6-11.3 ft.
	13.0	13.0						13.0		NO RECOVERY 12.9-13.0 ft.
	Run #5 13.0-16.0 ft.	Recovery 4.0 ft. including 0.5 ft of slough								Clayey Sandstone as above 10.6-11.3 ft.
								14.0		
								14.5		Silty Sandy Claystone, dark yellowish brown (10YR 4/2), silt to fine sand, subangular, well sorted, firm to hard, blocky breakage, 2cm ironstone concretions, slightly moist,
								15.0		Clayey sandstone as above 10.6-11.3, no caliche or ironstone, minor limonite staining.
16.0	16.0	16.0						15.7		Silty sandy claystone as above 14.5-15.0, heavy limonite stain across top.
16.0	16.0	16.0						16.0		Begin 09-18-97
Box 3 of 3 16.0-20.0 ft.	Run #6 16.0-18.0 ft.	Recovery 4.0 ft including 1.1 ft of slough						16.7		Silty Claystone, light olive gray (5Y 6/1), moderate yellowish brown (10YR 5/4), with limonite patches dark yellowish orange (10YR 6/6), well sorted, some sand on fractures with limonite cement, firm to hard - crumbly, v
								17.0		Claystone slightly moist, NO VOCS
										Dusky yellowish brown (10YR 2/2), firm to hard crumbly - to blocky, carbonaceous in part, slightly moist, No VOCs.
	18.0	18.0						18.0		Claystone As Above 16.9-18.0 ft.
	Run #7 18.0-20.0 ft.	Recovery 1.0 ft including 1.0 ft of slough						19.0		
								20.0		T.D. = 20 ft.
20.0	20.0	20.0								

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24097
Location - North: East:
Date: 09-18-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 18.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS — MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-5-97

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN/ALVAN (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		
Box 1 of 3 0.0-8.5 ft.	0.0-4.0 ft Run #1	3.8 ft Recovery					GC	0.8		Clay, Silt, Sand, Gravel, moderate brown (5YR 3/4), Subangular to sub round gravel - quartzite, granitic RF, subangular fine sand, subangular, well graded, non ~~porous~~ porous, not cemented, hard, breaks into bulky massive, v. slightly moist, no VOCs. NO VOCS MICA
							~~GC~~/~~SP~~ SC	1.0		Sandy Clay ~~loam~~ to Clayey Sand ~~loam~~ with root hair throughout occasional gravel, ~~grat~~ moderate brown (5YR 3/4) gravel subangular to sub round, quartzite and granitic rock fragments, sand fine, gravel, subangular quartz and mafics, firm to hard, doesn't break, v. slightly moist, NO VOCS
								2.0		
								2.3		
							GW	2.5		Crushed Granitic Fragment
							~~GC~~/~~SP~~ SC	3.0		Clayey Sand ~~loam~~ with occasional gravel, pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2), gravel - quartzite and granitic rock frags, sub-angular to sub round, fine sand, quartz and mafics, subangular, well sorted sand, caliche around gravel, dead roots, hard, does not break-up, v. slightly moist, NO VOCS.
	4.0-7.0 ft Run #2	3.8 ft including 0.8 ft of splash Recovery						4.0		Clayey Sand As Above 2.5-4.0 ft.
							GW	4.2 4.3		Crushed Granitic Fragment
							~~GC~~/~~SP~~ SC	5.0		Clayey Sand As Above 2.5-4.0 ft.
								5.5		TOP OF BEDROCK
								6.0		Clayey Sandstone, pale yellowish brown (10YR 6/3) to dark yellowish orange (10YR 6/6), fine sand, quartz and mafics, trace ironstone concretions at top.
								6.3		Subangular, well sorted, firm, slightly plastic, slightly moist, no VOCS. Heavy limonite at top.
										Sandstone, grayish orange (10YR 7/4), fine, well sorted, subangular quartz and mafics, porous, uncemented (disaggregates on drying), slightly moist, no VOCS.
	7.0-10.0 ft Run #3	3.4 ft including 0.4 ft of splash Recovery						7.0		
								7.6		Sandstone As Above 6.3-7.0 ft.
8.5								8.0		Slightly Clayey (Clayey Sandstone) grayish orange (10YR 7/4) with limonite stains - light brown (5YR 5/6), fine sand, quartz and mafics, subangular, soft to firm, massive, trace ~~deposit~~ ironstone concretions - soft, insect borings?
								8.5		
								9.0		v. slightly wet, NO VOCS
								9.2		Sandstone As Above 6.3-7.0 ft.
								9.6		Clayey Sandstone As Above 7.6-9.2 ft.
	10.0	0.4						10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24097
Location - North: East:
Date: 09-18-97 / 09-19-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 18.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Quigley DATE 11-5-97

TOP/BOTTOM OF CORE BARREL	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0	10.0	10.0						10.0		
10.0	10.0	10.0					10.4	RPK 11.0		Clayey Sandstone As Above 7.6-9.2ft
										10.4 Sandstone As Above 6.3-7.0ft
								10.8 12.0		Clayey Sandstone As Above 7.6-9.2 ft.
								11.7 12.0 11.9		Sandstone As Above 6.3-7.0
										Clayey Sandstone 7.6-9.2 ft.
								12.5		Sandstone As Above 6.3-7.0ft.
								13.0		Sandstone As Above 6.3-7.0 ft.
										heavy ironstone/limonite stain at 13.5 ft.
								14.0		
								14.8 15.0		Clayey Sandstone As Above 7.6-9.2ft.
										Claystone, dark yellowish brown (10YR 4/2), well sorted, non porous, some random fractures with limonite or manganese cement, firm to hard, irregular breakage, very slightly moist, No VOCs.
16.0	16.0	16.0						16.0		
16.0	16.0	16.0								Claystone; pale yellowish brown (10YR 6/2) to to dark yellowish brown (10YR 4/2), firm to hard, well sorted, non-porous, irregular breakage, very slightly moist, No VOCs
								17.0		
18.0	18.0	18.0						18.0		T.D 18.0 ft.
								19.0		
								20.0		

Box 1 of 3 8.5 ft - 16.0 ft.
Run #4 10.0 - 13.0 ft.
Recovery 3.6 ft including 3.4 ft of Eolian sh.
Run #5 13.0 - 16.0 ft.
Recovery 4.0 ft including 0.4 ft of Eolian sh.
Box 3 of 3 16.0 - 18.0 ft.
Run #6 16.0 - 18.0 ft.
Recovery

Begin 09/19/97

NOTES. General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #24197
Location - North: _____ East: _____
Date: 11-3-97
Geologist: R. KOEHLER
Drilling Equip.: SEDPROBE - MACROCORE

Surface Elevation: _____
Area: B-PONDS
Total Depth: 16.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 12-5-97

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0					SC	0.0		Clayey, some silt: ~~Clay, silt~~, sand (gravel), dark brown (10YR 4/3 to 3/3), well graded, angular to subround, granite, quartzite, plastic, massive, moist, root hairs and grass
							GC	0.5		~~Clay, silt, sand~~, clayey ~~sand~~ silt: Clay, silt, sand, very dark brown (10YR 3/1) to yellowish brown (10YR 5/4), clay to coarse sand, well graded, subangular to subround, quartz granitic sand clasts, clay clasts(?), massive, moist, root hairs
							SC	1.0		
								1.7		
							GW	2.0		Gravel; gray (10YR 5/1), quartzite, fractured
								3.0		No Recovery 2.0-4.0 ft.
	4.0	4.0						4.0		Silty, some
	4.0	4.0					CL	5.0		~~Clay, silt~~, sandy gravel; mottled dark gray (10YR 4/1), limonite-brownish yellow (10YR 6/8), light olive brown (2.5Y 5/2), well graded, clay to coarse sand, quartz, quartzite, granitic, subangular to subround, firm to hard, not plastic, dry.
							GC	6.0		
								6.4		~~Sandy Clay~~. ~~Possible Recovered Cobble~~ ~~Clayey Sand~~; olive gray (5Y 5/2) to limonitic brownish yellow (10YR 6/3), clayey at top - cleaner at bottom (some 0.5 ft clean sands), fine sand at top - some medium sand at bottom, quartz/mafics, manganese coatings(?), subangular to rounded, med sand may be frosted, firm, layered or laminated, caliche along old root sand vertical fracture, not plastic, slightly moist
							CL	7.0		
	8.0	8.0						7.9		No Recovery 7.9-8.0 ft.
	8.0	8.0						8.0		Top of Bedrock
								9.0		Sandstone; light brownish gray (2.5Y 6/2) to limonitic stained - brownish yellow (10YR 6/8); fine to medium sands, quartz and mafics, subangular to rounded, medium frosted, well sorted, unconsolidated - uncemented, friable, slightly moist.
								10.0		Bottom of sand = 10.0 ft.

Box 1 of 2 0.0 - 10.5 ft.

Run #1 0.0 - 4.0 ft. Recovery 2.0 ft. (rock lodged in cutting shoe)

Run #2 4.0 - 8.0 ft. Recovery 4.0 ft incl. 0.1 ft slough

Run #3 8.0 - 11.0 ft. Recovery 3.0 ft. incl. 0.4 ft slough

Change Symbol

Change Symbol

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: #24197
Location - North: East:
Date: 11-3-97
Geologist: R KOEHLER
Drilling Equip.: GEOPROBE - MACROCORE

Surface Elevation:
Area: B-PONDS
Total Depth: 16.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: 2" - CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Dreyer DATE 12-5-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.5 / 10.5	Run #4 8.0-11.0ft.	Recovery 3 ft. See previous page						10.0		Clayey sandstone, light brownish gray (2.5YR 6/2) to limonitic-brownish yellow (10YR 6/8); fine sand, subangular to subround, quartz and mafics, well sorted, massive, firm, uncemented, very slightly moist.
Box 2 of 2 10.5-16.0ft.	11.0 Run #4 11.0-14.0ft.	11.0 Recovery 4.9 ft incl. 0.5ft of slough						11.0		As Above 10.0-11.0 ft. Bottom less clayey than top.
								12.0		Sandstone, light brownish gray (2.5YR 6/2) to limonitic-brownish yellow (10YR 6/8); fine to medium grained, subangular to round, medium sandsorted, quartz and mafics, unconsolidated, uncemented, soft, wet, especially wet from 12.6ft down.
								13.0		
	14.0 Run #5 14.0-16.0ft	14.0 Recovery 3.5ft. incl. 1.3ft. of slough						13.5		Claystone, dark grayish brown (2.5Y 4/2) with limonitic (stain and cement) fractures - red (2.5YR 4/8) inclined 60° contact with overlying sand, random fractures, crumbly breaking, firm, moist, plastic
								14.0		Claystone As Above 13.5-14.0 Fracturing and limonitic stain/cement continues intermittently on below 15.0 ft. Brittle and crumbly below 15.0 ft.
								15.0		
16.0	16.0	0.0						16.0		16.0 ft = T.D.
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24397
Location - North: East:
Date: 09/22/97
Geologist: R. KOEALER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 23.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACRO CORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0.0		Clayey Gravel/Sand
Box 1 of 3 0.0-9.4 ft.	Run #1 0.0-4.0 ft.	Recovery 2.8 ft.					GC	1.0, 2.0, 2.3, 3.0		Clay, Silt, Sand, ~~Gravel~~, pale yellowish brown (10YR 6/2) to limonitic stained - dark yellowish orange (10YR 6/6), some light olive gray (5Y 5/2) at above to 1.5 ft, below 1.5 ft grades down to dusky yellowish brown (10YR 2/2) to moderate brown (5YR 3/4); gravel - quartzite and granitic fractured, part subangular, sand - silt to v. coarse, subangular - subrounded, quartz and granitic, well graded, massive, firm, part plastic, part crumbly, root hairs to 4.0 ft, slightly moist. 3.2 ppm on Mini Rae in void adj. to large gravel. (22.7 on actually cutting core)
										No Recovery 2.8-4.0 ft.
	Run #2 4.0-7.0 ft.	Recovery 0.3 ft. including 0.8 ft. slough						4.0, 4.3, 5.0, 6.0, 6.6, 7.0		As Above 0.0-2.8 ft., moderate yellowish brown (10YR 3/4) TOP OF BEDROCK. Claystone, 4.3-4.6 very pale orange (10YR 8/2) 4.6-5.2 dusky yellow (5Y 6/4) 5.2-7.0 grades down to brownish gray (5YR 4/1). possibly compacted pellets or clasts of clay, occasional patches of calicle, massive, soft to firm, plastic at top - crumbly at bottom, slightly moist. Trace carbonaceous matter. 170 ppm Mini Rae at 7.0 (? dubious reading?)
										No Recovery 6.6-7.0 ft.
	Run #3 7.0-10.0 ft.	Recovery 3.9 ft including 0.7 ft of slough.						7.0, 8.0, 9.0, 9.4, D.C.	H H H H	Claystone As Above 4.3-6.6 random fractures. Limonite stained zones may be horizontal fractures with limonitic cement. Brownish gray to 8.8 ft (5YR 4/1) then dusky yellow to 9.7 ft (5Y 6/4), brownish gray in last 0.5 ft. <10 ppm VOC's w/mini RAE. H = Hematite/Limonite
9.4										
9.4 ↓										
0.0	10.0	10.0								

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24397
Location - North: East:
Date: 09/22/97 / 09/23/97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 23.0 ft.
Company: TIERRA Project No.: WARF-97
Sample Type: CONTINUOUS MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL: [signature] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 9.4-15.4 ft.	Run #4 10.0-13.0 ft	Recovery 4.0 ft including 0.4 ft slough						10.0		Claystone As Above 4.3-6.6 ft. May become silty about 11.3 ft. Brownish gray (5YR 4/1) Firm, crumbly No VOCs
	Run #5 13.0-15.0 ft	Recovery 3.3 ft including 0.5 ft slough						11.0		
								12.0		
								13.0		Clayey Sandstone to sandy claystone, pale yellowish brown (10YR 6/2), fine sand, subang to subround, quartz and mafics, non-porous, firm, slightly moist No VOCs
								13.4		Claystone As Above (Silty) 4.3-6.6 ft.
								14.0		Sandstone, part clayey very pale orange (10YR 8/2) to pale yellowish brown (10YR 6/2) with occasional limonite dark yellowish orange (10YR 6/6), silt to fine sand, subang to subround, quartz and mafics, friable clayey, soft disaggregates if clean, porous, moist, (clayey ~~14.0-14.2~~, 14.2-14.6)
								14.8		Sandy Claystone ~~Clayey Sandstone~~, Light olive gray (5Y 5/2), fine
15.4								15.0		Sandy AA Claystone 14.8-15.0 Same as in sandstone above (13.4-14.8), possibly some mica, non-porous, firm, crumbly, slightly moist
15.4 / 15.7	Run #6 15.0-17.0 ft	Recovery 3.0 ft including 0.5 ft slough						15.5		Silty claystone, pale yellowish brown (10YR 6/2) to limonite stained dk. yellowish orange (10YR 6/6), hard, non-porous, massive, slightly moist, No VOCs. limonite at top and bottom
								16.0		Claystone pale yellowish brown (10YR 6/2) with limonite dk. yellowish orange (10YR 6/6), firm to hard, crumbly, no obvious fractures, though may be intensely fractured, slightly moist, no VOCs. Trace carbonaceous matter.
Box 3 of 15.4- ft.	Run #7 17.0-19.0 ft	Recovery 0.9 ft (compressed)						17.0		Clay-Stone AA 15.5-17.0 ft. Has a zone of dusky yellow brown at top (10YR 2/2) ~0.2 ft thick limonite bar.
								17.9		
								18.0		No Recovery 17.9-19.0 ft. Core liner jammed.
	Run #8 19.0-21.0 ft	Recovery 4.0 ft mud 1.6 ft slough						19.0		Claystone As Above 15.5-17.0 ft. H = limonite stain
								20.0		

NOTES: General: USCS is modified for this log as follows: slough from core #8 not saved, too muddy
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24397
Location - North: East:
Date: 09-23-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-POND 5
Total Depth: 23.0 Ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
20.0	20.0 Run # 8 19.0-21.0 ft	20.0 Recovery 4.0 ft incl 1.0 ft slough						20.0		Claystone As Above 15.5-17.0 ft
										H: limonite stain
								21.0		H
	21.0 Run #9 21.0-23.0 ft	21.0 Recovery 3.0 ft Including 0.2 ft of mudstone								Claystone As Above 15.5-17.0 ft
Box 3 of 3 15.4-23.0 ft.								22.0		H
23.0	23.0	23.0						23.0		T.D. = 23.0 Ft.
								24.0		
								25.0		
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24497
Location - North: East:
Date: ~~3/19~~ 09-24-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: 13-PONDS
Total Depth: 18.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS — MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0								Sandy Clay, some Fe.
Box 1 of 3 0.0 — 8.8 ft.	Run #1 0.0 - 4.0 ft.	Recovery 2.8 ft.			Change Symb.		CL SC	0.0		~~Clay, Sand~~, Gravel; dusky yellowish brown, 10YR 3/2; subround to fractured gravel, subangular to subround silt to coarse sand, quartzite and granitic sands & gravel, non-porous, moist, root hairs abundant.
							CL	0.6		Sandy Clay; grades down from dusky yellowish brown 10YR 2/2 at top to moderate yellowish brown 10YR 5/4 at bottom; limonite stains at bottom dark yellowish orange 10YR 6/6; trace iron stone concretions, non porous, soft, plastic, moist, root hairs
								1.6		
								RPK 09/24/97		
								1.8		
					COPS!		SC	2.0		Clayey Sand with caliche layer (looks like gravel) at top, moderate yellowish brown to dark yellowish orange 10YR 5/4 to 10YR 4/6, fine sand, subangular, quartz and mafics, poss. bly clay clasts, zone of iron stone concretions some in new caliche thin section, soft, moist, root hairs
								2.8		No Recovery 2.8-4.0 ft
								4.0		
	Run #2 4.0-7.0 ft.	Recovery 3.3 ft with trace sloush.					CL			Clay, possibly a sand composed of clay sand grains, mod yellowish brown 10YR 5/4 to dk yellowish orange 10YR 6/6 at top, bottom 0.5 ft pale yellowish brown 10YR 6/2 to brownish gray 5YR 4/1, caliche patches, soft, massive, moist, trace rootlets in bottom, no VOCs.
								5.0		
								5.2		TOP OF BEDROCK
								6.0		Claystone; pale yellowish brown 10YR 6/2 to brownish gray 5YR 4/1 with dark yellowish orange 10YR 6/6 limonite stains, caliche at top and near bottom, firm, crumbly, very slightly moist, non porous, trace carbonaceous matter, no VOCs.
								7.0		
	Run #3 7.0-10.0 ft.	Recovery 4.0 ft including 0.3 ft sloush.								Claystone as above 5.3 to 7.0 ft.
8.8								8.0		
8.8								8.2		Graded contact really Silty(?) Claystone, similar to 5.2-7.0 interval, firm to hard, no VOCs
Box 2 of 3 8.8-15.0								9.0		
								10.0		H = heavy limonitic stain

No VOC's Run #1

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 24497
Location - North: East:
Date: 09-24-97
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: B-PONDS
Total Depth: 18.0 ft.
Company: TIERRA Project No.: WARP-97
Sample Type: CONTINUOUS - MACROCORE

EG&G LOGGING SUPERVISOR
APPROVAL: [signature] DATE 11-25-97

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	(H) = heavy limonite stain SAMPLE DESCRIPTION
10.0	10.0	2		—				10.0		
Box 2 of 2 8.8-15.0 ft.	Run #4 10.0-13.0 ft	Recovery 4 ft, 1 ft, 1 ft, 0.2 ft		—				11.0		(H) Silty Claystone grading down to Sandy Claystone; very pale orange (10YR 8/2) to limonite stained dark yellowish orange (10YR 6/6); firm, subangular sand, well sorted, quartz and mafics, non porous except for horizontal fractures (?) with limonite stains and/or cement, firm, crumbly, very slightly moist, no VOC's.
				RPK	RPK			12.0		
				/				12.3		(H) Sandstone, v. pale orange (10YR 8/2) to dark yellowish orange (10YR 6/6), firm sand, quartz and mafics subangular, uncemented, friable, slightly moist, subhorizontal fracture at top w/ heavy limonite stain, No VOC's
	13							12.7		Clayey Sandstone As Above 12.3-12.7 but firm to plastic, not crumbly or friable, No VOC's
	Run #5 13.0-14.0	Recovery 0.2 ft incl. 0.1 ft slough						13.0		Clayey Sandstone As Above 12.3-12.7 but again firm to plastic, clay content here and above looks low
			14.0 ft					14.0		Trace Sandstone right at bottom.
	Run #6							14.2		Clayey Sandstone As Above 13.0-14.0 ft.
				/						Claystone, light olive gray (5Y 6/1) to dark yellowish orange (10YR 6/6), limonite stain, massive, firm to hard, crumbly, (H) ← Sand in fracture, heavy limonite stain. IRONSTONE TOO
	Run #6	Recovery	RPK					15.0		RPK
	14.0-16.0 ft	Recovery 2 ft incl. 0.5 ft slough								Very slightly moist, non-porous (except along fractures?)
								16.0		
Box 3 of 3 15.0-18.0 ft.	16.0	16.0								Claystone As Above 14.2-16.0 ft
	Run #7 16.0-18.0 ft	Recovery 3 ft incl. 0.2 ft of slough		/						(H) Couple of sub vertical fractures with limonite cement, one possible zone of slickensides (due to geoprobe?)
				/				17.0		← Slickensides
								18.0		
18.0	18.0	18.0								T.D. = 18.0 ft.
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 25097
Location - North: East:
Date: 2-18-98 / 5-28-98 (6)
Geologist: T. Louseth (Rig) F. Erasby (Log)
Drilling Equip.: STRATIDRILL
Surface Elevation:
Area: S.W. of El Pond.
Total Depth: 25 ft.
Company: Tierra Project No.:
Sample Type: Continuous Core.

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE INBOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 4	Run No. 1 0-4.0'	Rec. 3.5'					GC	0		0'-0.4' Clayey Gravel - Some Sand & Silt. - Topsoil - Dusky Yellowish Brown (10YR 2/2). Gravel ang. to Sub ang. quartzite - Well Graded. Some broken Cobbles. Sl. Damp
							CL	1		0.4'-3.1' - Clay - Some silt, Trace gravel & Sd. - Pale Yellowish Brown (10YR 6/2) with Grayish Orange (10YR 7/4) mottling. Int. Sl. damp. - Prob. mod Plasticity. - Small to med. - gravel scattered in Intervals (Cobbles)
								2		
							CL	3		
								4		
Box 1 of 4	Run No. 2 4.0'-8.0'	Rec. 3.7					CL	5		3.1-3.5 Sandy Clay - Some gravel - Moderate Yellowish Brown (10YR 5/4) to ~~3.5-4.0' - No Recovery~~ Sl. Damp. - Wx. mod. Friable -
								6		3.5-4.0' No Recovery
								7		4.0'-7.3 Sandy Clay - Tr. Gravel some Silt - Moderate Yellowish Brown (10YR 5/4) with Dark Yellowish Orange (10YR 6/6) mottling. - Core wx., Sl. Damp, mod. friable. - Some quartz gravel freq. Also some Ironstone and clay. Clast. - Interval appears reworked. (FG)
							GW	8		
Box 1 of 4	Run No. 3 8.0'-12.0'	Rec. 4.0'					GW	9		7.3-7.5 - Clayey Gravel - Some silt and Sd. - Tr. Cobbles - Dark Yellowish Brown (10YR 4/2) to Dusky Yellowish Brown (10YR 2/2) Sl. Damp. -
								10		7.5-8.0' - No Recovery

Core Stored in Lexan Sleeves - Still Damp.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 25097
Location - North: East:
Date: 2/18/98 & 5/28/98 Rig 6-1
Geologist: T. Lerseth (Rig) F. Grogsby (Log)
Drilling Equip.: Strataprobe
Surface Elevation:
Area: SW of B1 Pond
Total Depth: 25'
Company: Terra Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 4	Run No. 3 8.0'-12.0'	Rec.: 4.0'						10, 11, 12		8.0'-8.9' Clayey Gravel - Some silt & sd. - Matrix Dusky Brown (5YR-2/2). Gravel well graded - Some broken cobbles. Interval damp - Estimated med. plasticity. - Top 0.1' of interval is compacted clay from above - 8.9'-12.0' Clay - Tr. sd. - Dark Yellowish Brown (10YR-4/2) with Grayish Orange (10YR 7/4) mottling - dry - Sl. damp - Sticky & Plastic - Prob. high Plasticity. Wh. Calcite nodules occur below 10'
Box 2 of 4	Run No. 4 12.0'-15.5'	Rec.: 4.0'		45°	Fault			13, 14, 15		12.0'-25.0' Top of bedrock (Top 25' of interval probably compacted clay from above.) Claystone - gravel imbedded at contact. - Dominate color is Dark Yellowish Brown (10YR-4/2) with intervals of alternation/intermixing that are predominately Grayish Orange (10YR 7/4) Well defined shear zone (±45°) at 13 ft. - Calcite nodule in shear. - Breccia zone from 12'-13' - and below shear to undetermined depth because of over compacted core in lexan tubes. - Induced fracturing interest ~~bedding or fe~~ ~~parting~~ plane. Horizontal bedding or parting planes from 2.4' to TD.
Box 3 of 4	Run No. 5 15.5'-18.5'	Rec.: 4.0'		60° 35° 45°				16, 17, 18		
Box 3 of 4	Run No. 6 18.5'-22.5'	Rec.: 4.0'						19, 20		

NOTES. General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 25097
Location - North: East:
Date: 2/18/98 & 5/2/98
Geologist: T. Lausenth (R.g) F. Grigsby (Log)
Drilling Equip.: Strata probe
Surface Elevation:
Area: S.W. of B Pond
Total Depth: 25.0'
Company: Terra Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE INDEX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 4	Run No. 7 20.5'-22.5'	Rec. 2.0'		60°	Horizontal			20 21 22		Second well defined shear at ± 21' @ 45°. Colluvium occurring in shear. Shears - Possibly related to pushing or reopening healed fractures occur as follows. 16.5' - 60° 17.6' - 45° 18.4' - 45° 24.6'± 60' @ 45° (+ FeO stain) 24.6'± 45°
Box 4 of 4	Run No. 8 22.5'-25.0'	Recovered: 2.0'		45° 45°				23 24 25	TD	Entire interval sl. damp - clayey. - Dense to med. indurated. - All depths approximate because of over-compaction of core tubes. - Daily Report shear also reported TD at 25.0'. with hole backfilled with filter pack to 29.5.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

APPENDIX E.2

WELL CONSTRUCTION LOGS

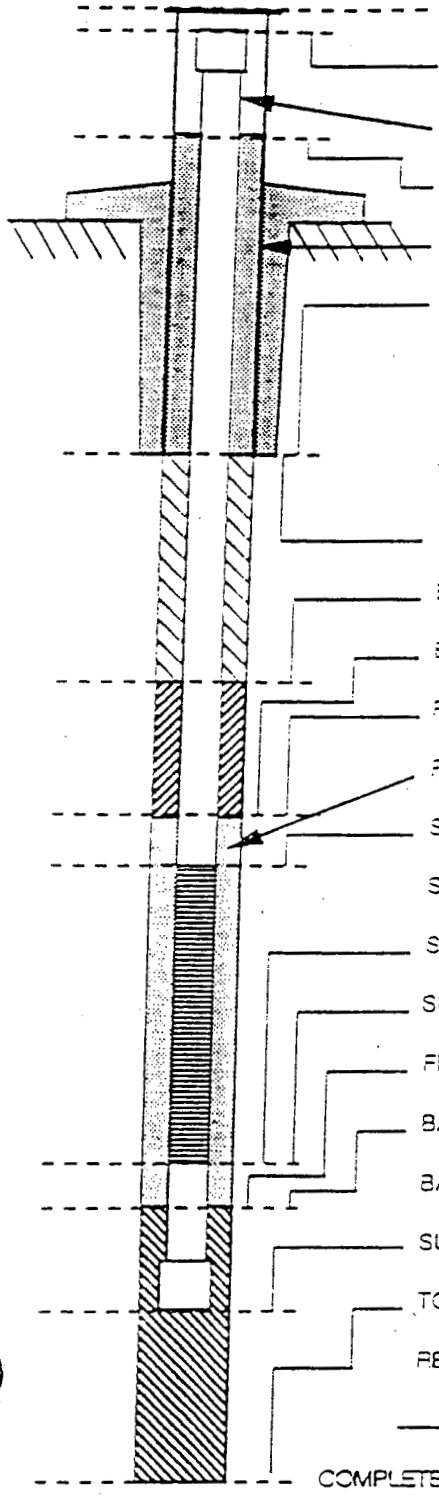
U.S. Department of Energy Rocky Flats Plant

Form GT.68
(Rev. 2)
CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C0197 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater
SCREENED FORMATION: AL/BR DRILLING CONTRACTOR: DGI
DRILLING METHOD: STRATAPROBE DATE DRILLED: 091197 DATE COMPLETED: 091197
RIG GEOLOGIST: ~~J. Boylan~~ F. Grigsby LOGGING GEOLOGIST: J. Boylan/F. Grigsby
COMPLETED DEPTH (FT): 9.4 ESTIMATED DEPTH TO BEDROCK (FT): 5.2
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 091197
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 111397



PROTECTIVE CASING, TOP (FT): _____ (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5'
SURFACE CASING, I.D. (IN): 0.5 TYPE: Sch 40 PVC
SURFACE SEAL, TOP (FT): 0 TYPE: Granular bentonite
PROTECTIVE CASING, I.D. (IN): _____ TYPE: _____
PROTECTIVE CASING, BOTTOM (FT): _____
IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____
SECONDARY CASING, I.D. (IN): N/A TYPE: _____
CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____
GROUT SEAL, TOP (FT): N/A TYPE: _____
BENTONITE SEAL, TOP (FT): 0 TYPE: Granular bentonite
BENTONITE SEAL, BOTTOM (FT): 3.4
FILTER PACK, TOP (FT): 3.4
FILTER PACK TYPE: 10-20 silica sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 4.5 SCREEN, TOP (FT): 4.5
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 9.4 TYPE: Sch 40 PVC BRAND: _____
SUMP, TOP (FT): N/A TYPE: _____
FILTER PACK, BOTTOM (FT): ~~9.4~~ 10.4
BACKFILL, TOP (FT): 9.4 TYPE: 10-20 silica sand
BACKFILL, BOTTOM (FT): 10.4
SUMP, BOTTOM (FT): N/A-no sump
TOTAL DEPTH (FT): 10.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: _____

COMPLETED BY: J. Boylan DATE: 102397
CHECKED BY: _____ DATE: _____

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
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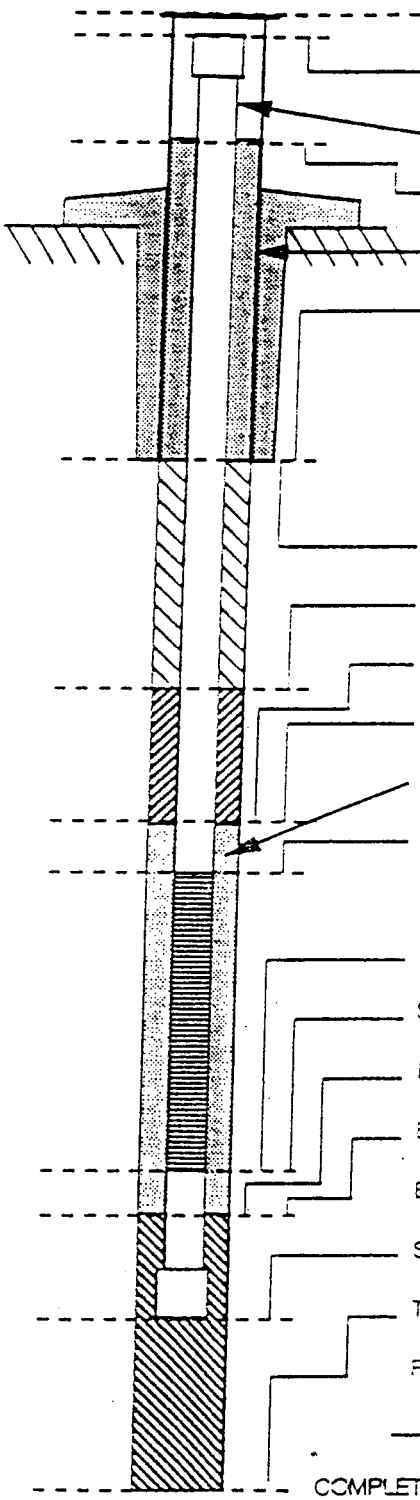
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00297 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 081497 DATE COMPLETED: 081597
FIG GEOLOGIST: ~~J. Boylan~~ F Grigsby LOGGING GEOLOGIST: J. BOYLAN/F. Grigsby
COMPLETED DEPTH (FT): 10.3 ESTIMATED DEPTH TO BEDROCK (FT): 6.4
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 081497
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 081597



PROTECTIVE CASING, TOP (FT): 2.3' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.92'
SURFACE CASING, I.D. (IN): 2in TYPE: PVC
SURFACE SEAL, TOP (FT): 1.06 TYPE: Concrete
PROTECTIVE CASING, I.D. (IN): 6 TYPE: Steel
PROTECTIVE CASING, BOTTOM (FT): 2.7'
IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 1.0' TYPE: ¼" pellets
BENTONITE SEAL, BOTTOM (FT): 3.0'
FILTER PACK, TOP (FT): 3.0'
FILTER PACK TYPE: Silica Sand (16-40) BRAND: CSSI
SURFACE CASING, BOTTOM (FT): FG ~~3.5'~~ 3.3 SCREEN, TOP (FT): 3.3
SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 2
SCREEN, BOTTOM (FT): ~~8.5'~~ 8.3 TYPE: PVC BRAND:
SUMP, TOP (FT): ~~8.5'~~ 8.3 TYPE: Sch. 40 PVC
FILTER PACK, BOTTOM (FT): FG ~~10.5'~~ 10.3
BACKFILL, TOP (FT): N/A TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): FG ~~10.5'~~ 10.3
TOTAL DEPTH (FT): FG ~~10.5~~ 10.3

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: F. Grigsby/J. Boylan DATE: 081597
CHECKED BY: J. Boylan DATE: 081597

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00397 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: ~~Ac~~ Bedrock DRILLING CONTRACTOR: Ground Exploration Co. Inc.

DRILLING METHOD: Hollow Stem Auger DATE DRILLED: 9/29/97 DATE COMPLETED: 9/29/97

FIG GEOLOGIST: Robert Smith LOGGING GEOLOGIST: W. Whiton

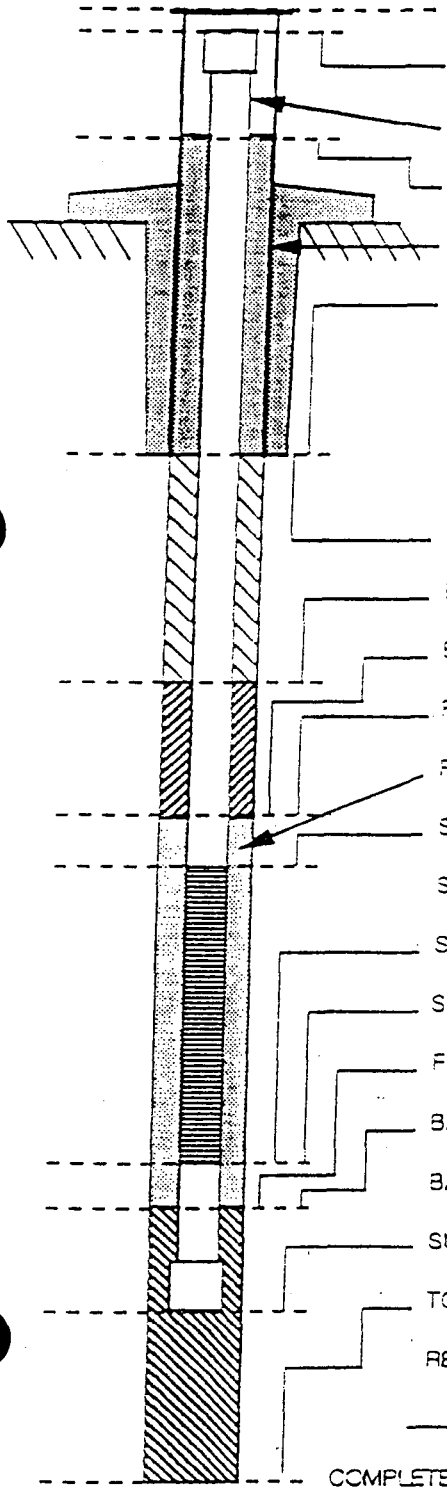
COMPLETED DEPTH (FT): 11.0 ESTIMATED DEPTH TO BEDROCK (FT): 1.0 feet

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8.0 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): None DATE MEASURED: 9/29/97

COMPLETED WATER LEVEL (FT): 12.03 from TOC DATE MEASURED: 102997



PROTECTIVE CASING, TOP (FT): ~~12.55~~ (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): _____

SURFACE CASING, I.D. (IN): 2.0 TYPE: PVC, Sch. 40

SURFACE SEAL, TOP (FT): _____ TYPE: _____

PROTECTIVE CASING, I.D. (IN): _____ TYPE: _____

PROTECTIVE CASING, BOTTOM (FT): _____

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): N/A TYPE: _____

CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL, TOP (FT): None TYPE: N/A

BENTONITE SEAL, TOP (FT): 1.0 TYPE: Pel-Plug pellets, 1/4" dia

BENTONITE SEAL, BOTTOM (FT): 3.0

FILTER PACK, TOP (FT): 3.0

FILTER PACK TYPE: 16-40 mesh silica BRAND: CSSI

SURFACE CASING, BOTTOM (FT): ~~9.0~~ 4.0 SCREEN, TOP (FT): 4.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 9.0 TYPE: PVC, Sch 40 BRAND: _____

SUMP, TOP (FT): 9.0 TYPE: PVC Sch. 40

FILTER PACK, BOTTOM (FT): 11.0

BACKFILL, TOP (FT): N/A TYPE: _____

BACKFILL, BOTTOM (FT): N/A

SUMP, BOTTOM (FT): 11.0

TOTAL DEPTH (FT): 11.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: _____

COMPLETED BY: Robert A. Smith DATE: 9/29/97

CHECKED BY: _____ DATE: _____

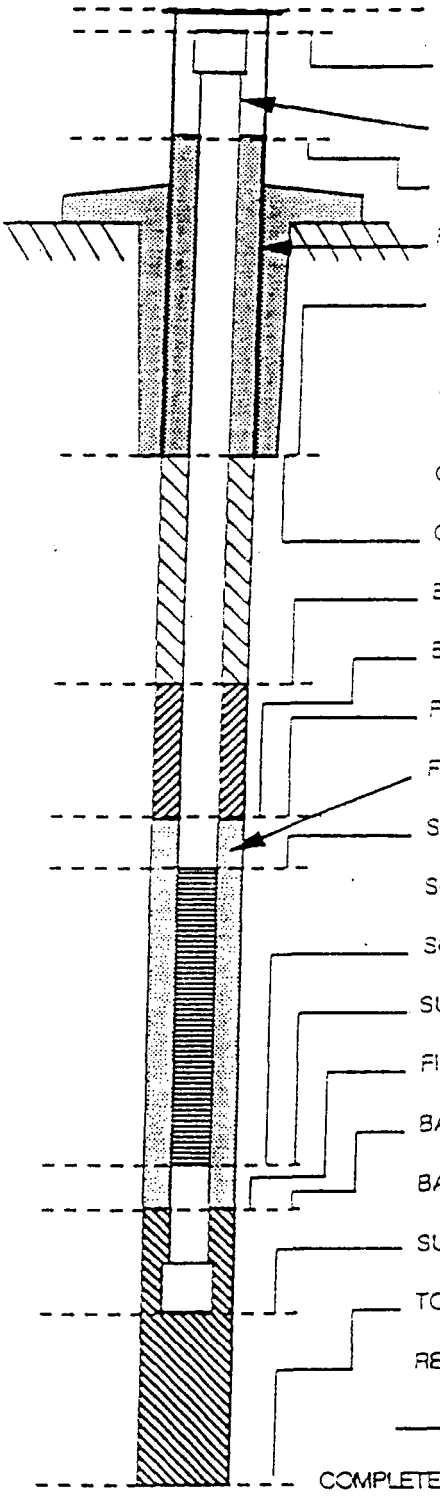
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~2~~) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C0597 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL/BR DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 072997 DATE COMPLETED: 080697
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN
COMPLETED DEPTH (FT): 22.9 ESTIMATED DEPTH TO BEDROCK (FT): 16.9
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): ~14' in core DATE MEASURED: 072997
COMPLETED WATER LEVEL (FT): 11.24 (from TOC) DATE MEASURED: 100897



PROTECTIVE CASING, TOP (FT): 1.91 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.53
SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): 0.61 TYPE: Concrete
PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel
PROTECTIVE CASING, BOTTOM (FT): 1.6
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 1.5 TYPE: ¼" Pel Plug pellets by PDSCO
BENTONITE SEAL, BOTTOM (FT): 4.2
FILTER PACK, TOP (FT): 4.2
FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 5.9 SCREEN, TOP (FT): 5.9
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0
SCREEN, BOTTOM (FT): 20.9 TYPE: Sch. 40 PVC BRAND:
SUMP, TOP (FT): 20.9 TYPE: Sch. 40 PVC
FILTER PACK, BOTTOM (FT): 22.9
BACKFILL, TOP (FT): N/A TYPE: N/A
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 22.9
TOTAL DEPTH (FT): 22.9

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ~~080697 replaces 3179~~ (JNS) 080797

COMPLETED BY: J. Boylan DATE: 080697
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

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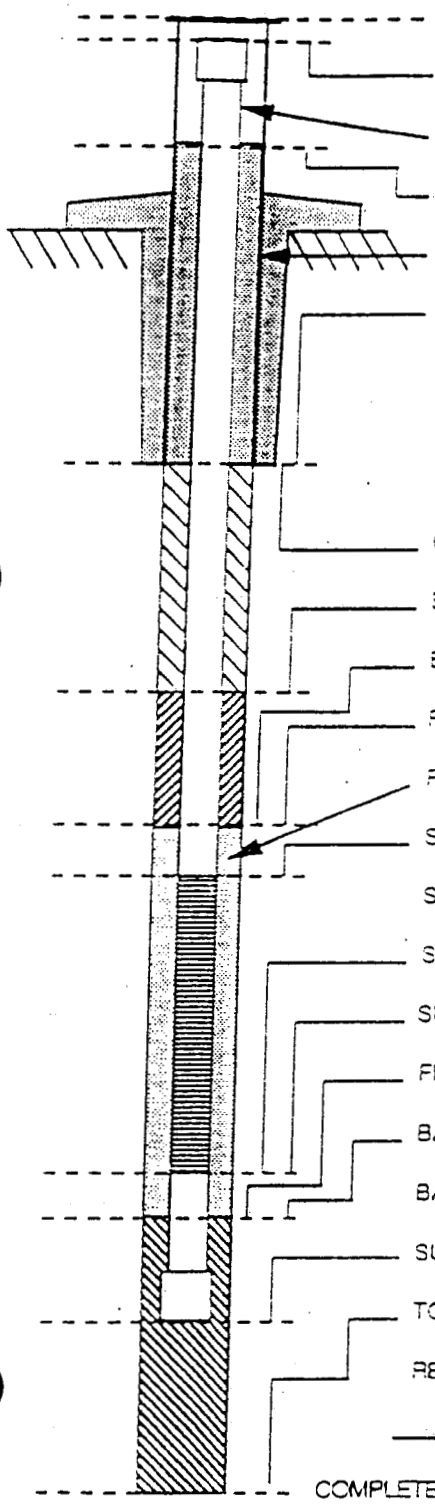
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C0697 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL/BR DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 081397 DATE COMPLETED: 081397
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN
COMPLETED DEPTH (FT): 10.0 ESTIMATED DEPTH TO BEDROCK (FT): ~~Not~~ 081397 4.1
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 081397 (in open h
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 100697



PROTECTIVE CASING, TOP (FT): _____ (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 2.04
SURFACE CASING, I.D. (IN): _____ TYPE: _____
SURFACE SEAL, TOP (FT): _____ TYPE: _____
PROTECTIVE CASING, I.D. (IN): _____ TYPE: _____
PROTECTIVE CASING, BOTTOM (FT): _____
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____
SECONDARY CASING, I.D. (IN): N/A TYPE: _____
CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____
GROUT SEAL, TOP (FT): N/A TYPE: _____
BENTONITE SEAL, TOP (FT): 0.6 TYPE: 1/4" bentonite pellets
BENTONITE SEAL, BOTTOM (FT): 2.5
FILTER PACK, TOP (FT): 2.5
FILTER PACK TYPE: 16-40 silica sand BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 3.0 SCREEN, TOP (FT): 3.0
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0
SCREEN, BOTTOM (FT): 8.0 TYPE: Sch 40 PVC BRAND: _____
SUMP, TOP (FT): 8.0 TYPE: Sch 40 PVC
FILTER PACK, BOTTOM (FT): 10.0
BACKFILL, TOP (FT): 10.0 TYPE: Native materials
BACKFILL, BOTTOM (FT): 10.4
SUMP, BOTTOM (FT): 10.0
TOTAL DEPTH (FT): 10.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Well 0C697 replaces 31791.

COMPLETED BY: J. Boylan DATE: 081397
CHECKED BY: _____ DATE: _____

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00797 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 081297 DATE COMPLETED: 08139

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

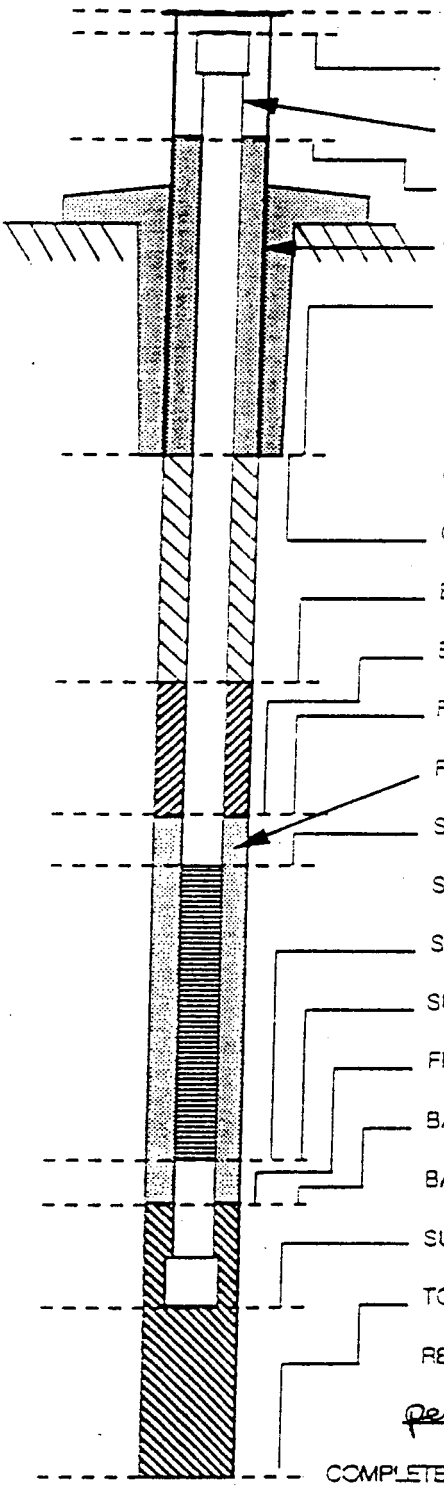
COMPLETED DEPTH (FT): 28.8 ESTIMATED DEPTH TO BEDROCK (FT): Not penetrated

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 081297 (open ho

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 2.0'

SURFACE CASING, I.D. (IN): TYPE:

SURFACE SEAL, TOP (FT): TYPE:

PROTECTIVE CASING, I.D. (IN): TYPE:

PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): TYPE:

BENTONITE SEAL, TOP (FT): 9.2 TYPE: ¼" bentonite pellets

BENTONITE SEAL, BOTTOM (FT): 13.0

FILTER PACK, TOP (FT): 13.0

FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 16.8 SCREEN, TOP (FT): 16.8

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 26.8 TYPE: Sch 40 PVC BRAND:

SUMP, TOP (FT): 26.8 TYPE: Sch 40 PVC

FILTER PACK, BOTTOM (FT): 28.8

BACKFILL, TOP (FT): N/A TYPE:

BACKFILL, BOTTOM (FT): N/A

SUMP, BOTTOM (FT): 28.8

TOTAL DEPTH (FT): 28.8

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: 00797 replaces 35691 (which is 7' E of 00797). Did not penetrate bedrock, although it was reported @ 25.2' in 35691.

COMPLETED BY: J. Boylan DATE: 081397

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C0897 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: ~~A~~ WBR DRILLING CONTRACTOR: Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 073197 DATE COMPLETED: 080697

RIG GEOLOGIST: J. Boylan LOGGING GEOLOGIST: J. Boylan

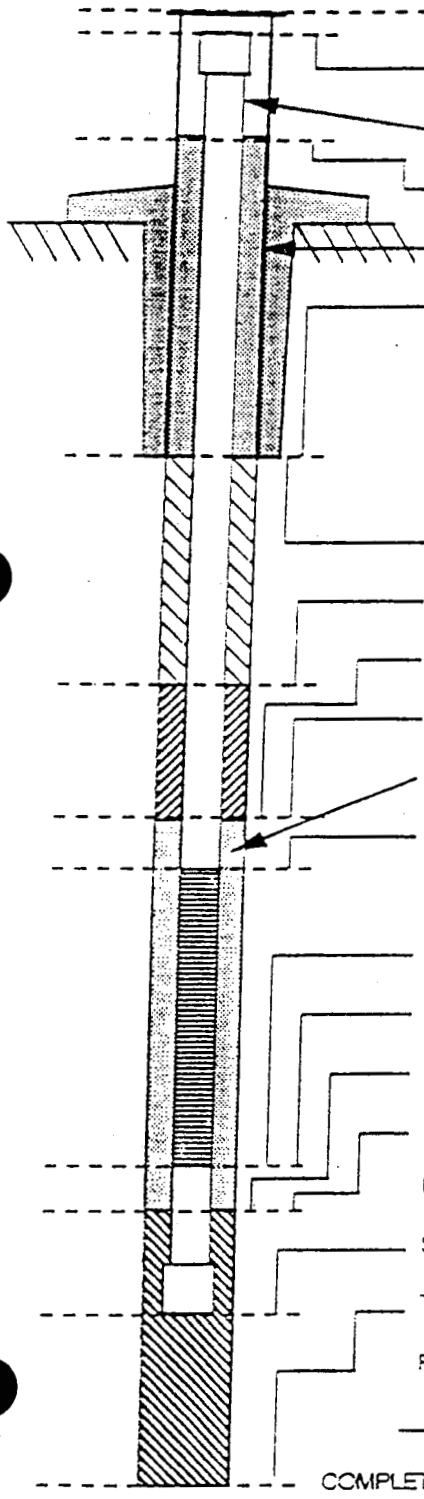
COMPLETED DEPTH (FT): 30.5 ESTIMATED DEPTH TO BEDROCK (FT): < 11.3

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 073197 (open hole)

COMPLETED WATER LEVEL (FT): ~~4.5~~ DATE MEASURED: ~~110197~~



PROTECTIVE CASING, TOP (FT): _____ (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~2.0~~ 1.0

SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): _____ TYPE: _____

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): _____

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): N/A TYPE: _____

CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL, TOP (FT): 2 TYPE: Pure Gold

BENTONITE SEAL, TOP (FT): 9.1 TYPE: ¼" Pel Plug pellets by PDSCo

BENTONITE SEAL, BOTTOM (FT): 11.7

FILTER PACK, TOP (FT): 11.7

FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 13.5 SCREEN, TOP (FT): 13.5

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 28.5 TYPE: Sch 40 PVC BRAND: _____

SUMP, TOP (FT): 28.5 TYPE: Sch 40 PVC

FILTER PACK, BOTTOM (FT): 30.5

BACKFILL, TOP (FT): 30.5 TYPE: Native materials

BACKFILL, BOTTOM (FT): 30.6

SUMP, BOTTOM (FT): 30.5

TOTAL DEPTH (FT): 30.6

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: _____

COMPLETED BY: J. Boylan DATE: 080697

CHECKED BY: _____ DATE: _____

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C0997 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 080497 DATE COMPLETED: 080[redacted]

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

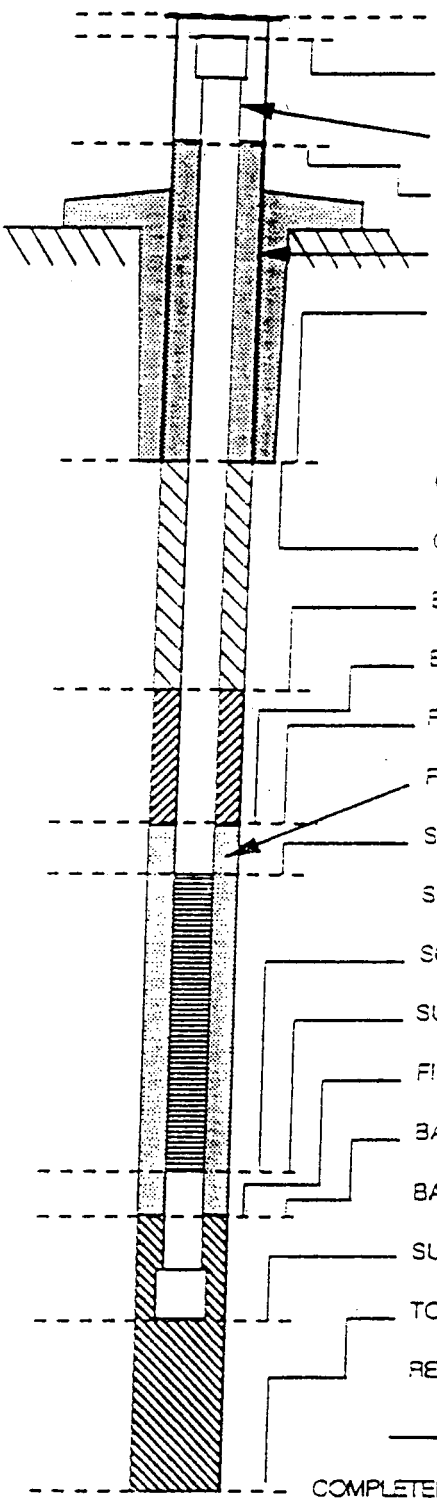
COMPLETED DEPTH (FT): 12.4 ESTIMATED DEPTH TO BEDROCK (FT): 10.5

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~9.4' in core DATE MEASURED: 080497

COMPLETED WATER LEVEL (FT): 8.41/6.31 DATE MEASURED: ~~080497~~/110497



PROTECTIVE CASING, TOP (FT): 2.3 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.9

SURFACE CASING, I.D. (IN): 2 TYPE: Sch.40 PVC

SURFACE SEAL TOP (FT): 0.1 TYPE: Concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 1.7

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): N/A TYPE:

BENTONITE SEAL TOP (FT): 2.0 TYPE: ¼" Pel Plug pellets by [redacted]

BENTONITE SEAL BOTTOM (FT): 4.0

FILTER PACK, TOP (FT): 4.0

FILTER PACK TYPE: 16-40 silica sand BRAND: CSS1

SURFACE CASING, BOTTOM (FT): 5.4 SCREEN, TOP (FT): 5.4

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 10.4 TYPE: Sch.40 PVC BRAND:

SUMP, TOP (FT): 10.4 TYPE: Sch.40 PVC

FILTER PACK, BOTTOM (FT): 12.4

BACKFILL, TOP (FT): N/A TYPE: N/A

BACKFILL, BOTTOM (FT): N/A

SUMP, BOTTOM (FT): 12.4

TOTAL DEPTH (FT): 12.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: 00997 replaces 3786

COMPLETED BY: J. Boylan DATE: ~~JAB~~ 080497

CHECKED BY: DATE:

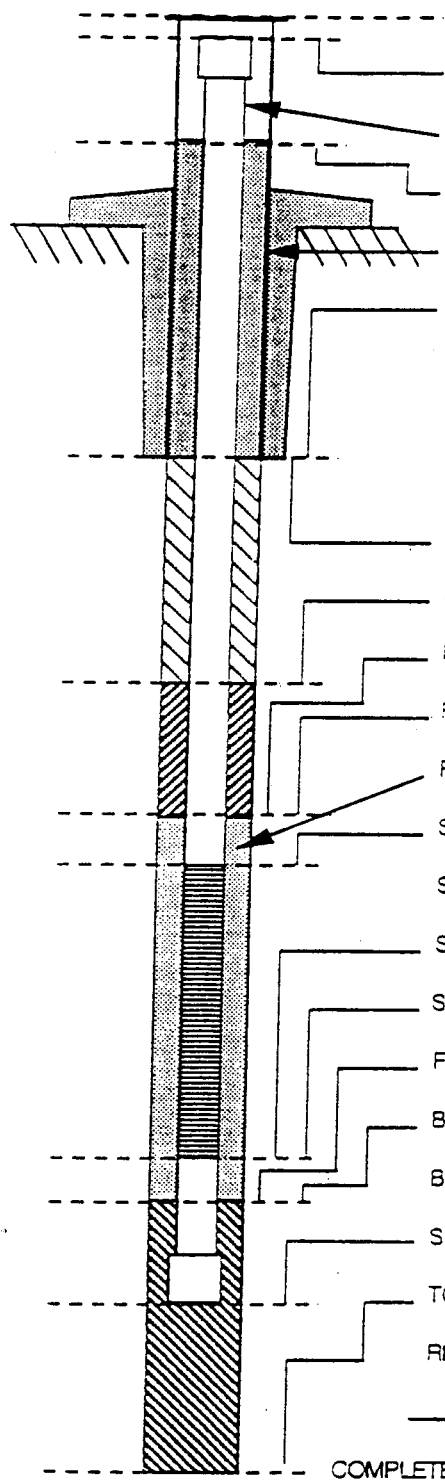
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01097 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 071497-071697 DATE COMPLETED: 071697
RIG GEOLOGIST: J. BOYLAN/R. KOEHLER/W. WHITON LOGGING GEOLOGIST: J. BOYLAN/R. KOEHLER/W. WHITON
COMPLETED DEPTH (FT): 42.5 ESTIMATED DEPTH TO BEDROCK (FT): 49.4
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): Ø
INITIAL WATER LEVEL (FT): 22.35 / 22.11 DATE MEASURED: 071597 / 071697 (open hole)
COMPLETED WATER LEVEL (FT): 21.57 from TOC DATE MEASURED: 071797



PROTECTIVE CASING, TOP (FT): 2.5 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 2.0
SURFACE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): 1.3 TYPE: Concrete
PROTECTIVE CASING, I.D. (IN): 6 TYPE: Steel
PROTECTIVE CASING, BOTTOM (FT): 2.5
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): 2 TYPE: Pure Gold
BENTONITE SEAL, TOP (FT): 15.0 TYPE: PdS Co. Medium Bentonite Plug
BENTONITE SEAL, BOTTOM (FT): 17.9
FILTER PACK, TOP (FT): 17.9
FILTER PACK TYPE: 16-40 silica sand BRAND: Colorado Silica
SURFACE CASING, BOTTOM (FT): ~~N/A~~ 19.81 SCREEN, TOP (FT): 19.81
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0
SCREEN, BOTTOM (FT): 39.8 TYPE: Sch. 40 PVC BRAND:
SUMP, TOP (FT): 39.8 TYPE: Sch. 40 PVC
FILTER PACK, BOTTOM (FT): 41.7
BACKFILL, TOP (FT): 41.7 TYPE: Bentonite: 41.7-44.0; 10-20 sand (CSSI brand): 44.0-51.9; Native materials: 51.9-53.5
BACKFILL, BOTTOM (FT): 53.5
SUMP, BOTTOM (FT): 42.5
TOTAL DEPTH (FT): 53.5

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: J. Boylan DATE: 080197
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01197 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: GROUND EXPLORATION

DRILLING METHOD: HSA DATE DRILLED: 7/18/97 RPK 7/18/97 COMPLETED: 7/18/97

RIG GEOLOGIST: ~~J. BOYLAN~~ R. KOEHLER RPK 7/18/97 LOGGING GEOLOGIST: ~~J. BOYLAN~~ 7/18/97 R. KOEHLER

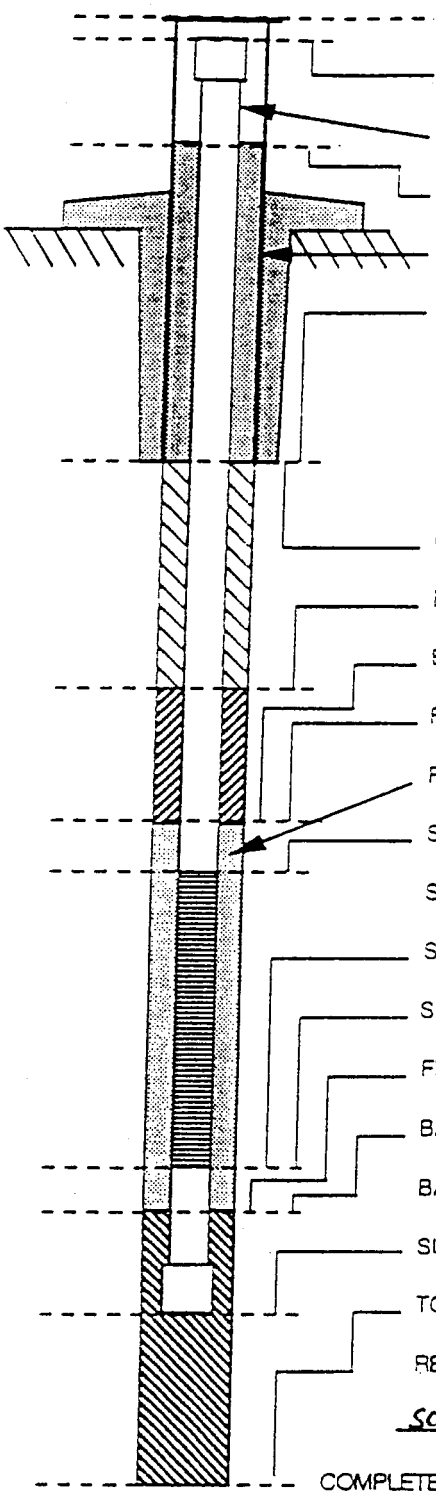
COMPLETED DEPTH (FT): 30.0 ESTIMATED DEPTH TO BEDROCK (FT): 28.0

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): Ø

INITIAL WATER LEVEL (FT): 12.96 DATE MEASURED: 7/18/97 (open hole)

COMPLETED WATER LEVEL (FT): 13.6 from TOC DATE MEASURED: 07/21/97



PROTECTIVE CASING, TOP (FT): 2.67 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 2.28

SURFACE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): 1.5 TYPE: concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: Steel

PROTECTIVE CASING, BOTTOM (FT): 2.7

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): ~~0.0~~ 1.2 TYPE: Pure Gold

BENTONITE SEAL, TOP (FT): 7.7 TYPE: PDS Co. Medium Bentonite Plug

BENTONITE SEAL, BOTTOM (FT): 11.0

FILTER PACK, TOP (FT): 11.0

FILTER PACK TYPE: 16-40 Silica Sand BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): N/A SCREEN, TOP (FT): 13.0'

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 28.0 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 28.0 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 30.0

BACKFILL, TOP (FT): 30.0 TYPE: Native material 30.0'-31.0'

BACKFILL, BOTTOM (FT): 31.0

SUMP, BOTTOM (FT): 30.0 } 2" split spoon covehole

TOTAL DEPTH (FT): 31.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: 5 gallons of distilled water added to well to help settle filter pack in addition to 5 gallons added to hydrate bentonite filter pack seal.

COMPLETED BY: R. KOEHLER / J. Boylan DATE: 7/18/97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: ~~0197~~ #01297 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL RPK 072297 DRILLING CONTRACTOR: GROUND EXPLORATION

DRILLING METHOD: HSA

RIG GEOLOGIST: ~~J. BOYLAN~~ R. KOEHLER 072297 DATE DRILLED: 0721/0722/97 DATE COMPLETED: 072297

COMPLETED DEPTH (FT): 36.0' LOGGING GEOLOGIST: ~~J. BOYLAN~~ R. KOEHLER 072297

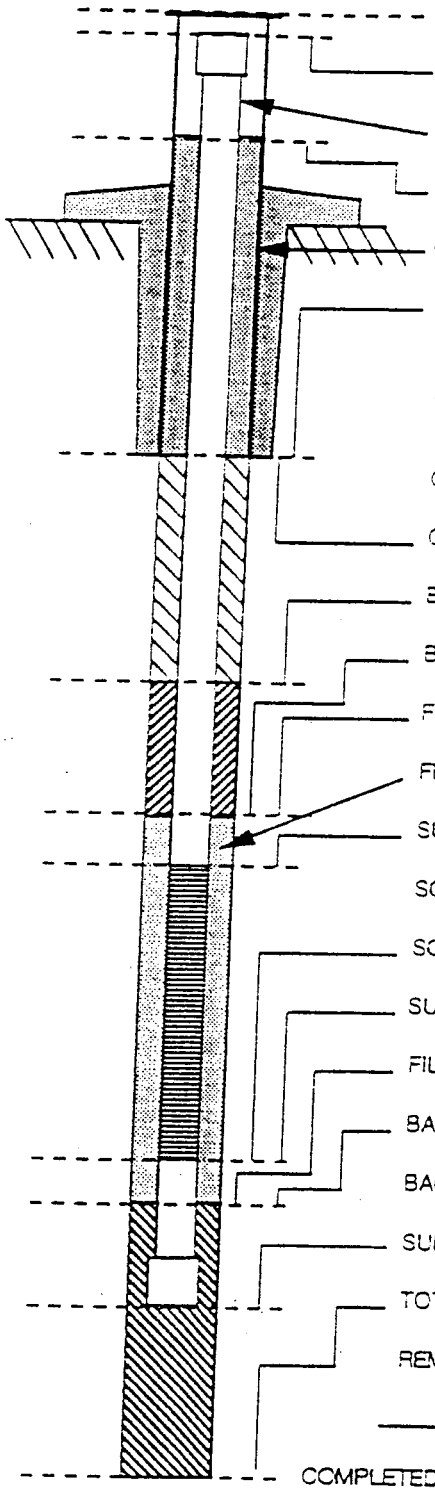
ESTIMATED DEPTH TO BEDROCK (FT): 34.1'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): Ø

INITIAL WATER LEVEL (FT): 11.0' DATE MEASURED: 072297 (open hole)

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 2.3 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~2.3~~ 2.1

SURFACE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): 0.9 TYPE: concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.7

IF APPLICABLE

SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): 2.0 TYPE: Pure Gold

BENTONITE SEAL, TOP (FT): 8.5' TYPE: Pel-Plug PDS Co.

BENTONITE SEAL, BOTTOM (FT): 11.0

FILTER PACK, TOP (FT): 11.0

FILTER PACK TYPE: 16-40 Silica Sand BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): N/A SCREEN, TOP (FT): 14.0'

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 34.0 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 34.0 TYPE: Sch 40 PVC

FILTER PACK, BOTTOM (FT): 36.0

BACKFILL, TOP (FT): ~~0.5~~ ~~36.5~~ 36.0 RPK 072297 TYPE: Native material, settled out overnight

BACKFILL, BOTTOM (FT): 36.5

SUMP, BOTTOM (FT): 36.0

TOTAL DEPTH (FT): 36.5

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: R. Koehler DATE: 07 22 97

CHECKED BY: DATE:

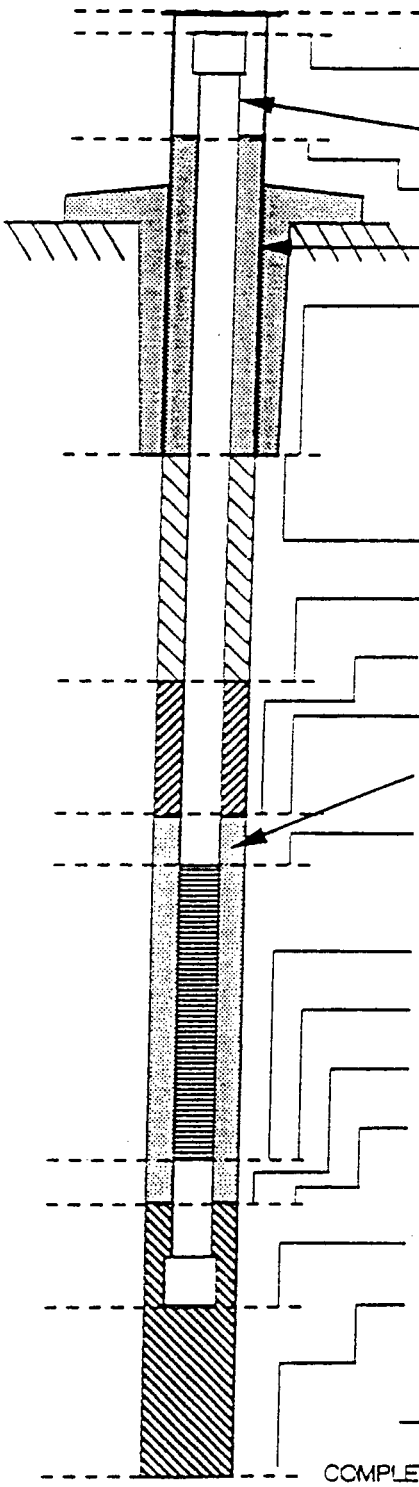
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 0397 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL/BR DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 072897 DATE COMPLETED: 080697
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN
COMPLETED DEPTH (FT): 24.2 ESTIMATED DEPTH TO BEDROCK (FT): 20.9
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): 6.35 DATE MEASURED: 072997 (open hole)
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 2.4 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.94
SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): 0.4 TYPE: concrete
PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel
PROTECTIVE CASING, BOTTOM (FT): 1.6

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 1.3 TYPE: 1/4" Pel-Plug pellets by PDS
BENTONITE SEAL, BOTTOM (FT): 5.1
FILTER PACK, TOP (FT): 5.1
FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 7.2 SCREEN, TOP (FT): 7.2
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0
SCREEN, BOTTOM (FT): 22.2 TYPE: Sch. 40 PVC BRAND:
SUMP, TOP (FT): 24.2 TYPE: Sch. 40 PVC
FILTER PACK, BOTTOM (FT): 24.4
BACKFILL, TOP (FT): 24.2 TYPE: CSSI 16-40 silica sand
BACKFILL, BOTTOM (FT): 24.4
SUMP, BOTTOM (FT): 24.2
TOTAL DEPTH (FT): 24.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: J. Boylan DATE: 080697
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01497 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: ~~THERMAL~~ Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 7/22-23/97 DATE COMPLETED: 7/23/97

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

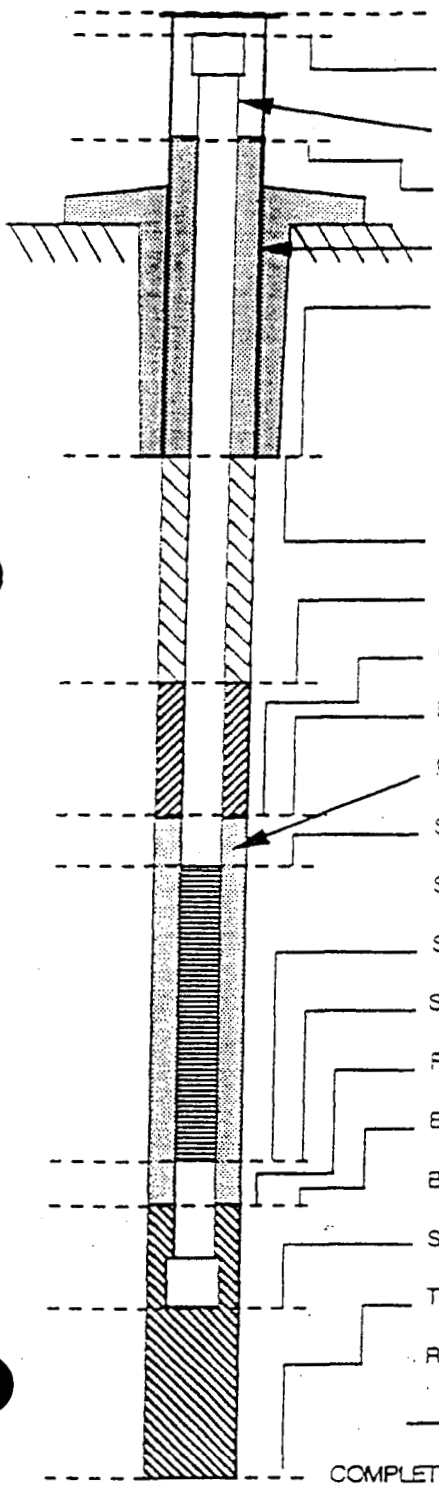
COMPLETED DEPTH (FT): 25.0 ESTIMATED DEPTH TO BEDROCK (FT): 22.5

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): 17.4 DATE MEASURED: 072397 (openhole)

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 2.2 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.9

SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC

SURFACE SEAL TOP (FT): 1.2 TYPE: Concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.8

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): N/A BOTTOM (FT): N/A

GROUT SEAL TOP (FT): 2.0 TYPE: Pure Gold

BENTONITE SEAL, TOP (FT): 9.0 TYPE: 1/4" bentonite pellets ("Pel-Plug")

BENTONITE SEAL, BOTTOM (FT): 11.0

FILTER PACK, TOP (FT): 11.0

FILTER PACK TYPE: 16-40 silica sand BRAND: CSS 1

SURFACE CASING, BOTTOM (FT): 13.0 SCREEN, TOP (FT): 13.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 23.1 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 23.1 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 25.0

BACKFILL, TOP (FT): N/A TYPE: N/A

BACKFILL, BOTTOM (FT): N/A

SUMP, BOTTOM (FT): 25.0

TOTAL DEPTH (FT): 25.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: J. Boylan DATE: 080697

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01597 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 072597 DATE COMPLETED: 072897

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

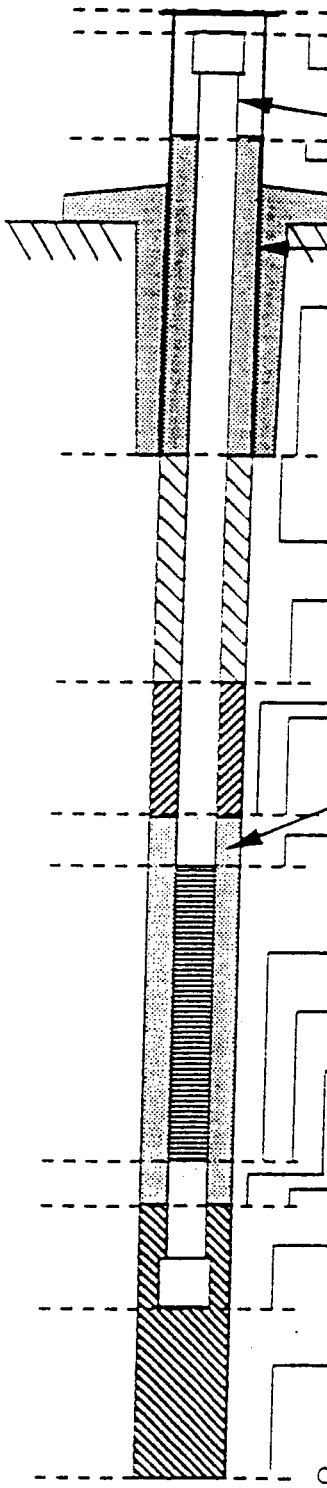
COMPLETED DEPTH (FT): ~~31.5~~ 31.6 ESTIMATED DEPTH TO BEDROCK (FT): 28.5

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~~12.4~~ 18.4 DATE MEASURED: 072497 } in caved, original 072597 } hole

COMPLETED WATER LEVEL (FT): 13.35 DATE MEASURED: 072897 in well set in offset h



PROTECTIVE CASING, TOP (FT): 2.76 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 2.36

SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): 0.9 TYPE: concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.24

IF APPLICABLE

SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): 2 TYPE: Pure Gold

BENTONITE SEAL, TOP (FT): 7.0 TYPE: ¼" Pel-Plug pellets by PDS

BENTONITE SEAL BOTTOM (FT): 11.0

FILTER PACK, TOP (FT): 11.0

FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 14.6 SCREEN, TOP (FT): 14.6

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 29.6 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 29.6 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 31.6

BACKFILL, TOP (FT): N/A TYPE: N/A

BACKFILL, BOTTOM (FT): N/A

SUMP, BOTTOM (FT): 31.6

TOTAL DEPTH (FT): 31.6

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Unable to install well in original hole due to repeated caving. Offset 6½' WSW & drilled hole, installed 01597. (Core is from orig. hole.)

COMPLETED BY: J. Boylan DATE: 072897

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C1697 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater

SCREENED FORMATION: AL DRILLING CONTRACTOR: Tierra Environmental

DRILLING METHOD: Push hammer DATE DRILLED: 0825-2797 DATE COMPLETED: 082797

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

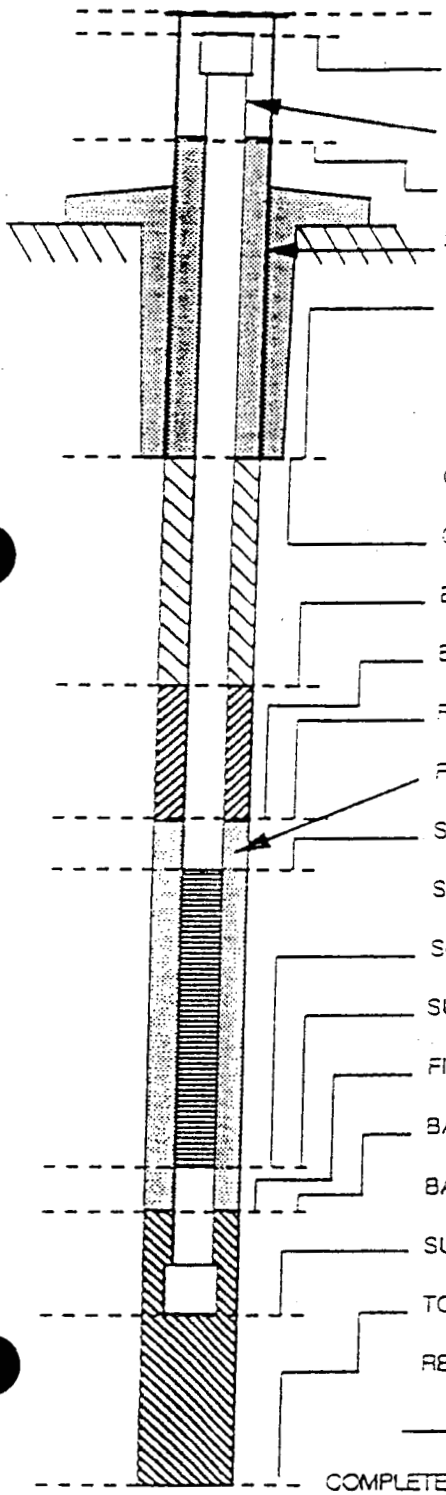
COMPLETED DEPTH (FT): 28.35 ESTIMATED DEPTH TO BEDROCK (FT): 28.0

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): ~~0.75~~ 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~22' in core DATE MEASURED: 082797

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.96

SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch 40 PVC

SURFACE SEAL, TOP (FT): 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 0.4

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Aquaset® granulated bentonite

BENTONITE SEAL, BOTTOM (FT): 16.5

FILTER PACK, TOP (FT): 16.5

FILTER PACK TYPE: 16-40 sand BRAND: C-SS1

SURFACE CASING, BOTTOM (FT): 18.46 SCREEN, TOP (FT): 18.46

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 28.2 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 28.2 TYPE: Sch 40 PVC

FILTER PACK, BOTTOM (FT): 28.3

BACKFILL, TOP (FT): 28.3 TYPE: Native materials

BACKFILL, BOTTOM (FT): 29.0

SUMP, BOTTOM (FT): 28.35

TOTAL DEPTH (FT): 29.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: J. Boylan DATE: 082797

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01797 PROJECT NAME: WARP-97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: GROUND EXPLORATION

DRILLING METHOD: HOLLOW STEM AUGER DATE DRILLED: 09/02-03/97 DATE COMPLETED: 09/03/97

RIG GEOLOGIST: MARK WOODS (0-22.0 ft) R. KOEHLER (22.0-30.0 ft) LOGGING GEOLOGIST: MARK WOODS (0-22 ft) R. KOEHLER (22-30 ft)

COMPLETED DEPTH (FT): 24 ~~30.0 ft~~ ESTIMATED DEPTH TO BEDROCK (FT): 22.0 ft

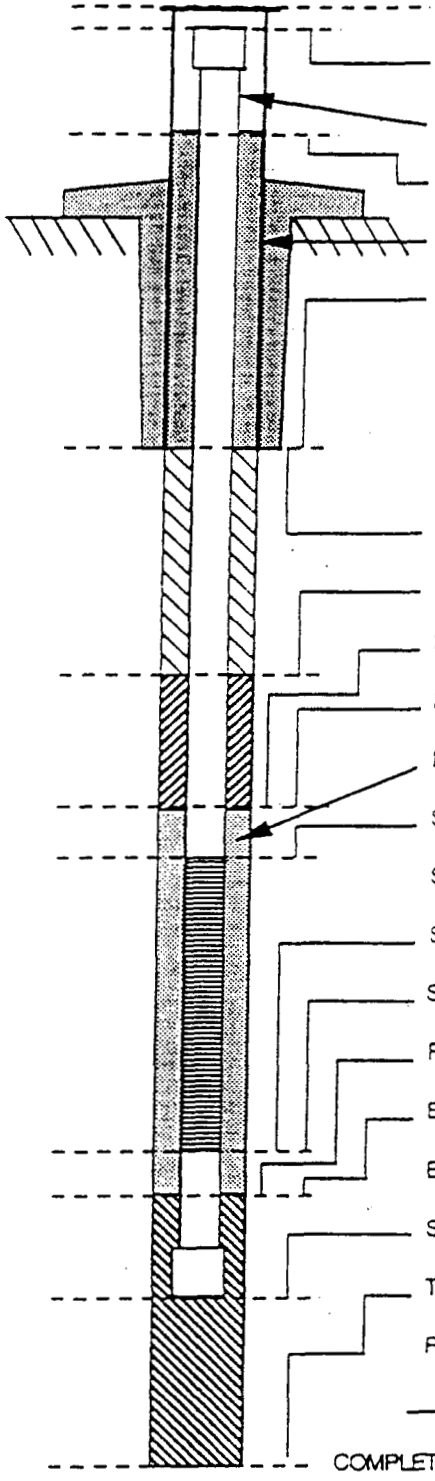
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8 inch

In incomplete well (TD=22, extended to 30 ft

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0

INITIAL WATER LEVEL (FT): 21.51 ft DATE MEASURED: 0905 on 09/03/97

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 2.3 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~2.74 ft~~ 2.0

SURFACE CASING, I.D. (IN): 2 inch TYPE: PVC Sch. 40

SURFACE SEAL, TOP (FT): 1.1 TYPE: Concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.7

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): ~~0.0 ft~~ 2 TYPE: PURE GOLD 9.9 lb/gal

BENTONITE SEAL, TOP (FT): 7.0 ft TYPE: RK 9/3/97 ~~6~~ Pelleted, PEL-PLUG 1/4 inch

BENTONITE SEAL, BOTTOM (FT): 9.9 ft.

FILTER PACK, TOP (FT): 9.9 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 12.0 ft. SCREEN, TOP (FT): 12.0 ft

SCREEN SLOT SIZE (.000 IN): 0.010 in SCREEN, I.D. (IN): 2 inch

SCREEN, BOTTOM (FT): 22.0 ft. TYPE: PVC Sch 40 BRAND:

SUMP, TOP (FT): 22.0 ft. TYPE: PVC Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 25.5 ft

BACKFILL, TOP (FT): 25.5 ft TYPE: Bentonite, Pelleted 1/4 inch, Pel Plug

BACKFILL, BOTTOM (FT): 30 ft (in 2 inch corehole, auger to 28 ft - 8 inch hole)

SUMP, BOTTOM (FT): 24 ft.

TOTAL DEPTH (FT): 30 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER DATE: 09/03/97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01897 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ GROUNDW

SCREENED FORMATION: AL DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE : PUSH, HAMMER DATE DRILLED: 080797-081397 DATE COMPLETED: 081397

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

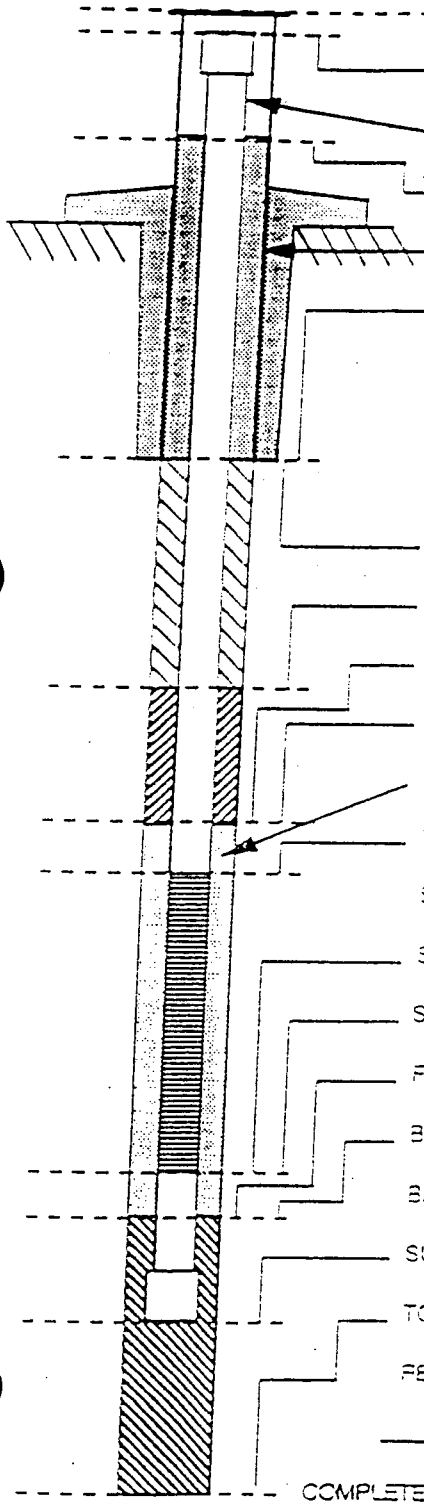
COMPLETED DEPTH (FT): 23.0 ESTIMATED DEPTH TO BEDROCK (FT): 23.2

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): 6.7 (open hole muck) 7.2 " " " DATE MEASURED: 081297 081397

COMPLETED WATER LEVEL (FT): 7.51 DATE MEASURED: 081497



PROTECTIVE CASING, TOP (FT): ~~FLUSH~~ (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.5'

SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC

SURFACE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite

PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 0.93

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): N/A TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite

BENTONITE SEAL BOTTOM (FT): 1.9

FILTER PACK, TOP (FT): 1.9

FILTER PACK TYPE: 16-40 Silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 13.0 SCREEN, TOP (FT): 13.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 22.8 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 22.8 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 23.0

BACKFILL, TOP (FT): 23.0 TYPE: Native materials

BACKFILL, BOTTOM (FT): 24.0

SUMP, BOTTOM (FT): 23.0

TOTAL DEPTH (FT): 24.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: J. Boylan DATE: 102397

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C1997 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 090897 DATE COMPLETED: 0909

FIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: ~~J. BOYLAN~~ R. KOEHLER

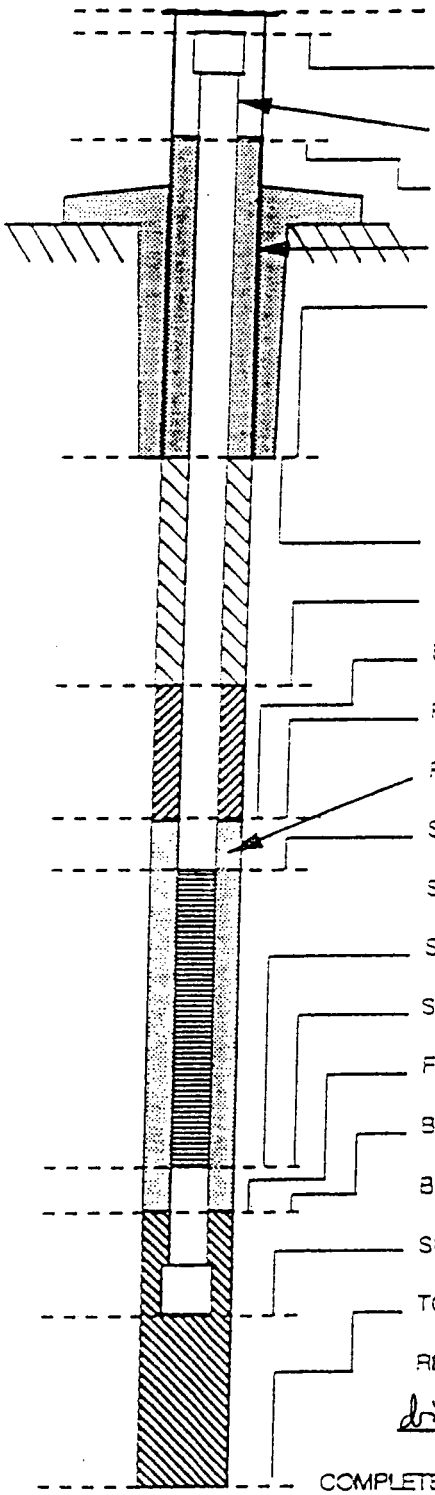
COMPLETED DEPTH (FT): 14.0 ESTIMATED DEPTH TO BEDROCK (FT): 12.0

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~16' in core DATE MEASURED: 081497 (in original, logged Geoprobe core, not in final offset location)

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 2.8 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.9

SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): 0.8 TYPE: concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.2

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): N/A

SECONDARY CASING, I.D. (IN): N/A TYPE: N/A

CENTRALIZER, O.D. (IN): N/A TOP (FT): N/A BOTTOM (FT): N/A

GROUT SEAL, TOP (FT): N/A TYPE: N/A

BENTONITE SEAL, TOP (FT): 1.6 TYPE: ¼" pellets

BENTONITE SEAL, BOTTOM (FT): 5.1

FILTER PACK, TOP (FT): 5.1

FILTER PACK TYPE: 16-40 sand BRAND: CSS1

SURFACE CASING, BOTTOM (FT): 7.0 SCREEN, TOP (FT): 7.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 12.0 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 12.0 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 14.8

BACKFILL, TOP (FT): 14.0 TYPE: ~~Sch. 4~~ 16-40 sand

BACKFILL, BOTTOM (FT): 14.8

SUMP, BOTTOM (FT): 14.0

TOTAL DEPTH (FT): 14.8

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Repeated caving & tip refusal prevented installation via Geoprobe drilling techniques. Well finally installed using HSA techniques.

COMPLETED BY: J. Boylan DATE: 090997

CHECKED BY: DATE:

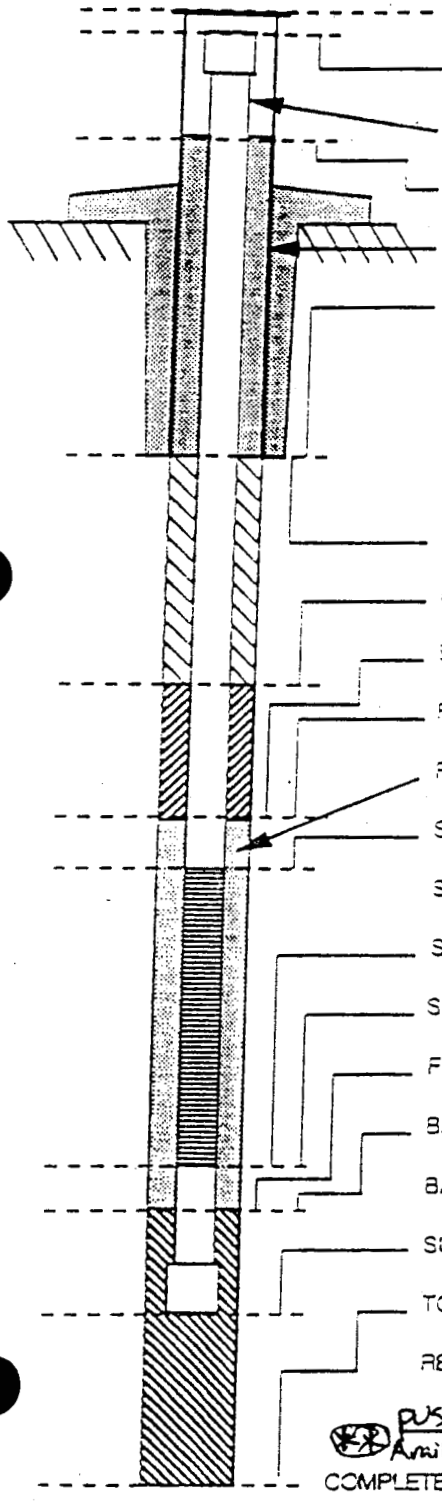
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 2)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C2097 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP Groundwater
SCREENED FORMATION: AL DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Push Hammer DATE DRILLED: 081997 DATE COMPLETED: 082097
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN
COMPLETED DEPTH (FT): 12.09 ESTIMATED DEPTH TO BEDROCK (FT): 11.7
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): ~10' in core (1.4 (openhole)) DATE MEASURED: 081897 (082097)
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.85 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.75
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch 40 PVC
SURFACE SEAL, TOP (FT): 0 TYPE: Granular bentonite
PROTECTIVE CASING, I.D. (IN): 2 TYPE: Sch 40 PVC
PROTECTIVE CASING, BOTTOM (FT): 0.55

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 0 TYPE: Granular bentonite
BENTONITE SEAL, BOTTOM (FT): 5.9
FILTER PACK, TOP (FT): 5.9
FILTER PACK TYPE: 16-40 silica sand BRAND: CSS 1
SURFACE CASING, BOTTOM (FT): 7.04 SCREEN, TOP (FT): 7.04
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 11.93 TYPE: Sch 40 PVC (**) see remarks BRAND:
SUMP, TOP (FT): 11.93 TYPE: Sch 40 PVC
FILTER PACK, BOTTOM (FT): 12.09 (*) see remarks
BACKFILL, TOP (FT): 12.09 (*) TYPE: Native materials
BACKFILL, BOTTOM (FT): 14.0
SUMP, BOTTOM (FT): 12.09
TOTAL DEPTH (FT): 14.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: (*) Borehole was very mucky during installation, and well string pushed to completed depth, so filter may not extend to indicated depth.
(**) Available well screen components were stenciled.

COMPLETED BY: J. Boylan DATE: 082097
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev. 3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C2197 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration

DRILLING METHOD: HSA DATE DRILLED: 090997 DATE COMPLETED: 090997

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

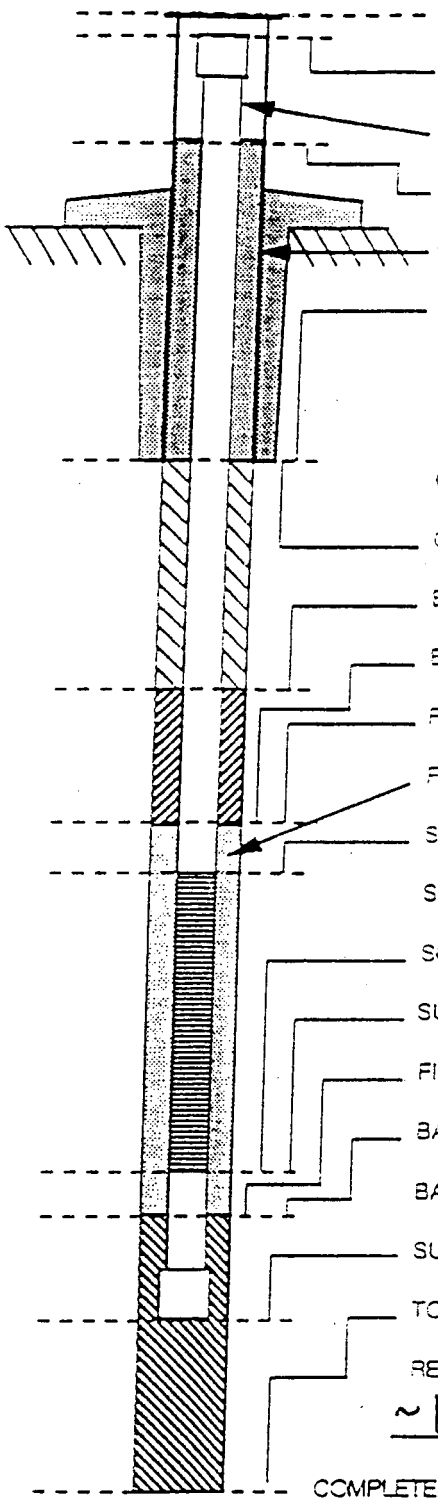
COMPLETED DEPTH (FT): 12.9 ESTIMATED DEPTH TO BEDROCK (FT): 10.9

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 090997 (open hole)

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 2.5 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.7

SURFACE CASING, I.D. (IN): 2 TYPE: Sch 40 PVC

SURFACE SEAL, TOP (FT): 1 TYPE: concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.5

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.9 TYPE: 1/4" pellets

BENTONITE SEAL, BOTTOM (FT): 4.0

FILTER PACK, TOP (FT): 4.0

FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 5.9 SCREEN, TOP (FT): 5.9

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2.0

SCREEN, BOTTOM (FT): 10.9 TYPE: Sch. 40 PVC BRAND:

SUMP, TOP (FT): 10.9 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 12.9

BACKFILL, TOP (FT): N/A TYPE:

BACKFILL, BOTTOM (FT): N/A

SUMP, BOTTOM (FT): 12.9

TOTAL DEPTH (FT): 12.9

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Unable to fully remove thin layer of caved soil ~1-3" thick, at ~3' depth (See logbook ER-WARP-LB-97-207, p. 135-136.)

COMPLETED BY: J. Boylan DATE: 090997

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 02297 ALLUVIUM PROJECT NAME: 1997 WARP 97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~WEATHERED BEDROCK~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 09-25-97 DATE COMPLETED: 09-25-97

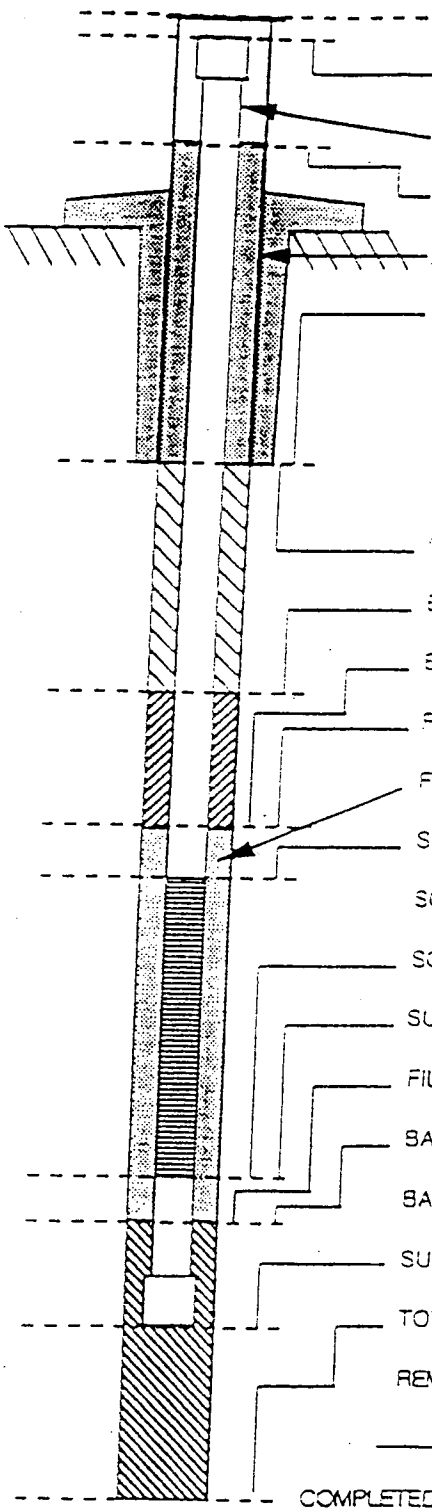
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~15.0 ft.~~ 12.18 ESTIMATED DEPTH TO BEDROCK (FT): 11.3 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 092597

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.70 ft (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.65 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~0.4~~ 0 TYPE: Granulated bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Schedule 40

PROTECTIVE CASING, BOTTOM (FT): 0.68 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 6.0 ft.

FILTER PACK, TOP (FT): 6.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 7.12 ft SCREEN, TOP (FT): 7.12 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 12.02 ft. TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 12.02 ft. TYPE: PVC, Sch 40 w/pop rivets

FILTER PACK, BOTTOM (FT): 12.0 ft

BACKFILL, TOP (FT): 12.0 ft. TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): 15.0 ft.

SUMP, BOTTOM (FT): 12.18 ft.

TOTAL DEPTH (FT): 15.0 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: R. KOEHLER DATE: 09-25-97

CHECKED BY: J. Boylan DATE: 102397

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #02397 PROJECT NAME: 097 WARP-97 PROGRAM: GROUNDWATER

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 09-29-97 DATE COMPLETED: 09-29-97

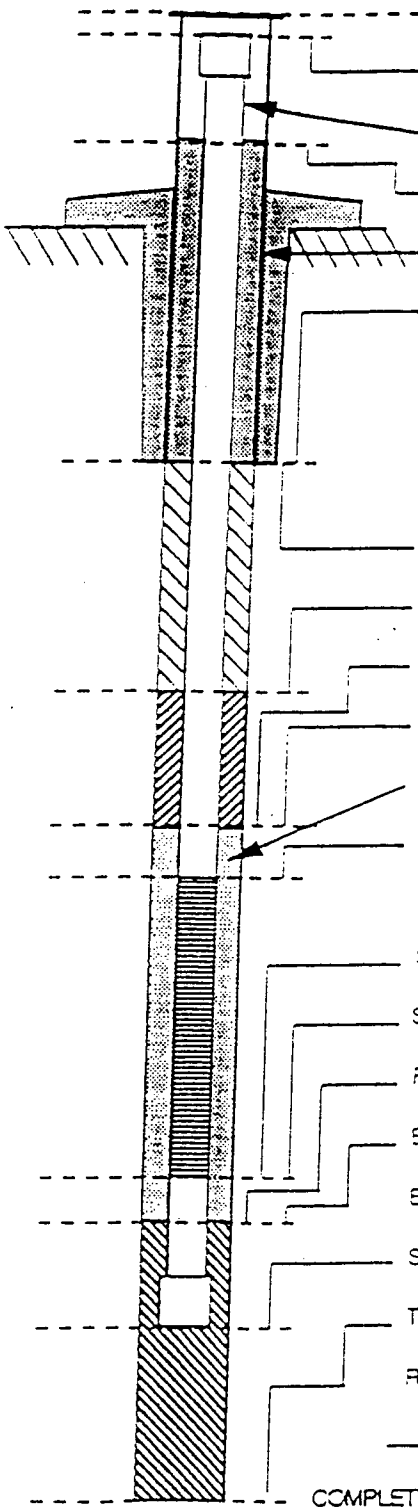
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~13.0 ft.~~ 11.12' ESTIMATED DEPTH TO BEDROCK (FT): 10.2 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A INITIAL WATER LEVEL (FT): Dry (openhole) DATE MEASURED: 092997

COMPLETED WATER LEVEL (FT): 9.56 DATE MEASURED: 111897



PROTECTIVE CASING, TOP (FT): 0.89 ft. (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.81 ft. w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~NA~~ 0 TYPE: Granulated bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Schedule 40

PROTECTIVE CASING, BOTTOM (FT): 0.56 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 5.0 ft.

FILTER PACK, TOP (FT): 5.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 6.07 ft. SCREEN, TOP (FT): 6.07 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 10.97 ft. TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 10.97 ft. TYPE: PVC, Sch 40, w/poprivets

FILTER PACK, BOTTOM (FT): 11.0 ft

BACKFILL, TOP (FT): 11.0 ft. TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): 13.0 ft.

SUMP, BOTTOM (FT): 11.124 ft.

TOTAL DEPTH (FT): 13.0 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER DATE: 09-29-97

CHECKED BY: J. Baylor DATE: 102397

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 02497 PROJECT NAME: 1997 WARP ~~97~~ PROGRAM: GROUNDWATER

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: TERRA

DRILLING METHOD: GEOPROBE – MACROCORE DATE DRILLED: 09-26-97 DATE COMPLETED: 09-26-97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

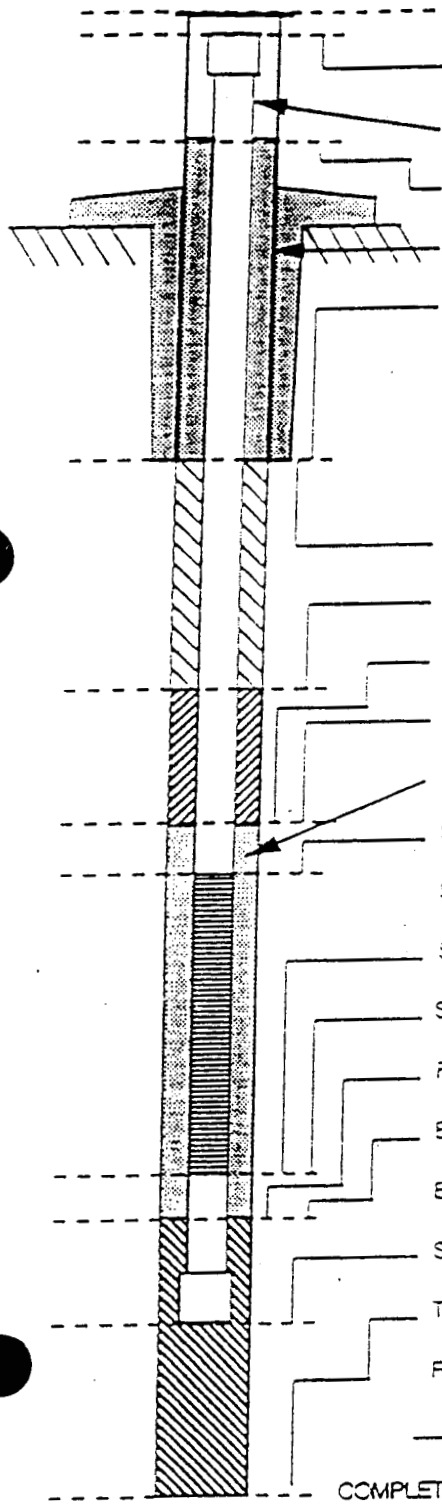
COMPLETED DEPTH (FT): ~~18.0 ft~~ 11.1 ESTIMATED DEPTH TO BEDROCK (FT): 10.8 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0 N/A

INITIAL WATER LEVEL (FT): ~13' in core DATE MEASURED: 09 26 97

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.48 ft. (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.42 ft w/o cap

SURFACE CASING, I.D. (IN): ~~1½"~~ 3/4" TYPE: PVC, Sch 40 RPK 9/24/97

SURFACE SEAL TOP (FT): ~~NA~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1½" TYPE: PVC, SCH 40

PROTECTIVE CASING, BOTTOM (FT): 0.96 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 6.0 ft.

FILTER PACK, TOP (FT): 6.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 6.048 ft. SCREEN, TOP (FT): 6.048 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 10.95 ft. TYPE: PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 10.95 ft. TYPE: PVC, Sch 40 w/pop rivets

FILTER PACK, BOTTOM (FT): 11.0 ft.

BACKFILL, TOP (FT): 11.0 ft. TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): 18.0 ft.

SUMP, BOTTOM (FT): 11.10 ft.

TOTAL DEPTH (FT): 18.0 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: DATE:

CHECKED BY: J. Baylan DATE: 102397

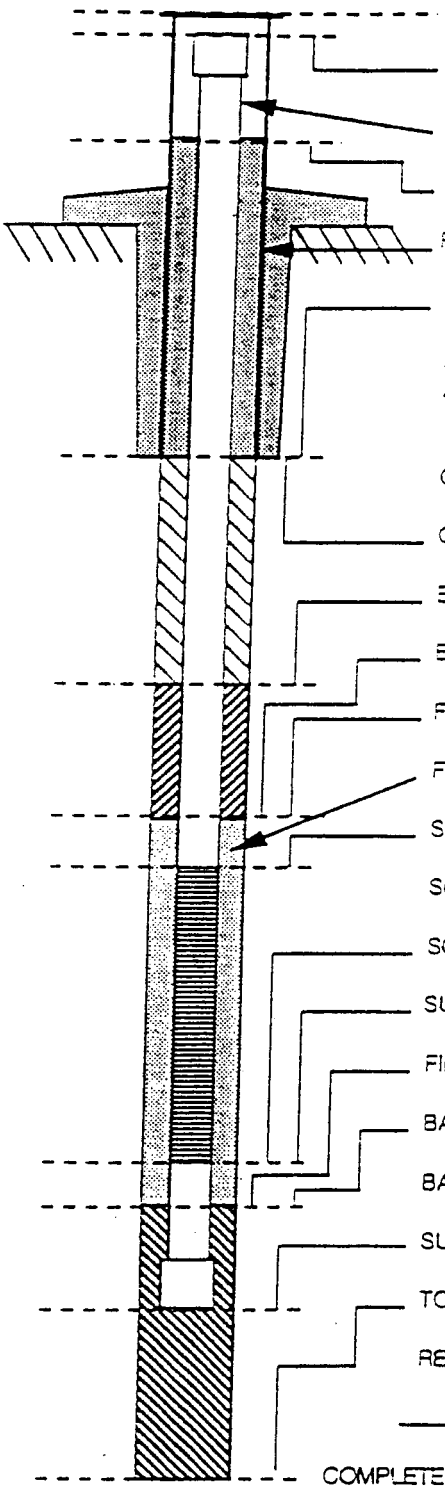
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C2697 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 092797 DATE COMPLETED: 092797
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN
COMPLETED DEPTH (FT): 28.4 ESTIMATED DEPTH TO BEDROCK (FT): 24.8
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): ~22' in core DATE MEASURED: 092797
COMPLETED WATER LEVEL (FT): 24.51 DATE MEASURED: 100297



PROTECTIVE CASING, TOP (FT): 2.2 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.9
SURFACE CASING, I.D. (IN): 2 TYPE: Sch 40 PVC
SURFACE SEAL TOP (FT): 0.8 TYPE: Concrete
PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel
PROTECTIVE CASING, BOTTOM (FT): 2.8

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): 2 TYPE: Pure Gold
BENTONITE SEAL, TOP (FT): 10.7 TYPE: ¼" bentonite pellets
BENTONITE SEAL, BOTTOM (FT): 14.0
FILTER PACK, TOP (FT): 14.0
FILTER PACK TYPE: 16-40 silica sand BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 16.14 SCREEN, TOP (FT): 16.14
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2
SCREEN, BOTTOM (FT): 26.14 TYPE: Sch 40 PVC BRAND:
SUMP, TOP (FT): 26.14 TYPE: Sch 40 PVC
FILTER PACK, BOTTOM (FT): 28.4
BACKFILL, TOP (FT): N/A TYPE:
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 28.4
TOTAL DEPTH (FT): 28.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: J. Boylan DATE: 092797
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
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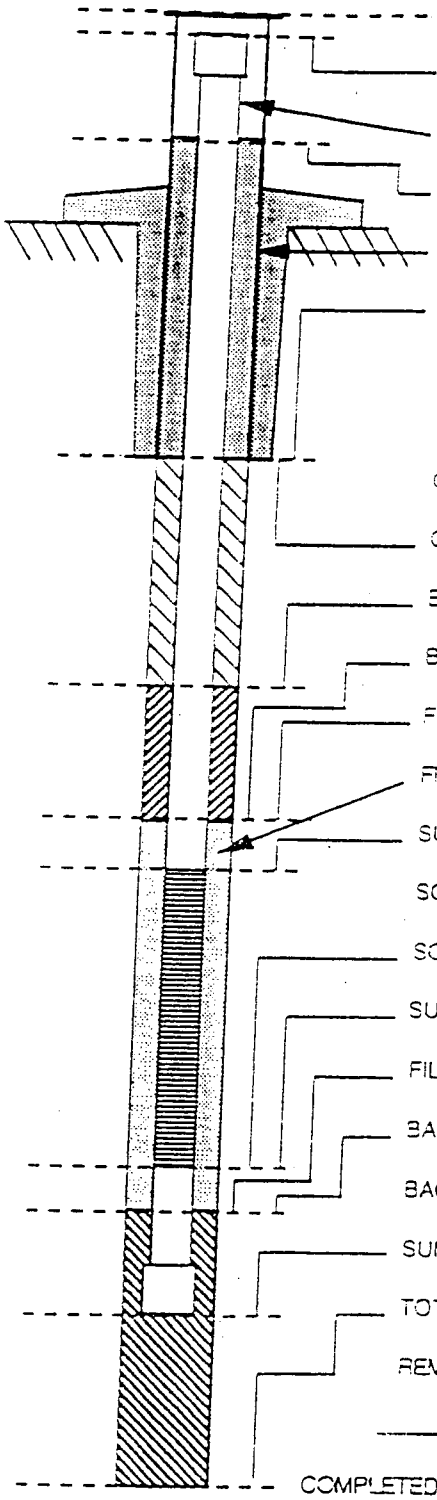
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C2797 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP
SCREENED FORMATION: AL DRILLING CONTRACTOR: Ground Exploration
DRILLING METHOD: HSA DATE DRILLED: 9/24-25/97 DATE COMPLETED: 9/29/97
RIG GEOLOGIST: ~~J. Boylan~~ F. Grigsby LOGGING GEOLOGIST: ~~J. Boylan~~ F. Grigsby
COMPLETED DEPTH (FT): 43.6 ESTIMATED DEPTH TO BEDROCK (FT): 39.3
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): ~37' in core DATE MEASURED: 092597
COMPLETED WATER LEVEL (FT): 36.76 DATE MEASURED: 100297



PROTECTIVE CASING, TOP (FT): 3.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 2.52
SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): 0.84 TYPE: Concrete
PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel
PROTECTIVE CASING, BOTTOM (FT): 2.0

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): 2 TYPE: Pure Gold
BENTONITE SEAL, TOP (FT): 24.2 TYPE: 1/4" pellets
BENTONITE SEAL, BOTTOM (FT): 28.0
FILTER PACK, TOP (FT): 28.0
FILTER PACK TYPE: 16-40 silica sand BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 31.31 SCREEN, TOP (FT): 31.31
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 2
SCREEN, BOTTOM (FT): 41.35 TYPE: Sch 40 PVC BRAND:
SUMP, TOP (FT): 41.35 TYPE: Sch 40 PVC
FILTER PACK, BOTTOM (FT): 43.6
BACKFILL, TOP (FT): N/A TYPE:
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 43.6
TOTAL DEPTH (FT): 43.6

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: J. Boylan DATE: 101497
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C2897 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP

SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: Ground Exploration Co. Inc.

DRILLING METHOD: ~~6~~ HSA DATE DRILLED: 9/23/97 DATE COMPLETED: 09-23-97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

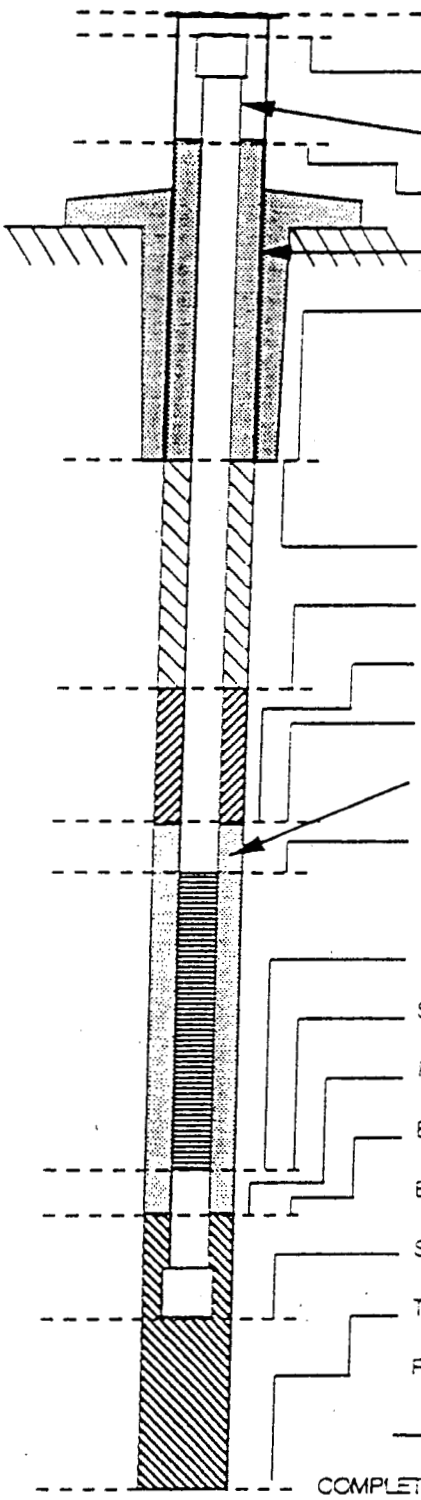
COMPLETED DEPTH (FT): 39.0' ESTIMATED DEPTH TO BEDROCK (FT): 37.3'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 8 inch.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 09-23-97

COMPLETED WATER LEVEL (FT): 36.70 DATE MEASURED: 100297



PROTECTIVE CASING, TOP (FT): 2.4 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.75

SURFACE CASING, I.D. (IN): 2 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): 0.7 TYPE: Concrete

PROTECTIVE CASING, I.D. (IN): 6 TYPE: steel

PROTECTIVE CASING, BOTTOM (FT): 2.6

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): 2 TYPE: PureGold

BENTONITE SEAL, TOP (FT): 15.8' TYPE: Pellets

BENTONITE SEAL, BOTTOM (FT): 19.6

FILTER PACK, TOP (FT): 19.6

FILTER PACK TYPE: Silica Sand (16-40) BRAND: CSST

SURFACE CASING, BOTTOM (FT): ~~36.75~~ 21.74 SCREEN, TOP (FT): 21.74'

SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 2 in.

SCREEN, BOTTOM (FT): 36.75 TYPE: PVC BRAND:

SUMP, TOP (FT): 36.75 TYPE: PVC - Sch. 40

FILTER PACK, BOTTOM (FT): 39.0'

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 39.0'

TOTAL DEPTH (FT): 39.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: F. Grigsby

COMPLETED BY: F. Grigsby, J. Baylan DATE: ~~1000~~ 092397-100297

CHECKED BY: DATE:

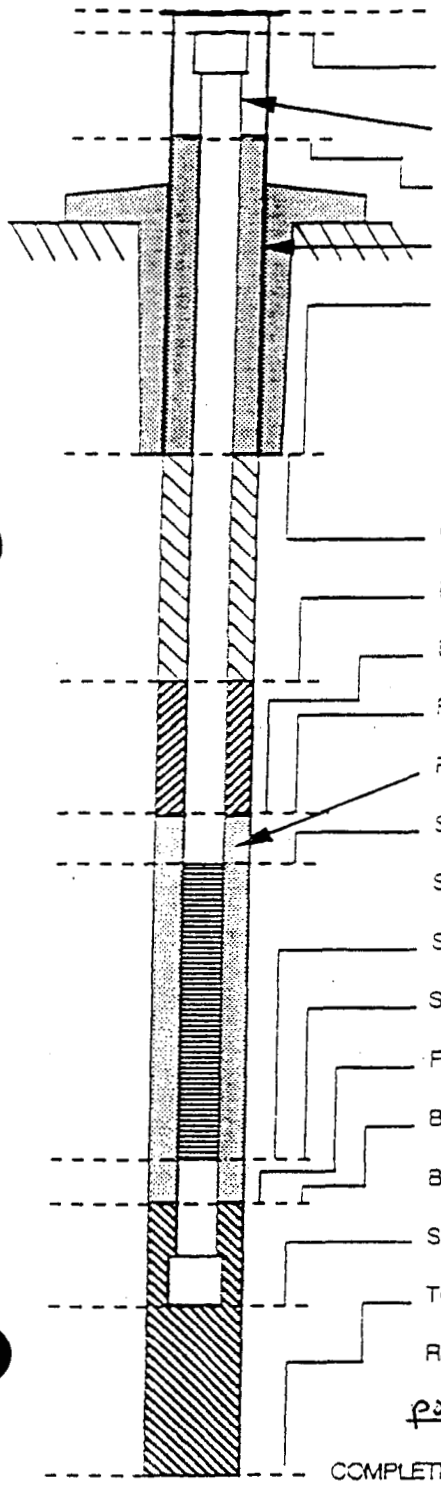
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 05197 PROJECT NAME: 199 ~~OU~~ ARP 1 HSS 118.1 PROGRAM: 199 ~~OU~~ ARP 1 HSS 118.1
SCREENED FORMATION: AL/Fill DRILLING CONTRACTOR: TEG/DGI
DRILLING METHOD: Strataprobe: push, hammer DATE DRILLED: 091797 DATE COMPLETED: 091797
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN
COMPLETED DEPTH (FT): 28.03 ESTIMATED DEPTH TO BEDROCK (FT): 27.2
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.125

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): ~8' incere DATE MEASURED: 091697
COMPLETED WATER LEVEL (FT): 8.62' below TOC DATE MEASURED: 091997



PROTECTIVE CASING, TOP (FT): 0.75 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.70 (TOC)
SURFACE CASING, I.D. (IN): 0.875 TYPE: Stainless steel
SURFACE SEAL, TOP (FT): ~0.4 TYPE: Granular bentonite
PROTECTIVE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC
PROTECTIVE CASING, BOTTOM (FT): 1.25
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular bentonite
BENTONITE SEAL, BOTTOM (FT): Approx. 16'
FILTER PACK, TOP (FT): Approx. 16'
FILTER PACK TYPE: 10-20 silica sand BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 17.71 SCREEN, TOP (FT): 17.71
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.875
SCREEN, BOTTOM (FT): 27.97 TYPE: Stainless steel BRAND:
SUMP, TOP (FT): 27.97 TYPE: Screw-on stainless steel endcap
FILTER PACK, BOTTOM (FT): 28.0 (Approx.)
BACKFILL, TOP (FT): N/A TYPE: ~~No b. Hole cap/sump attached~~
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 28.03
TOTAL DEPTH (FT): 28.03

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: No VOC detections. No backfill, but expendable point (stainless) is present below base of well.

COMPLETED BY: J. Boylan DATE: 091797

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C5397 PROJECT NAME: 199[illegible] WARP IHSS 118.1 PROGRAM: 199[illegible] WARP IHS[illegible]

SCREENED FORMATION: AL/Fill/bedrock DRILLING CONTRACTOR: TEG/DGI

DRILLING METHOD: Stratoprobe: push hammer DATE DRILLED: 091897 DATE COMPLETED: 091997

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

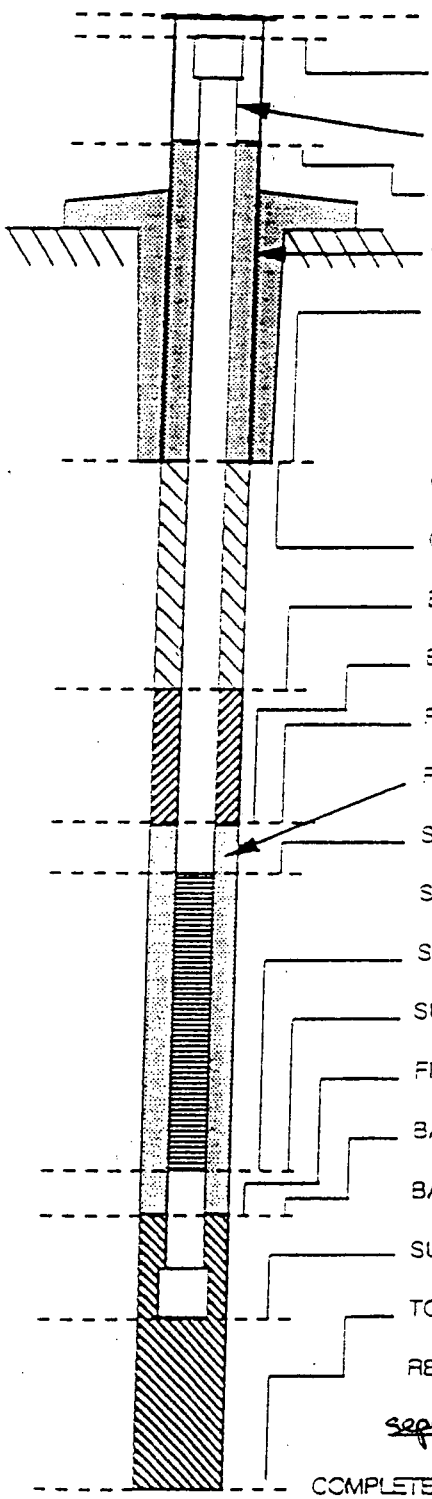
COMPLETED DEPTH (FT): 24.79 ESTIMATED DEPTH TO BEDROCK (FT): 21.5

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.125

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~10' in core DATE MEASURED: 091897

COMPLETED WATER LEVEL (FT): 9.59' below TOC DATE MEASURED: 092097



PROTECTIVE CASING, TOP (FT): 0.75 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.65 (TOC)

SURFACE CASING, I.D. (IN): 0.875 TYPE: Stainless steel

SURFACE SEAL, TOP (FT): ~0.3 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 1.25

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular bentonite

BENTONITE SEAL, BOTTOM (FT): Approx. 12

FILTER PACK, TOP (FT): Approx. 12

FILTER PACK TYPE: 10-20 silica sand BRAND: CSS1

SURFACE CASING, BOTTOM (FT): 14.49 SCREEN, TOP (FT): 14.49

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.875

SCREEN, BOTTOM (FT): 24.79 TYPE: stainless steel BRAND:

SUMP, TOP (FT): N/A TYPE: No bottom cap/sump attached

FILTER PACK, BOTTOM (FT): 24.79

BACKFILL, TOP (FT): 24.9 (approx) TYPE: native materials, (stainless steel) expendable point

BACKFILL, BOTTOM (FT): 27.0

SUMP, BOTTOM (FT): N/A

TOTAL DEPTH (FT): 27.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Base of screen is open, snugged against expendable point th[illegible] separates well filterpack from backfill. Hits to 140 ppm off 24.0-27.0 interval.

COMPLETED BY: J. Boylan DATE: 091897

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 05497 PROJECT NAME: ~~1997 WARP~~ IHSS 118.1 PROGRAM: ~~1997 WARP~~ IHSS 118.1

SCREENED FORMATION: AL/Fill DRILLING CONTRACTOR: TEG/DGI

DRILLING METHOD: Strateprobe: push, hammer DATE DRILLED: 092597 DATE COMPLETED: 092597

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

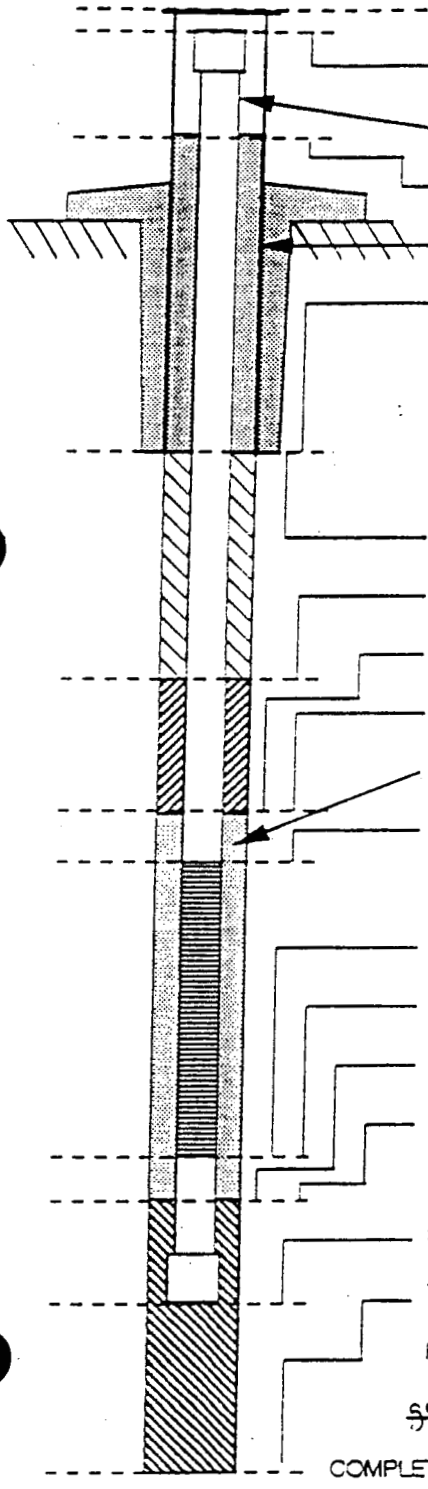
COMPLETED DEPTH (FT): 22.42 ESTIMATED DEPTH TO BEDROCK (FT): 22.1

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.125

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~9' in core DATE MEASURED: 092597

COMPLETED WATER LEVEL (FT): 6.52 DATE MEASURED: 092697



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.1' below ground

FLUSH-MOUNT INSTALLATION

SURFACE CASING, I.D. (IN): 0.875 TYPE: Stainless steel

SURFACE SEAL, TOP (FT): 0.4' below ground TYPE: granular bentonite

PROTECTIVE CASING, I.D. (IN): 1.75 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 1.08

IF APPLICABLE

SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.4 TYPE: PDS Co granular bentonite

BENTONITE SEAL, BOTTOM (FT): Approx. 15½

FILTER PACK, TOP (FT): Approx. 15½

FILTER PACK TYPE: 10-20 silica sand BRAND: CSS 1

SURFACE CASING, BOTTOM (FT): 17.21 SCREEN, TOP (FT): 17.21

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.875

SCREEN, BOTTOM (FT): 22.35 TYPE: stainless steel BRAND:

SUMP, TOP (FT): 22.35 TYPE: threaded stainless steel end cap

FILTER PACK, BOTTOM (FT): Approx. 22.4

BACKFILL, TOP (FT): 22.35 TYPE: Native materials + (stainless steel) expendable point

BACKFILL, BOTTOM (FT): 27.0

SUMP, BOTTOM (FT): 22.42

TOTAL DEPTH (FT): 27.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Flush-mount well w/concrete pad + steel & brass cover to 0.1' above ground. Expendable point separates bottom of well from backfill.

COMPLETED BY: J. Boylan DATE: 092597

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 05697 PROJECT NAME: 199 WARP 1 HSS 118.1 PROGRAM: 199 WARP LH 8.1

SCREENED FORMATION: AL/Fill DRILLING CONTRACTOR: TEG/DGI

DRILLING METHOD: Strategrade: push & hammer DATE DRILLED: 092497 DATE COMPLETED: 092497

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

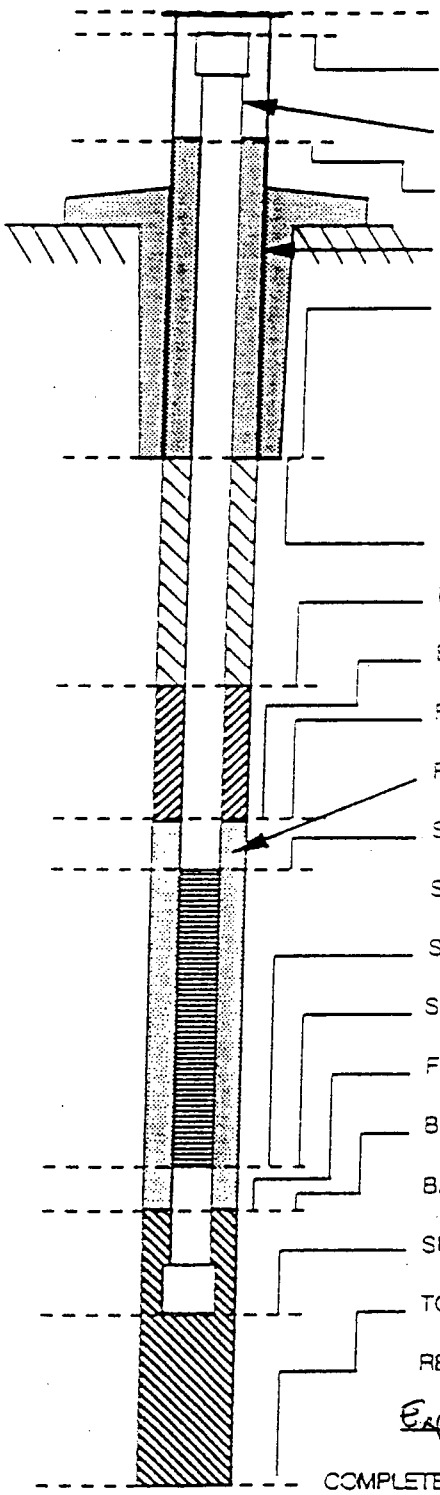
COMPLETED DEPTH (FT): 18.87 ESTIMATED DEPTH TO BEDROCK (FT): 18.8

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.125

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~8' in core DATE MEASURED: 092497

COMPLETED WATER LEVEL (FT): 6.85 DATE MEASURED: 092697



PROTECTIVE CASING, TOP (FT): 0.1 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.02' below ground

FLUSH-MOUNT INSTALLATION

SURFACE CASING, I.D. (IN): 0.875 TYPE: Stainless steel

SURFACE SEAL TOP (FT): 0.4' below ground TYPE: granular bentonite

PROTECTIVE CASING, I.D. (IN): 1.75 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 0.96

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): ____

SECONDARY CASING, I.D. (IN): N/A TYPE: ____

CENTRALIZER, O.D. (IN): N/A TOP (FT): ____ BOTTOM (FT): ____

GROUT SEAL TOP (FT): N/A TYPE: ____

BENTONITE SEAL TOP (FT): 0.4 TYPE: granular bentonite

BENTONITE SEAL BOTTOM (FT): Approx. 12'

FILTER PACK, TOP (FT): Approx. 12'

FILTER PACK TYPE: 10-20 silica sand BRAND: CSS 1

SURFACE CASING, BOTTOM (FT): 13.66 SCREEN, TOP (FT): 13.66

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.875

SCREEN, BOTTOM (FT): 18.81 TYPE: stainless steel BRAND: ____

SUMP, TOP (FT): 18.81 TYPE: Threaded stainless steel end cap

FILTER PACK, BOTTOM (FT): Approx. 18.87

BACKFILL, TOP (FT): 18.87 TYPE: Native materials + stainless steel expendable point

BACKFILL, BOTTOM (FT): 22.0

SUMP, BOTTOM (FT): 18.87

TOTAL DEPTH (FT): 22.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Flush-mount well w/concrete pad + steel & brass cover to 0.1' above grou[illegible]

Expendable point separates bottom of well from backfill.

COMPLETED BY: J. Boylan DATE: 092597

CHECKED BY: ____ DATE: ____

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) 2R 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C5897 PROJECT NAME: 199 ~~OUAP~~ IHSS118.1 PROGRAM: 199 ~~OUAP~~ IHSS118.1

SCREENED FORMATION: Alluvium/bedrock DRILLING CONTRACTOR: TEG/DSI

DRILLING METHOD: Stratoprobe: push hammer DATE DRILLED: 092097 DATE COMPLETED: 092097

RIG GEOLOGIST: J. Boylan LOGGING GEOLOGIST: J. Boylan

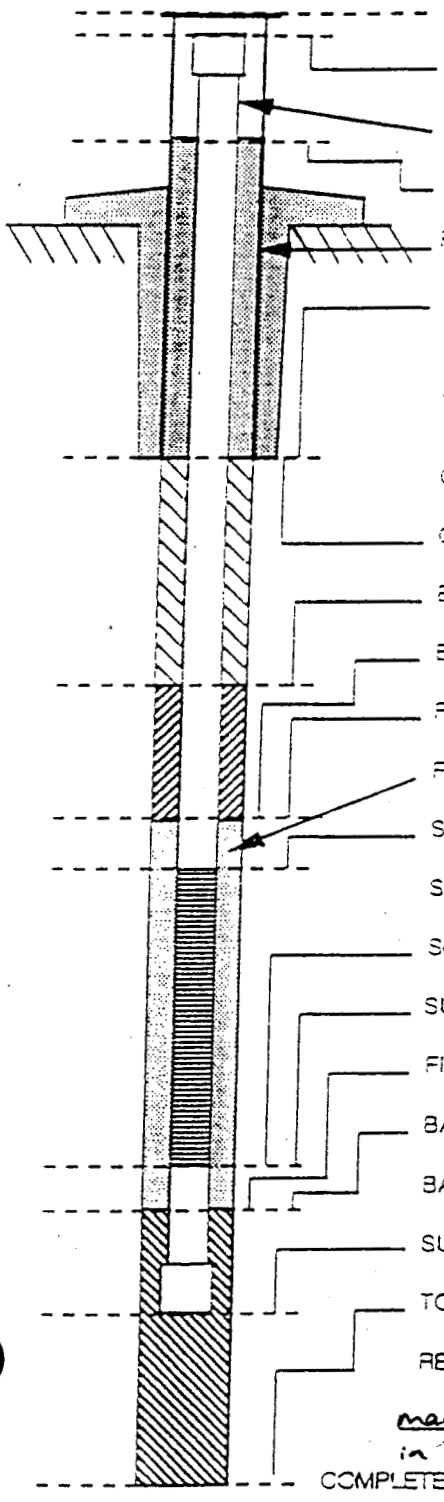
COMPLETED DEPTH (FT): 22.30 ESTIMATED DEPTH TO BEDROCK (FT): 21.4

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.125

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~~0.55~~ ~5' in core DATE MEASURED: 092097

COMPLETED WATER LEVEL (FT): 7.45' below TOC DATE MEASURED: 092397



PROTECTIVE CASING, TOP (FT): 0.58' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~0.55~~ ~~0.58~~ 0.55 (TOC)

SURFACE CASING, I.D. (IN): 0.875 TYPE: Stainless steel

SURFACE SEAL, TOP (FT): ~0.1 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 1.42'

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular bentonite

BENTONITE SEAL, BOTTOM (FT): Approx. 15.5'

FILTER PACK, TOP (FT): Approx 15.5'

FILTER PACK TYPE: 10-40 silica sand BRAND: CSS1

SURFACE CASING, BOTTOM (FT): 17.16 SCREEN, TOP (FT): 17.16

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.875

SCREEN, BOTTOM (FT): 22.30 TYPE: Stainless steel BRAND:

SUMP, TOP (FT): N/A TYPE: No bottom cap/sump attached

FILTER PACK, BOTTOM (FT): Approx. 22.3

BACKFILL, TOP (FT): Approx. 22.4 TYPE: Native materials + expendable point (stainless steel)

BACKFILL, BOTTOM (FT): 24.0

SUMP, BOTTOM (FT): N/A

TOTAL DEPTH (FT): 24.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Base of screen is open, initially snugged against expendable point but may have become separated. Point separates filter pack from backfill. Hits + free product in 20.45–20.95' core.

COMPLETED BY: J. Boylan DATE: 092097

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 05997 PROJECT NAME: 199 ~~OU~~ WARP (HSS 118.1) PROGRAM: ~~199~~ WARP (HS

SCREENED FORMATION: AL/Fill/bedrock DRILLING CONTRACTOR: TEG/DGI

DRILLING METHOD: Stratoprobe: push & hammer DATE DRILLED: 092297 DATE COMPLETED: 092297

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: J. BOYLAN

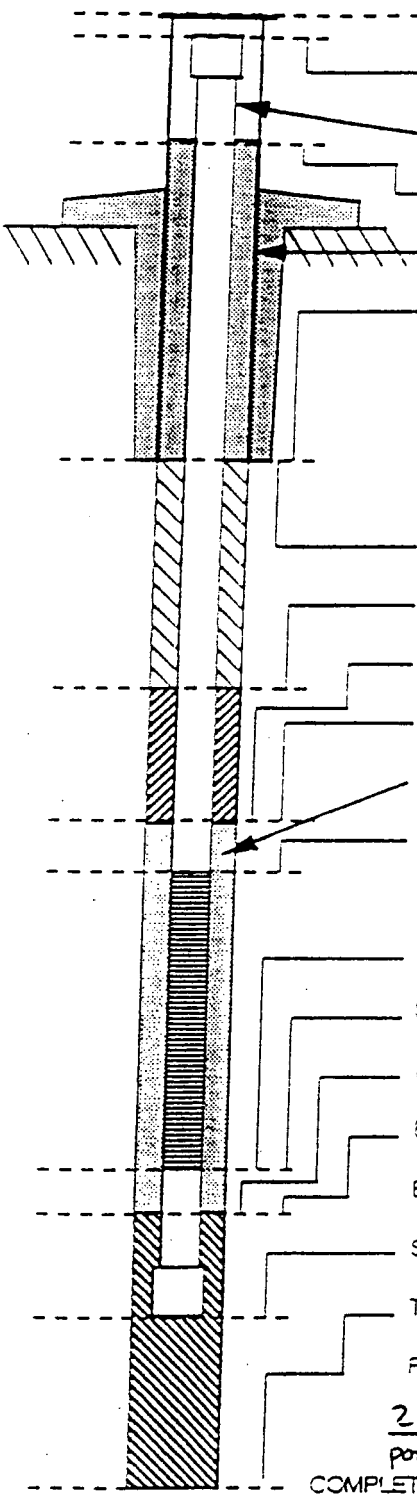
COMPLETED DEPTH (FT): 22.45 ESTIMATED DEPTH TO BEDROCK (FT): 20.3

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.125

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ≈12' in core DATE MEASURED: ~~05~~ 092297

COMPLETED WATER LEVEL (FT): 8.07' below TOC DATE MEASURED: 092397



PROTECTIVE CASING, TOP (FT): 0.9 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.7 (TOC)

SURFACE CASING, I.D. (IN): 0.875 TYPE: Stainless steel

SURFACE SEAL, TOP (FT): ~0.1 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): ~~2.0~~ 1.75 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 0.52

IF APPLICABLE

SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular bentonite

BENTONITE SEAL, BOTTOM (FT): Approx. 15.5

FILTER PACK, TOP (FT): Approx. 15.5

FILTER PACK TYPE: 10-20 silica sand BRAND: CSS1

SURFACE CASING, BOTTOM (FT): 17.25 SCREEN, TOP (FT): 17.25

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.875

SCREEN, BOTTOM (FT): 22.39 TYPE: Stainless steel BRAND:

SUMP, TOP (FT): 22.39 TYPE: Threaded stainless steel end cap

FILTER PACK, BOTTOM (FT): Approx 22.45

BACKFILL, TOP (FT): Approx 22.45 TYPE: Bentonite chips & expendable point (stainless steel)

BACKFILL, BOTTOM (FT): 30.0

SUMP, BOTTOM (FT): 22.45

TOTAL DEPTH (FT): 30.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Free product present; source thought to be top of bed, 20.3'. May be present to TD of bore hole. DNAPL + LNAPL. Expendable point separates well from backfill.

COMPLETED BY: J. Boylan DATE: 092297

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10197 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consultants

DRILLING METHOD: Geoprobe DATE DRILLED: 3-11-97 DATE COMPLETED: 3-11-97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

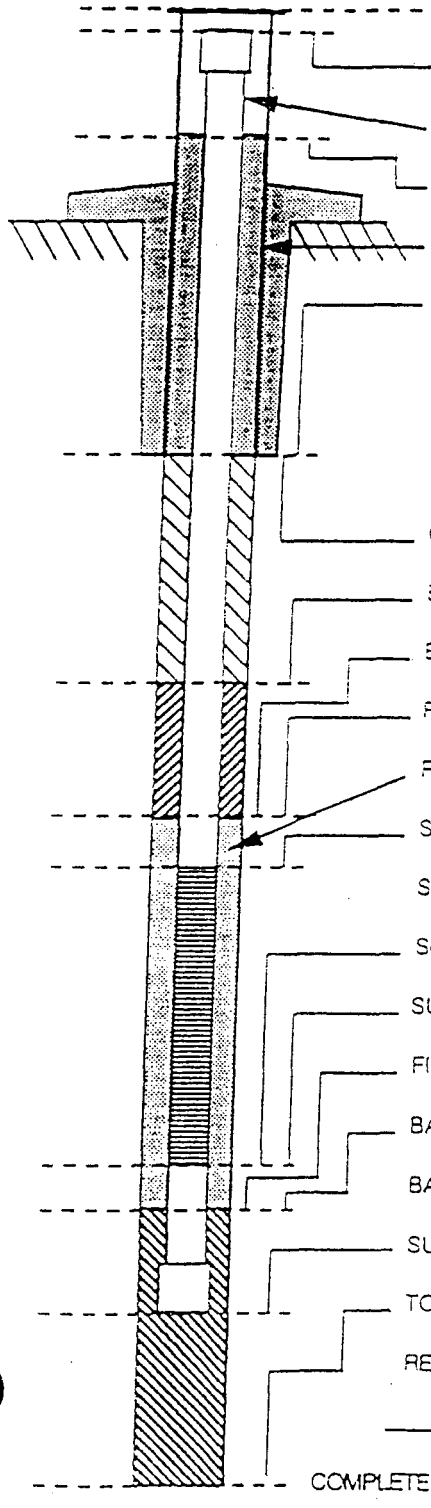
COMPLETED DEPTH (FT): 16.95' ESTIMATED DEPTH TO BEDROCK (FT): 13.7'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 3-11-97

COMPLETED WATER LEVEL (FT): 15.63 DATE MEASURED: 3-19-97



PROTECTIVE CASING, TOP (FT): .3' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): .33'

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL, TOP (FT): GL. TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): .95'

IF APPLICABLE

SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL, TOP (FT): NA TYPE: NA

BENTONITE SEAL, TOP (FT): GL TYPE: Bentonite Granules

BENTONITE SEAL, BOTTOM (FT): 12.5'

FILTER PACK, TOP (FT): 12.5'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 12.95 SCREEN, TOP (FT): 12.95'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 16.95 TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 16.45

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 16.45

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Frank C. Grigsby DATE: 07-15-97

CHECKED BY: DATE:

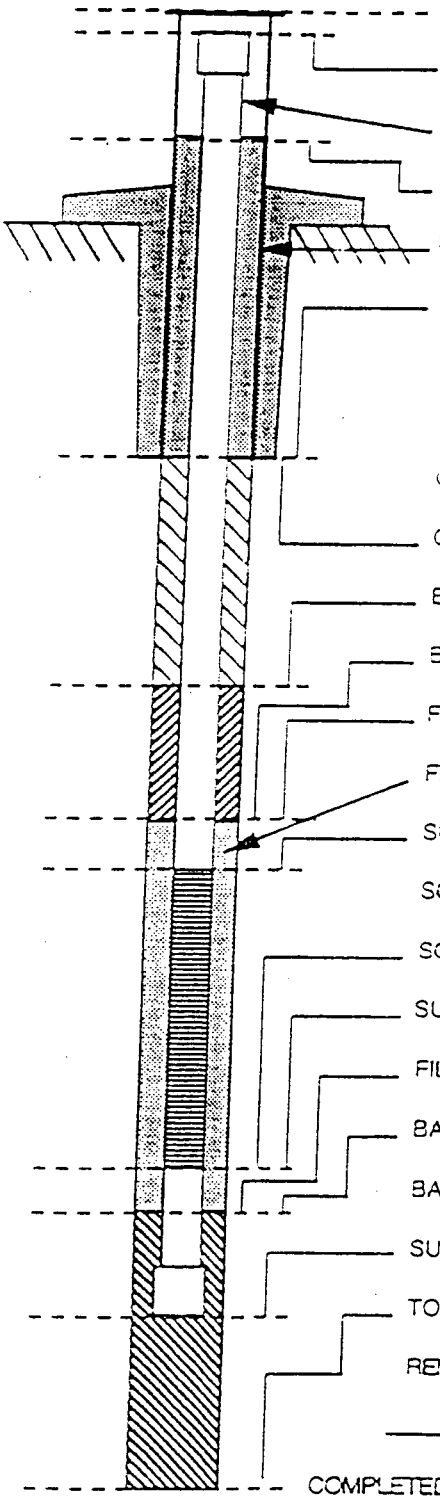
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10297 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: DATE COMPLETED:
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 14.0' ESTIMATED DEPTH TO BEDROCK (FT): 12.5'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): ~~NA~~ FG Not Meas. DATE MEASURED:
COMPLETED WATER LEVEL (FT): 10.83 DATE MEASURED: 3/12/97



PROTECTIVE CASING, TOP (FT): 0.35' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.4
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC - Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.90

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL TOP (FT): NA TYPE: NA
BENTONITE SEAL TOP (FT): GL. TYPE: Bentonite Granules
BENTONITE SEAL BOTTOM (FT): 9'
FILTER PACK, TOP (FT): 9'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 9.6' SCREEN, TOP (FT): 9.6'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 13.9 TYPE: PVC - Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 14.0'
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 14.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07-15-97
CHECKED BY: DATE:

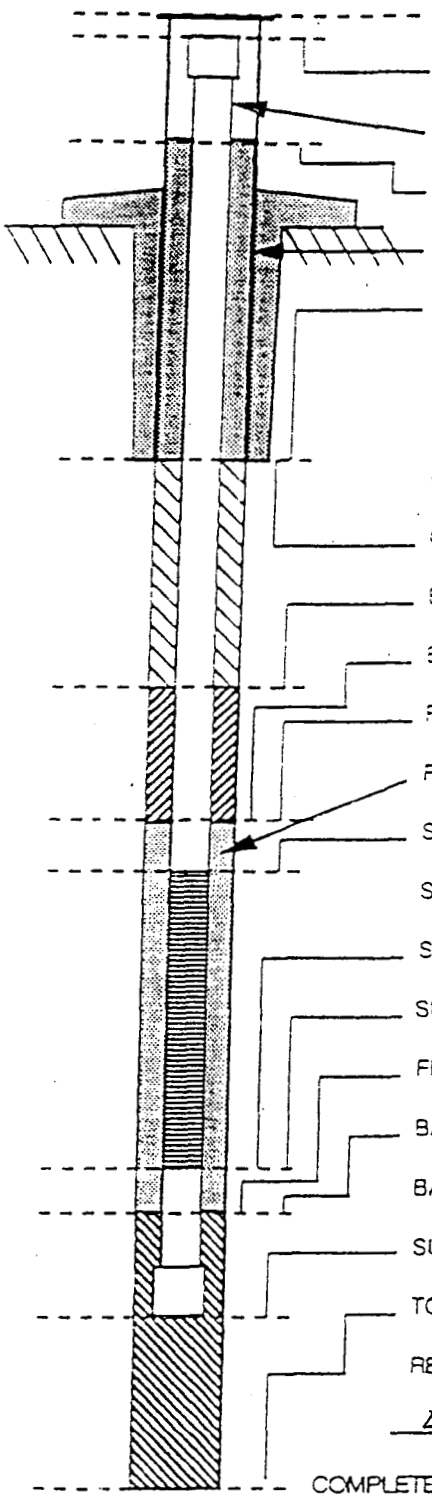
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10397 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 3-17-97 DATE COMPLETED: 3-20-97
FIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 23' ESTIMATED DEPTH TO BEDROCK (FT): 21-22' Est.
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): 10.95 DATE MEASURED: 3-20-97
COMPLETED WATER LEVEL (FT): 11.32 DATE MEASURED: 3-24-97



PROTECTIVE CASING, TOP (FT): 0.3' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.4'
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL TOP (FT): G.L. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.95'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL TOP (FT): NA TYPE: NA
BENTONITE SEAL TOP (FT): G.L. TYPE: Bentonite Granules
BENTONITE SEAL BOTTOM (FT): 17.0'
FILTER PACK, TOP (FT): 17.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 18.6' SCREEN, TOP (FT): 18.6'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 22.6' TYPE: PVC Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): Approx. 20'
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 23.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Casing spudded to depth because of flowing sand

COMPLETED BY: Fred C. Grigsby DATE: 07-15-97
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.2) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10497 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consul[redacted]

DRILLING METHOD: Geoprobe DATE DRILLED: 3-25-97 DATE COMPLETED: 3-2[redacted]

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

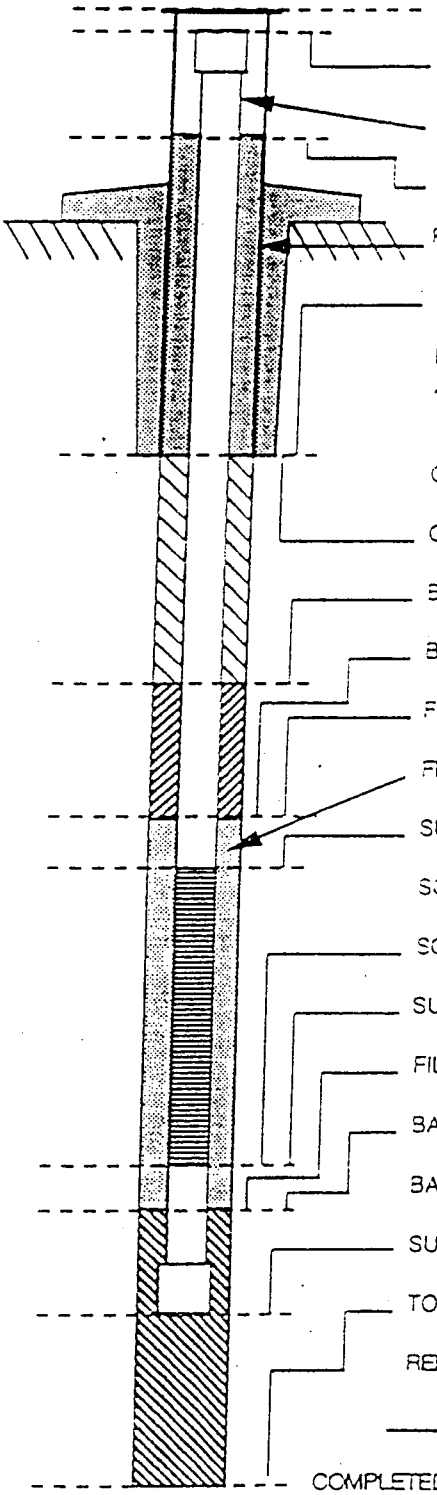
COMPLETED DEPTH (FT): 9.0' ESTIMATED DEPTH TO BEDROCK (FT): 6-8'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Not Measured DATE MEASURED:

COMPLETED WATER LEVEL (FT): 4.20' (TOC) DATE MEASURED: 3-27-97



PROTECTIVE CASING, TOP (FT): 0.4' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.5'

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): .85'

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL TOP (FT): NA TYPE: NA

BENTONITE SEAL TOP (FT): GL TYPE: Bentonite Granule[redacted]

BENTONITE SEAL BOTTOM (FT): 5.0'

FILTER PACK, TOP (FT): 5.0'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 6-28' SCREEN, TOP (FT): 6-28'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 8.28' TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 9.0'

BACKFILL, TOP (FT): 8.28 TYPE: Filter Pack

BACKFILL, BOTTOM (FT): 9.0'

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 9.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07-15-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10597 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants

DRILLING METHOD: Geoprobe DATE DRILLED: 3-26-97 DATE COMPLETED: 3-26-97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

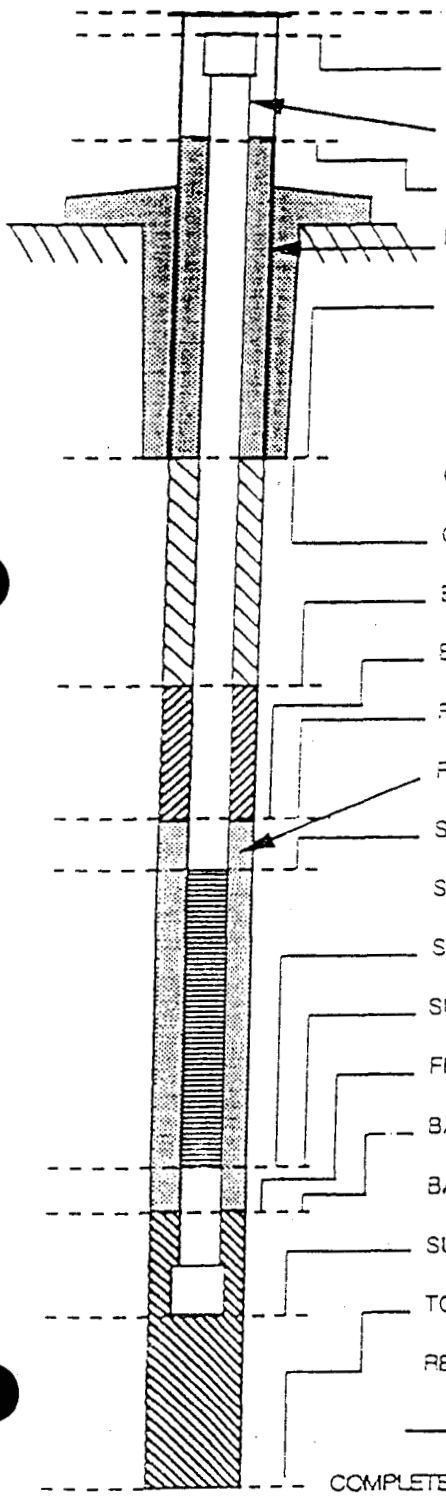
COMPLETED DEPTH (FT): 14.2' ESTIMATED DEPTH TO BEDROCK (FT): 12-8'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 3-26-97

COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 3-27-97



PROTECTIVE CASING, TOP (FT): 0.7' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0-9' *

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): GL TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.55

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL TOP (FT): NA TYPE: NA

BENTONITE SEAL TOP (FT): GL TYPE: Bentonite Granules

BENTONITE SEAL BOTTOM (FT): 5.0'

FILTER PACK, TOP (FT): 5.0'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 6.0' SCREEN, TOP (FT): 6-0'

SCREEN SLOT SIZE (.000 IN): .010 in. SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 10.0' TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 10.0'

BACKFILL, TOP (FT): 10.0' TYPE: Bentonite Granules

BACKFILL, BOTTOM (FT): 14.2

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 14.2'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: * Cut off 0.9-2' sticks up at 14 in. Lots

COMPLETED BY: Fred C. Grigsby DATE: 07-15-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10697 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consultants

DRILLING METHOD: Geoprobe DATE DRILLED: 3-11-97 DATE COMPLETED: 3-11-97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

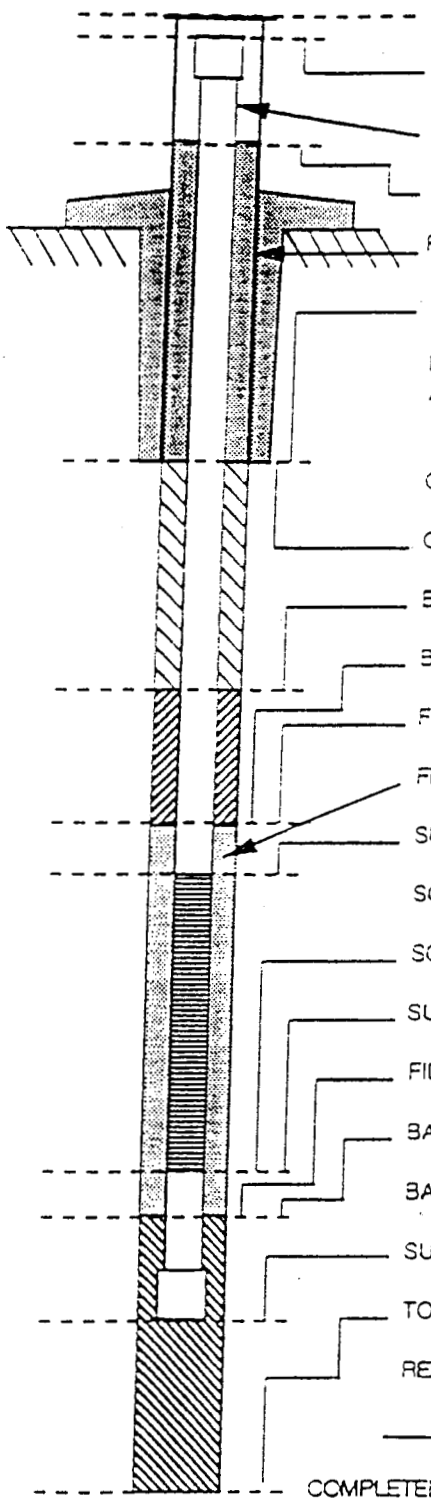
COMPLETED DEPTH (FT): 12.0' ESTIMATED DEPTH TO BEDROCK (FT): 10.0'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Not Measured DATE MEASURED: —

COMPLETED WATER LEVEL (FT): 1.34 DATE MEASURED: 3-12-97



PROTECTIVE CASING, TOP (FT): 0.4' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.5'

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): GL TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.85'

IF APPLICABLE

SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL TOP (FT): NA TYPE: NA

BENTONITE SEAL TOP (FT): GL TYPE: Bentonite Granules

BENTONITE SEAL BOTTOM (FT): 3.0'

FILTER PACK, TOP (FT): 3.0'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 8.0' SCREEN, TOP (FT): 8.0'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 12.0' TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 12.0'

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 12.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Frank C. Grigsby DATE: 07-15-97

CHECKED BY: DATE:

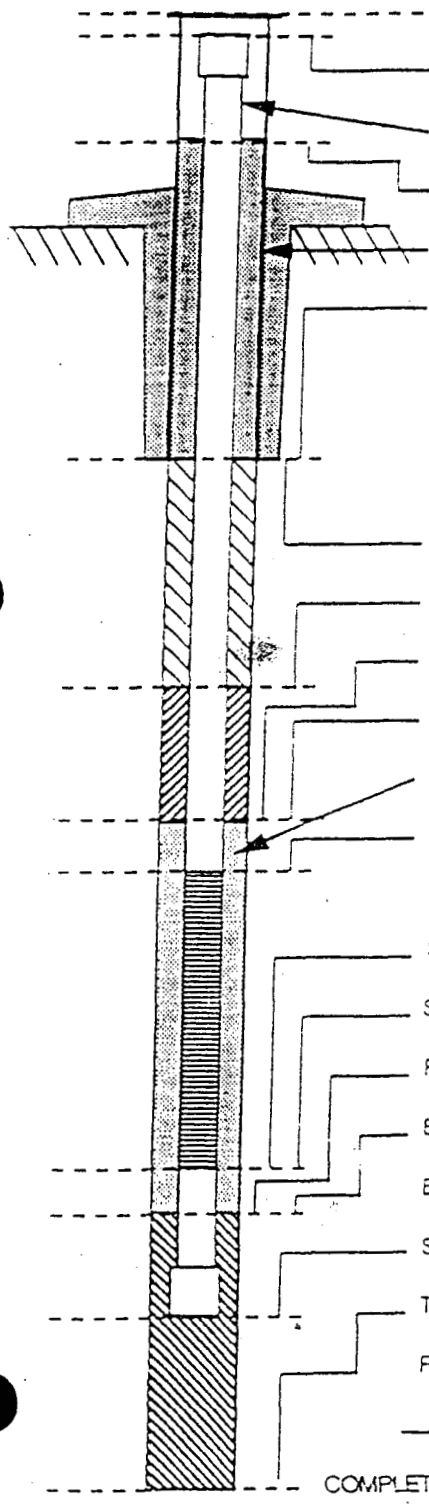
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10797 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 3-27-97 DATE COMPLETED: 3-27-97
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): ~~16.5~~ 15+' ESTIMATED DEPTH TO BEDROCK (FT): ~~16.0'~~ 16. Not Intersected
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): 13' DATE MEASURED: 3-27-97
COMPLETED WATER LEVEL (FT): 13.32(est) DATE MEASURED: 3-28-97



PROTECTIVE CASING, TOP (FT): 0.4' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL TOP (FT): G.L. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC - Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.85'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL TOP (FT): NA TYPE: NA
BENTONITE SEAL TOP (FT): G.L. TYPE: Bentonite Granules
BENTONITE SEAL BOTTOM (FT): 12.0'
FILTER PACK, TOP (FT): 12.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 13.5' SCREEN, TOP (FT): 13.5'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 15.5' TYPE: PVC Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 15.5'±
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 15.5'±

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Dragsby DATE: 07-16-97
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

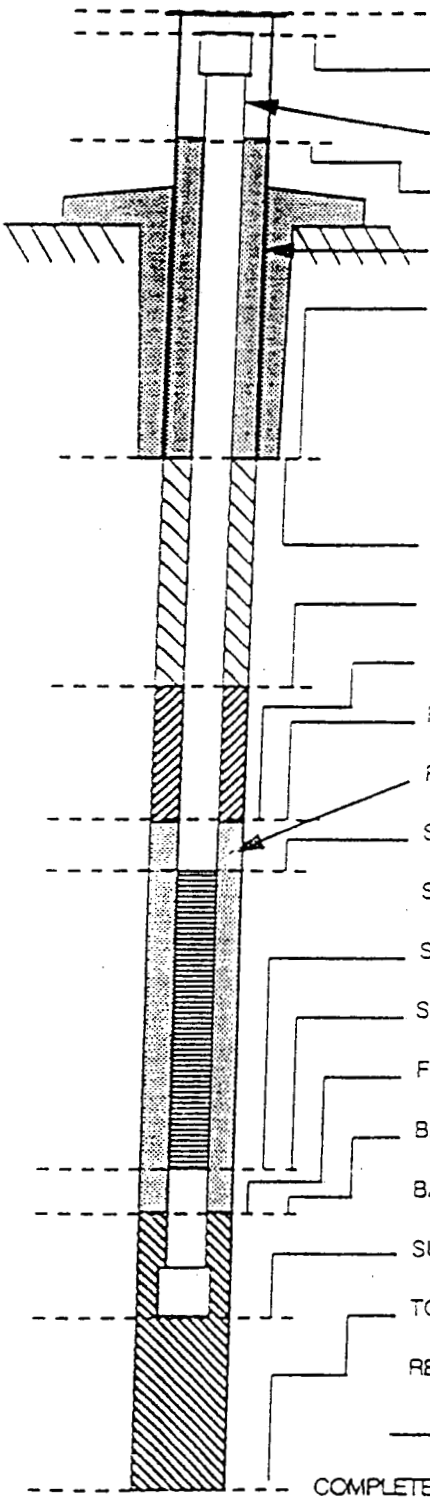
Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10897 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultant
DRILLING METHOD: Geoprobe DATE DRILLED: 3-13-97 DATE COMPLETED: 3-13-97
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 10.0' ESTIMATED DEPTH TO BEDROCK (FT): 6-2'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Not Measured DATE MEASURED: 3-13-97
COMPLETED WATER LEVEL (FT): 4.32 DATE MEASURED: 3-19-97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5'
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.85
IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA
CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL, TOP (FT): NA TYPE: NA
BENTONITE SEAL, TOP (FT): GL. TYPE: Bentonite Granules
BENTONITE SEAL, BOTTOM (FT): 2.0
FILTER PACK, TOP (FT): 2.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 2.2 SCREEN, TOP (FT): 2.2
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 8.2 TYPE: PVC Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 8.2'
BACKFILL, TOP (FT): 8.2 TYPE: Filter Pack/Bluff
BACKFILL, BOTTOM (FT): 10.0
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 10.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07-16-97
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10997 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants

DRILLING METHOD: Geoprobe DATE DRILLED: 3/12/97 DATE COMPLETED: 3/13/97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

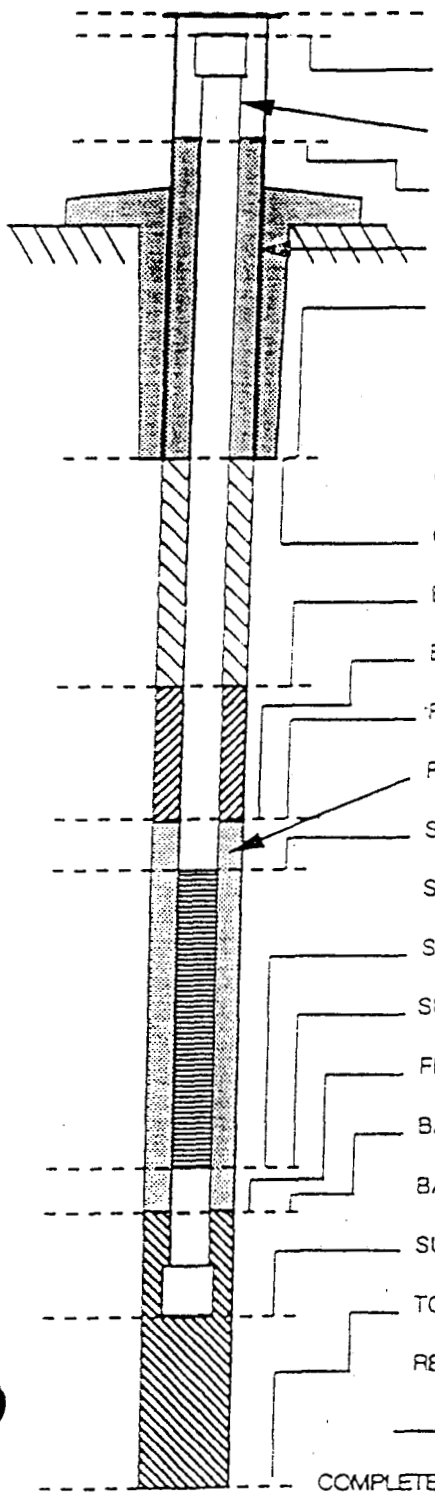
COMPLETED DEPTH (FT): 12.0' ESTIMATED DEPTH TO BEDROCK (FT): 4.0'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Not taken DATE MEASURED: --

COMPLETED WATER LEVEL (FT): 9.55 DATE MEASURED: 3-13-97



PROTECTIVE CASING, TOP (FT): 0.3' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.4'

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.95'

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL TOP (FT): NA TYPE: NA

BENTONITE SEAL TOP (FT): GL. TYPE: Bentonite Granules

BENTONITE SEAL BOTTOM (FT): 6.4'

FILTER PACK, TOP (FT): 6.4'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 7.4' SCREEN, TOP (FT): 7.4'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 11.4' TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 12.0'

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 12.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07-16-97

CHECKED BY: DATE:

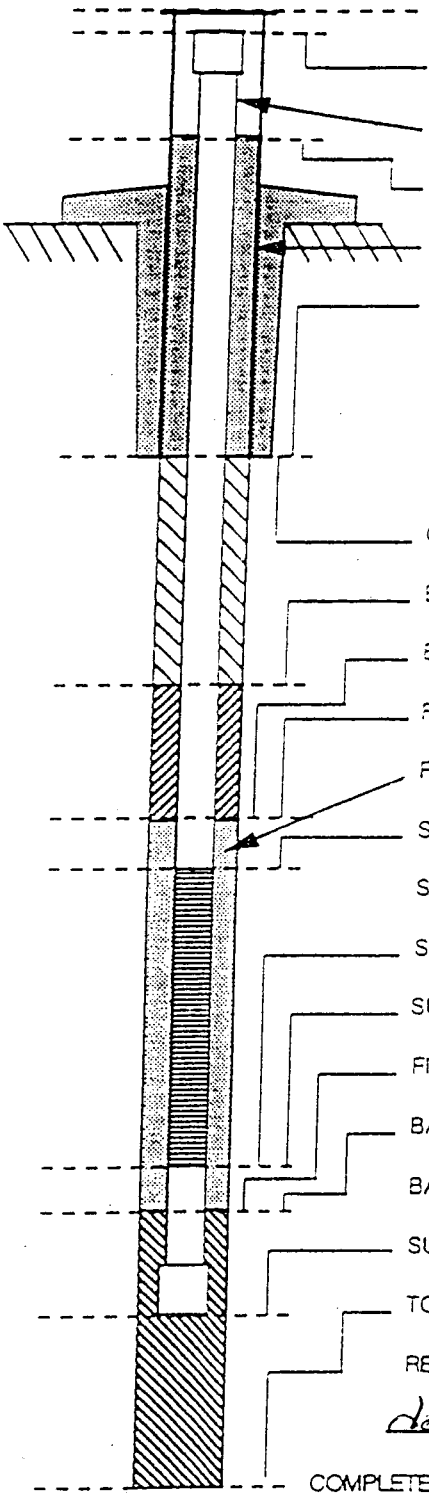
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11097 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 3-28-97 DATE COMPLETED: 3-2[illegible]
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 11.0' ESTIMATED DEPTH TO BEDROCK (FT): 4.8'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 3-28-97
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4/1/97



PROTECTIVE CASING, TOP (FT): *0.7 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): *0.8
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC-Sch.40
SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC-Sch.40
PROTECTIVE CASING, BOTTOM (FT): 0.55'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL TOP (FT): NA TYPE: NA
BENTONITE SEAL TOP (FT): GL. TYPE: Bentonite Granules
BENTONITE SEAL BOTTOM (FT): 2.0'
FILTER PACK, TOP (FT): 2.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 2.0' SCREEN, TOP (FT): 2.0'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 6.0' TYPE: PVC-Sch.40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 6.0'
BACKFILL, TOP (FT): 6.0' TYPE: Bentonite Granules
BACKFILL, BOTTOM (FT): 11.0'
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT):

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: * Casing stickup cut off 0.16' at water date & Reset Protective Casing

COMPLETED BY: Fred Dingsby DATE: 07-16-97
CHECKED BY: DATE:

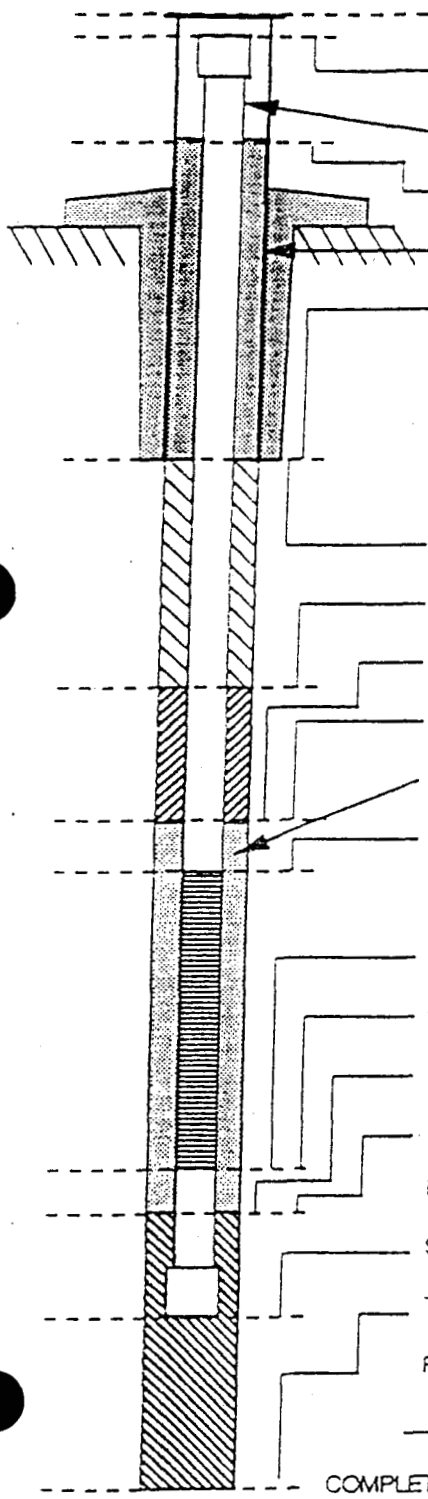
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11197 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 3-12-97 DATE COMPLETED: 3-12-97
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): ~~10.3~~ ESTIMATED DEPTH TO BEDROCK (FT): 7.3'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 3-12-97
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 3-13-97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL, TOP (FT): GL. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.85

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL, TOP (FT): NA TYPE: NA
BENTONITE SEAL, TOP (FT): GL. TYPE: Bentonite Granules
BENTONITE SEAL, BOTTOM (FT): 5.0'
FILTER PACK, TOP (FT): 5.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 6.3 SCREEN, TOP (FT): 6.3
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 10.3 TYPE: PVC Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 10.3
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 10.3'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 03-17-97
CHECKED BY: ~~Fred C.~~ F.G. DATE:

U.S. Department of Energy Rocky Flats Plant

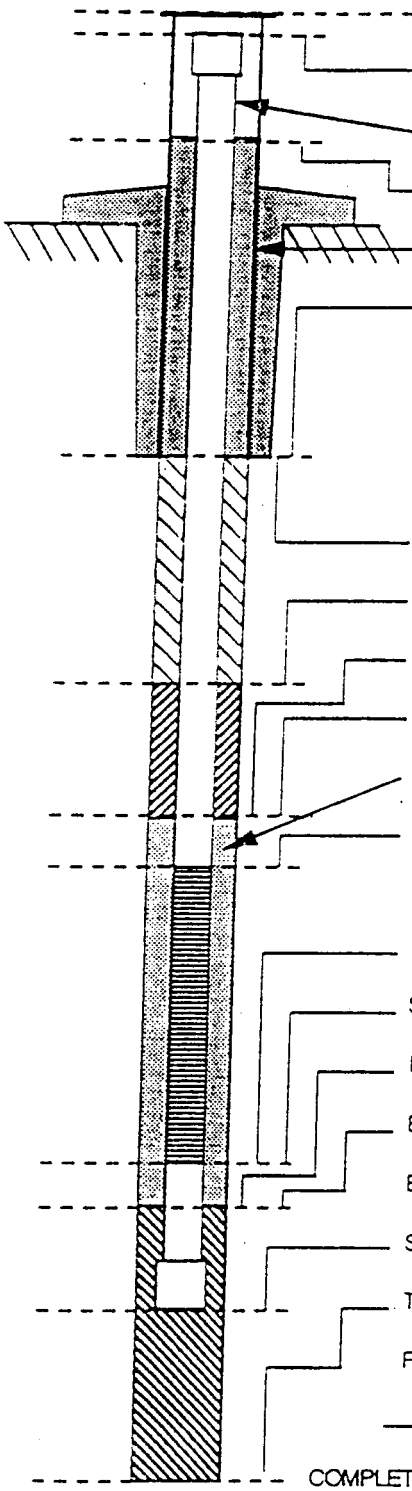
Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11297 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Bedrock DRILLING CONTRACTOR: Tierra Environmental Con
DRILLING METHOD: Geoprobe DATE DRILLED: 4-1-97 DATE COMPLETED: 4-1-97
RIG GEOLOGIST: E. Gregsby LOGGING GEOLOGIST: E. Gregsby
COMPLETED DEPTH (FT): 14.0' ESTIMATED DEPTH TO BEDROCK (FT): 5.1'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2in

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 4-1-97
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4-14-97



PROTECTIVE CASING, TOP (FT): 0.5 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.6
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL, TOP (FT): GL TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 in TYPE: PVC - Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.75

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL, TOP (FT): NA TYPE: NA
BENTONITE SEAL, TOP (FT): GL TYPE: Bentonite Granules
BENTONITE SEAL, BOTTOM (FT): 11.0'
FILTER PACK, TOP (FT): 11.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSST
SURFACE CASING, BOTTOM (FT): ~~10.0'~~ 12.0 SCREEN, TOP (FT): ~~10.0'~~ 12.0' ft.
SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4
SCREEN, BOTTOM (FT): 14.0' TYPE: PVC - Sch 40 BRAND:
SUMP, TOP (FT): NA TYPE:
FILTER PACK, BOTTOM (FT): 14.0'
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 14.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Gregsby DATE: 07-17-97
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
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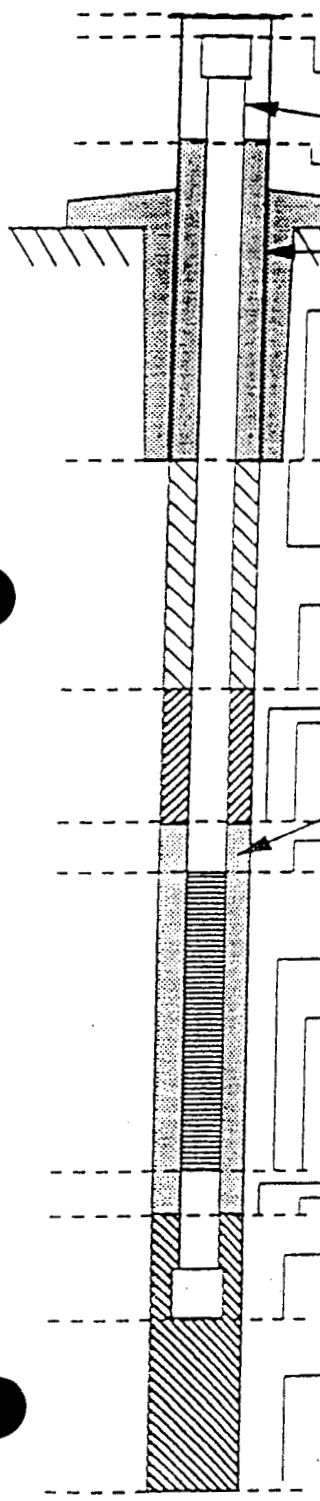
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11397 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 4-9-97 DATE COMPLETED: 4-10-97
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 12.0' ESTIMATED DEPTH TO BEDROCK (FT): 8.0'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): NOT Measured DATE MEASURED:
COMPLETED WATER LEVEL (FT): 8.74 DATE MEASURED: 4-14-97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40
PROTECTIVE CASING, BOTTOM (FT): ~~[illegible]~~ 0.75'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL TOP (FT): NA TYPE: NA
BENTONITE SEAL TOP (FT): GL TYPE: Bentonite granules
BENTONITE SEAL BOTTOM (FT): 8.0'
FILTER PACK, TOP (FT): 8.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 9.2 SCREEN, TOP (FT): 9.2'
SCREEN SLOT SIZE (.000 IN): .010 in. SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 13.2 TYPE: PVC Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): ? 13.2 ±
BACKFILL, TOP (FT): 13.2 TYPE: Sand Slurry.
BACKFILL, BOTTOM (FT): 15.6
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 15.6'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Casing string spudded to TD. Bottom of hole filled with sand slurry.

COMPLETED BY: Fred C. Grigsby DATE: 07-17-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

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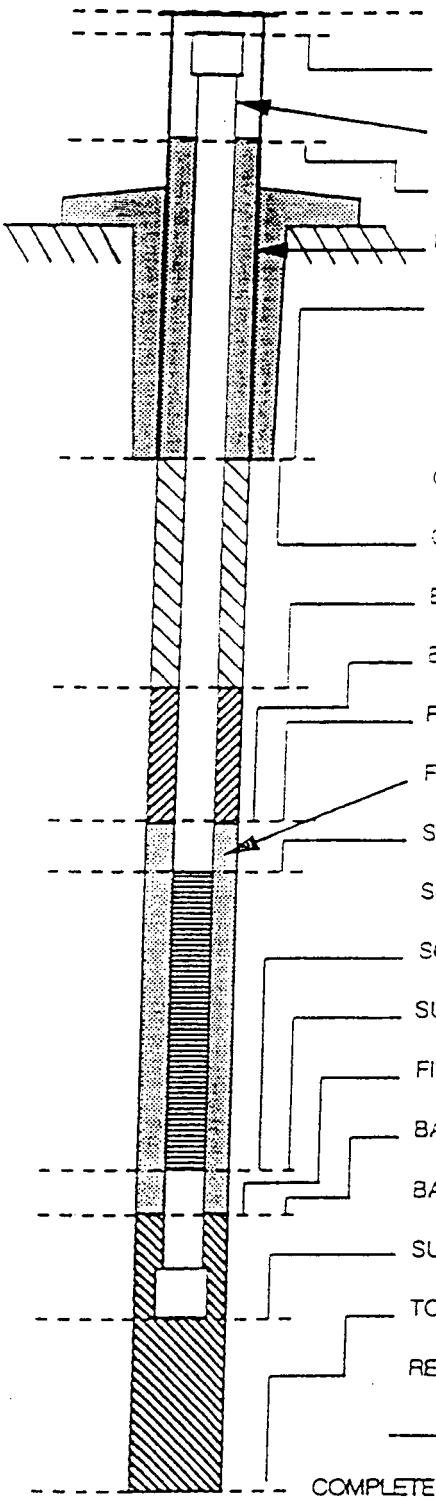
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11497 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 4-9-97 DATE COMPLETED: 4-9-97
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 12.0' ESTIMATED DEPTH TO BEDROCK (FT): 6.0'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 4-9-97
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4-14-97



PROTECTIVE CASING, TOP (FT): 0.4' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5'
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC-Sch.40
SURFACE SEAL TOP (FT): G.L. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.85'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA
GROUT SEAL TOP (FT): NA TYPE: NA
BENTONITE SEAL TOP (FT): G.L. TYPE: Bentonite Granules
BENTONITE SEAL BOTTOM (FT): 4.0
FILTER PACK, TOP (FT): 4.0'
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 4.8' SCREEN, TOP (FT): 4.8'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 8.8' TYPE: PVC Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 8.8'
BACKFILL, TOP (FT): 8.8' TYPE: Bentonite Granules
BACKFILL, BOTTOM (FT): 12.0'
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 12.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred Grigsby DATE: 07-17-97
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11597 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants

DRILLING METHOD: Geoprobe DATE DRILLED: 4-8-97 DATE COMPLETED: 4-8-97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

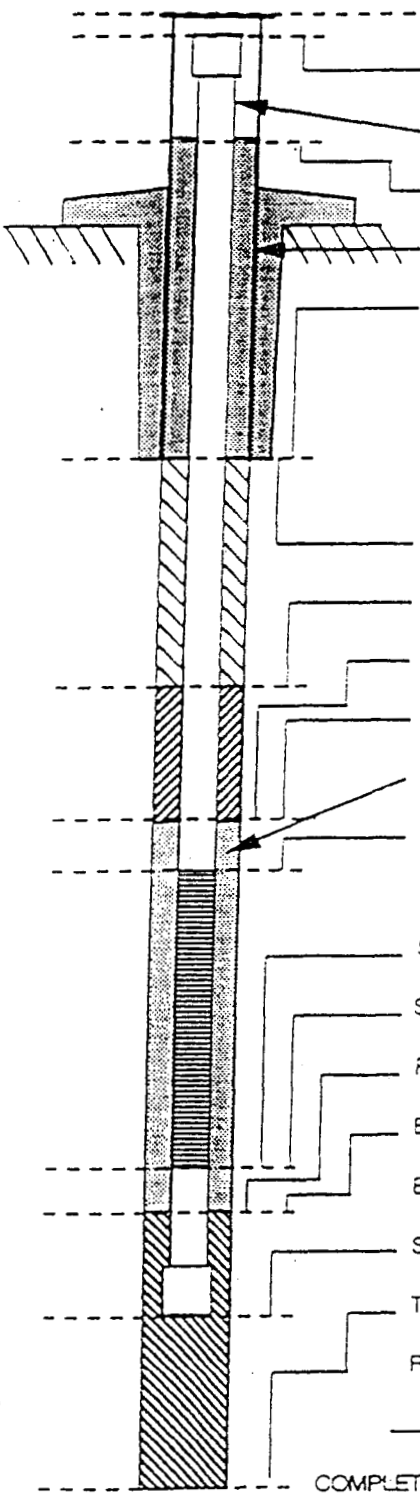
COMPLETED DEPTH (FT): 14.2' ESTIMATED DEPTH TO BEDROCK (FT): 11.8'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 4-8-97

COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4-14-97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.5

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): G.L. TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.5'

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL TOP (FT): NA TYPE: NA

BENTONITE SEAL TOP (FT): G.L. TYPE: Bentonite Granules

BENTONITE SEAL BOTTOM (FT): 7.5'

FILTER PACK, TOP (FT): 7.5'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 8.48 SCREEN, TOP (FT): 8.48

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 12.48' TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 14.2

BACKFILL, TOP (FT): 12.48 TYPE: Filter Pack

BACKFILL, BOTTOM (FT): 14.2

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 14.2

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07-17-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11697 PROJECT NAME: SW-59 PROGRAM:

SCREENED FORMATION: ALLUV. DRILLING CONTRACTOR: Tierra Environmental Consultants

DRILLING METHOD: Geoprobe DATE DRILLED: 3-14-97 DATE COMPLETED: 3-18-97

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

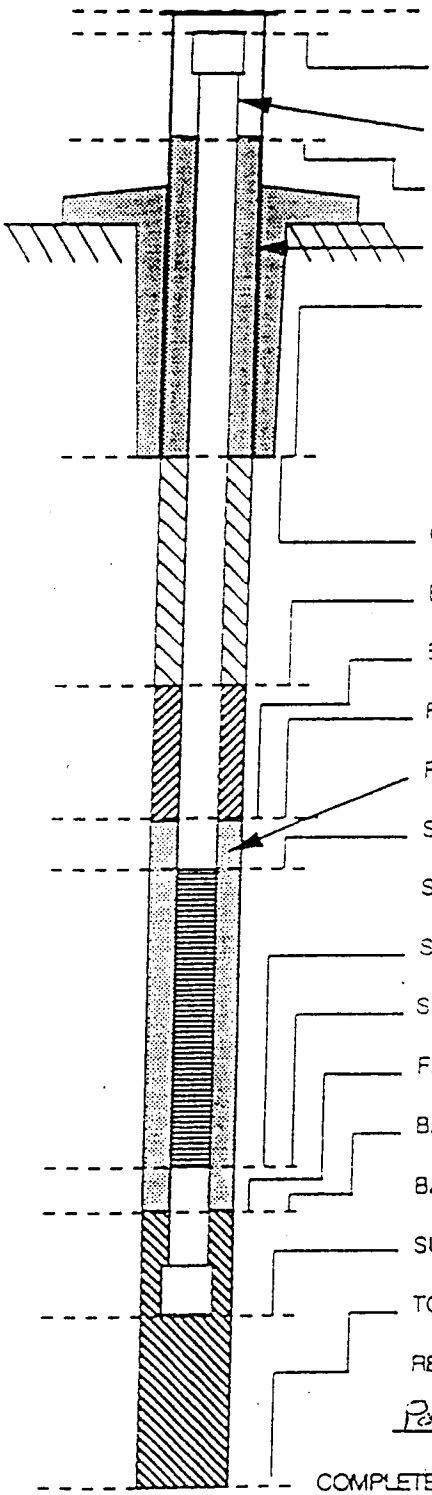
COMPLETED DEPTH (FT): 30.5 ESTIMATED DEPTH TO BEDROCK (FT): 26.1 *

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 3/18/97

COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 3/19/97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.46

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): GL. TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.25

IF APPLICABLE: SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA

SECONDARY CASING, I.D. (IN): NA TYPE: NA

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL TOP (FT): NA TYPE: NA

BENTONITE SEAL TOP (FT): 25.0' TYPE: Bentonite granules

BENTONITE SEAL BOTTOM (FT): 25.0'

FILTER PACK, TOP (FT): 25.0'

FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 26.5 SCREEN, TOP (FT): 26.5

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 30.5 TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE: NA

FILTER PACK, BOTTOM (FT): 30.5

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 30.5

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: * Bedrock Contact transitional - Possible Contact at ±29.

COMPLETED BY: Fred C. Grigsby DATE: 07-17-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

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(Rev.3)
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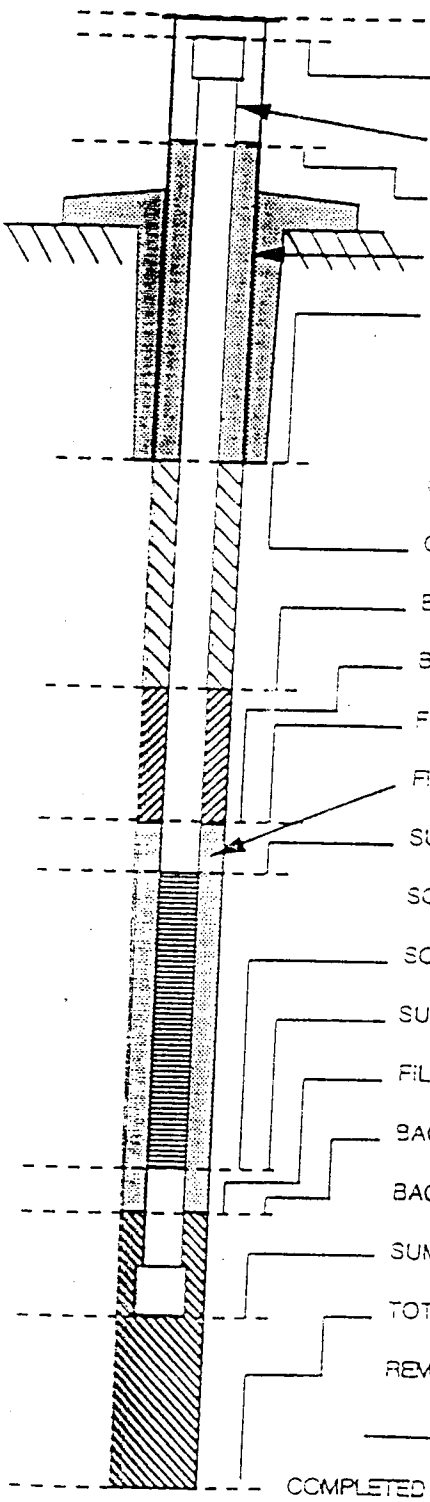
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11797 PROJECT NAME: SW-59 PROGRAM:
SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consultants
DRILLING METHOD: Geoprobe DATE DRILLED: 4-3-97 DATE COMPLETED: 4-7-97
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 15.0' ESTIMATED DEPTH TO BEDROCK (FT): 6.5'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 4-7-97
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4-8-97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.46
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL, TOP (FT): G.L. TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC - Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.85'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): NA
SECONDARY CASING, I.D. (IN): NA TYPE: NA
CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL, TOP (FT): NA TYPE: NA
BENTONITE SEAL, TOP (FT): G.L. TYPE: Bentonite Granules
BENTONITE SEAL, BOTTOM (FT): 2.5'
FILTER PACK, TOP (FT): 2.5 ft.
FILTER PACK TYPE: 16-40 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 3.5' SCREEN, TOP (FT): 3.5'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 7.5' TYPE: PVC - Sch. 40 BRAND:
SUMP, TOP (FT): NA TYPE: NA
FILTER PACK, BOTTOM (FT): 7.5'
BACKFILL, TOP (FT): ~~12.0~~ 7.5' TYPE: Bentonite Granules & Slough
BACKFILL, BOTTOM (FT): 15.0'
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): 15.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07/17/97
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 11897 PROJECT NAME: SW 59 PROGRAM:

SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental Consu

DRILLING METHOD: Geoprobe DATE DRILLED: 4-11-97 DATE COMPLETED: 4-11-97

RIG GEOLOGIST: John Boylan LOGGING GEOLOGIST: John Boylan

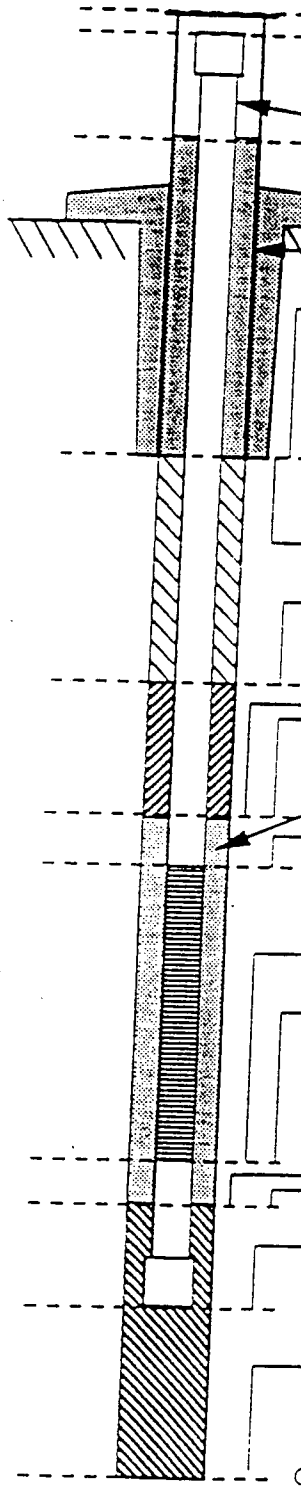
COMPLETED DEPTH (FT): 18.0 ESTIMATED DEPTH TO BEDROCK (FT): 6.3'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED:

COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4-14-97



PROTECTIVE CASING, TOP (FT): 0.4 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.5

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch 40

SURFACE SEAL, TOP (FT): G.L. TYPE: Bentonite Granules

PROTECTIVE CASING, I.D. (IN): 1 1/4 TYPE: PVC - Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.85

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): G.L. TYPE: Bentonite Granules

BENTONITE SEAL, BOTTOM (FT): ~~5.9~~ 6.0'

FILTER PACK, TOP (FT): ~~5.9~~ 6.0'

FILTER PACK TYPE: Silica Sand (16-40) BRAND: CSS

SURFACE CASING, BOTTOM (FT): 6.9 SCREEN, TOP (FT): 6.9

SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 10.9' TYPE: PVC Sch. 40 BRAND:

SUMP, TOP (FT): NA TYPE:

FILTER PACK, BOTTOM (FT): 11.0

BACKFILL, TOP (FT): 11.0 TYPE: Bentonite Granules

BACKFILL, BOTTOM (FT): 18.0'

SUMP, BOTTOM (FT): NA

TOTAL DEPTH (FT): 18.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: [signature] DATE: 07-16-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20197 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP Groundwater

SCREENED FORMATION: ~~[illegible]~~ bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 7-22-97 DATE COMPLETED: 7-22-97

RIG GEOLOGIST: William M Whiton LOGGING GEOLOGIST: William M Whiton

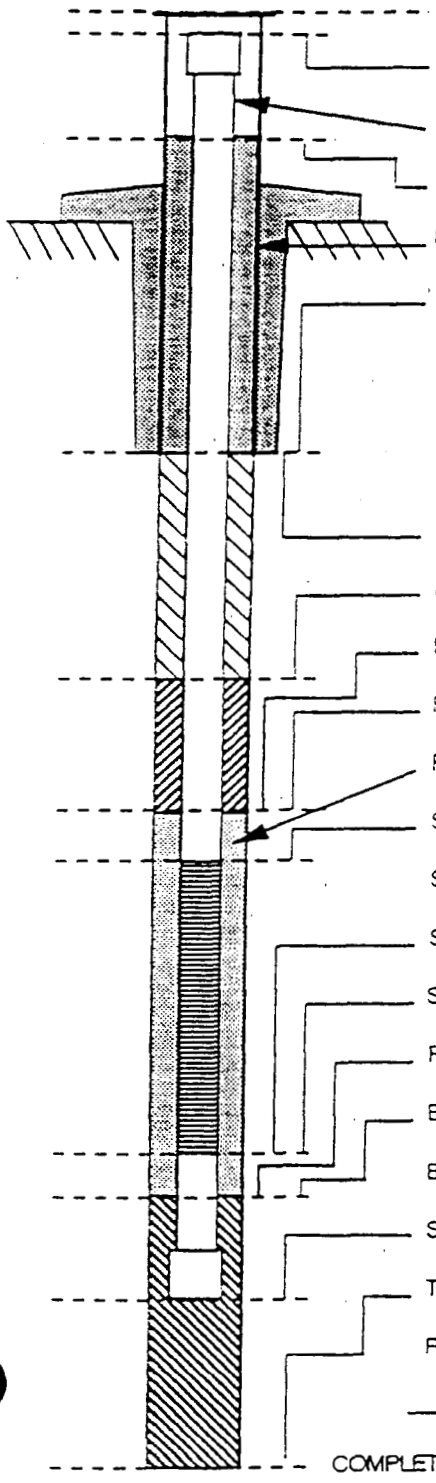
COMPLETED DEPTH (FT): ~~7.50~~ 6.79 ESTIMATED DEPTH TO BEDROCK (FT): 2.4

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~3.0~~ N/A

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 7-22-97

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 7-22-97



PROTECTIVE CASING, TOP (FT): 0.63' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.61'

SURFACE CASING, I.D. (IN): 0.75 TYPE: Schedule 40 PVC

SURFACE SEAL TOP (FT): 0.0 TYPE: Bentonite (granulated)

PROTECTIVE CASING, I.D. (IN): 1.50 TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.90'

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): ~~N/A~~ ~~NA~~ 0.0 7-22-97 TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite

BENTONITE SEAL BOTTOM (FT): 1.20'

FILTER PACK, TOP (FT): 1.20

FILTER PACK TYPE: 16-40 SAND BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 2.29 SCREEN, TOP (FT): 2.29

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 6.59' TYPE: PVC Sch 40 BRAND:

SUMP, TOP (FT): 6.59' TYPE: PVC Sch 40

FILTER PACK, BOTTOM (FT): 6.75

BACKFILL, TOP (FT): 6.75 TYPE: Bentonite

BACKFILL, BOTTOM (FT): ~~6.95~~ 7.5' 7-22-97

SUMP, BOTTOM (FT): 6.79

TOTAL DEPTH (FT): 7.5'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: William M Whiton DATE: 7-22-97

CHECKED BY: J. Boylan DATE: 10 27 97

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
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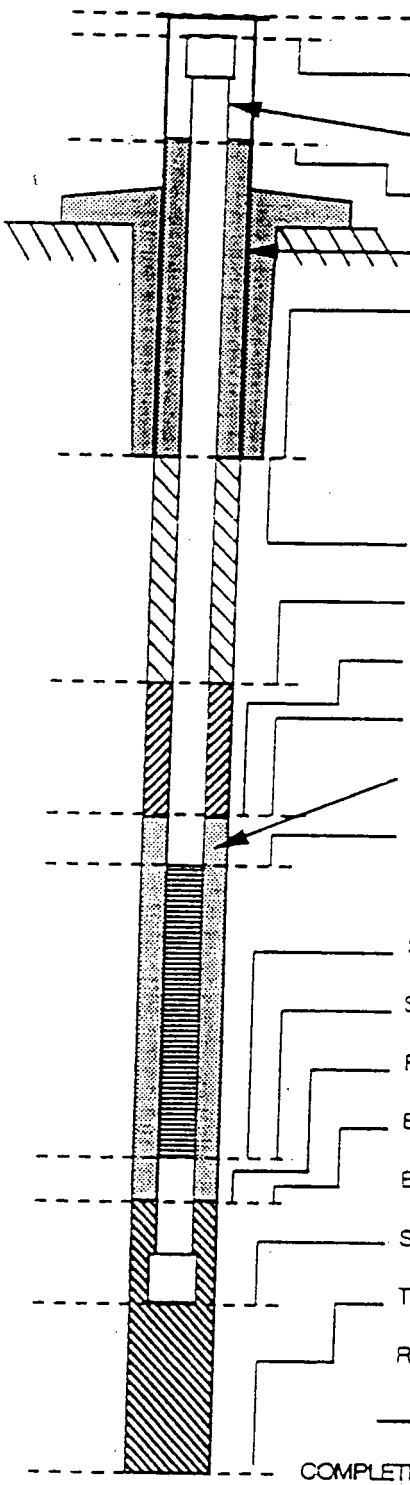
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20397 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP Groundwater
SCREENED FORMATION: ~~WUSU~~ bedrock DRILLING CONTRACTOR: TERRA
DRILLING METHOD: Geoprobe DATE DRILLED: 7-21-97 DATE COMPLETED: 072197
RIG GEOLOGIST: William M Whiton LOGGING GEOLOGIST: William M Whiton
COMPLETED DEPTH (FT): ~~6.32~~ ~~6.79~~ 6.8 ESTIMATED DEPTH TO BEDROCK (FT): 2.0
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0
QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0.0~~ N/A INITIAL WATER LEVEL (FT): DRY DATE MEASURED: ~~7-18-97~~ 07219
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: ~~7-18-97~~ 072297



PROTECTIVE CASING, TOP (FT): 0.65 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.64
SURFACE CASING, I.D. (IN): 0.75 TYPE: Schedule 40 PVC
SURFACE SEAL, TOP (FT): 0.0 TYPE: Bentonite
PROTECTIVE CASING, I.D. (IN): 1.50 TYPE: ASTM D 1785 PVC, sch. 40
PROTECTIVE CASING, BOTTOM (FT): 0.83

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: granular Aquaset
BENTONITE SEAL, BOTTOM (FT): 1.2
FILTER PACK, TOP (FT): 1.2
FILTER PACK TYPE: 16-40 SAND BRAND: CSSI
SURFACE CASING, BOTTOM (FT): ~~2.9~~ 2.1 (7-21-97) SCREEN, TOP (FT): 2.1
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): ~~6.32~~ 6.6 TYPE: PVC sch. 40 BRAND:
SUMP, TOP (FT): ~~6.32~~ 6.6 TYPE: PVC, sch. 40
FILTER PACK, BOTTOM (FT): 12.0 ~~6.6~~
BACKFILL, TOP (FT): 6.6 TYPE: 16-40 CSSI SAND
BACKFILL, BOTTOM (FT): 12.0
SUMP, BOTTOM (FT): ~~6.79~~ 6.8
TOTAL DEPTH (FT): 12.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: William M Whiton DATE: 7-21-97
CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

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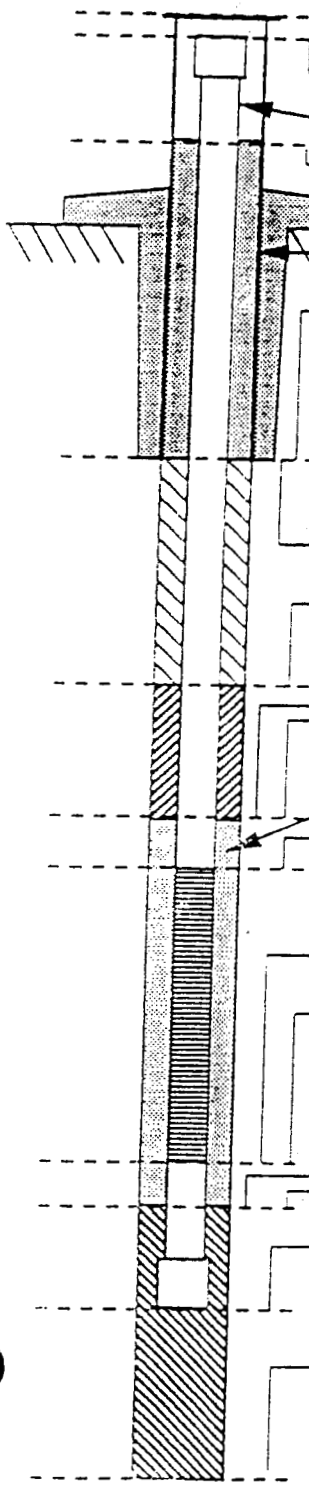
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20597 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater
SCREENED FORMATION: Bedrock DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GeoPROBE DATE DRILLED: 7-18-97 DATE COMPLETED: 071897
RIG GEOLOGIST: William M. Whiton LOGGING GEOLOGIST: William M. Whiton
COMPLETED DEPTH (FT): 10.41 ESTIMATED DEPTH TO BEDROCK (FT):
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 7-18-97
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: ~~7-18-97~~ 072297



PROTECTIVE CASING, TOP (FT): 0.581 (FROM GROUND SURFACE)
WMW 7-18-97
SURFACE CASING (STICKUP), TOP (FT): 0.50
SURFACE CASING, I.D. (IN): 0.75 TYPE: PVC Schedule 40
SURFACE SEAL TOP (FT): 0.0 TYPE: Bentonite
PROTECTIVE CASING, I.D. (IN): 1.50 TYPE: Sch.40 PVC
PROTECTIVE CASING, BOTTOM (FT): 0.69

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): N/A TYPE:
BENTONITE SEAL TOP (FT): 0.0 TYPE: granular
BENTONITE SEAL BOTTOM (FT): 3.25
FILTER PACK, TOP (FT): 3.25
FILTER PACK TYPE: 16-40 SAND BRAND: CSSI
SURFACE CASING, BOTTOM (FT): ~~5.31~~ 5.52 SCREEN, TOP (FT): 5.52
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 10.20 TYPE: PVC Sch40 BRAND:
SUMP, TOP (FT): 10.20 TYPE: PVC, Sch40
FILTER PACK, BOTTOM (FT): ~~N/A~~ 10.41
BACKFILL, TOP (FT): N/A TYPE:
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 10.41
TOTAL DEPTH (FT): 10.41

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: William M. Whiton DATE: 7-18-97
CHECKED BY: J. Boylan DATE: 102797

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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20697 PROJECT NAME: 1997 WARP 97 PROGRAM: 1997 WARP Ground

SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 09-02-97 DATE COMPLETED: 09-02-97

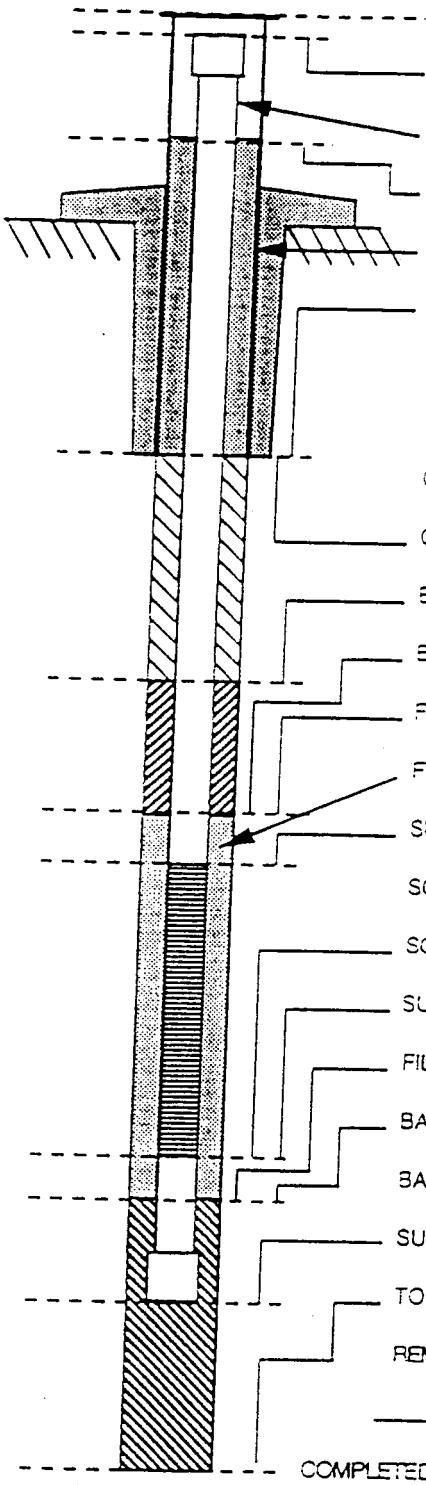
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): 13.0 ft 10.0 ESTIMATED DEPTH TO BEDROCK (FT): 8.9 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 090297

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.85 ft. (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.85 ft.

SURFACE CASING, I.D. (IN): 3/4 inch TYPE: PVC Sch 40

SURFACE SEAL TOP (FT): NA TYPE:

PROTECTIVE CASING, I.D. (IN): 1.5 inch TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.49 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: AQUASET GRANULAR BENTONITE

BENTONITE SEAL BOTTOM (FT): 4.0 ft.

FILTER PACK, TOP (FT): 4.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc

SURFACE CASING, BOTTOM (FT): 4.97 ft. SCREEN, TOP (FT): 4.97 ft.

SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN, I.D. (IN): 3/4 inch

SCREEN, BOTTOM (FT): 9.34 ft TYPE: 3/4 inch PVC Sch 40 BRAND:

SUMP, TOP (FT): 9.34 ft. TYPE: PVC sch 40 w/cap & int

FILTER PACK, BOTTOM (FT): 10.0 ft.

BACKFILL, TOP (FT): 10.0 ft. TYPE: Colo Silica Sand Inc, Silica Sand 16-40

BACKFILL, BOTTOM (FT): 13.0 ft.

SUMP, BOTTOM (FT): 10.0 ft

TOTAL DEPTH (FT): 13.0 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Robert Koehler DATE: 09-02-97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

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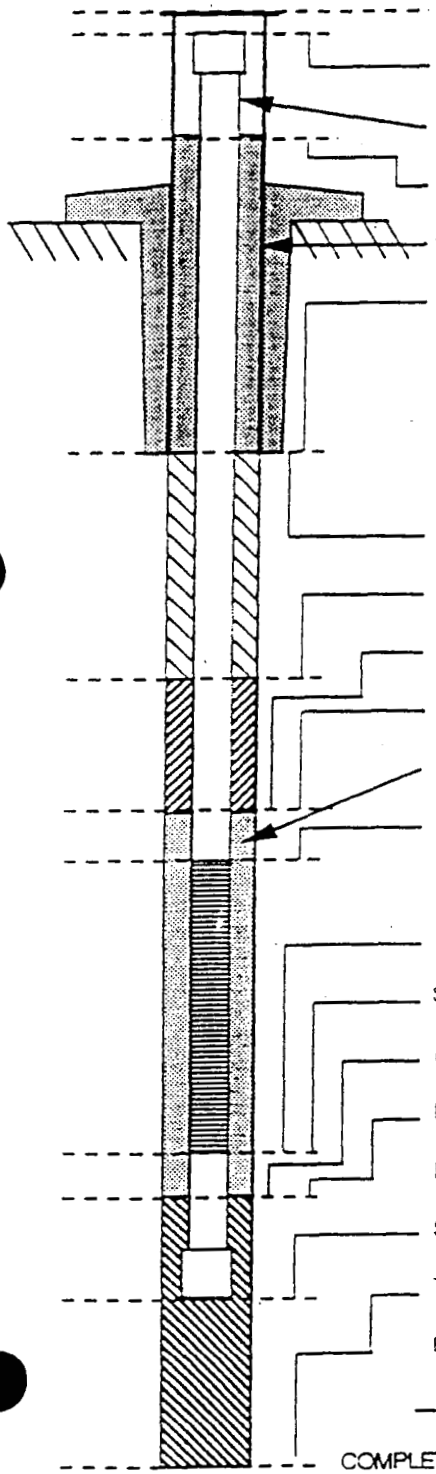
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20797 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater
SCREENED FORMATION: ~~AL 3.6 - 3.6~~ DRILLING CONTRACTOR: TERRA
DRILLING METHOD: GEOPROBE DATE DRILLED: 7-17-97 DATE COMPLETED: 7-18-97
RIG GEOLOGIST: William M. Whiton LOGGING GEOLOGIST: William M Whiton
COMPLETED DEPTH (FT): 8.8' ESTIMATED DEPTH TO BEDROCK (FT): 8.6'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): Dry / DRY DATE MEASURED: 7-18-97
COMPLETED WATER LEVEL (FT): ~~[illegible]~~ DATE MEASURED: ~~7-17-97~~ 071897



PROTECTIVE CASING, TOP (FT): 0.53 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.52
SURFACE CASING, I.D. (IN): 0.75 TYPE: Schedule 40 PVC
SURFACE SEAL, TOP (FT): 0.0 TYPE: Bentonite
PROTECTIVE CASING, I.D. (IN): 1.50 TYPE: Sch.40 PVC
PROTECTIVE CASING, BOTTOM (FT): 0.6

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 0.0 bgl TYPE: granular (Aquaset Fluid Tech
BENTONITE SEAL, BOTTOM (FT): 3.1
FILTER PACK, TOP (FT): 3.1
FILTER PACK TYPE: 16-40 SAND BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 3.6 ~~4.0~~ SCREEN, TOP (FT): 3.6 ~~4.0~~
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 8.6' TYPE: Sch.40 PVC BRAND:
SUMP, TOP (FT): 8.6' TYPE: Sch.40 PVC
FILTER PACK, BOTTOM (FT): 8.8'
BACKFILL, TOP (FT): 8.8' TYPE: CSSI 16-40 SAND
BACKFILL, BOTTOM (FT): 12.0'
SUMP, BOTTOM (FT): 8.8'
TOTAL DEPTH (FT): 12.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: William M Whiton DATE: 7-18-97
CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

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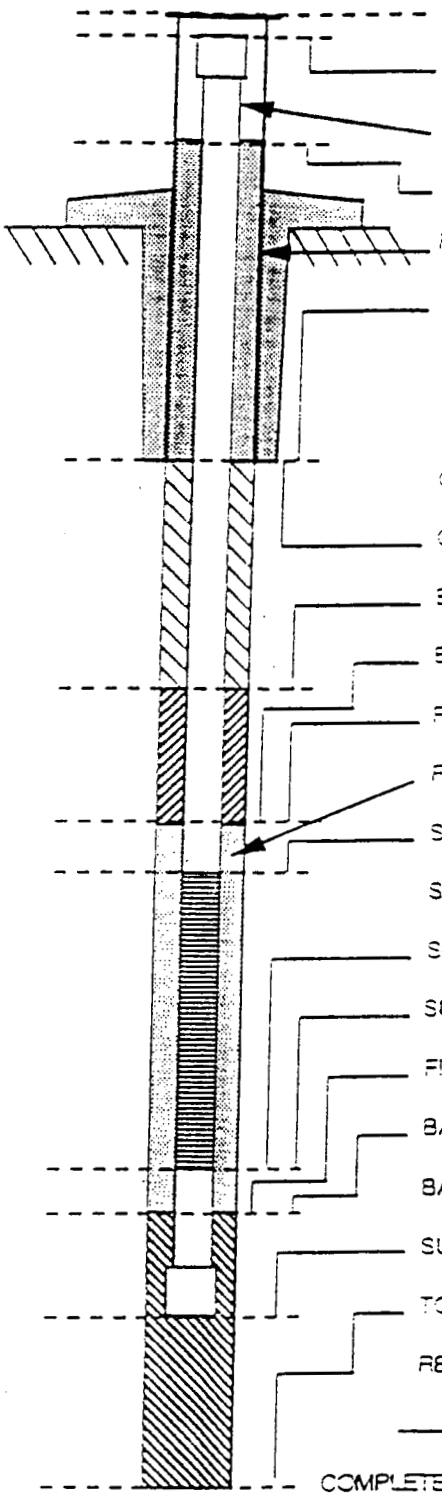
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C-21097 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP Groundwater
SCREENED FORMATION: ~~Alluvium~~ Bedrock DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe DATE DRILLED: 082997 DATE COMPLETED: 082997
RIG GEOLOGIST: J. Boylan LOGGING GEOLOGIST: J. Boylan
COMPLETED DEPTH (FT): 8.12 ESTIMATED DEPTH TO BEDROCK (FT): 0.2
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY (in core) DATE MEASURED: 082997
COMPLETED WATER LEVEL (FT): 8.78 DATE MEASURED: 111397



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.98
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): 0 TYPE: Granulated bentonite
PROTECTIVE CASING, I.D. (IN): 2.0 TYPE: Sch. 40 PVC
PROTECTIVE CASING, BOTTOM (FT): 0.4
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): Ground surf. (0.0) TYPE: Aquaset granulated bentonite
BENTONITE SEAL, BOTTOM (FT): 2.3
FILTER PACK, TOP (FT): 2.3
FILTER PACK TYPE: Silica sand, 16-40 BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 3.09 SCREEN, TOP (FT): 3.09
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 7.96 TYPE: Sch 40 PVC BRAND:
SUMP, TOP (FT): 7.96 TYPE: Sch 40 PVC
FILTER PACK, BOTTOM (FT): 8.12
BACKFILL, TOP (FT): 8.12 TYPE: Native materials
BACKFILL, BOTTOM (FT): 8.3
SUMP, BOTTOM (FT): 8.12
TOTAL DEPTH (FT): 8.3

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: J. Boylan DATE: 082997
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21197 PROJECT NAME: ~~GROUNDWATER~~ 1997 WARP PROGRAM: ~~WARP~~ GROUNDWATER

SCREENED FORMATION: ~~WEATHERED~~ BEDROCK DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE MACROCORE DATE DRILLED: 08/06/97-08/07/97 DATE COMPLETED: 08/07/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

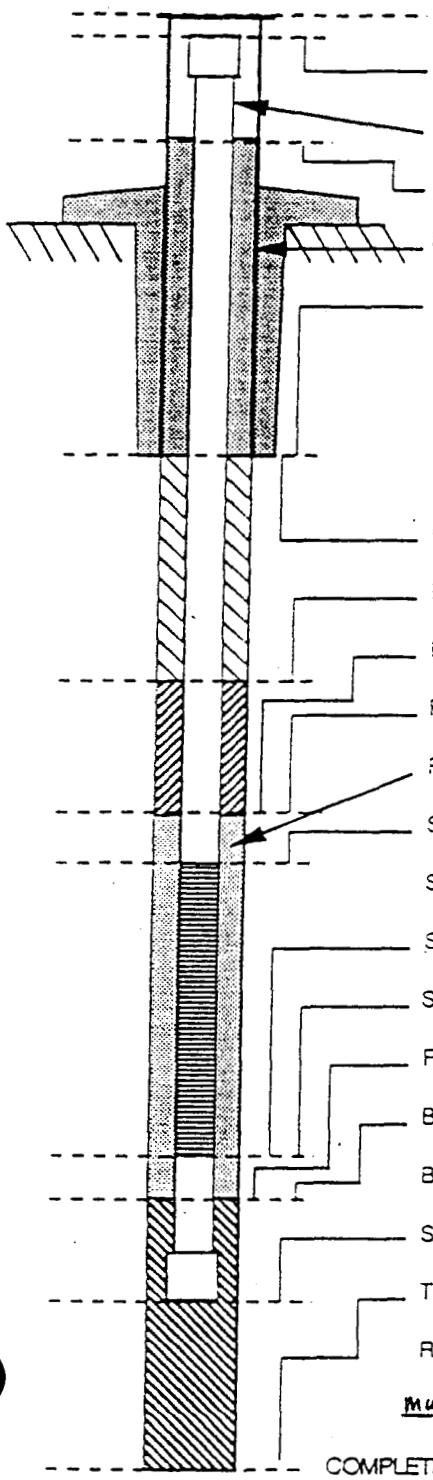
COMPLETED DEPTH (FT): ~~10.5 ft~~ 10.353 ESTIMATED DEPTH TO BEDROCK (FT): 0.6 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): ~~2~~ (2)

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A

INITIAL WATER LEVEL (FT): 0.0 (open hole depth 4.0, during rain) DATE MEASURED: 08/06/97

COMPLETED WATER LEVEL (FT): 6.08 DATE MEASURED: 08/07/97



PROTECTIVE CASING, TOP (FT): 0.5 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.47 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch 40

SURFACE SEAL, TOP (FT): 0.0 ft TYPE: GRANULAR BENTONITE; AQUASET

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.95 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 ft TYPE: GRANULAR BENTONITE

BENTONITE SEAL, BOTTOM (FT): 2.0 ft.

FILTER PACK, TOP (FT): 2.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc

SURFACE CASING, BOTTOM (FT): 2.41 ft SCREEN, TOP (FT): 2.41 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 7.31 ft. TYPE: Sch 40 PVC BRAND:

SUMP, TOP (FT): 7.31 ft TYPE: Sch 40 PVC

FILTER PACK, BOTTOM (FT): 10.353 ft.

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 10.353 ft

TOTAL DEPTH (FT): 10.353 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: A Sump ~~was not~~ installed rather than backfilled with bentonite because of mud slurry in hole.

COMPLETED BY: ROBERT KOEHLER DATE: 08/07/97

CHECKED BY: J. Boylan DATE: 10/28/97

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21297 PROJECT NAME: ~~GROUNDWATER~~ 1997 WARP PROGRAM: ~~WARP~~ Groundwater

SCREENED FORMATION: ~~WEATHERED~~ BEDROCK DRILLING CONTRACTOR: TERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 08/06/97 DATE COMPLETED: 08/06/97

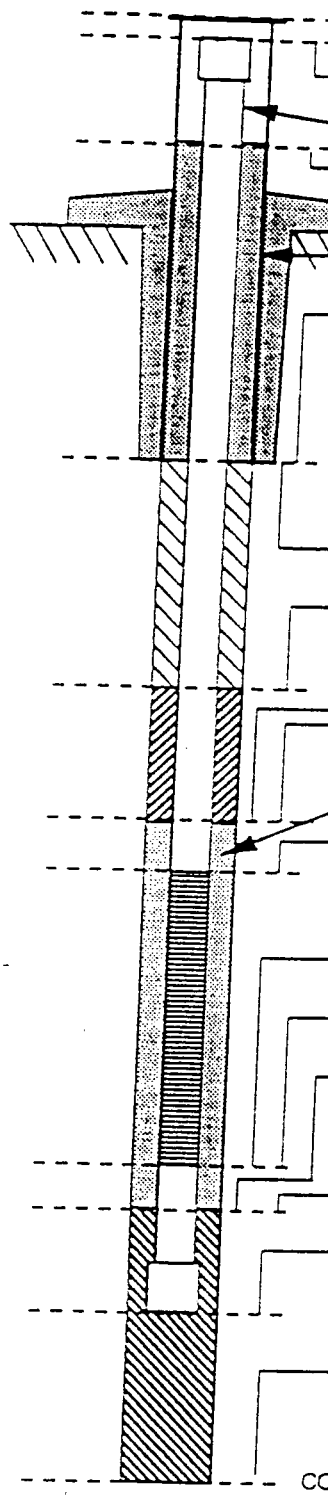
RIG GEOLOGIST: R KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~10.3 ft~~ 6.0 ESTIMATED DEPTH TO BEDROCK (FT): 0.3 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 080697

COMPLETED WATER LEVEL (FT): 2.64 DATE MEASURED: 110697



PROTECTIVE CASING, TOP (FT): 0.45 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~0.45 ft~~ RPK Approximately 0.35 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch 40

SURFACE SEAL TOP (FT): 0.0 ft TYPE: GRANULAR BENTONITE; AQUASET

PROTECTIVE CASING, I.D. (IN): 1.5" ~~1.5 ft~~ RPK TYPE: PVC ~~GRAN~~ RPK Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.95 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): N/A TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: GRANULAR BENTONITE; AQUASET

BENTONITE SEAL BOTTOM (FT): 1.0 ft

FILTER PACK, TOP (FT): 1.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc

SURFACE CASING, BOTTOM (FT): ~~0.38 ft~~ 0.97 SCREEN, TOP (FT): ~~0.38 ft~~ 0.97

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 5.85 ft TYPE: PVC Sch 40 BRAND:

SUMP, TOP (FT): 5.85 ft TYPE: PVC Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 6.0 ft

BACKFILL, TOP (FT): 6.0 ft TYPE: Granular Bentonite; Aquaset

BACKFILL, BOTTOM (FT): 10.3 ft

SUMP, BOTTOM (FT): 6.0 ft

TOTAL DEPTH (FT): 10.3 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Installed during rainstorm. Damp conditions made working with filter pack and bentonite difficult.

COMPLETED BY: ROBERT KOEHLER DATE: 08/06/97

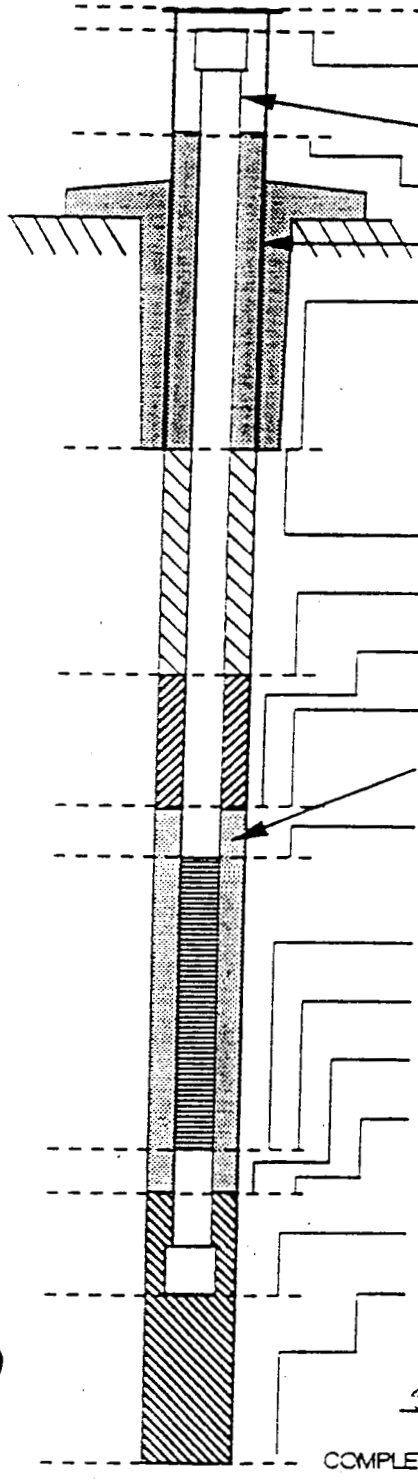
CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21397 PROJECT NAME: ~~GROUNDWATER 1997~~ WARP PROGRAM: ~~WARP~~ Groundwater
SCREENED FORMATION: ~~WEATHERED BEDROCK~~ DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE CONTINUOUS MACRO CORE DATE DRILLED: 08/05/97 DATE COMPLETED: 08/05/97
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER
COMPLETED DEPTH (FT): 6.0 ft. ESTIMATED DEPTH TO BEDROCK (FT): 0.7 ft.
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch
QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A INITIAL WATER LEVEL (FT): ~~N/A~~ Dry (open hole) DATE MEASURED: 080597
COMPLETED WATER LEVEL (FT): ~~N/A~~ Dry RPK 9/3/97 DATE MEASURED: 09/09/97 RPK 09/09/97



PROTECTIVE CASING, TOP (FT): 0.4 ft. (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.3 ft.
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch 40
SURFACE SEAL TOP (FT): 0.0 ft. TYPE: GRANULAR BENTONITE; AQUASET
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC Sch 40
PROTECTIVE CASING, BOTTOM (FT): ~~1.0 ft~~ 1.04
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): N/A TYPE:
BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: GRANULAR BENTONITE; AQUASET
BENTONITE SEAL BOTTOM (FT): 1.0 ft.
FILTER PACK, TOP (FT): 1.0 ft.
FILTER PACK TYPE: SILICA SAND 16-40 BRAND: COLO. SILICA SAND INC.
SURFACE CASING, BOTTOM (FT): 0.95 ft. SCREEN, TOP (FT): 0.95 ft.
SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 5.84 ft. TYPE: PVC Sch 40 BRAND:
SUMP, TOP (FT): 5.84 ft TYPE: PVC Sch 40
FILTER PACK, BOTTOM (FT): 6.0 ft.
BACKFILL, TOP (FT): 6.0 ft TYPE: GRANULAR BENTONITE; AQUASET
BACKFILL, BOTTOM (FT): 9.8 ft.
SUMP, BOTTOM (FT): 6.0 ft.
TOTAL DEPTH (FT): 9.8 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Ground surface chewed up by Geoprobe foot so measurement of depths relative to ground level are difficult.

COMPLETED BY: Robert Koehler DATE: 08/05/97
CHECKED BY: J. Baylor DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21497 PROJECT NAME: ~~GROUNDWATER~~ PM7 WARP PROGRAM: ~~WARP~~ Groundwater

SCREENED FORMATION: ~~WEATHERED~~ BEDROCK DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE CONTINUOUS CORE DATE DRILLED: 08/04/97 DATE COMPLETED: 08/04/97

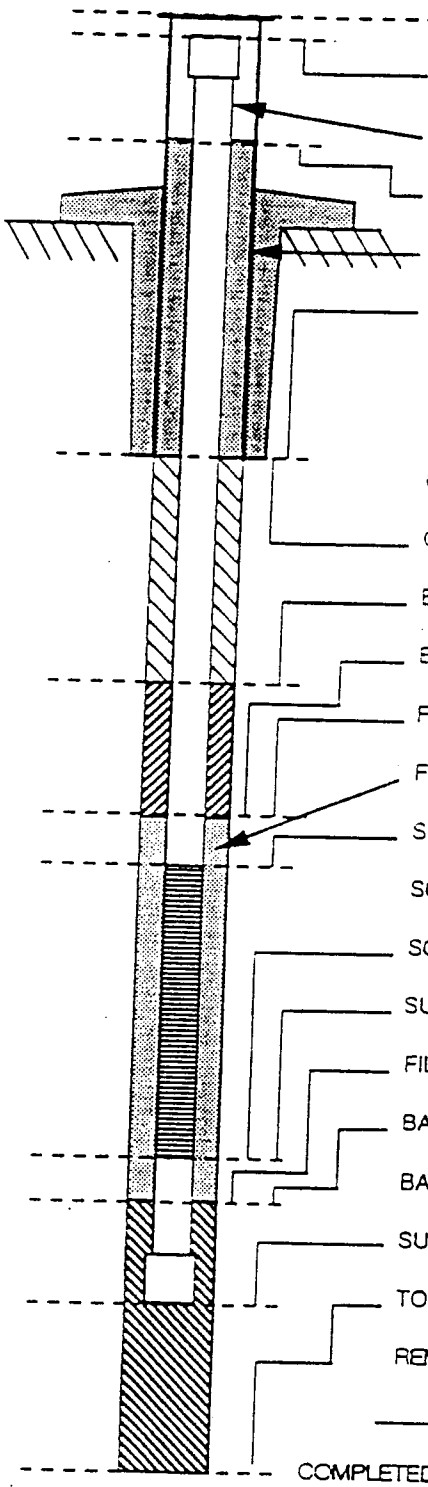
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~7.55 ft~~ RPK 9/9/97 ESTIMATED DEPTH TO BEDROCK (FT): 0.4 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch (GEOPROBE MACROCORE)

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A ∅ INITIAL WATER LEVEL (FT): ~~N/A~~ Dry (open hole) DATE MEASURED: 080497

COMPLETED WATER LEVEL (FT): ~~N/A~~ 7.45 ft RPK 9/9/97 DATE MEASURED: 9/9/97



PROTECTIVE CASING, TOP (FT): 0.5 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.4 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch 40

SURFACE SEAL TOP (FT): 0.0 TYPE: Granular Bentonite/Aquaseal

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): ~~1.0 ft.~~ 0.9

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: Granular Bentonite/Aquaseal

BENTONITE SEAL BOTTOM (FT): 1.0 ft

FILTER PACK, TOP (FT): 1.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): ~~N/A~~ 2.48 SCREEN, TOP (FT): 2.48 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 7.39 ft TYPE: Sch 40 BRAND:

SUMP, TOP (FT): 7.39 ft TYPE: Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 7.55 ft

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 7.55 ft

TOTAL DEPTH (FT): 7.55 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: R. KOEHLER DATE: 08/04/97

CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21597 PROJECT NAME: ~~GROUNDWATER~~ 1997 WARP PROGRAM: WARP Groundwater

SCREENED FORMATION: ~~WEATHERED~~ BEDROCK DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE CONTINUOUS CORE DATE DRILLED: 08/04/97 DATE COMPLETED: 08/04/97

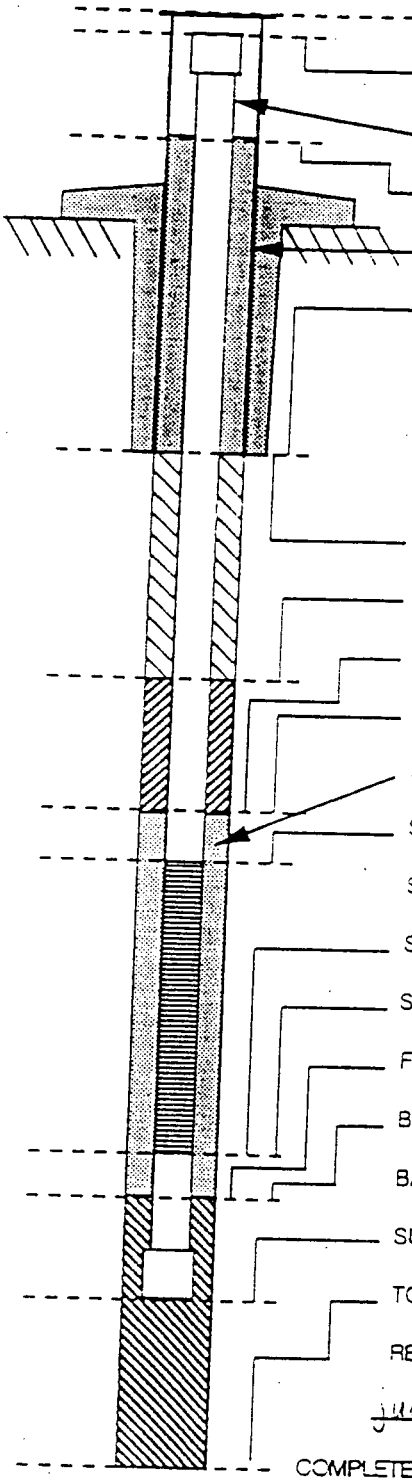
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): 5.3 ft ESTIMATED DEPTH TO BEDROCK (FT): 0.3 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch (GEOPROBE MACROCORE)

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA ∅ INITIAL WATER LEVEL (FT): NA Dry (open hole) DATE MEASURED: 080497

COMPLETED WATER LEVEL (FT): NA 4.35 ft RPK 9/9/97 DATE MEASURED: 09/09/97



PROTECTIVE CASING, TOP (FT): 0.7 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~0.6 ft~~ 0.67

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC SCH 40

SURFACE SEAL TOP (FT): 0.0 TYPE: GRANULAR BENTONITE; AQUASET

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC SCH 40

PROTECTIVE CASING, BOTTOM (FT): 0.8 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: GRANULAR BENTONITE; AQUASET

BENTONITE SEAL BOTTOM (FT): 1.0 ft

FILTER PACK, TOP (FT): 1.0 ft

FILTER PACK TYPE: SILICA SAND BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): ~~NA~~ 0.27 SCREEN, TOP (FT): 0.27 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 5.4 ft TYPE: PVC SCH 40 BRAND:

SUMP, TOP (FT): 5.4 ft TYPE: PVC SCH 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 5.3 ft

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 5.3 ft

TOTAL DEPTH (FT): 5.3 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: 3/4 of a foot of bentonite at top of screen was judged acceptable for a shallow/temporary well 8/7/97 RPK

COMPLETED BY: ROBERT KOEHLER DATE: 08/04/97

CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21697 PROJECT NAME: 1997 Nav PROGRAM: Groundwater

SCREENED FORMATION: Bedrock DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe Continuous Core DATE DRILLED: 8/1/97 DATE COMPLETED: 8/1/97

RIG GEOLOGIST: R. Koehler LOGGING GEOLOGIST: R. Koehler

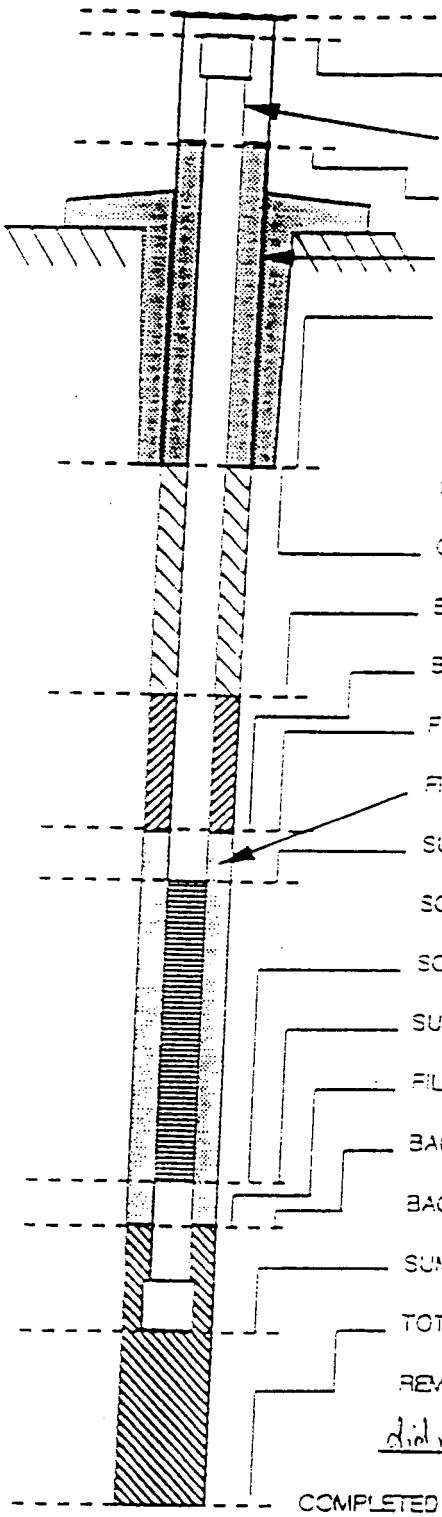
COMPLETED DEPTH (FT): 8.8 ft ESTIMATED DEPTH TO BEDROCK (FT): 0.2 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 08/01/97

COMPLETED WATER LEVEL (FT): 5.78 ft DATE MEASURED: 09/09/97



PROTECTIVE CASING, TOP (FT): 0.64 ft FROM GROUND SURFACE:

SURFACE CASING (STICKUP), TOP (FT): 0.54 ft estimate from top protective casing

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch 40

SURFACE SEAL TOP (FT): 0.0 TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 2" TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.5 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 1.0 ft

FILTER PACK, TOP (FT): 1.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo Silica Sand Inc

SURFACE CASING, BOTTOM (FT): SCREEN, TOP (FT):

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 8.7 ft TYPE: PVC Sch 40 BRAND:

SUMP, TOP (FT): 8.7 ft TYPE: Sch 40 PVC w/ cap rivets

FILTER PACK, BOTTOM (FT): 8.8 ft

BACKFILL, TOP (FT): NA TYPE

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 8.8 ft

TOTAL DEPTH (FT): 8.8 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Screen PVC used throughout well bore because 1.) haste, 2.) did not have short sections of surface casing. Ground surface disturbed by drilling - slight difficulty measuring depths from ground level

COMPLETED BY: Robert Koehler DATE: 08/01/97

CHECKED BY: J. Boylan DATE: 080197

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21797 PROJECT NAME: ~~GROUNDWATER 1997 WARP~~ PROGRAM: ~~WARP~~ Groundwater

SCREENED FORMATION: ~~WEATHERED~~ BEDROCK DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE CONTINUOUS CORE DATE DRILLED: 08-01-97 DATE COMPLETED: 08-01-97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

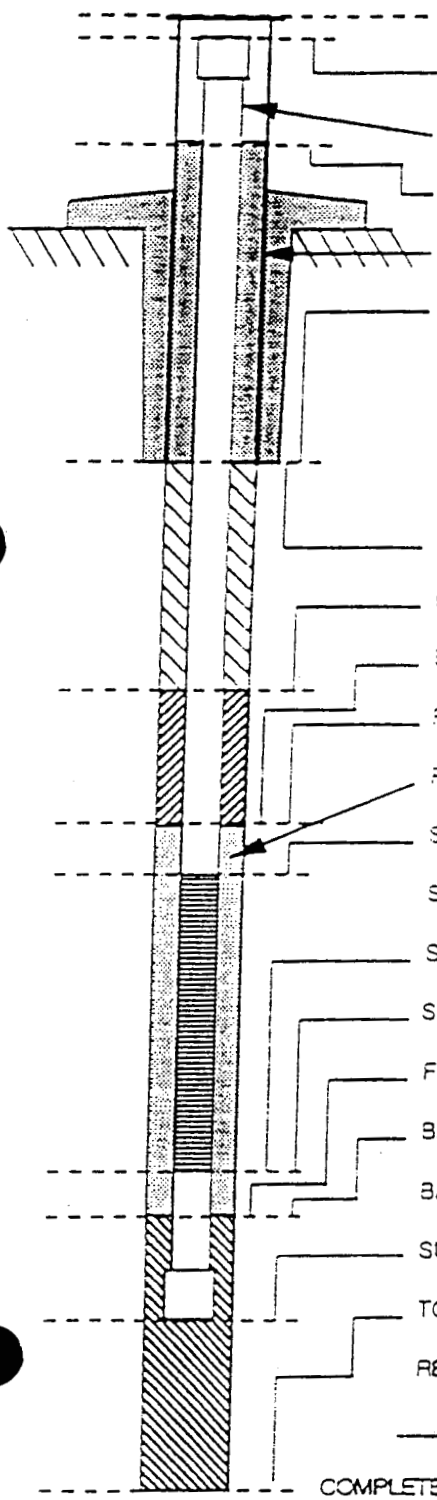
COMPLETED DEPTH (FT): 10 ft ESTIMATED DEPTH TO BEDROCK (FT): 0.1 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A

INITIAL WATER LEVEL (FT): NA (DRY) DATE MEASURED: 080197

COMPLETED WATER LEVEL (FT): NONE (DRY) DATE MEASURED: 08-01-97



PROTECTIVE CASING, TOP (FT): 0.5 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.4 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: Sch 40 PVC

SURFACE SEAL, TOP (FT): 0.0 TYPE: GRANULAR BENTONITE; AQUASET

PROTECTIVE CASING, I.D. (IN): 2.0" TYPE: Sch 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 0.5 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE

BENTONITE SEAL, TOP (FT): 0.0 ft TYPE: GRANULAR BENTONITE; AQUASET

BENTONITE SEAL, BOTTOM (FT): 1.0 ft.

FILTER PACK, TOP (FT): 1.0 ft.

FILTER PACK TYPE: SILICA SAND 16-40 BRAND: Colo Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 0.9 ft. SCREEN, TOP (FT): 0.9 ft.

SCREEN SLOT SIZE (.000 IN): 0.010 in SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 5.8 ft. TYPE: Sch 40 PVC BRAND:

SUMP, TOP (FT): 5.8 ft TYPE: PVC w/ pop rivet (Sch. 40)

FILTER PACK, BOTTOM (FT): 6.0 ft.

BACKFILL, TOP (FT): ~~NA~~ 6.0 RPK 8/1/97 TYPE: Granular Bentonite; Aquaset

BACKFILL, BOTTOM (FT): ~~NA~~ 10.0 ft. RPK 8/1/97

SUMP, BOTTOM (FT): 6.0 ft.

TOTAL DEPTH (FT): 10.0 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: ROBERT KOEHLER DATE: 08-01-97

CHECKED BY: J. Bangham DATE: 102797

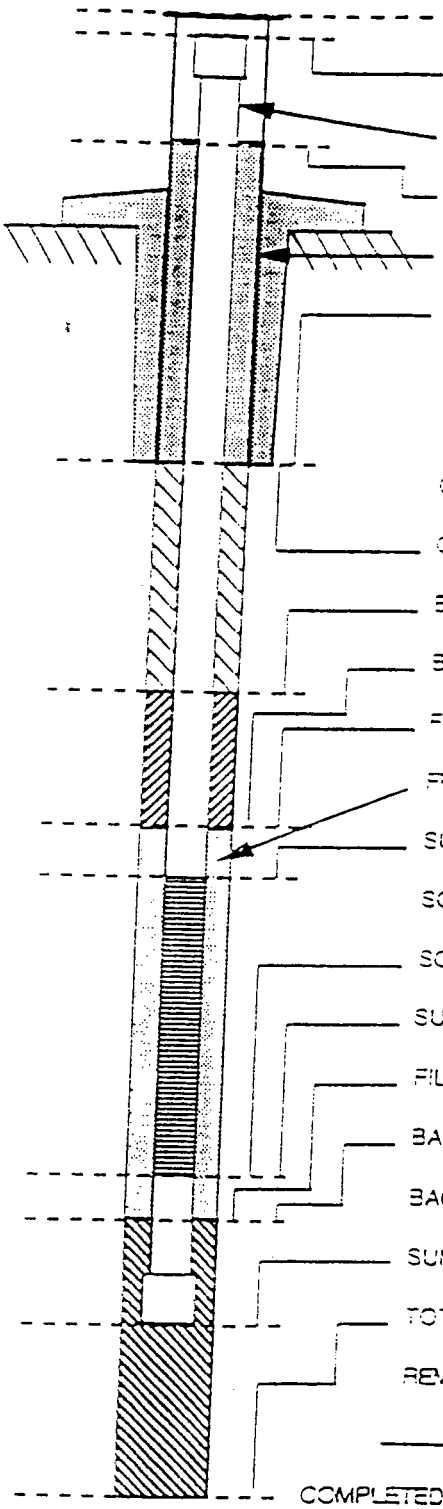
U.S. Department of Energy Rocky Flats Plant

Form GT.5B
(Rev.3)
CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21897 PROJECT NAME: 1997 WARP PROGRAM: 1997 WARP (Grou...
SCREENED FORMATION: AL DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE : PUSH HAMMER DATE DRILLED: 073197 DATE COMPLETED: 073197
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 6.0 ESTIMATED DEPTH TO BEDROCK (FT):
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DATE MEASURED:
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): FROM GROUND SURFACE:
SURFACE CASING (STICKUP), TOP (FT): 0.5
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite
PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: Sch. 40 PVC
PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE
SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):
SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): N/A TYPE:
BENTONITE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite
BENTONITE SEAL BOTTOM (FT): 1.0
FILTER PACK, TOP (FT): 1.0
FILTER PACK TYPE: 16-40 Silica sand BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 1.0 SCREEN, TOP (FT): 1.0
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 5.9 TYPE: Sch. 40 PVC BRAND:
SUMP, TOP (FT): 5.9 TYPE: Sch. 40 PVC
FILTER PACK, BOTTOM (FT): 6.0
BACKFILL, TOP (FT): 6.0 TYPE: Granulated bentonite
BACKFILL, BOTTOM (FT): 8.0
SUMP, BOTTOM (FT): 6.0
TOTAL DEPTH (FT): 8.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: J. Baylan DATE: 102397
CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) ORR 3/31/96

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21997 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater

SCREENED FORMATION: AL DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE : PUSH HAMMER DATE DRILLED: 073197 DATE COMPLETED: 073197

FIG GEOLOGIST: ~~R. KOETTER~~ F. Grigsby LOGGING GEOLOGIST: ~~R. KOETTER~~ F. Grigsby

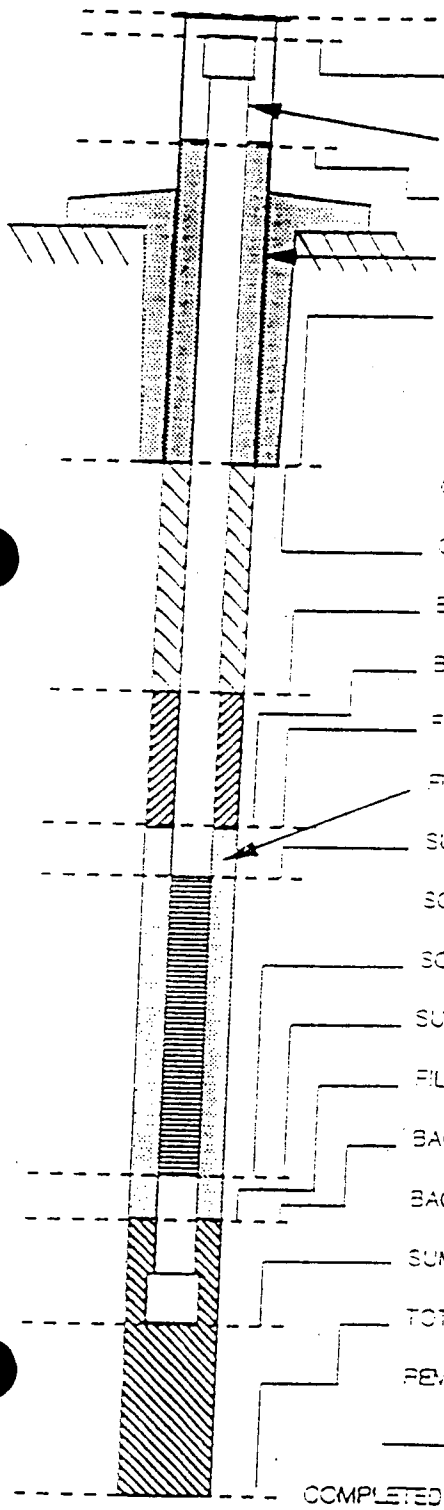
COMPLETED DEPTH (FT): 7.5 ESTIMATED DEPTH TO BEDROCK (FT): _____

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____

COMPLETED WATER LEVEL (FT): _____ DATE MEASURED: _____



PROTECTIVE CASING, TOP (FT): _____ FROM GROUND SURFACE

SURFACE CASING (STICKUP), TOP (FT): 0.5

SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC

SURFACE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite (Quasset)

PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): _____

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): N/A TYPE: _____

CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL TOP (FT): N/A TYPE: _____

BENTONITE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite (Quasset)

BENTONITE SEAL BOTTOM (FT): 1.0

FILTER PACK, TOP (FT): 1.0

FILTER PACK TYPE: 16-40 silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 2.5 SCREEN, TOP (FT): 2.5

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): ~~7.5~~ 7.4 TYPE: Sch. 40 PVC BRAND: _____

SUMP, TOP (FT): ~~7.5~~ 7.4 TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 9.0

BACKFILL, TOP (FT): 7.5 TYPE: 16-40 silica sand

BACKFILL, BOTTOM (FT): 9.0

SUMP, BOTTOM (FT): 7.5

TOTAL DEPTH (FT): 9.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: _____

COMPLETED BY: J. Boylan DATE: 102397

CHECKED BY: _____ DATE: _____

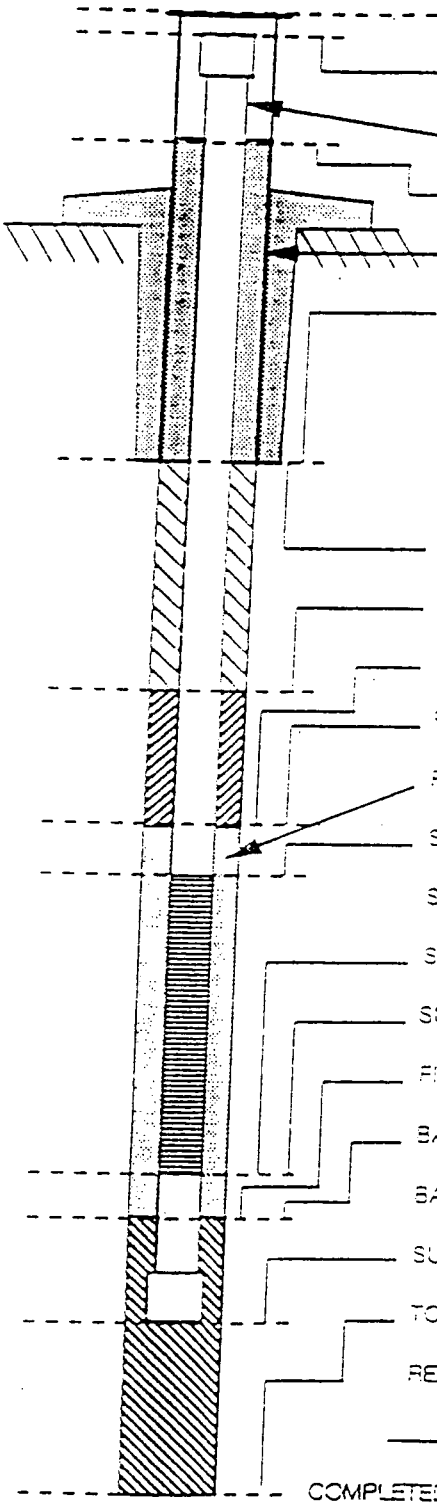
U.S. Department of Energy Rocky Flats Plant

Form GT.58
(Rev. 3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22097 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater
SCREENED FORMATION: AL DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE : PUSH HAMMER DATE DRILLED: 072997 DATE COMPLETED: 072997
RIG GEOLOGIST: ~~B. Koehler~~ F. Grigsby LOGGING GEOLOGIST: ~~B. Koehler~~ F. Grigsby
COMPLETED DEPTH (FT): 7.0 ESTIMATED DEPTH TO BEDROCK (FT): _____
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____
COMPLETED WATER LEVEL (FT): _____ DATE MEASURED: _____



PROTECTIVE CASING, TOP (FT): _____ FROM GROUND SURFACE:
SURFACE CASING (STICKUP), TOP (FT): 0.5
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite/Aquaset
PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: Sch. 40 PVC
PROTECTIVE CASING, BOTTOM (FT): _____
IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____
SECONDARY CASING, I.D. (IN): N/A TYPE: _____
CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____
GROUT SEAL TOP (FT): N/A TYPE: _____
BENTONITE SEAL TOP (FT): 0.0 TYPE: Granulated bentonite/Aquaset
BENTONITE SEAL BOTTOM (FT): 1.0
FILTER PACK, TOP (FT): 1.0
FILTER PACK TYPE: 16-40 Silica sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 1.9 SCREEN, TOP (FT): 1.9
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 6.9 TYPE: Sch. 40 PVC BRAND: _____
SUMP, TOP (FT): 6.9 TYPE: Sch. 40 PVC
FILTER PACK, BOTTOM (FT): 7.0
BACKFILL, TOP (FT): 7.0 TYPE: Granulated bentonite
BACKFILL, BOTTOM (FT): 8.0
SUMP, BOTTOM (FT): 7.0
TOTAL DEPTH (FT): 8.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: _____

COMPLETED BY: J. Boylan DATE: 102397
CHECKED BY: _____ DATE: _____

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) OPR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22197 PROJECT NAME: 1997 WARP ~~97~~ PROGRAM: Groundwater ~~GROUNDWATER MONITORING~~

SCREENED FORMATION: BEDROCK DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 07/28/97 DATE COMPLETED: 07/28/97

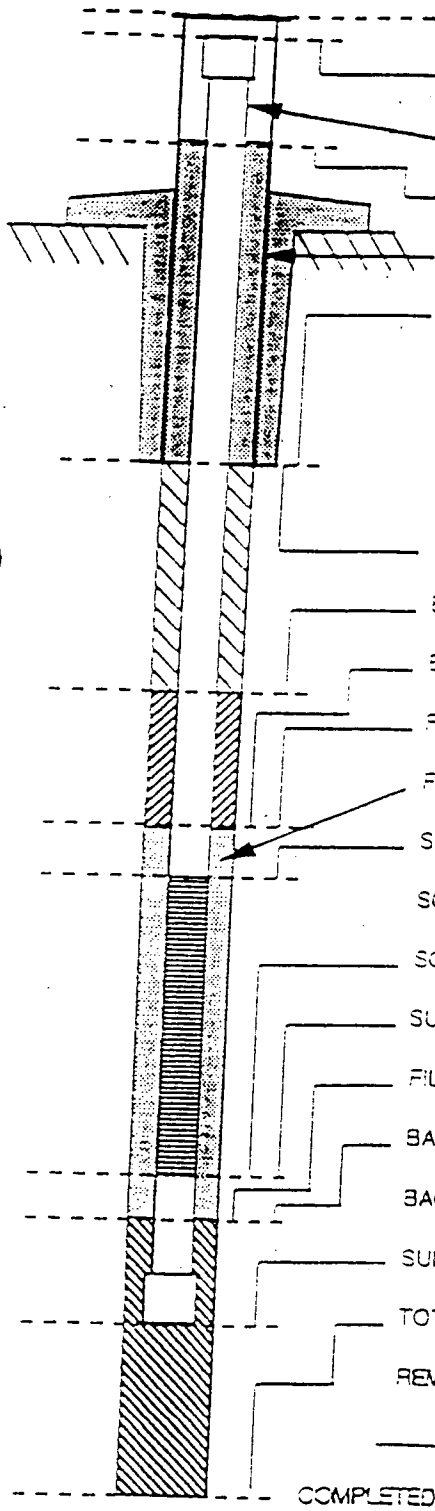
RIG GEOLOGIST: F. GRIGSBY (INSTALLATION) LOGGING GEOLOGIST: R. KOEHLER (GEOLOGY/DRILLING)

COMPLETED DEPTH (FT): ~~9.3 ft~~ ESTIMATED DEPTH TO BEDROCK (FT): 0.5 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): ~~7~~ RPK 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 07/28/97

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.5 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): NA TYPE:

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Schedule 40

PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaseal Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 1.0 ft.

FILTER PACK, TOP (FT): 1.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 1.0 ft. SCREEN, TOP (FT): 1.0 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 6.3 ~~6.5 ft~~ TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 6.3 ~~7.7~~ TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 7.84 ft.

BACKFILL, TOP (FT): 7.84 ft. TYPE: Native material, ~~well cuttings~~

BACKFILL, BOTTOM (FT): 9.3 ft.

SUMP, BOTTOM (FT): ~~7.84~~ 6.5

TOTAL DEPTH (FT): 9.3 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: R. KOEHLER DATE: 07/31/97

CHECKED BY: J. Baylor DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22297 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater

SCREENED FORMATION: ~~Laramie-Fox Hills~~ bedrock DRILLING CONTRACTOR: TIERRA ENV

DRILLING METHOD: Geoprobe DATE DRILLED: 7-24-97 DATE COMPLETED: 072497

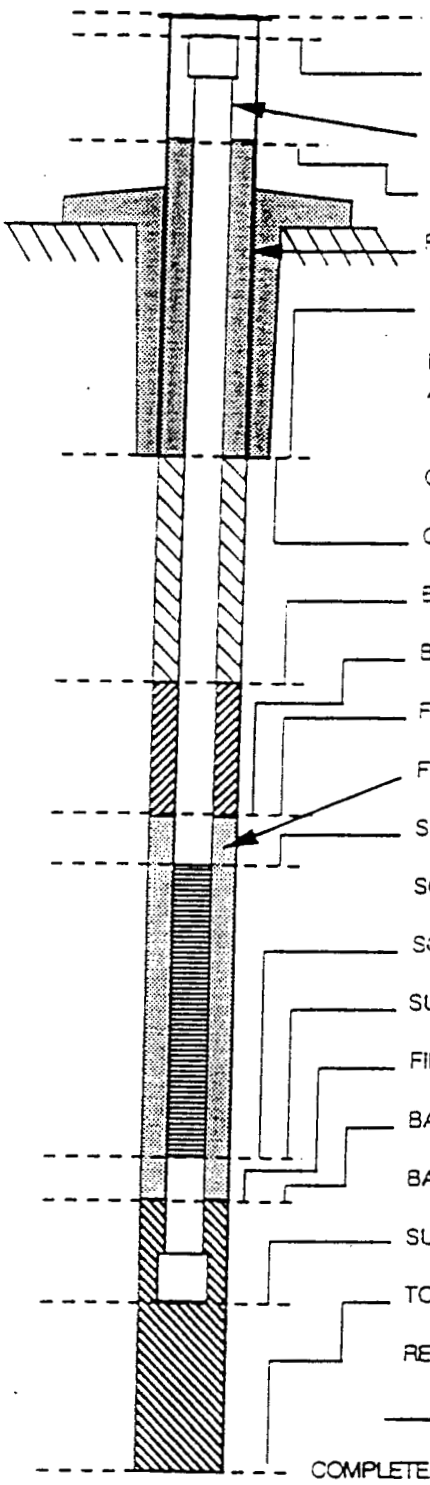
RIG GEOLOGIST: William M. Whitson LOGGING GEOLOGIST: William M Whitson

COMPLETED DEPTH (FT): 3.14 ESTIMATED DEPTH TO BEDROCK (FT): 1.4

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A ~~20~~ INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 072497

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.67 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.65

SURFACE CASING, I.D. (IN): 0.75 TYPE: PVC, Sch. 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: Granular Bentonite (Aquaset)

PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: PVC, Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.85

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): ~~0.0~~ N/A TYPE: N/A ~~Granular Bentonite (Aquaset)~~

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granulated bentonite

BENTONITE SEAL, BOTTOM (FT): 0.8

FILTER PACK, TOP (FT): 0.8

FILTER PACK TYPE: 16-40 SAND BRAND: CSSI

SURFACE CASING, BOTTOM (FT): ~~2.98~~ 1.2 SCREEN, TOP (FT): 1.2 ~~2.98~~ WMW 7-23-97

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 2.98 ~~1.4~~ WMW 7-23-97 TYPE: PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 2.98 ~~1.4~~ WMW 7-23-97 TYPE: PVC, Sch. 40

FILTER PACK, BOTTOM (FT): 3.14

BACKFILL, TOP (FT): 3.14 TYPE: Granular Bentonite (Aquaset)

BACKFILL, BOTTOM (FT): 6.2

SUMP, BOTTOM (FT): 3.14

TOTAL DEPTH (FT): 6.2

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: William M Whitson DATE: 7-24-97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: ~~2297~~ 22397 (WMW) PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater

SCREENED FORMATION: UHSU bedrock DRILLING CONTRACTOR: TIERRA ENVIRONMENTAL

DRILLING METHOD: GEOPROBE DATE DRILLED: 072397 DATE COMPLETED: 072397

RIG GEOLOGIST: William M Walton LOGGING GEOLOGIST: William M Walton

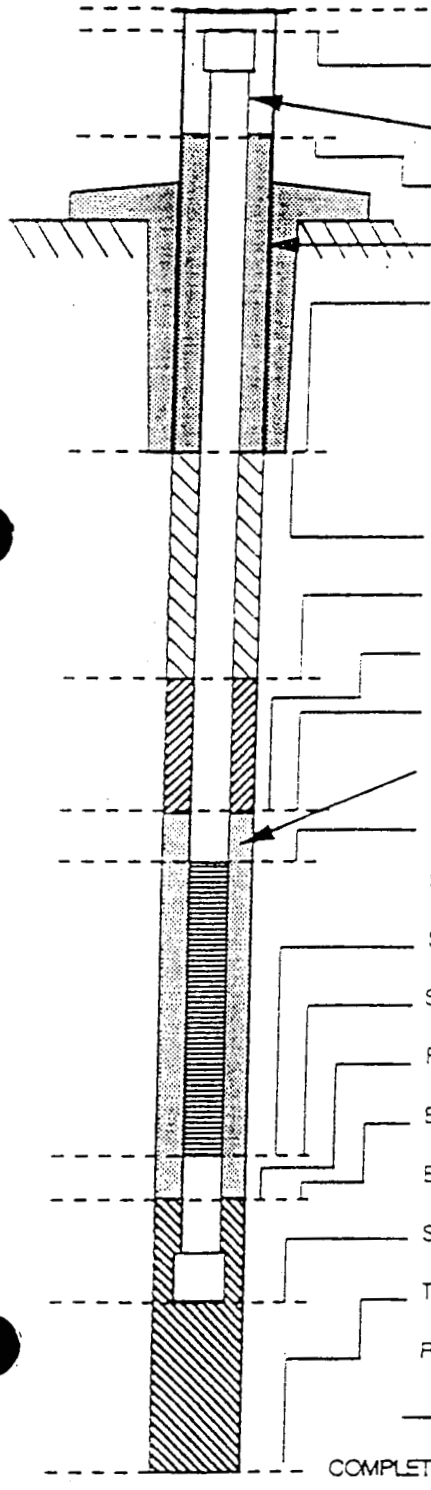
COMPLETED DEPTH (FT): 5.02 ESTIMATED DEPTH TO BEDROCK (FT): 1.0

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0.0~~ NA (AB)

INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 072397

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.71 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.70

SURFACE CASING, I.D. (IN): 0.75 TYPE: Schedule 40 PVC

SURFACE SEAL, TOP (FT): 0.0 TYPE: Bentonite

PROTECTIVE CASING, I.D. (IN): 1.50 TYPE: PVC, Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.80

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular (Aquaset)

BENTONITE SEAL, BOTTOM (FT): 0.75

FILTER PACK, TOP (FT): 0.75

FILTER PACK TYPE: 16-40 SAND BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 1.0 SCREEN, TOP (FT): 1.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 4.85 TYPE: PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 4.85 TYPE: PVC, Sch. 40

FILTER PACK, BOTTOM (FT): 5.02

BACKFILL, TOP (FT): 5.02 TYPE: Bentonite (Aquaset Granular)

BACKFILL, BOTTOM (FT): 10.6'

SUMP, BOTTOM (FT): 5.02

TOTAL DEPTH (FT): 10.6'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: William M Walton DATE: 7-23-97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/96

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22497 PROJECT NAME: 1997 WARP PROGRAM: ~~1997 WARP~~ Groundwater

SCREENED FORMATION: Weathered Bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 07/28/97 DATE COMPLETED: 07/28/97

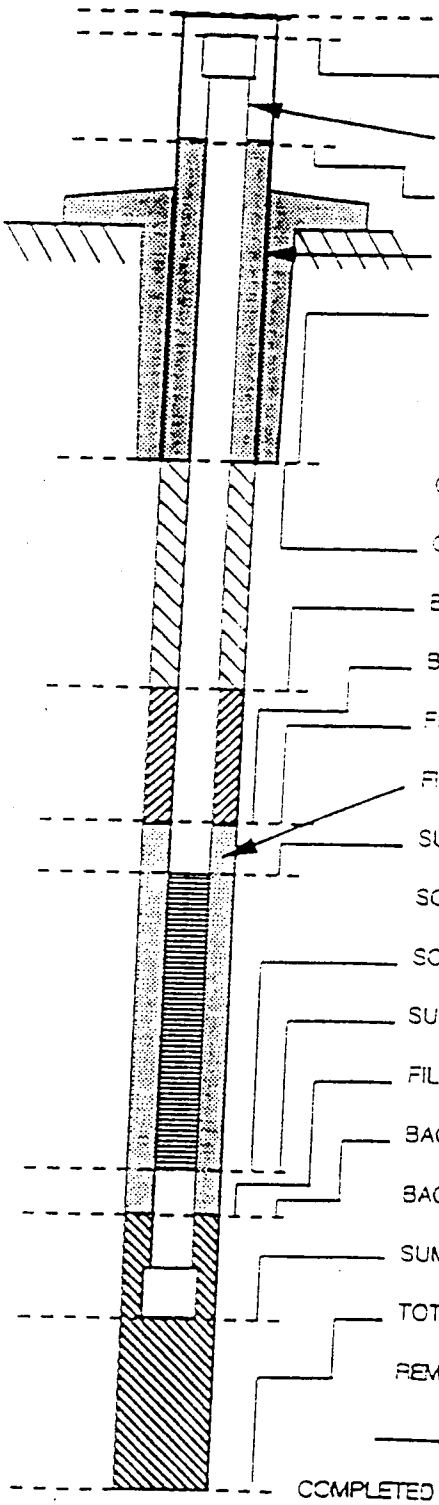
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): 6.0 ft ESTIMATED DEPTH TO BEDROCK (FT): 1.2 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 3/4"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 072897

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.0 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: Sch 40 PVC

SURFACE SEAL TOP (FT): ~~0.0~~ ~~N/A~~ 0.0 TYPE: ~~Granular Bentonite - Aquaset~~ Granulated bentonite

RPK 07/28/97 RPK 07/28/97

PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): N/A TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: Granular Bentonite - Aquaset

BENTONITE SEAL BOTTOM (FT): 1.0 ft.

FILTER PACK, TOP (FT): 1.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo Silica Sand

SURFACE CASING, BOTTOM (FT): 1.0 SCREEN, TOP (FT): 1.0 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 5.9 ft TYPE: Sch 40 PVC BRAND:

SUMP, TOP (FT): 5.9 ft. TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 6.0 ft.

BACKFILL, TOP (FT): 6.0 ft TYPE: Granular Bentonite - Aquaset

BACKFILL, BOTTOM (FT): 9.0 ft.

SUMP, BOTTOM (FT): 6.0 ft.

TOTAL DEPTH (FT): 9.0 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Geologic log TD says 10.0 ft but driller was in error. TD Actually is 9.0 ft.

COMPLETED BY: R. Koehler Robert Koehler DATE: 07/28/97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22597 PROJECT NAME: 1997 WARP A PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~Arapahoe~~ Bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 09/12/97 DATE COMPLETED: 09/12/97

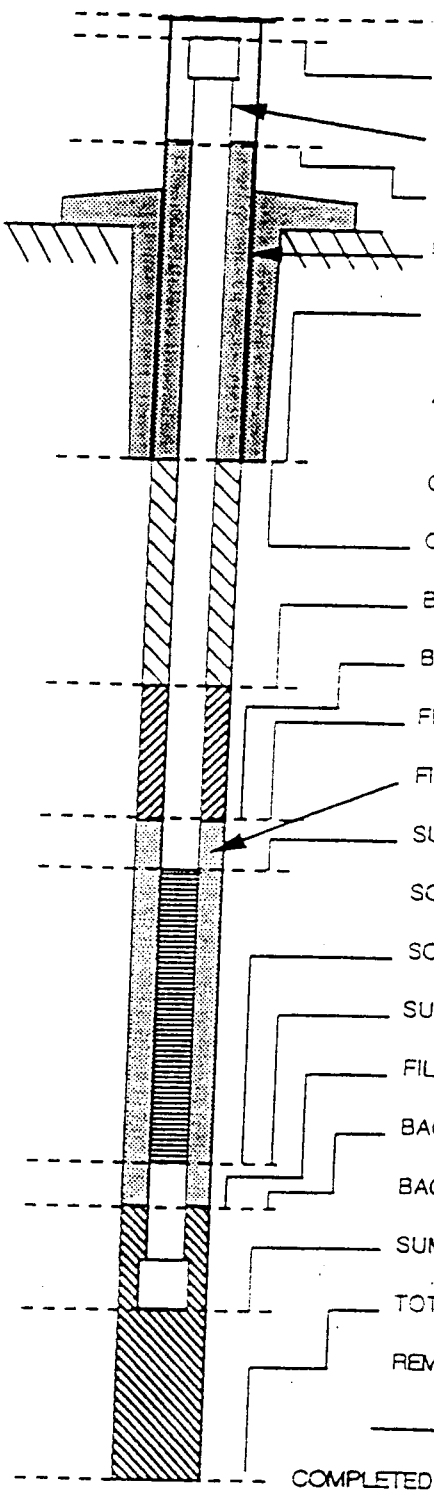
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~26.0 ft~~ 26.18 ESTIMATED DEPTH TO BEDROCK (FT): 2.3 ft weathered

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0" RPK 9/12/97

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0 INITIAL WATER LEVEL (FT): 17.17 ft DATE MEASURED: 09/12/97 open hole

COMPLETED WATER LEVEL (FT): 16.21 from TOC DATE MEASURED: 110397



PROTECTIVE CASING, TOP (FT): 0.62 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~0.62 ft w/cap~~ 0.55

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~NA~~ 0.0 TYPE: Granulated bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Schedule 40

PROTECTIVE CASING, BOTTOM (FT): 0.78 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 13.0 ft.

FILTER PACK, TOP (FT): 13.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 14.34 ft. SCREEN, TOP (FT): 14.34 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 26.02 ft TYPE: PVC, Schedule 40 BRAND:

SUMP, TOP (FT): 26.02 ft TYPE: PVC, Schedule 40 w/pop rivets

FILTER PACK, BOTTOM (FT): 26.18 ft

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 26.18 ft.

TOTAL DEPTH (FT): 26.18 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Robert Koehler Robert Koehler DATE: 09/12/97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 2) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #22697 PROJECT NAME: 1997 WARP-97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~Arapahoe Fm (?)~~ Below DRILLING CONTRACTOR: TERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 09/15-16/97 DATE COMPLETED: 09/16/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

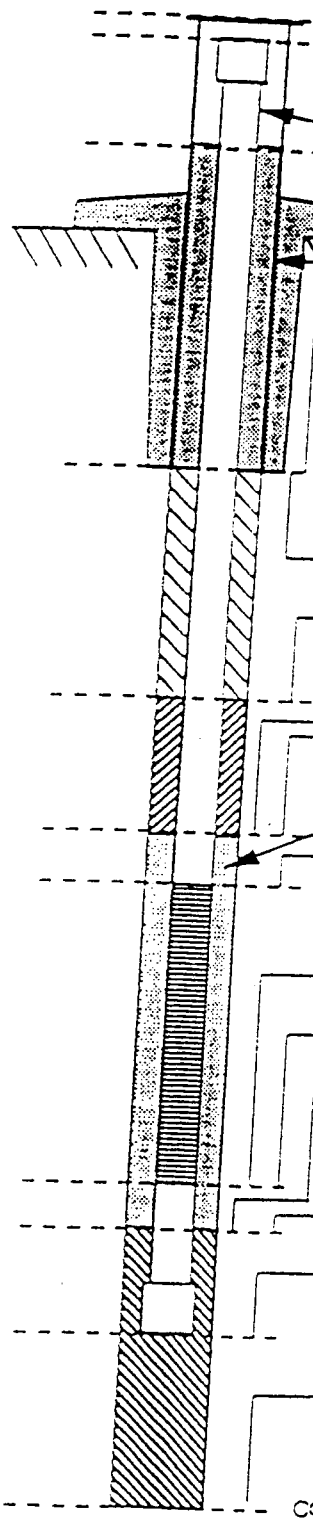
COMPLETED DEPTH (FT): 20.0 ft. ESTIMATED DEPTH TO BEDROCK (FT): 1.9 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): 11.85 DATE MEASURED: 09/16/97 open hole

COMPLETED WATER LEVEL (FT): 11.82 from TOC DATE MEASURED: 110397



PROTECTIVE CASING, TOP (FT): 0.55 ft (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.51 ft w/o cap

SURFACE CASING, I.D. (IN): ~~2~~ RPK 3/4" TYPE: PVC, Sch. 40

SURFACE SEAL TOP (FT): ~~N/A~~ 0.0 TYPE: Granulated bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.85 ft.

IF APPLICABLE

SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaseal Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 5.0 ft.

FILTER PACK, TOP (FT): 5.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 6.21 ft SCREEN, TOP (FT): 6.21 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 17.88 ft TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 17.88 ft TYPE: PVC, Sch 40, w/ pop rivets

FILTER PACK, BOTTOM (FT): 18.04 ft

BACKFILL, TOP (FT): 18.04 ft TYPE: Native material, sand cavings

BACKFILL, BOTTOM (FT): 20.0 ft.

SUMP, BOTTOM (FT): 18.04 ft

TOTAL DEPTH (FT): 20.0 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Difficulty setting well. Unconsolidated sands in well kept caving in filling hole to approximately 15.0 ft.

COMPLETED BY: ROBERT KOEHLER DATE: 09/16/97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) GRR 3/31/96

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #22797 PROJECT NAME: 1997 WARP ~~97~~ PROGRAM: GROUNDWATER ~~WARP 97~~

SCREENED FORMATION: BEDROCK ~~SANDSTONE~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE MICROCORE DATE DRILLED: 10/22/97 DATE COMPLETED: 10/22/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

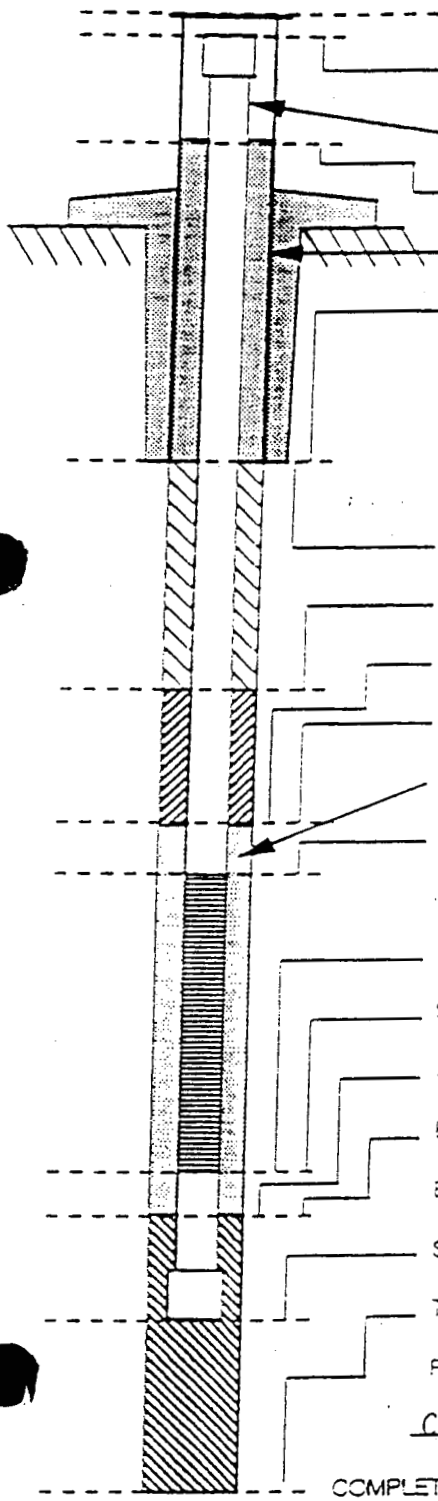
COMPLETED DEPTH (FT): 13.78 ~~14.0~~ ESTIMATED DEPTH TO BEDROCK (FT): 8.0 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): ~7' in core DATE MEASURED: 102297

COMPLETED WATER LEVEL (FT): 6.89 from TOC DATE MEASURED: 110597



PROTECTIVE CASING, TOP (FT): 0.50 w/o Cap / 0.59 ft w/ Cap FROM GROUND SURFACE:

SURFACE CASING (STICKUP), TOP (FT): 0.54 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): ~~NA~~ 0.0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): ~~0.22 ft w/o cap~~ 0.81

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquasil Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 7.75 ft

FILTER PACK, TOP (FT): 7.75 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 6.83 ft. SCREEN, TOP (FT): 6.83 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 13.62 ft TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 13.62 ft TYPE: PVC, Sch 40, w/ pop rivets

FILTER PACK, BOTTOM (FT): 8.5 ft *

BACKFILL, TOP (FT): NA TYPE

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 13.78 ft.

TOTAL DEPTH (FT): 14.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: * Unconsolidated medium sand (native) collapsed around well casing forming natural filter pack, top at 8.5 ft; balance is 16-40.

COMPLETED BY: Robert Koehler DATE: 10/22/97

CHECKED BY: J. Baylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22897 PROJECT NAME: 1997 WARP ~~97 SAP~~ PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~ARAPAHOE~~ Bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 09/~~09~~ 10/97 RPK 9/10/97 DATE COMPLETED: 09/10/97

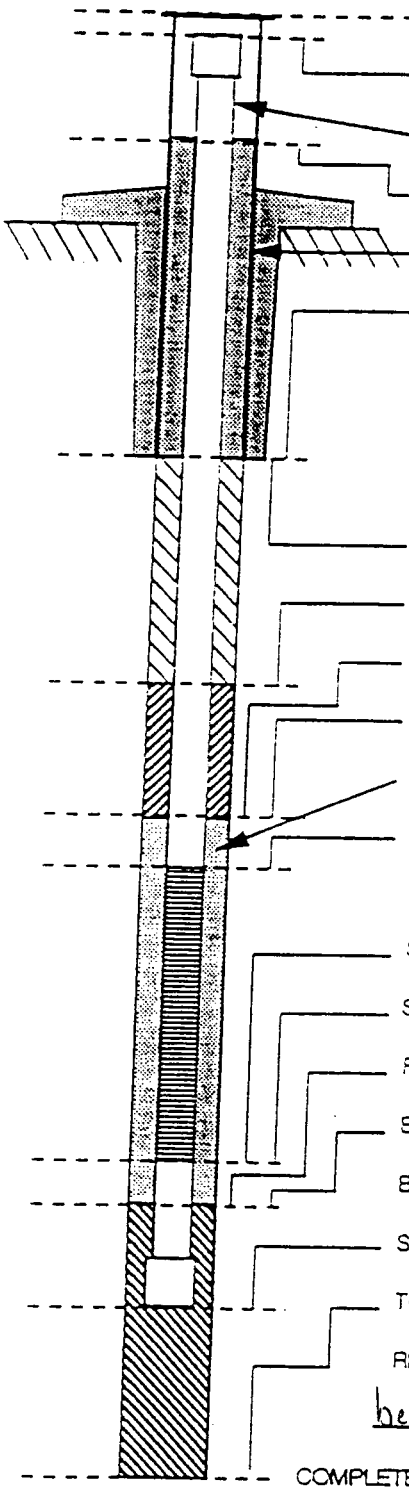
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): 24.2 ft. ESTIMATED DEPTH TO BEDROCK (FT): 10 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~SAP~~ 0 N/A INITIAL WATER LEVEL (FT): 6.22 ft. ← from ground level DATE MEASURED: 09/10/97

COMPLETED WATER LEVEL (FT): 6.48 (from TC) DATE MEASURED: 09/1/97



PROTECTIVE CASING, TOP (FT): 0.75 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.65 ft (w/o cap)

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch. 40

SURFACE SEAL TOP (FT): ~~SAP~~ ~~N/A~~ 0.0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): ~~SAP~~ ~~0.65~~ 0.66 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 10.0 ft } V. Difficult to get sand and bentonite into wet hole.

FILTER PACK, TOP (FT): 10.0 ft

FILTER PACK TYPE: 16-40 Silica Sand BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): ~~SAP~~ ~~13.26~~ 14.26 ft RK 9/10/97 SCREEN, TOP (FT): ~~13.26~~ 14.26 ft RK 9/10/97

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 24.05 ft TYPE: 3/4" PVC Sch 40 BRAND:

SUMP, TOP (FT): 24.05 ft. TYPE: PVC Sch 40 w/ pop rivets, 3/4" ID

FILTER PACK, BOTTOM (FT): 24.20 ft

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 24.20 ft

TOTAL DEPTH (FT): 24.20 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Water at 6.7 ft made getting filter pack sand and bentonite down hole difficult. Steel rod used to "tamp" to 10 ft.

COMPLETED BY: R. Koehler DATE: 09/10/97

CHECKED BY: J. Boylan DATE: 10/27/97

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev. 3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #22997 PROJECT NAME: 1997 WARP ~~97~~ PROGRAM: GROUNDWATER

SCREENED FORMATION: Bedrock ~~Sandstone~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 10/23/97 DATE COMPLETED: 10/23/97

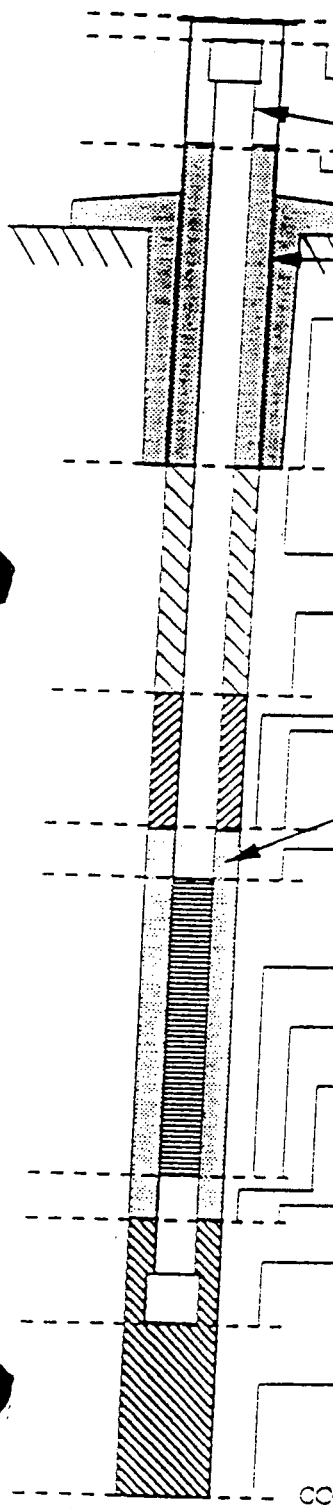
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~16.5 ft~~ 16.12 ESTIMATED DEPTH TO BEDROCK (FT): 5.75 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A INITIAL WATER LEVEL (FT): ~8' in core DATE MEASURED: 102397

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.63 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.60 ft w/cap 0.61 w/cap

SURFACE CASING, I.D. (IN): 3/4" ID TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): ~~N/A~~ 0.0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" ID TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.785 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): N/A TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 4.5 ft.

FILTER PACK, TOP (FT): 4.5 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): ~~4.45 ft~~ 4.29 SCREEN, TOP (FT): ~~4.45 ft~~ 4.29

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 15.96 ft TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 15.96 TYPE: PVC, Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 10.0 ft * Native material to T.D.

BACKFILL, TOP (FT): ~~N/A~~ 16.1 TYPE: Native materials

BACKFILL, BOTTOM (FT): ~~N/A~~ 16.5

SUMP, BOTTOM (FT): 16.118 ≈ 16.12

TOTAL DEPTH (FT): 16.5 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: * Hole had caved to 10.0 ft (steel tape), presumed to be flowing native sand, added filter pack extends from 10.0 → 4.5 ft.

COMPLETED BY: Robert Koehler DATE: 10/23/97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #23097 PROJECT NAME: 1997 WARP ~~97~~ PROGRAM: GROUNDWATER

SCREENED FORMATION: Alluvium/Bedrock ~~Sand & Gravel~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE – MACROCORE DATE DRILLED: 10/23/97 DATE COMPLETED: 10/23/97

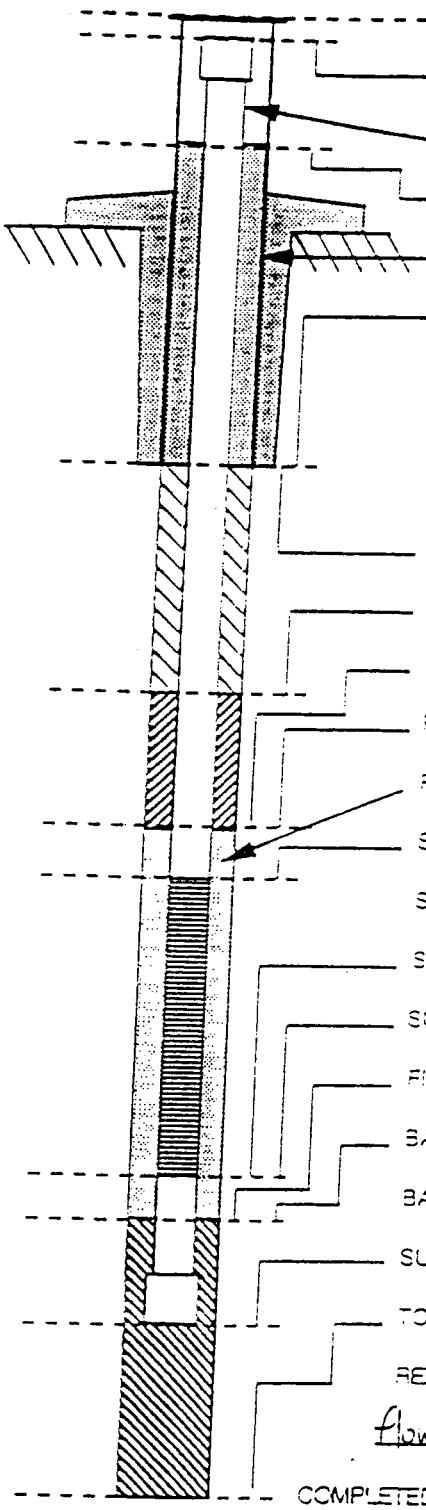
RIG GEOLOGIST: R. KOEHLER RPK 10/23/97 LOGGING GEOLOGIST: R. Koehler

COMPLETED DEPTH (FT): ~~15.0~~ 13.80 ft ESTIMATED DEPTH TO BEDROCK (FT): 6.5 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A ~~0~~ INITIAL WATER LEVEL (FT): ~6.2' in core DATE MEASURED: 102397

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.36 FROM GROUND SURFACE: w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.43 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" ID TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): ~~NA~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" ID TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): ~~0.85 ft~~ ~~0.87~~ 0.85

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 3.0 ft.

FILTER PACK, TOP (FT): 3.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 3.87 ft SCREEN, TOP (FT): 3.87 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4" ID

SCREEN, BOTTOM (FT): ~~13.98 ft~~ 13.64 TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): ~~13.98 ft~~ 13.64 TYPE: PVC, Sch 40, w/cap rivets

FILTER PACK, BOTTOM (FT): 10.25* Native filter pack 10.25-TD.

BACKFILL, TOP (FT): ~~NA~~ 14.0 TYPE: Native (hole collapsed)

BACKFILL, BOTTOM (FT): ~~NA~~ 15.0 ← RPK 10/23/97

SUMP, BOTTOM (FT): ~~13.896~~ 13.80 ft.

TOTAL DEPTH (FT): 15.0 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: *Holed collapsed to 10.25 ft (steel tape), presumed to be flowing native sand forming natural filter pack to TD.

COMPLETED BY: ROBERT KOEHLER DATE: 10-23-97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 23197 PROJECT NAME: WARP 97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~[illegible]~~ DRILLING CONTRACTOR: TERRA

DRILLING METHOD: GEOPROBE – MACROCORE DATE DRILLED: 09-19-97 DATE COMPLETED: 09-19-97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

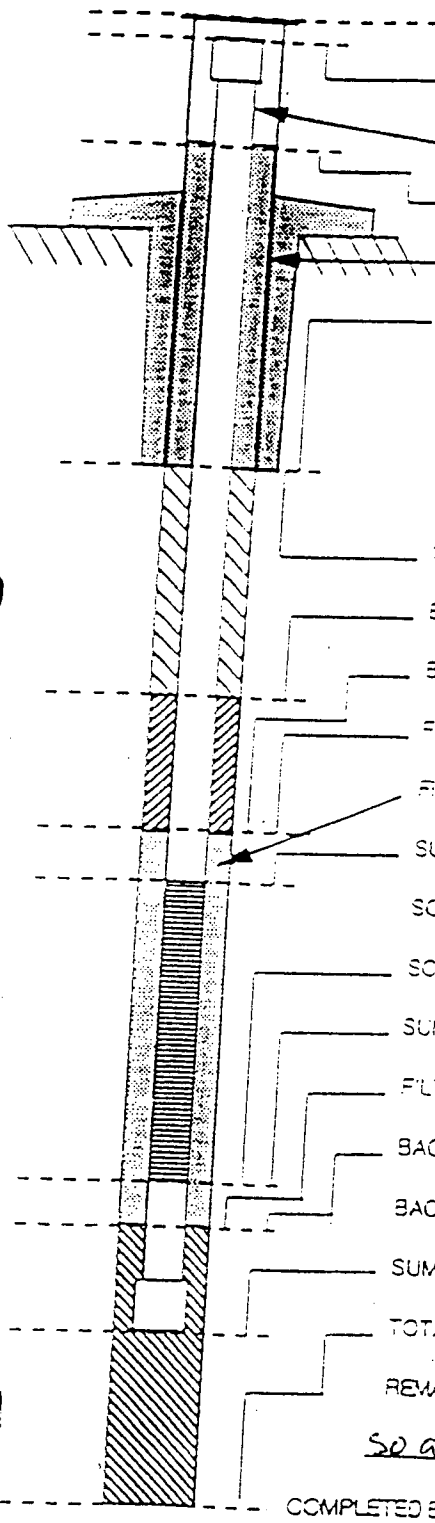
COMPLETED DEPTH (FT): ~~[illegible]~~ 17.26 ESTIMATED DEPTH TO BEDROCK (FT): 4.3 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 091997

COMPLETED WATER LEVEL (FT): 9.07 from TOC DATE MEASURED: 110497



PROTECTIVE CASING, TOP (FT): 0.90 ft. (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.86 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~NA~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.51 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ____

SECONDARY CASING, I.D. (IN): NA TYPE: ____

CENTRALIZER, O.D. (IN): NA TOP (FT): ____ BOTTOM (FT): ____

GROUT SEAL TOP (FT): NA TYPE: ____

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aqueset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 3.0 ft.

FILTER PACK, TOP (FT): 3.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 4.44 ft. SCREEN, TOP (FT): 4.44 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): ~~14.22 ft.~~ 14.23 TYPE: PVC, Sch. 40 BRAND: ____

SUMP, TOP (FT): ~~14.22 ft.~~ 14.23 TYPE: PVC, Sch 40, end piece w/pop rivets and "3" foot riser

FILTER PACK, BOTTOM (FT): 17.26 ft.

BACKFILL, TOP (FT): NA TYPE: ____

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 17.26 ft.

TOTAL DEPTH (FT): 17.26 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Unlike other Geoprobe wellpoints, installed a 3' sump so as to place screen as desired.

COMPLETED BY: ROBERT KOEHLER Robert Koehler DATE: 09-19-97

CHECKED BY: J. Boylan DATE: 102797

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 23297 PROJECT NAME: 1997 WARP 97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~ARAPAHOE FM~~ Bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 09/10-11/97 DATE COMPLETED: 09/11/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

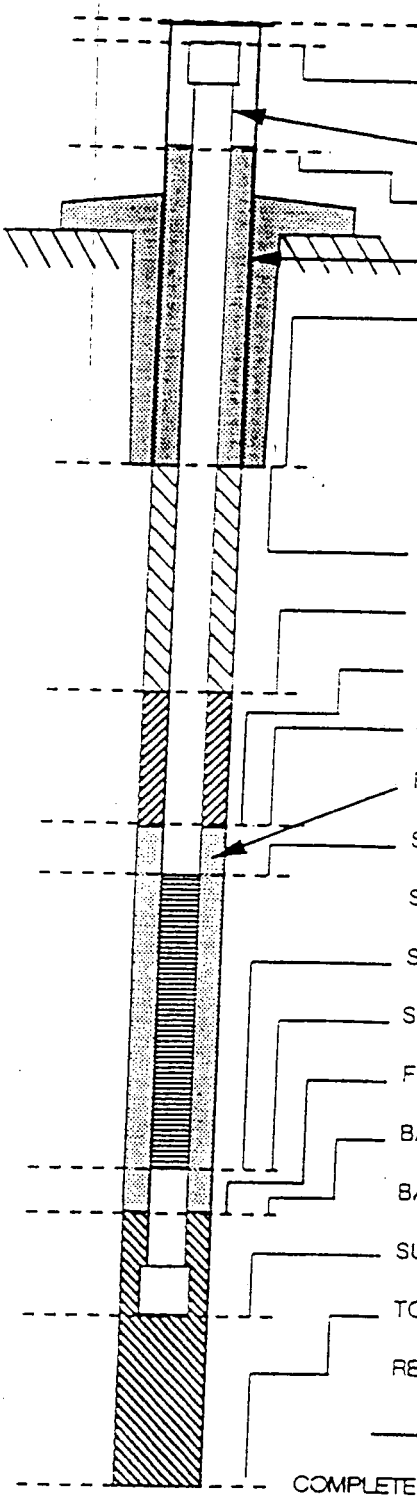
COMPLETED DEPTH (FT): ~~25.0 ft~~ 13.26 ESTIMATED DEPTH TO BEDROCK (FT): 9.1 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A

INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 110497



PROTECTIVE CASING, TOP (FT): 0.82 ft (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.77 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): ~~N/A~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, SCH 40

PROTECTIVE CASING, BOTTOM (FT): 0.60 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): N/A BOTTOM (FT):

SECONDARY CASING, I.D. (IN): N/A TYPE:

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): N/A TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 7.0 ft.

FILTER PACK, TOP (FT): 7.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 8.2 ft. SCREEN, TOP (FT): 8.2 ft.

SCREEN SLOT SIZE (.000 IN): 0.010 ft. SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 13.1 ft. TYPE: PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 13.1 ft. TYPE: PVC, Sch 40 w/pop rivets

FILTER PACK, BOTTOM (FT): 13.26 ft.

BACKFILL, TOP (FT): 13.26 ft TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): ~~13.26 ft~~ 25.0 ft RPK 3/11/97

SUMP, BOTTOM (FT): 13.26 ft.

TOTAL DEPTH (FT): 25.0 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: R. Koehler [signature] DATE: 9-11-97

CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #23397 PROJECT NAME: 1997 A WARP ~~97~~ JAB PROGRAM: GROUNDWATER

SCREENED FORMATION: Bedrock ~~Sandstone~~ JAB DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 10/27/97 DATE COMPLETED: 10/27/97

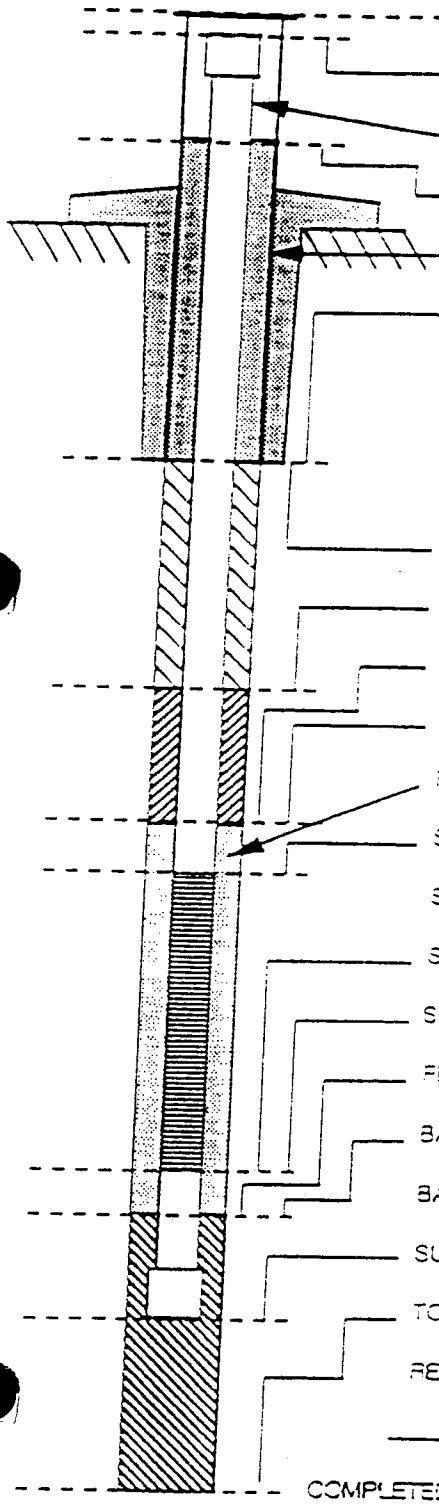
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): JAB ~~14.27 ft~~ 14.23 ESTIMATED DEPTH TO BEDROCK (FT): 5.5 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ NA RPK 10/27/97 INITIAL WATER LEVEL (FT): Dry (open hole) DATE MEASURED: 102797

COMPLETED WATER LEVEL (FT): 13.52 from TOC DATE MEASURED: 110497



PROTECTIVE CASING, TOP (FT): 0.64 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): ~~0.64 ft.~~ 0.59 ft. RPK 10/27/97

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL, TOP (FT): ~~NA~~ 0.5 RPK 10/27/97 TYPE: Aquasel Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.79 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE

BENTONITE SEAL, TOP (FT): 0.0 ft. TYPE: Aquasel Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 3.0 ft.

FILTER PACK, TOP (FT): 3.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc

SURFACE CASING, BOTTOM (FT): JAB ~~4.35~~ 4.31 SCREEN, TOP (FT): JAB ~~4.36 ft~~ 4.31

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): ~~14.12 ft~~ 14.07 JAB TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): ~~14.12 ft~~ 14.07 JAB TYPE: PVC Sch 40, 3/4, w/ pipe cap

FILTER PACK, BOTTOM (FT): JAB ~~14.28 ft~~ 14.23

BACKFILL, TOP (FT): NA TYPE

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): JAB ~~14.28 ft~~ 14.23

TOTAL DEPTH (FT): JAB ~~14.28 ft~~ 14.23

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER Robert Koehler DATE: 10/27/97

CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev. 3) GRR 3/31/96

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 23497 PROJECT NAME: 1997 WARP 97 PROGRAM: GROUNDWATER

SCREENED FORMATION: Bedrock ~~Sands~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE – MACROCORE DATE DRILLED: 10/28/97 DATE COMPLETED: 10/28/97

RIG GEOLOGIST: R KOEHLER LOGGING GEOLOGIST: R KOEHLER

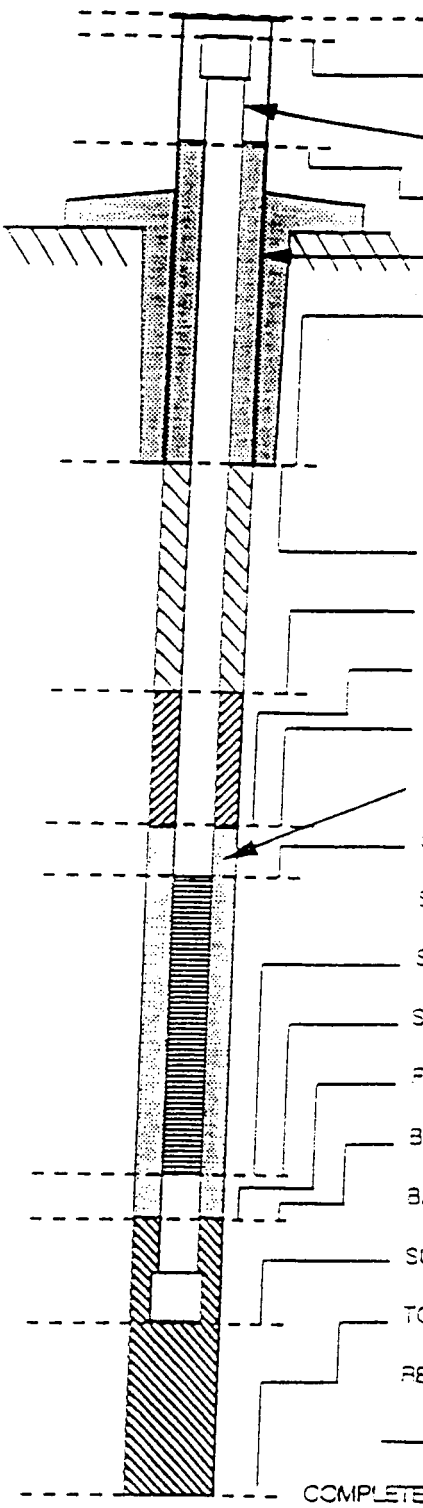
COMPLETED DEPTH (FT): 12.37 ft ESTIMATED DEPTH TO BEDROCK (FT): 2.4 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 10/30/97



PROTECTIVE CASING, TOP (FT): 0.54 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.46 ft

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL, TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.86 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE

BENTONITE SEAL, TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 1.5 ft

FILTER PACK, TOP (FT): 1.5 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 2.45 ft SCREEN, TOP (FT): 2.45 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 12.22 ft TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 12.22 ft TYPE: PVC, Sch 40, w/ pop rivets

FILTER PACK, BOTTOM (FT): 12.5 ft

BACKFILL, TOP (FT): 12.5 ft TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): 14.0 ft

SUMP, BOTTOM (FT): 12.37 ft

TOTAL DEPTH (FT): 14.0 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER DATE: 10/28/97

CHECKED BY: J. Boylan DATE: 110597

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 23597 PROJECT NAME: WARD 1997 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~LARAMIE(?) or ARAPAHOE(?)~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE – MACROCORE DATE DRILLED: 09/16-17/97 DATE COMPLETED: 09/17/97

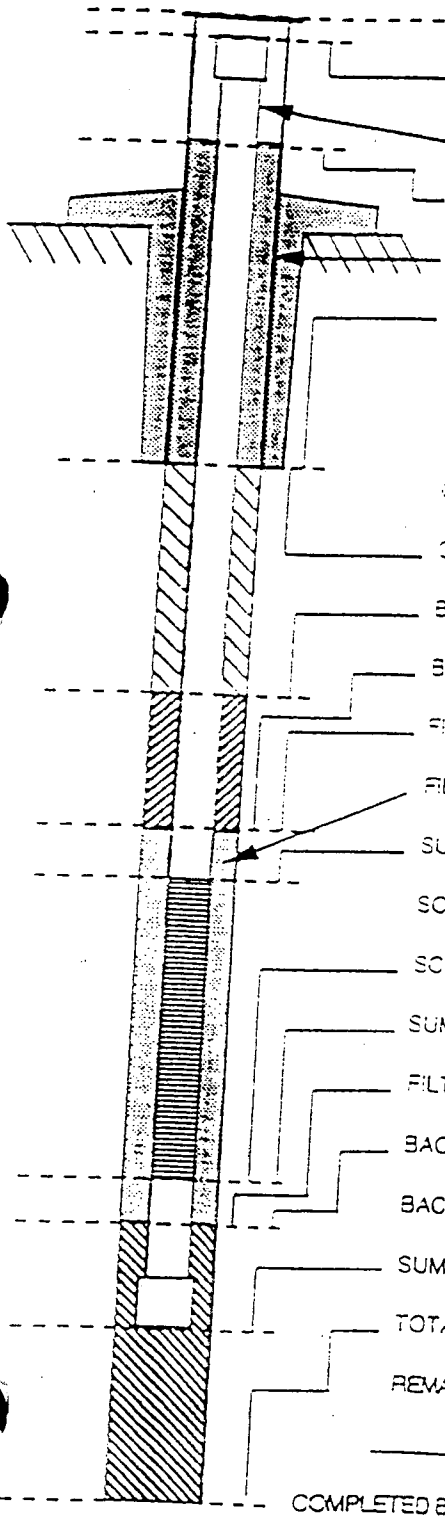
RIG GEOLOGIST: ROBERT KOEHLER LOGGING GEOLOGIST: ROBERT KOEHLER

COMPLETED DEPTH (FT): 19.35 ~~19.0 ft~~ ESTIMATED DEPTH TO BEDROCK (FT): 16 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A INITIAL WATER LEVEL (FT): ~15 (in core) DATE MEASURED: 091797

COMPLETED WATER LEVEL (FT): 13.77 DATE MEASURED: 103097



PROTECTIVE CASING, TOP (FT): 0.40 ft (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.34 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~NA~~ 0 TYPE Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): ~~0.70 ft~~ 1.0

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE

BENTONITE SEAL TOP (FT): 0.0 ft TYPE Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 8.0 ft

FILTER PACK, TOP (FT): 8.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 9.41 ft SCREEN, TOP (FT): 9.41 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 19.19 ft TYPE PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 19.19 ft TYPE PVC, Sch 40, w/ pop rivets

FILTER PACK, BOTTOM (FT): ~~19.19 ft~~ 19.35 ft RPK 9/17/97

BACKFILL, TOP (FT): ~~N/A 19.35~~ TYPE NA

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 19.35 ft

TOTAL DEPTH (FT): 19.35 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER Robert Koehler DATE: 09-17-97

CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #23697 PROJECT NAME: 1997 WARP-97 (AB) PROGRAM: GROUNDWATER

SCREENED FORMATION: Bedrock ~~Sandstone~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 10/28/97 DATE COMPLETED: 10/28/97

FIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

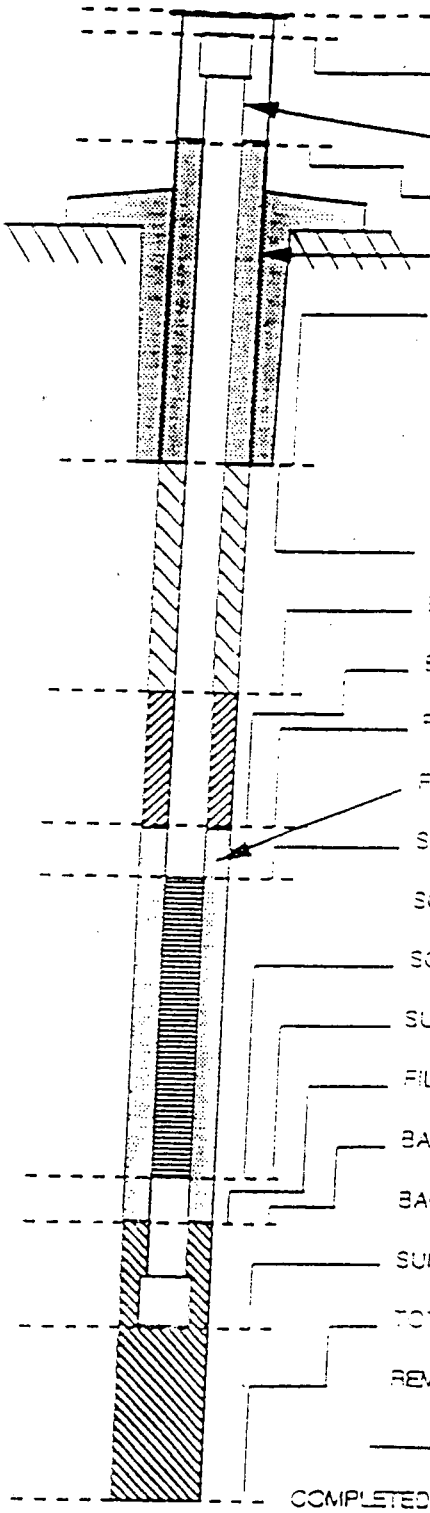
COMPLETED DEPTH (FT): 11.12 ft. ESTIMATED DEPTH TO BEDROCK (FT): 5.7 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____

COMPLETED WATER LEVEL (FT): _____ DATE MEASURED: _____



PROTECTIVE CASING, TOP (FT): 0.72 ft. (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.68 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL, TOP (FT): 0.0 ft. TYPE: Aquaset-1 Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.69 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): NA TYPE: _____

CENTRALIZER, O.D. (IN): NA TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL, TOP (FT): NA TYPE: _____

BENTONITE SEAL, TOP (FT): 0.0 ft TYPE: Aquaset-1 Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 3.0 ft.

FILTER PACK, TOP (FT): 3.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 4.19 ft SCREEN, TOP (FT): 4.19 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 10.96 ft TYPE: PVC, Sch 40 BRAND: _____

SUMP, TOP (FT): 10.96 ft TYPE: PVC, Sch 40, w/ pop rivets

FILTER PACK, BOTTOM (FT): ~~11.0 ft.~~ 11.12 ft RPK 10/29/97

BACKFILL, TOP (FT): NA TYPE: _____

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 11.12 ft

TOTAL DEPTH (FT): 11.12 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: _____

COMPLETED BY: Robert Koehler DATE: 10/28/97

CHECKED BY: J. Boylan DATE: 110597

U.S. Department of Energy Rocky Flats Plant RPK 10/30/97

Form GT.58 (Rev.3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #23797 (Alluvium) PROJECT NAME: WARP 97 (JAB) PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~Bedrock sandstone~~ (JAB) DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 10/29/97 DATE COMPLETED: 10/29/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

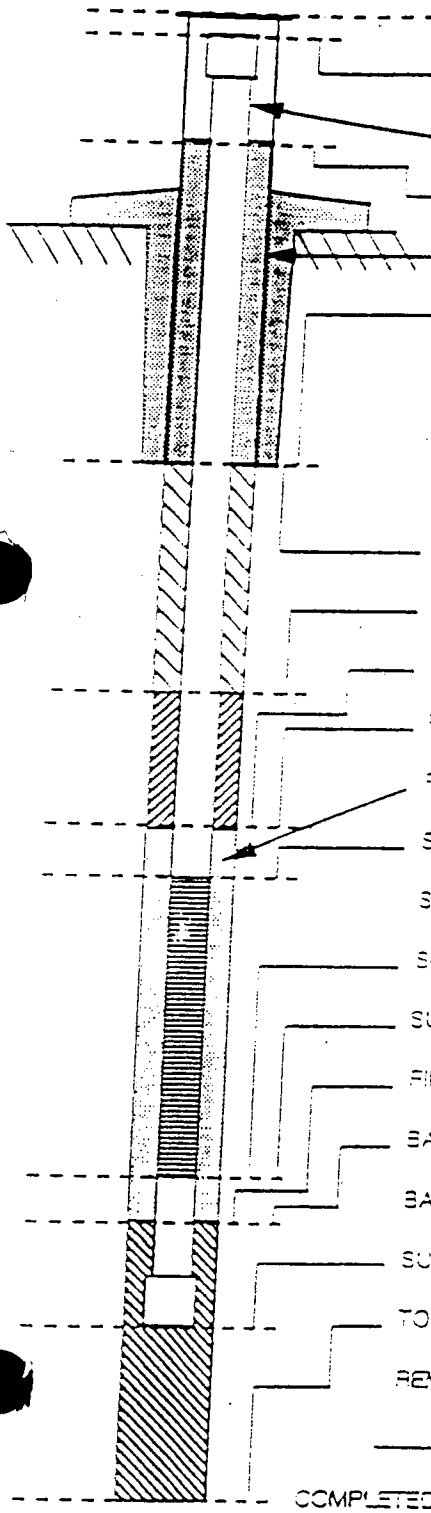
COMPLETED DEPTH (FT): ~~20.06 ft~~ (JAB) 20.16 ESTIMATED DEPTH TO BEDROCK (FT): 17 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____

COMPLETED WATER LEVEL (FT): _____ DATE MEASURED: _____



PROTECTIVE CASING, TOP (FT): 0.31 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.71 ft

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.63 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): NA TYPE: _____

CENTRALIZER, O.D. (IN): NA TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL TOP (FT): NA TYPE: _____

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 8.5 ft.

FILTER PACK, TOP (FT): 8.5 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 10.23 ft (JAB) SCREEN, TOP (FT): 10.23 ft (10.23) (JAB)

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): ~~19.70 ft~~ 20.0 (JAB) TYPE: PVC, Sch 40 BRAND: _____

SUMP, TOP (FT): ~~19.70 ft~~ 20.0 (JAB) TYPE: PVC, Sch 40, w/pipnivets

FILTER PACK, BOTTOM (FT): ~~20.06 ft~~ 20.16 (JAB)

BACKFILL, TOP (FT): NA TYPE: _____

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): ~~20.06 ft~~ 20.16 (JAB)

TOTAL DEPTH (FT): ~~20.06 ft~~ 20.16 (JAB)

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: _____

COMPLETED BY: ROBERT KOEHLER DATE: 10/30/97

CHECKED BY: J. Boylan DATE: 11/05/97

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) 3/31/96

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 23897 PROJECT NAME: 1997 WARP ~~97~~ (1A) PROGRAM: GROUNDWATER

SCREENED FORMATION: Bedrock ~~Sandstone~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE MACROCORE DATE DRILLED: 10/30/97 DATE COMPLETED: 10/30/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

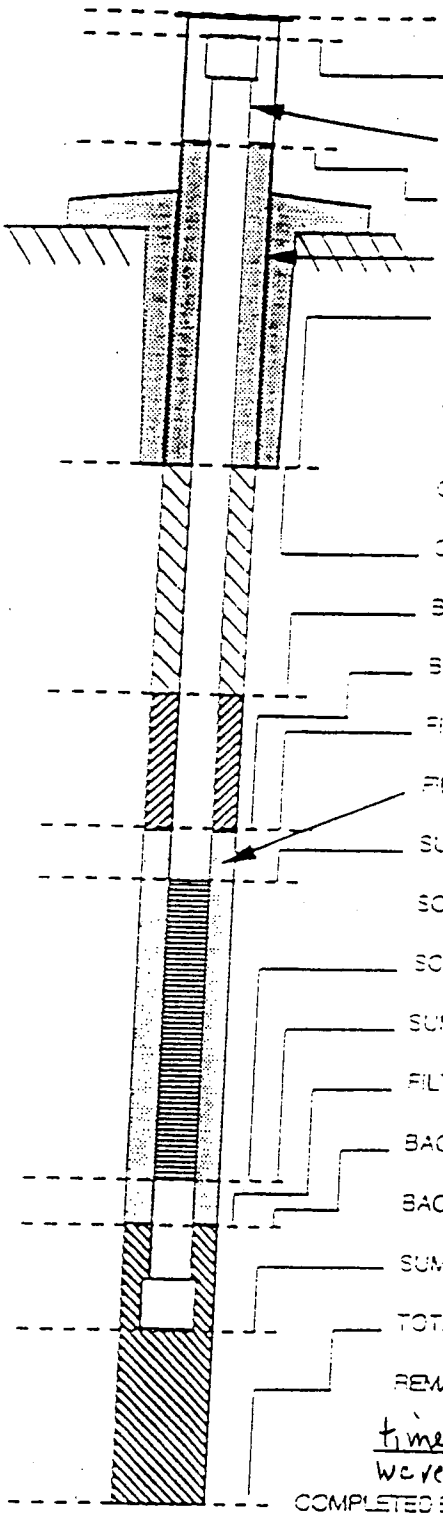
COMPLETED DEPTH (FT): 18.28 ft ESTIMATED DEPTH TO BEDROCK (FT): 12.5 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): ~12½ in core DATE MEASURED: 103097

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.39 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.35 ft

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 1½" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 1.03 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 6.8 ft

FILTER PACK, TOP (FT): 6.8 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 11.33 ft SCREEN, TOP (FT): 11.33 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 18.13 ft TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 18.13 ft TYPE: PVC, Sch 40, with pop rivets

FILTER PACK, BOTTOM (FT): 18.28 ft *

BACKFILL, TOP (FT): NA TYPE

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 18.28 ft

TOTAL DEPTH (FT): 18.28 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: * Hole had partially collapsed around well string by time it came to put in filter pack. we over built filter pack before we realized it.

COMPLETED BY: ROBERT KOEHLER DATE: 10/30/97

CHECKED BY: J. Boylan DATE: 110597

2-28 WATER

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev. 3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 23997 PROJECT NAME: 1997 WARP PROGRAM: (JAB) 1997 WARP Groundwater

SCREENED FORMATION: AL DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - PUSH, HAMMER DATE DRILLED: 091797-091897 DATE COMPLETED: 091897

FIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

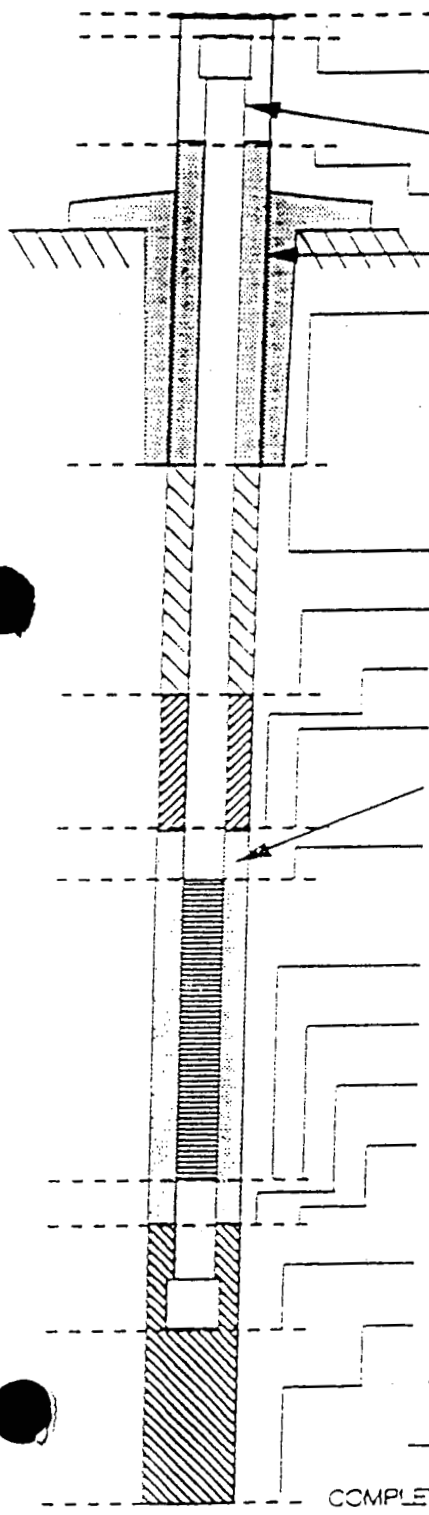
COMPLETED DEPTH (FT): 18.05 ESTIMATED DEPTH TO BEDROCK (FT): _____

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____

COMPLETED WATER LEVEL (FT): _____ DATE MEASURED: _____



PROTECTIVE CASING, TOP (FT): 0.7 FROM GROUND SURFACE:

SURFACE CASING (STICKUP), TOP (FT): 0.63

SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): 0.0 TYPE: Granulated bentonite

PROTECTIVE CASING, I.D. (IN): 1.5 TYPE: Sch. 40 PVC

PROTECTIVE CASING, BOTTOM (FT): 0.685

IF APPLICABLE — SECONDARY CASING, TOP (FT): N/A BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): N/A TYPE: _____

CENTRALIZER, O.D. (IN): N/A TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL, TOP (FT): N/A TYPE: _____

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granulated bentonite

BENTONITE SEAL, BOTTOM (FT): 7.0

FILTER PACK, TOP (FT): 7.0

FILTER PACK TYPE: 16-40 Silica sand BRAND: CSSI

SURFACE CASING, BOTTOM (FT): ~~0.0~~ 8.12 (JAB) SCREEN, TOP (FT): ~~8.07~~ 8.12 (JAB)

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 17.89 (17.89) TYPE: Sch. 40 PVC BRAND: _____

SUMP, TOP (FT): 17.89 (17.89) TYPE: Sch. 40 PVC

FILTER PACK, BOTTOM (FT): 18.0

BACKFILL, TOP (FT): 18.0 TYPE: Granulated bentonite

BACKFILL, BOTTOM (FT): 20.0

SUMP, BOTTOM (FT): 18.05

TOTAL DEPTH (FT): 20.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: _____

COMPLETED BY: J. Boylan DATE: 102397

CHECKED BY: _____ DATE: _____

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev. 3) CRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 24097 (Bedrock) PROJECT NAME: 1997 WHRP-97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~ARAPAHOE TO LARAMIE~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE — MACROCORE DATE DRILLED: 09/18-19/97 DATE COMPLETED: 09/19/97

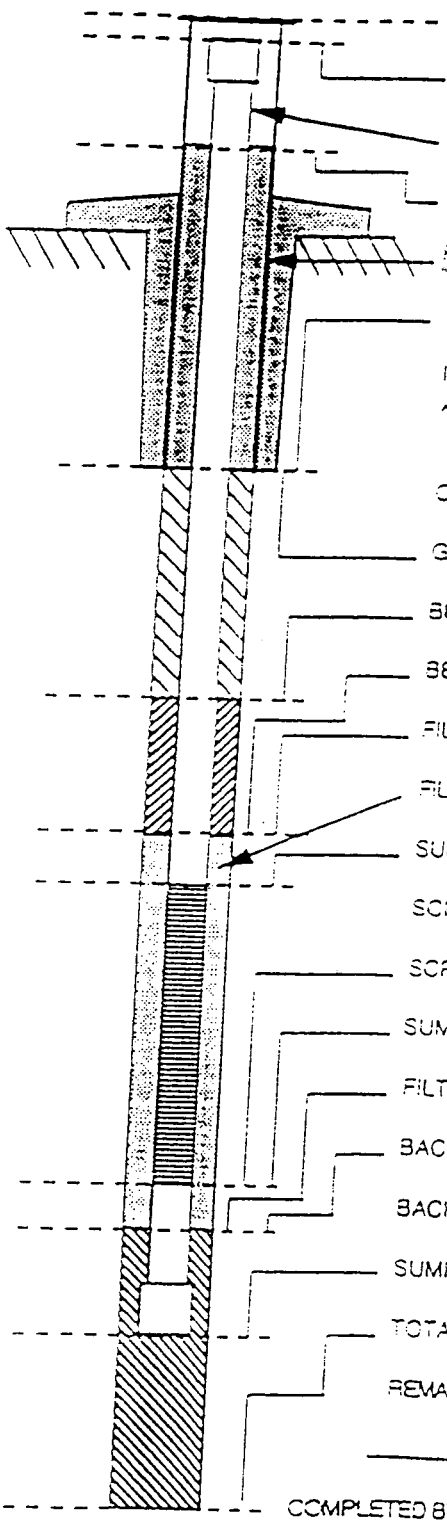
FIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~18.0~~ 18.22 ESTIMATED DEPTH TO BEDROCK (FT): 5.5 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A INITIAL WATER LEVEL (FT): Dry (open hole TD 16.4') DATE MEASURED: 09/1997

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.73 ft. (FROM GROUND SURFACE) w/cap

SURFACE CASING (STICKUP), TOP (FT): 0.67 ft. w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~NA~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch. 40

PROTECTIVE CASING, BOTTOM (FT): ~~0.70 ft.~~ 0.67

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaseal Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 7.0 ft.

FILTER PACK, TOP (FT): 7.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc

SURFACE CASING, BOTTOM (FT): ~~8.70 ft.~~ 8.29 ft. RPK 9/19/97 SCREEN, TOP (FT): ~~8.70 ft.~~ 8.29 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 18.06 ft. TYPE: PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 18.06 ft. TYPE: PVC, Sch 40, w/ pop rivets.

FILTER PACK, BOTTOM (FT): 18.22 ft.

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 18.22 ft.

TOTAL DEPTH (FT): 18.22 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER DATE:

CHECKED BY: J. Boylan DATE: 102897

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #24197 PROJECT NAME: 1997 A WARP-97 (JAS) PROGRAM: GROUNDWATER

SCREENED FORMATION: Bedrock Sandstone (JAS) DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE - MACROCORE DATE DRILLED: 11/3/97 DATE COMPLETED: 11/3/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

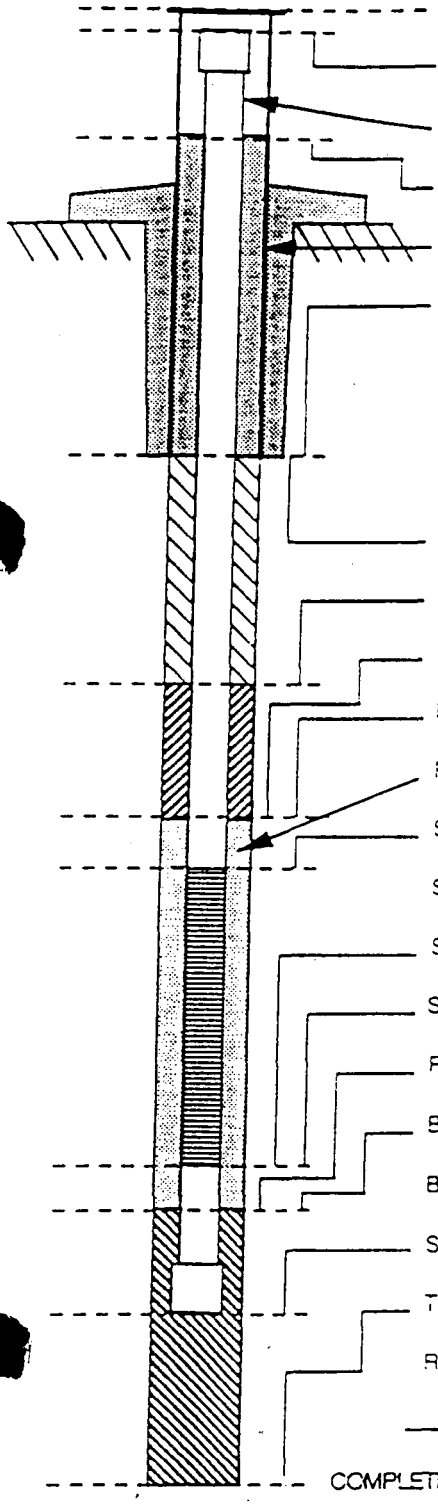
COMPLETED DEPTH (FT): 16.12 ft. ESTIMATED DEPTH TO BEDROCK (FT): 8.0

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): ~13 in core DATE MEASURED: 110397

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.68 ft. (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.60 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch 40

SURFACE SEAL, TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.75 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 5.5 ft.

FILTER PACK, TOP (FT): 5.5 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 6.21 ft SCREEN, TOP (FT): 6.21 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 15.96 ft. TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 15.96 TYPE: PVC, Sch 40, w/pop rivets

FILTER PACK, BOTTOM (FT): 16.12* (bottom may be as shallow as 15.5')

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 16.12

TOTAL DEPTH (FT): 16.12

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: * Native fill (collapsed hole 16.12 - 15.5 ft approx.); 15.5-5.5 ft with 16-40 silica sand

COMPLETED BY: ROBERT KOEHLER DATE: 11-3-97

CHECKED BY: DATE:

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 24297 PROJECT NAME: 1997 WARP ~~77~~ PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~Arapahoe~~ Bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 09/10/97 DATE COMPLETED: 09/10/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

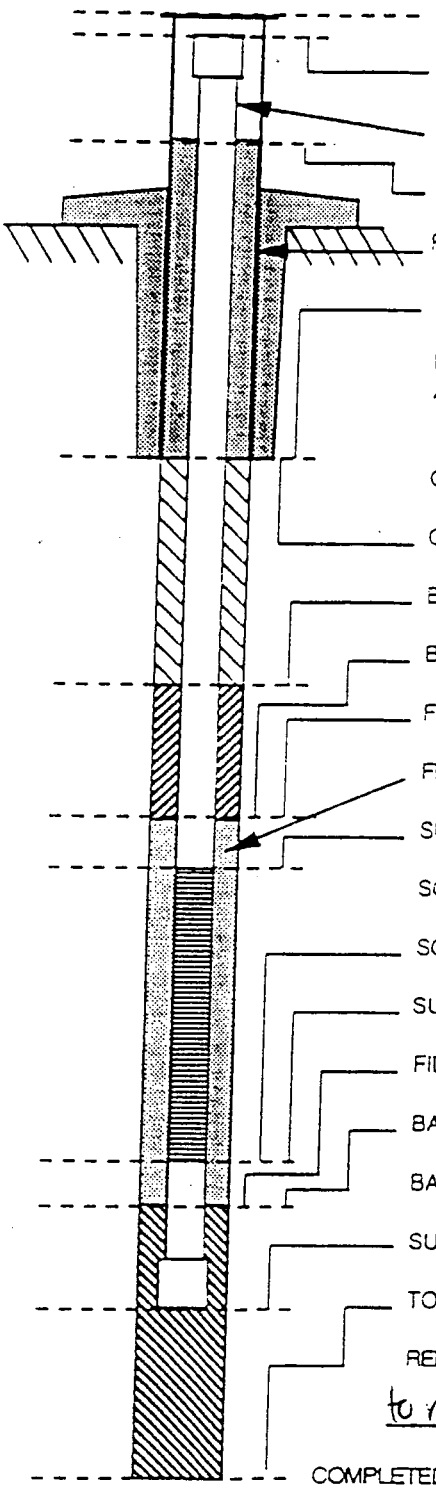
COMPLETED DEPTH (FT): 9.2 ft ESTIMATED DEPTH TO BEDROCK (FT): 1.0 ft based on well loc 22897

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A

INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): 8.12 (from TOC) DATE MEASURED: 09/9/97



PROTECTIVE CASING, TOP (FT): 0.78 ft (FROM GROUND SURFACE) RK 9/10/97

SURFACE CASING (STICKUP), TOP (FT): 0.78 ft

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Sch. 40

SURFACE SEAL TOP (FT): ~~N/A~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1/2" TYPE: PVC, Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.64 ft

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 3.0 ft

FILTER PACK, TOP (FT): 3.0 ft

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 4.18 ft SCREEN, TOP (FT): 4.18 ft

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 9.07 ft TYPE: PVC, Sch. 40 BRAND:

SUMP, TOP (FT): 9.07 ft TYPE: PVC, Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 9.23 ft

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 9.23 ft

TOTAL DEPTH (FT): 9.23 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Well #24297 is located 6.8 ft "east" (= parallel to road) of Well #22897. No Geologic Log for #24297

COMPLETED BY: R. Koehler DATE: 09/10/97

CHECKED BY: J. Boylan DATE: 10/28/97

U.S. Department of Energy Rocky Flats Plant

Form GT.68 (Rev.2) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 24397 Bedrock PROJECT NAME: 1997 WARP 97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~ARAPAHOE/ WARMAN~~ DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 09/22-23/97 DATE COMPLETED: 09/23/97

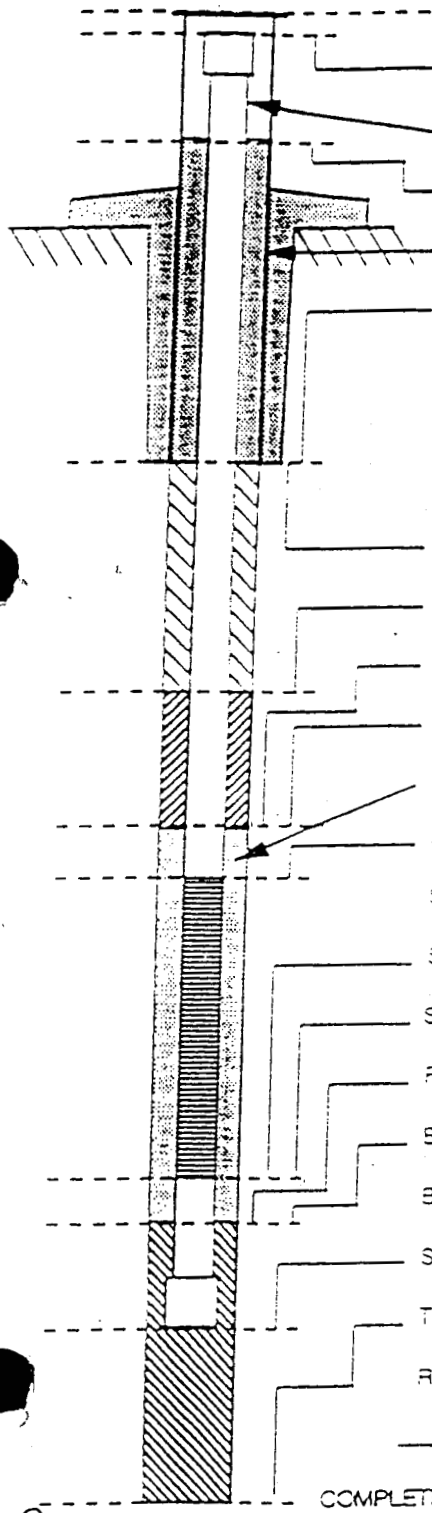
FIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

COMPLETED DEPTH (FT): ~~23.0 ft~~ ESTIMATED DEPTH TO BEDROCK (FT): 4.3 ft.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.5"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): 8.67 from TOC DATE MEASURED: 110397



PROTECTIVE CASING, TOP (FT): 0.69 ft. (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.61 ft.

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~N/A~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Schedule 40

PROTECTIVE CASING, BOTTOM (FT): 0.63 ft.

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE

BENTONITE SEAL TOP (FT): 0.0 ft. TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 12.5 ft.

FILTER PACK, TOP (FT): 12.5 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 13.39 ft. SCREEN, TOP (FT): 13.39 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 18.29 ft. TYPE: PVC, Sch 40 BRAND:

SUMP, TOP (FT): 18.29 ft. TYPE: PVC, Sch 40, w/ pop rivets

FILTER PACK, BOTTOM (FT): 18.45 ft

BACKFILL, TOP (FT): 18.45 ft. TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): 23.0 ft

SUMP, BOTTOM (FT): 18.45 ft.

TOTAL DEPTH (FT): 23.0 ft

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: ROBERT KOEHLER DATE: 09-23-97

CHECKED BY: DATE:

317/317

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) OPR 3/31/95

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #24497 PROJECT NAME: 1997 WARR-97 PROGRAM: GROUNDWATER

SCREENED FORMATION: ~~[illegible]~~ Bedrock DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE — MACROCORE DATE DRILLED: 09/24/97 DATE COMPLETED: 09/24/97

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

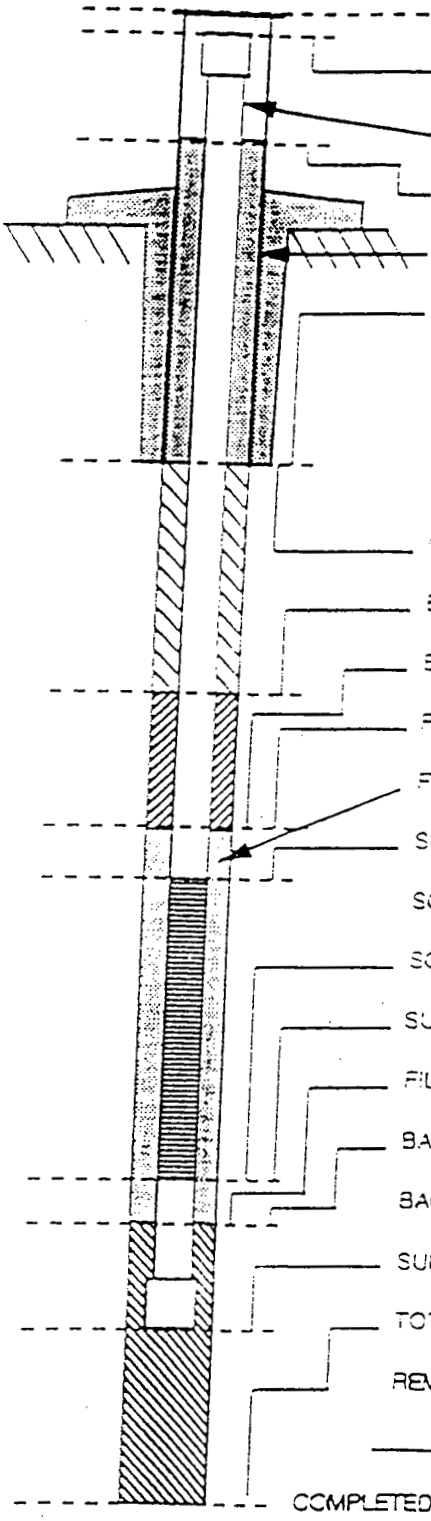
COMPLETED DEPTH (FT): ~~18.0 ft.~~ 17.1 ESTIMATED DEPTH TO BEDROCK (FT): 5.2 ft

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ~~0~~ N/A

INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____

COMPLETED WATER LEVEL (FT): 12.80 from TOC DATE MEASURED: 11/03/97



PROTECTIVE CASING, TOP (FT): 0.65 ft w/cap (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.60 ft w/o cap

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC, Schedule 40

SURFACE SEAL TOP (FT): ~~N/A~~ 0 TYPE: Granular bentonite

PROTECTIVE CASING, I.D. (IN): 1 1/2" TYPE: PVC, Schedule 40

PROTECTIVE CASING, BOTTOM (FT): 0.78 ft.

IF APPLICABLE — SECONDARY CASING, TOP (FT): NA BOTTOM (FT): _____

SECONDARY CASING, I.D. (IN): NA TYPE: _____

CENTRALIZER, O.D. (IN): NA TOP (FT): _____ BOTTOM (FT): _____

GROUT SEAL TOP (FT): NA TYPE: _____

BENTONITE SEAL TOP (FT): 0.0 ft TYPE: Aquaset Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 6.0 ft

FILTER PACK, TOP (FT): 6.0 ft.

FILTER PACK TYPE: Silica Sand 16-40 BRAND: Colo. Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 7.17 ft. SCREEN, TOP (FT): 7.17 ft.

SCREEN SLOT SIZE (.000 IN): 0.010" SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 16.94 ft. TYPE: PVC, Sch 40 BRAND: _____

SUMP, TOP (FT): ~~17.10~~ 16.94 ft TYPE: PVC, Sch 40 w/pop rivets

FILTER PACK, BOTTOM (FT): 17.10 ft

BACKFILL, TOP (FT): 17.10 ft. TYPE: Aquaset Granular bentonite

BACKFILL, BOTTOM (FT): 18.0 ft

SUMP, BOTTOM (FT): 17.10 ft

TOTAL DEPTH (FT): 18.0 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: _____

COMPLETED BY: ROBERT KOEHLER DATE: 09-24-97

CHECKED BY: J. Boylan DATE: 10/28/97

SW-A-002835

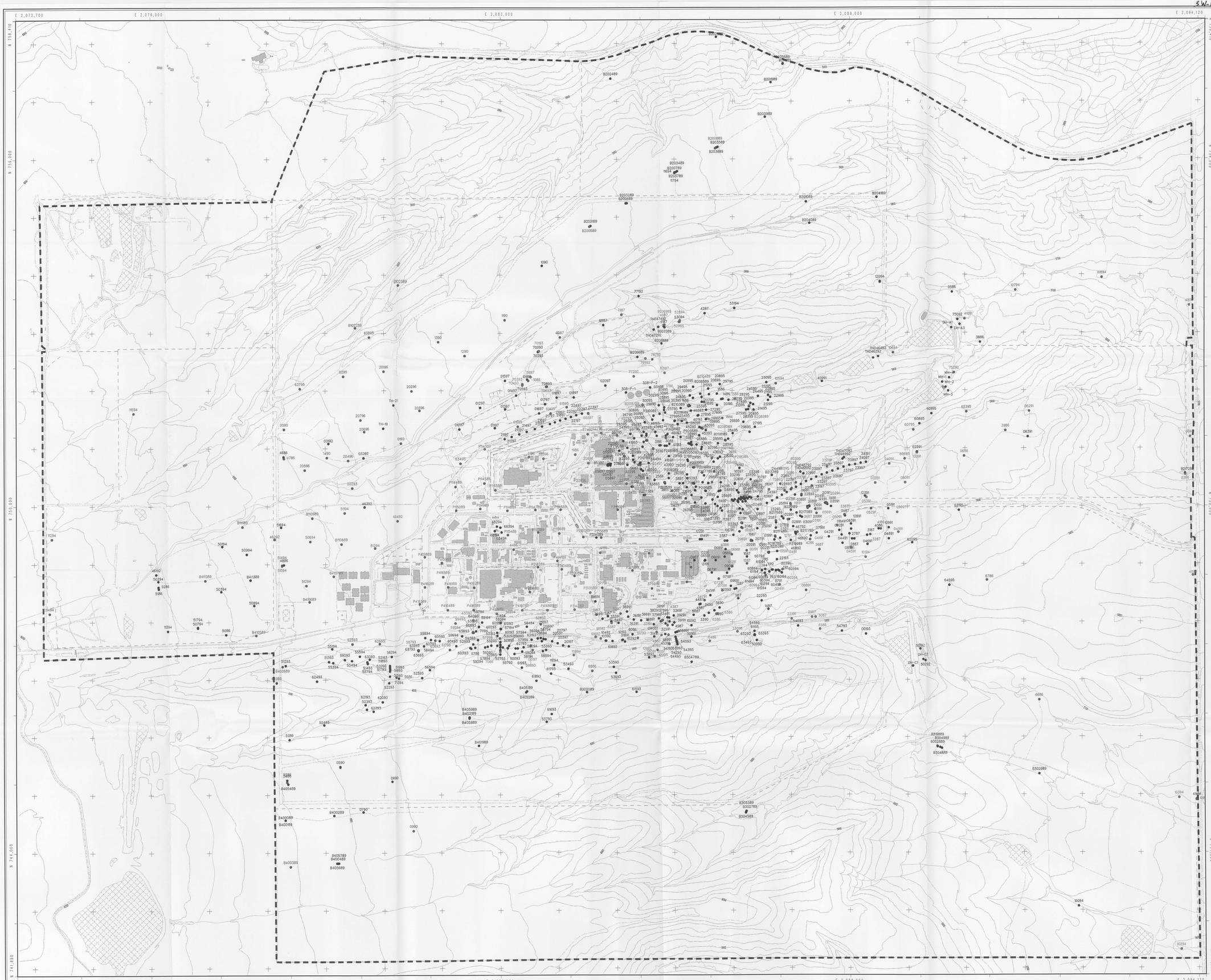


Plate 1
Groundwater Flow Monitoring Well Location Map

EXPLANATION

IMP Well Type

- Water Quality Flow Monitoring
- Industrial Area Flow Monitoring
- Background Flow Monitoring
- Non-IMP

Standard Map Features

- Buildings & other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS **Rocky Mountain Remediation Services, L.L.C.**
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: rfca-rpt/gw_well

September 03, 1998

SW-A-002835

Plate 2

Potentiometric Surface of Unconsolidated Surficial Deposits Second Quarter 1997

- Groundwater Monitoring Well
- Water Level Contour
- Dashed where inferred
- Intermediate Water Level Contour
- Dashed where inferred
- Foundation Drain
- Approximate extent of Unsaturated Area
- Area without Groundwater Elevation Data

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:

Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS

Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 98-0195

September 23, 1998

SW-A-002835

Plate 3

Potentiometric Surface of Unconsolidated Surficial Deposits Fourth Quarter 1997

- Groundwater Monitoring Well
- Water Level Contour
- Dashed where inferred
- Intermediate Water Level Contour
- Dashed where inferred
- Foundation Drain
- Approximate extent of Unsaturated Area
- Area without Groundwater Elevation Data

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

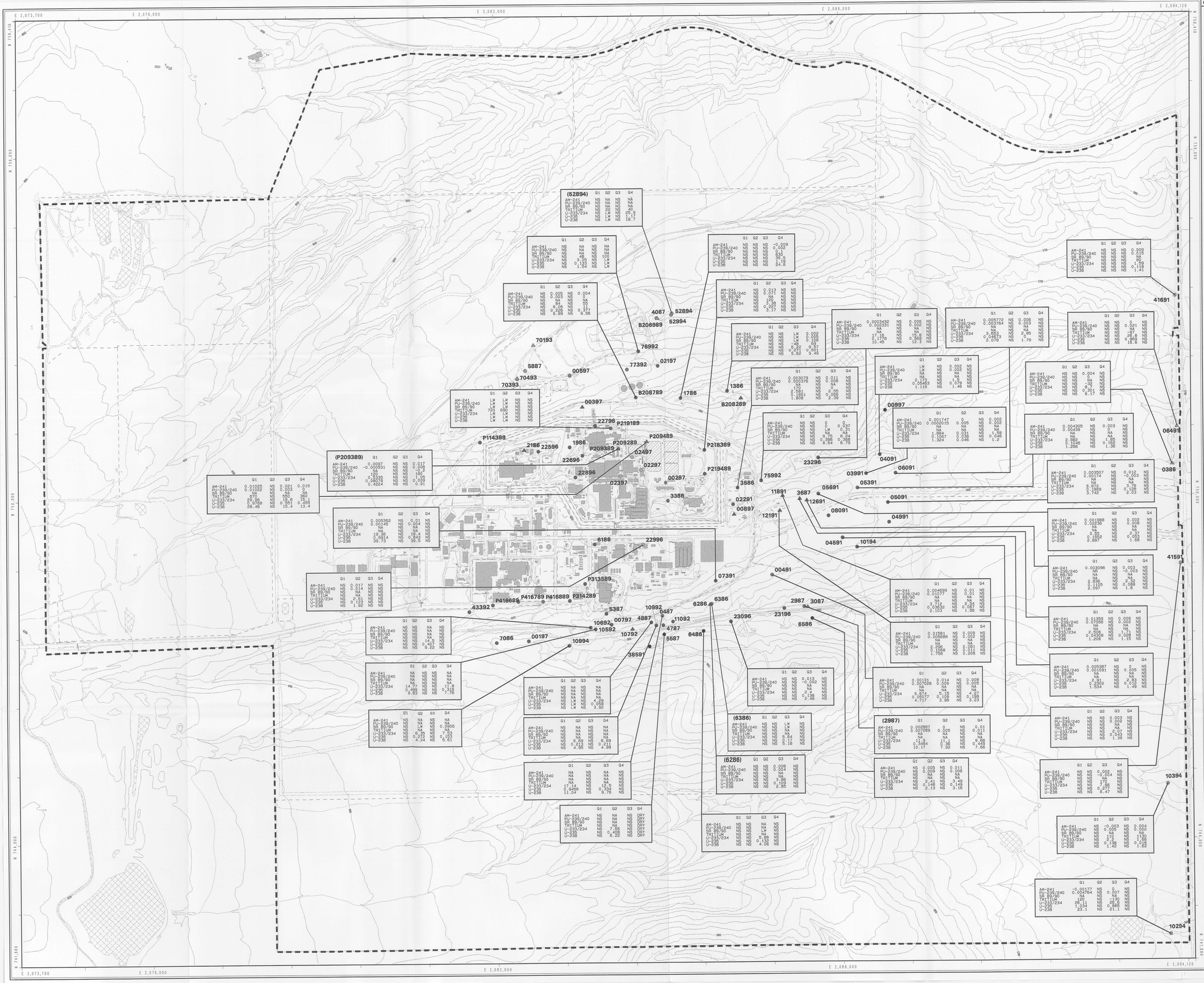
RMRS
Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 98-0195

November 05, 1998

SW-A-002835

Plate 4
Radionuclides in Groundwater
RFCA Wells, 1997



Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D
- Alluvial Wells
- Bedrock Wells

Wells shown with box plot have at least one value above Tier 2 Action Levels.

NS = Not Sampled
NA = Not Analyzed
LW = Lack of Water

All results in picoCuries per liter (pCi/L)

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS
Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 98-0218

November 06, 1998

SW-A-002835

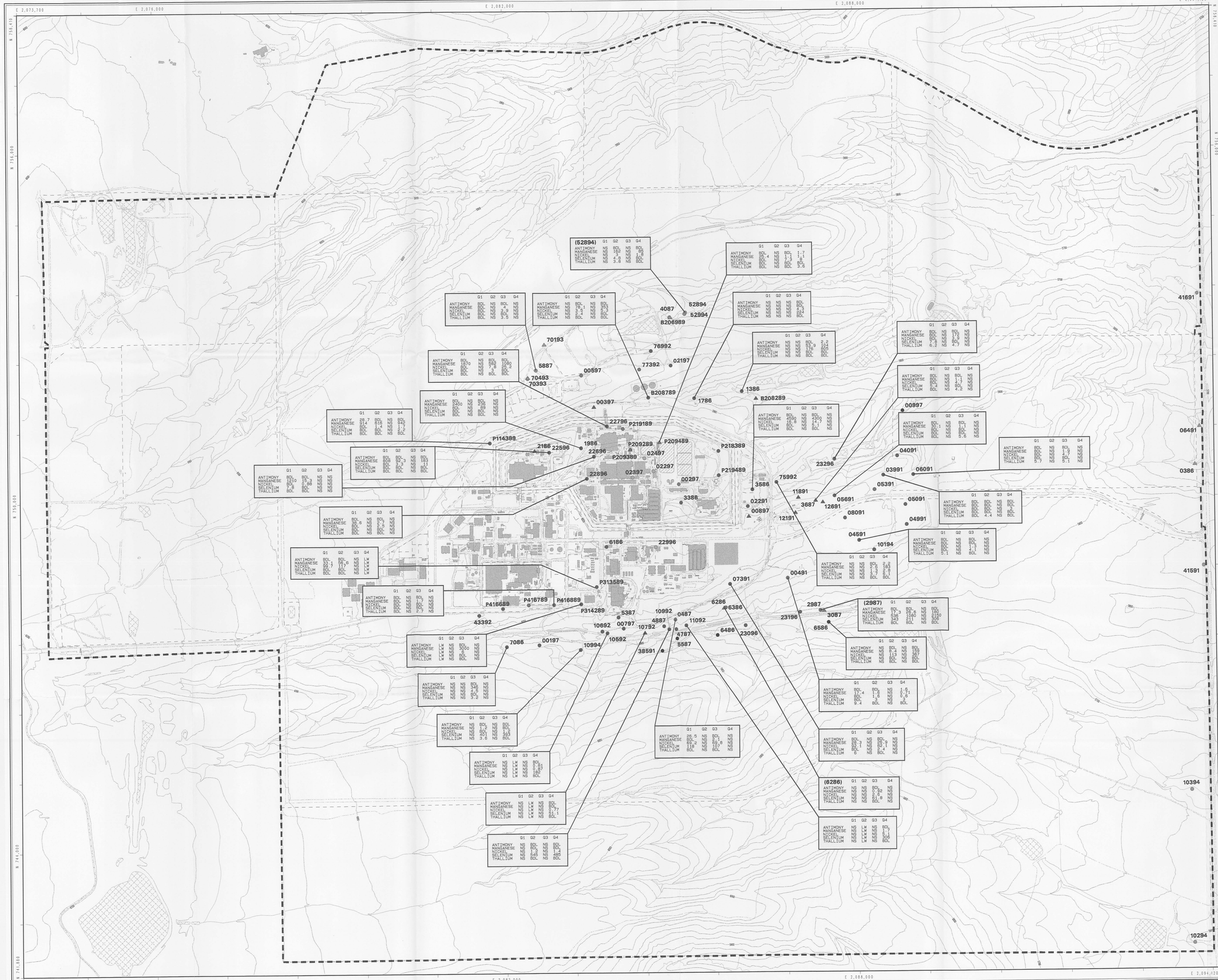


Plate 5
Dissolved Metals in Groundwater
RFCA Wells, 1997

Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D
- Alluvial Wells
- Bedrock Wells

Wells shown with box plot have at least one value above Tier 2 Action Levels.

NS = Not Sampled
NA = Not Analyzed
LW = Lack of Water

All results in micrograms per liter (ug/L)

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

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Rocky Mountain Remediation Services, L.L.C.
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MAP ID: 98-0218

November 06, 1998

SW-A-002835

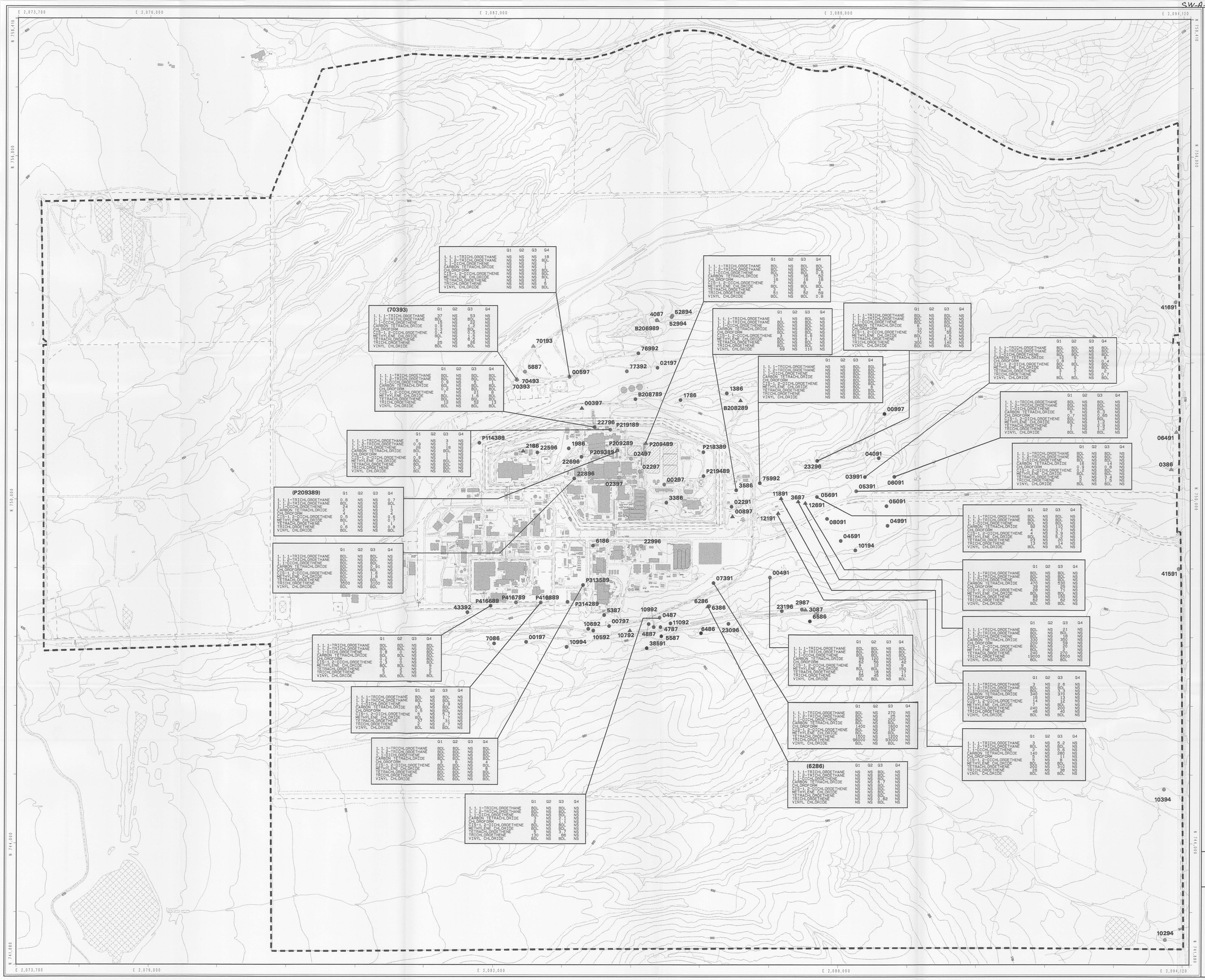

Plate 6
VOCs in Groundwater
RFCA Wells, 1997

Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D

- ○ Alluvial Wells
- △ Bedrock Wells

Wells shown with box plot have at least one value above Tier 2 Action Levels.

NS = Not Sampled
NA = Not Analyzed
LW = Lack of Water
BDL = Below Detection Limit

All results in micrograms per liter (ug/L)

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
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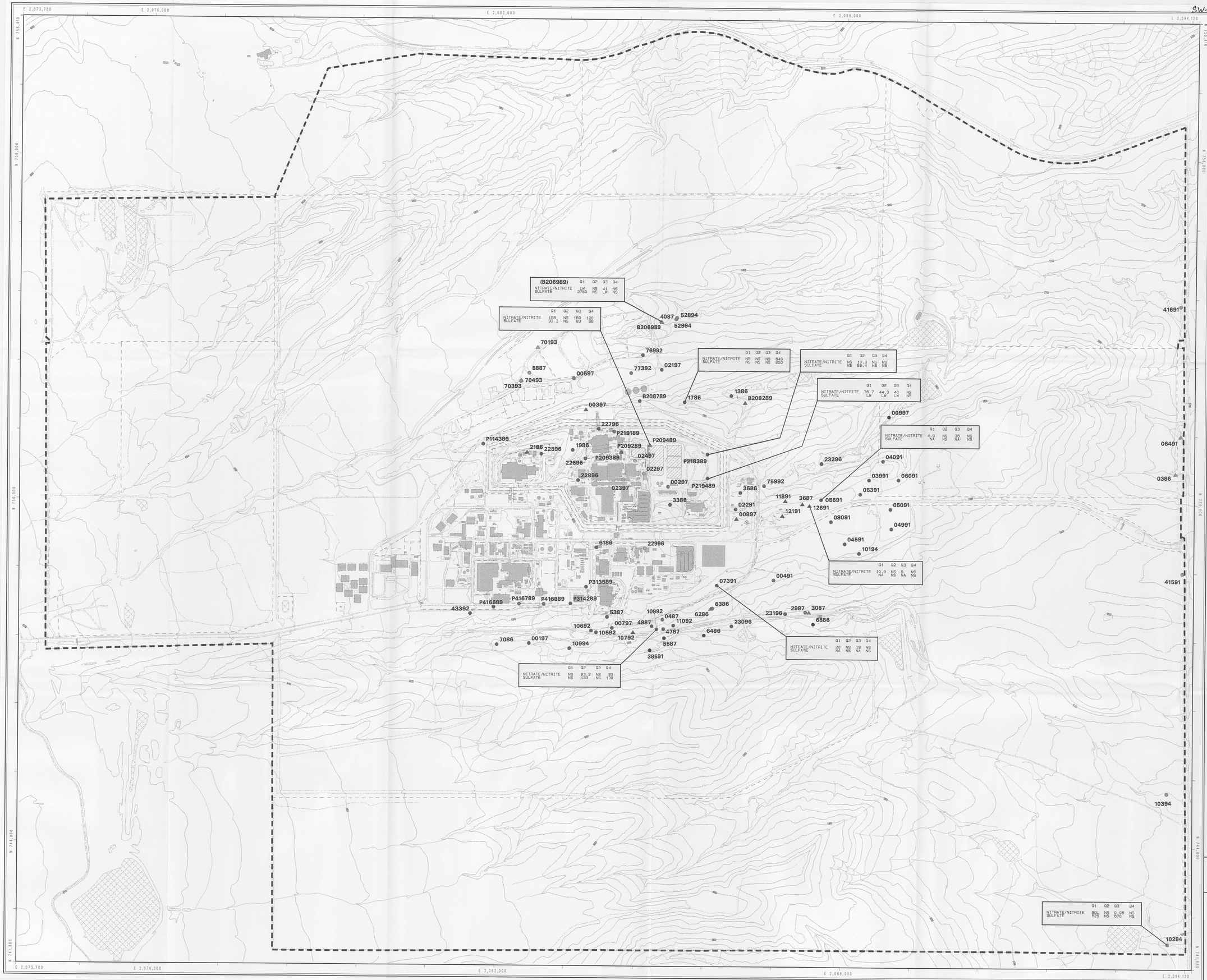

Plate 7
Water Quality Parameters in Groundwater RFCA Wells, 1997

Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D

○ Alluvial Wells

△ Bedrock Wells

Wells shown with box plot have at least one value above Tier 2 Action Levels.

NS = Not Sampled
NA = Not Analyzed
LW = Lack of Water

All results in milligrams per liter (mg/L)

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20′ Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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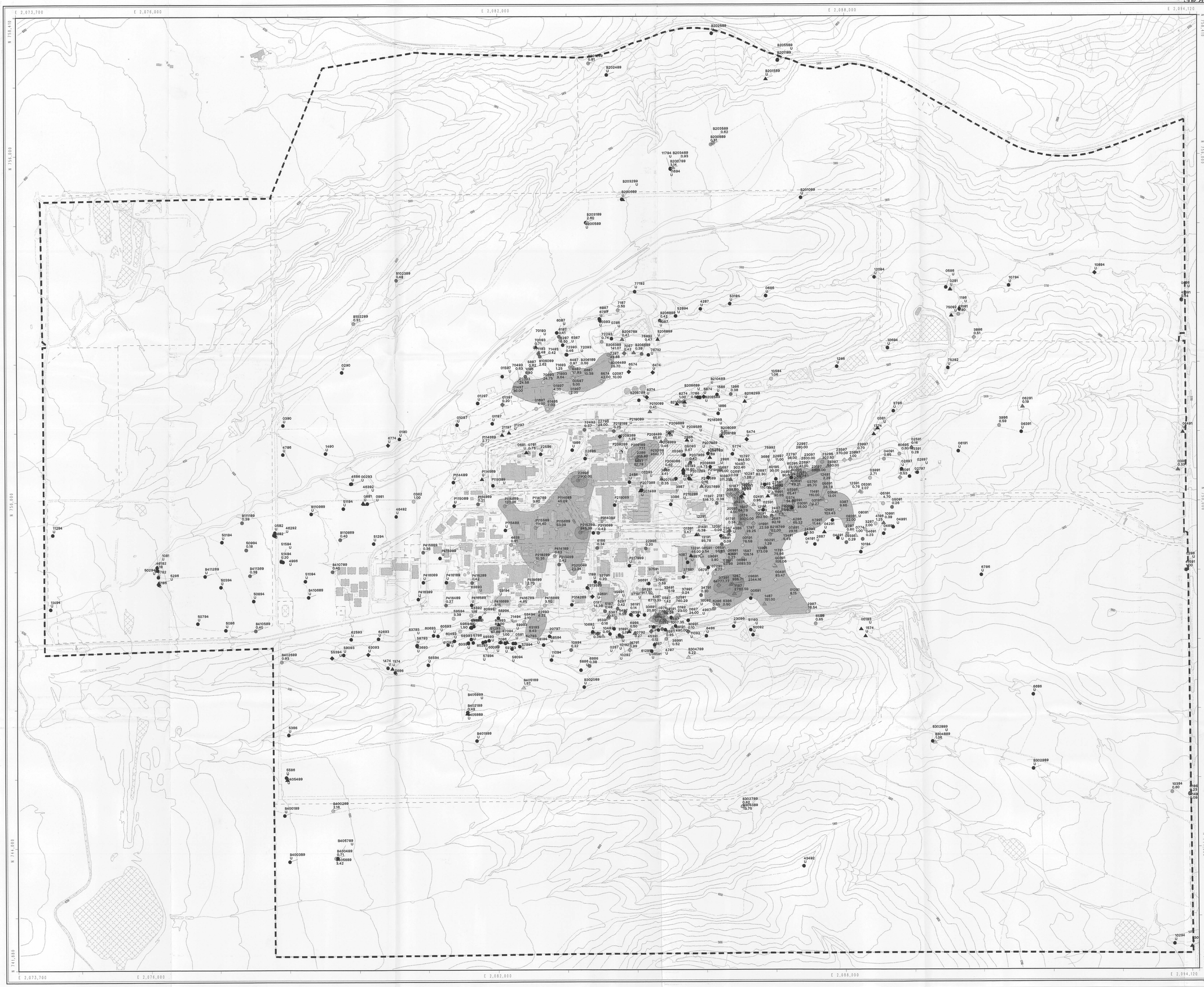

Plate 8
Trichloroethene Concentration in Groundwater, 1991-1997 (Avg.)

Trichloroethene concentration equal to or greater than 5 ug/L

Trichloroethene concentration equal to or greater than 500 ug/L

Trichloroethene Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 100
- 100 - 500
- > 500

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Tier 2 Action Level = 5 ug/L
Tier 1 Action Level = 500 ug/L

Note: 19 values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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November 06, 1998

SW-A-005833

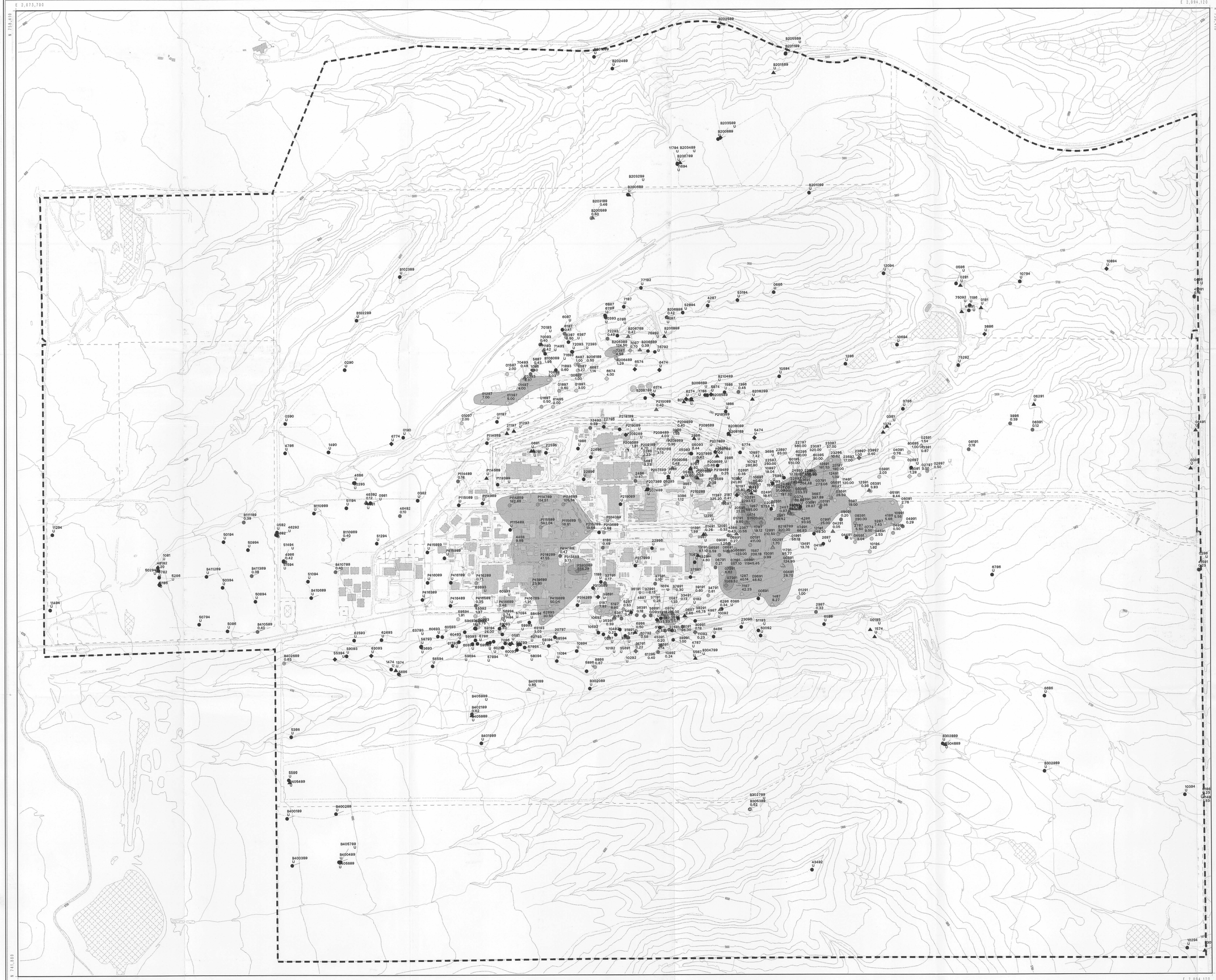

Plate 9
Tetrachloroethene Concentration in Groundwater, 1991-1997 (Avg.)

Tetrachloroethene concentration equal to or greater than 5 ug/L

Tetrachloroethene concentration equal to or greater than 500 ug/L

Tetrachloroethene Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 100
- 100 - 500
- > 500

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Tier 2 Action Level = 5 ug/L
Tier 1 Action Level = 500 ug/L

Note: 18 values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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Prepared by:

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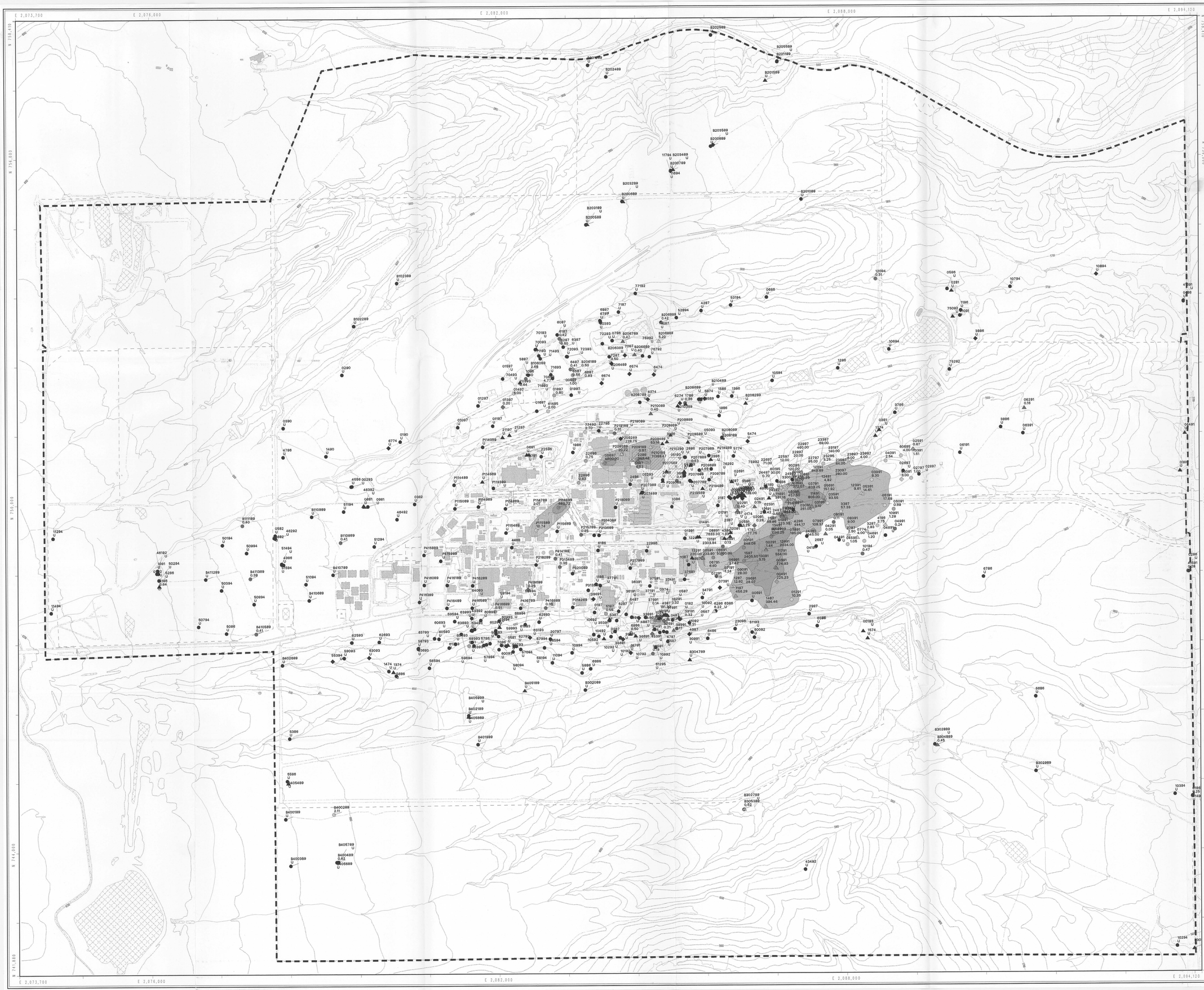
MAP ID: 98-0236

November 06, 1998

BW-A-002833

Plate 10
Carbon Tetrachloride Concentration in Groundwater, 1991-1997 (Avg.)



Carbon Tetrachloride concentration equal to or greater than 5 ug/L

Carbon Tetrachloride concentration equal to or greater than 500 ug/L

Carbon Tetrachloride Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 100
- 100 - 500
- > 500

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Tier 2 Action Level = 5 ug/L
Tier 1 Action Level = 500 ug/L

Note: 22 values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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Prepared by:

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MAP ID: 98-0236

November 07, 1998

SW-A-002835

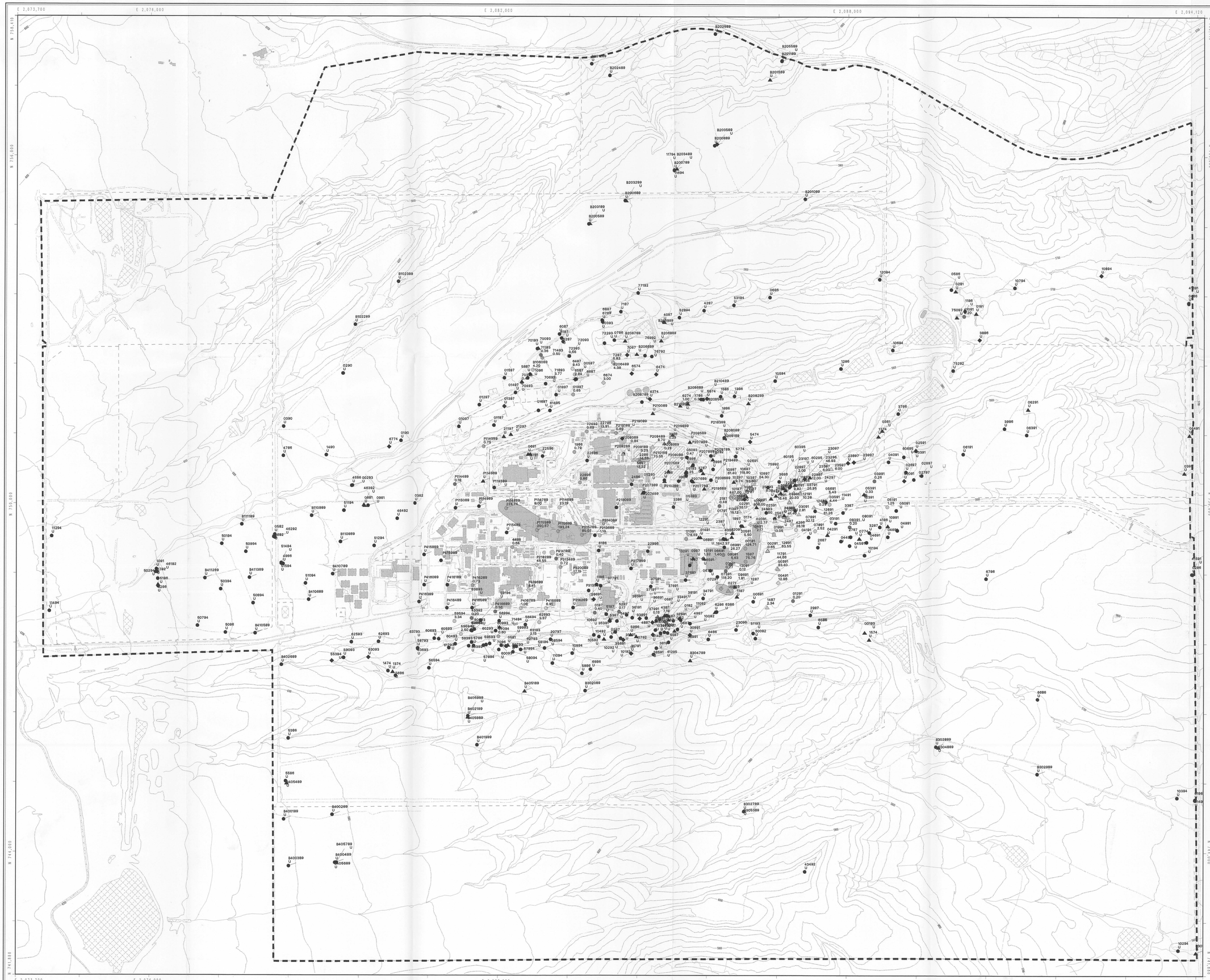

Plate 11
1,2-Dichloroethene Concentration in Groundwater, 1991-1997 (Avg.)

1,2-DCE concentration equal to or greater than 70 ug/L

1,2-Dichloroethene Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 70
- 70 - 500
- > 500

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Tier 2 Action Level = 70 ug/L
Tier 1 Action Level = 7000 ug/L

Note: No values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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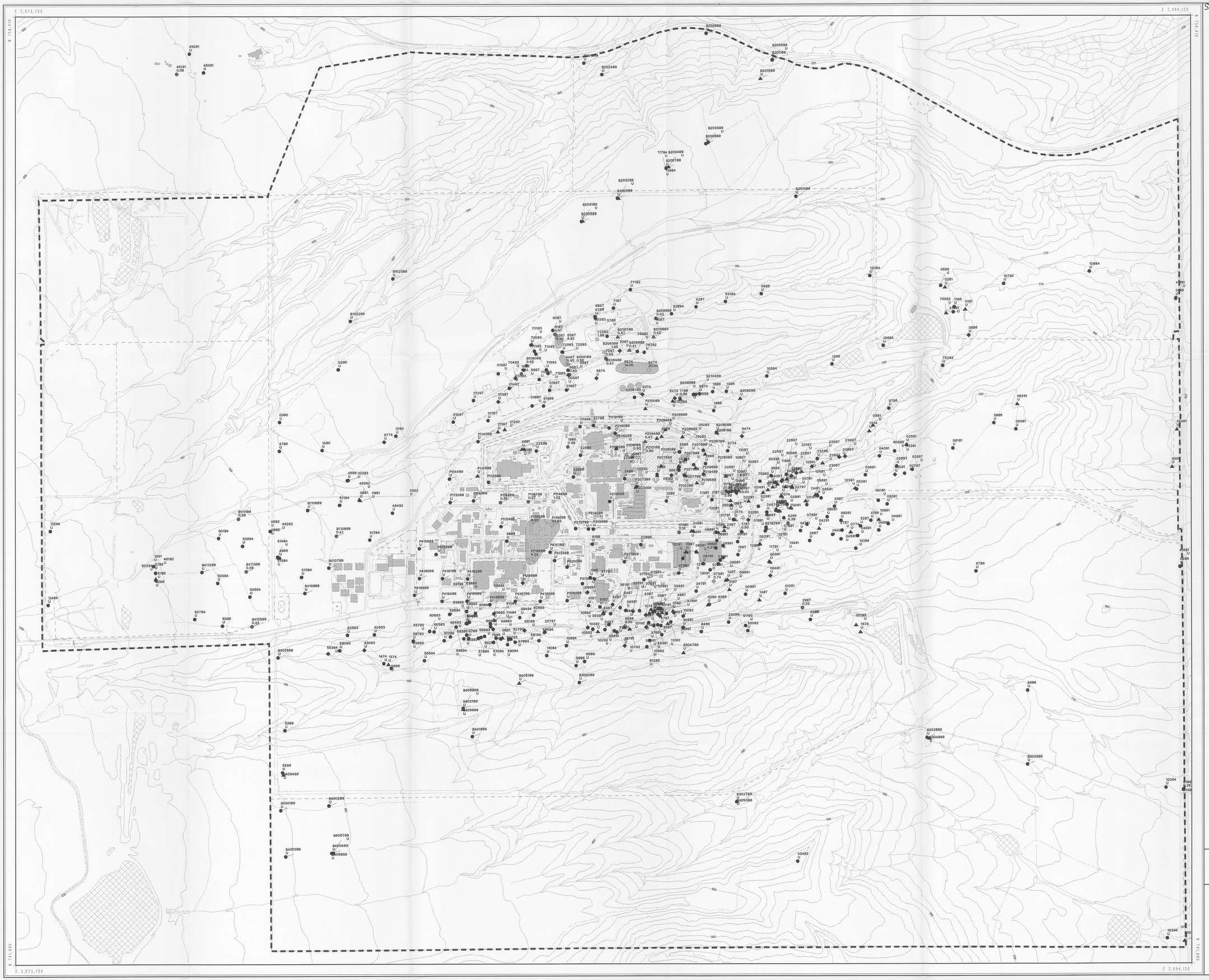

Plate 12
Vinyl Chloride Concentration in Groundwater, 1991-1997 (Avg.)

- Vinyl Chloride concentration equal to or greater than 2 ug/L
- Vinyl Chloride concentration equal to or greater than 200 ug/L

Vinyl Chloride Concentration (ug/l)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 100
- 100 - 200
- > 200

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Tier 2 Action Level = 2 ug/L
Tier 1 Action Level = 200 ug/L

Note: One value above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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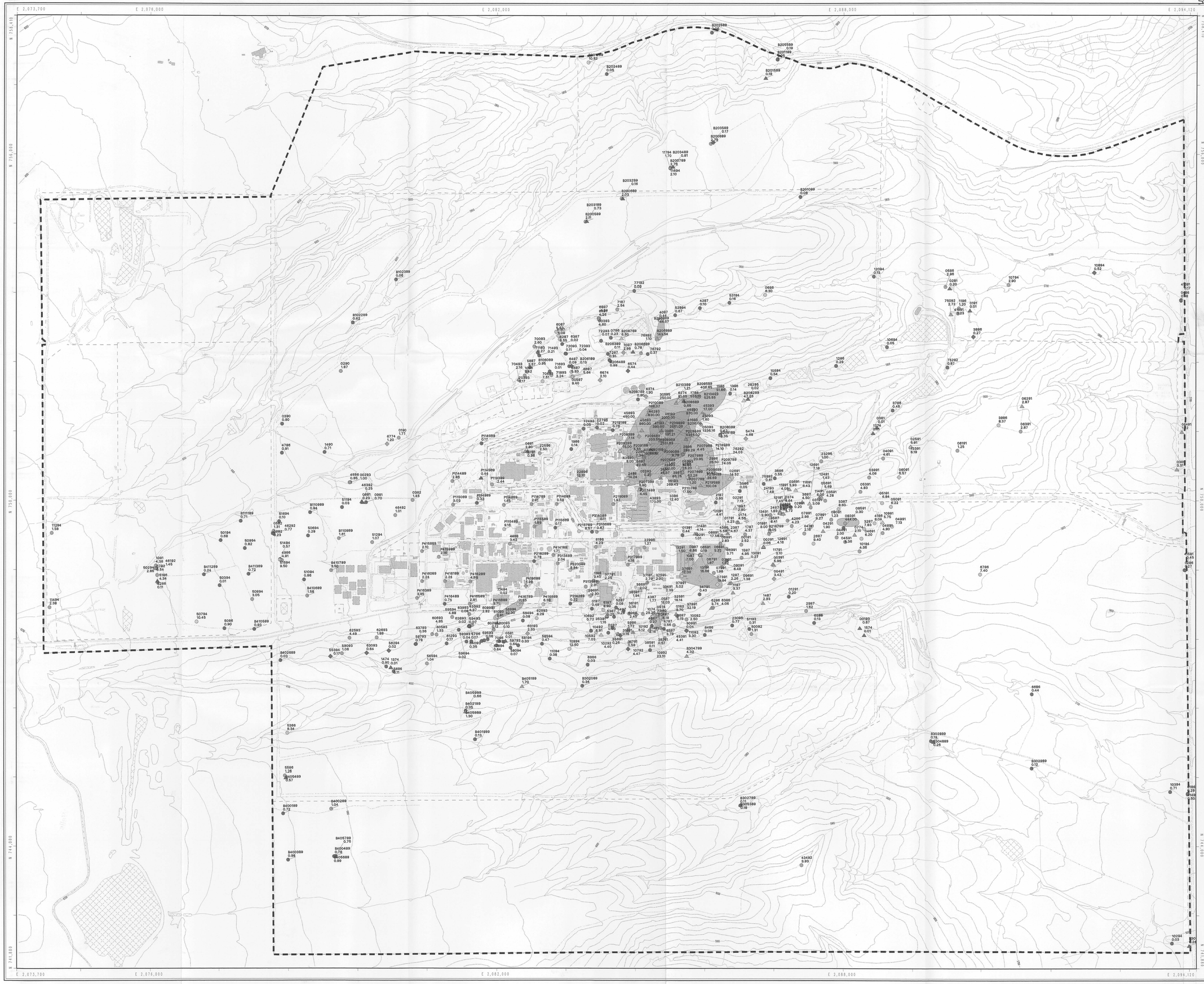

Plate 13
Nitrate Concentration in Groundwater, 1991-1997 (Avg.)

Nitrate concentration equal to or greater than 10 mg/L (as N)

Nitrate concentration equal to or greater than 1000 mg/L (as N)

Nitrate Concentration (mg/L)

- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 100
- 100 - 1000
- > 1000

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Background Level = 4.7 mg/L
Tier 2 Action Value = 10 mg/L
Tier 1 Action Value = 1000 mg/L

Note: 7 values above Tier 1 Action Value

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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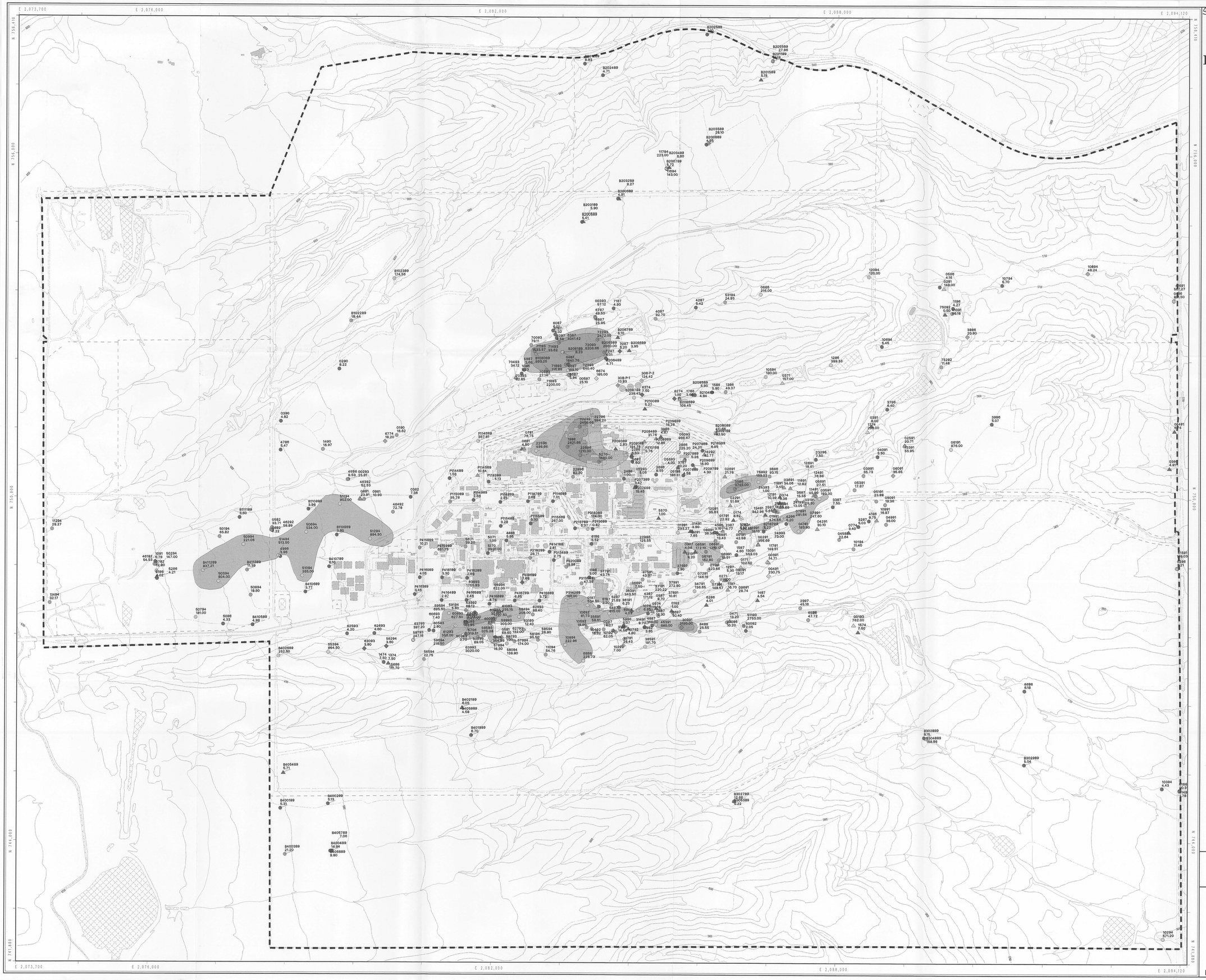

Plate 14

Dissolved Manganese Concentration in Groundwater, 1991-1997 (Avg.)

Manganese concentration equal to or greater than 183 ug/L

Manganese concentration equal to or greater than 1000 ug/L

Manganese Concentration (ug/L)

- 0 - 10
- 10 - 100
- 100 - 183
- 183 - 1000
- > 1000

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Background Level = 162 ug/L
Tier 2 Action Level = 183 ug/L
Tier 1 Action Level = 18,300 ug/L

Note: No values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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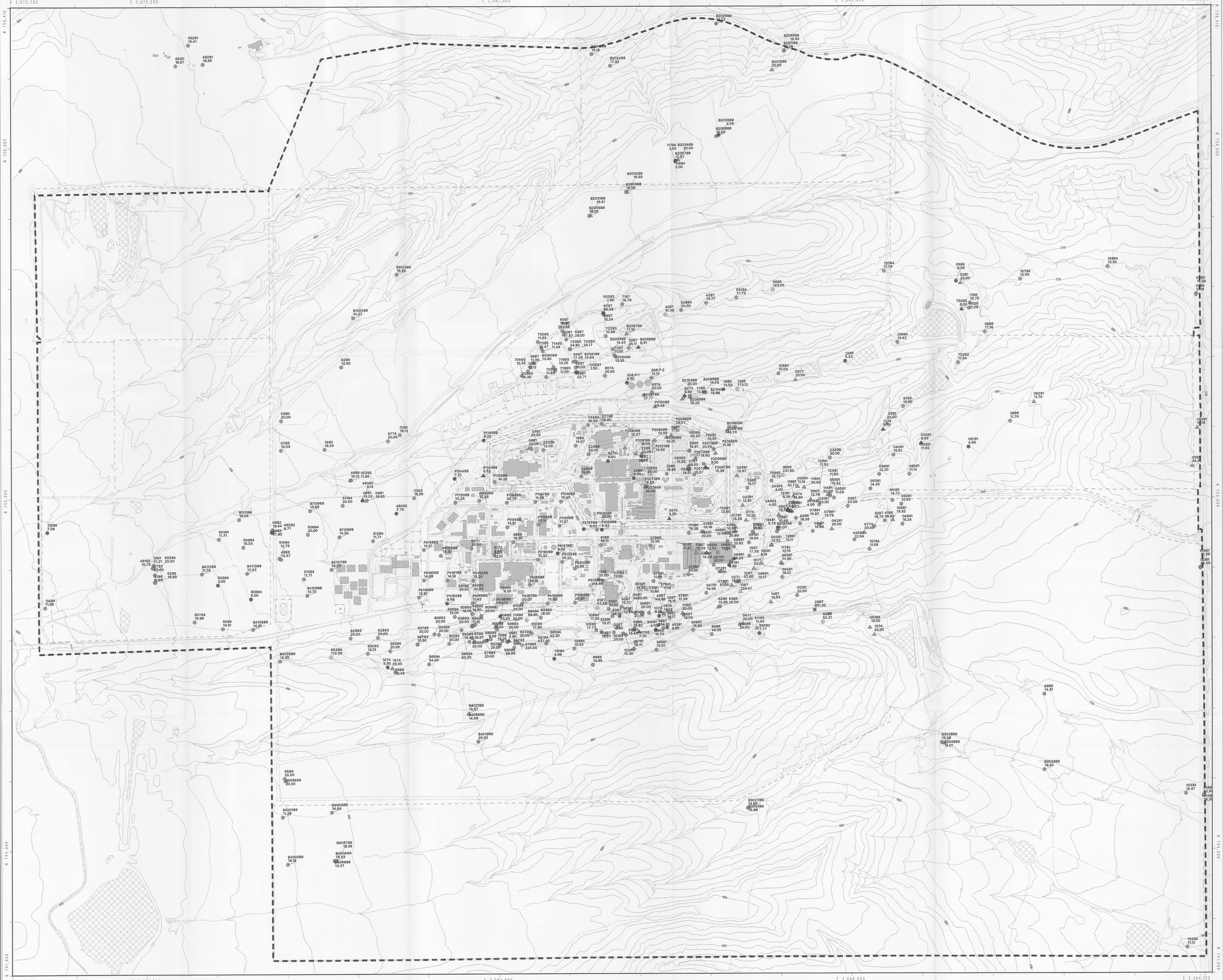

Plate 15

Dissolved Nickel Concentration in Groundwater, 1991-1997 (Avg.)

Nickel Concentration (ug/L) (1991-97)

- 0 - 10
- 10 - 50
- 50 - 100
- 100 - 500
- > 500

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Background Level = 21.4 ug/L
Tier 2 Action Value = 100 ug/L
Tier 1 Action Value = 10,000 ug/L

Note: No values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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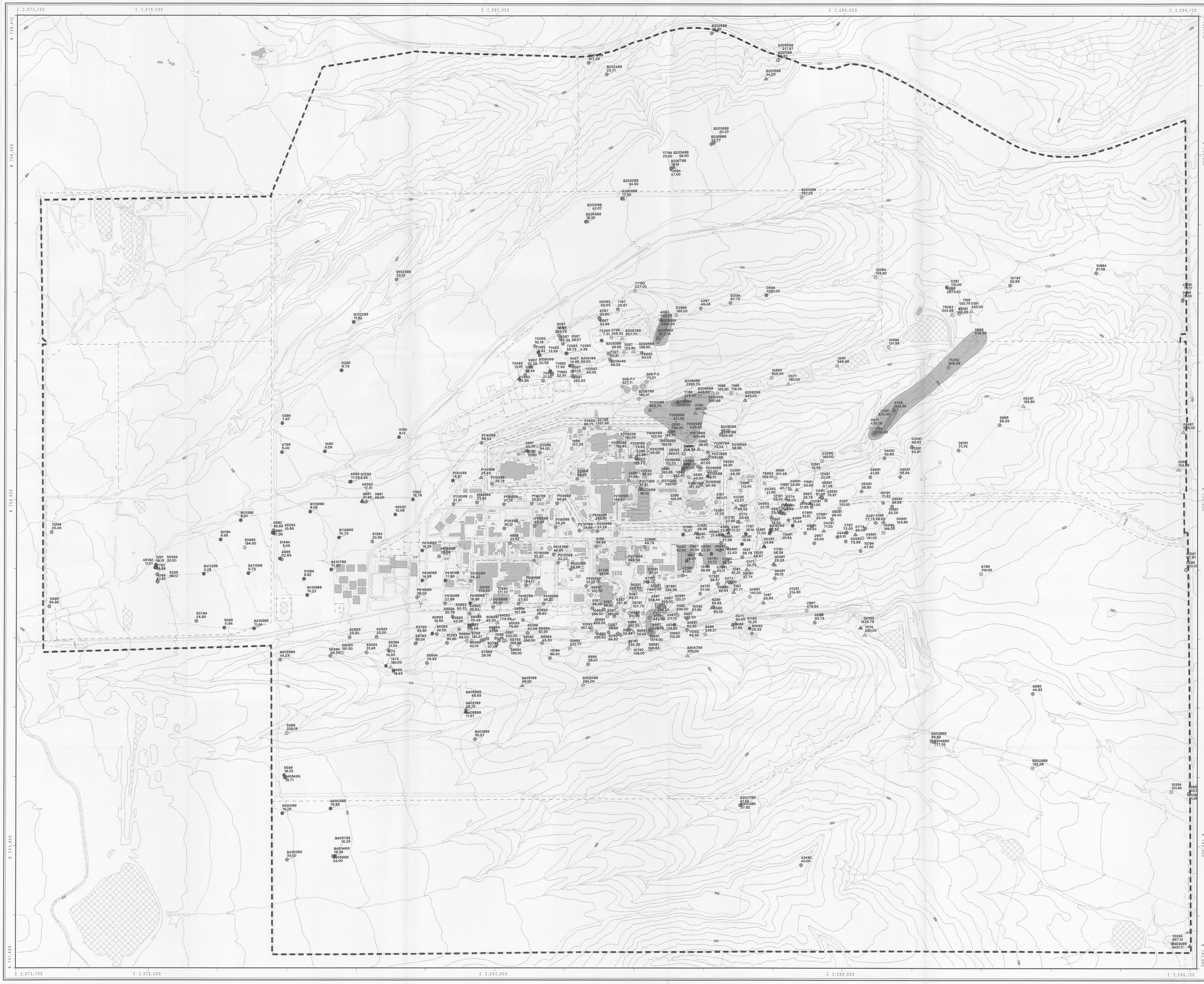

Plate 16
Sulfate Concentration in Groundwater, 1991-1997 (Avg.)

Sulfate concentration equal to or greater than 500 mg/L (As SO4)

Sulfate concentration equal to or greater than 1000 mg/L (As SO4)

Sulfate Concentration (mg/L)

- 0 - 20
- 20 - 100
- 100 - 500
- 500 - 750
- 750 - 1000
- > 1000

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Background Level = 436 mg/L
Tier 2 Action Level = 500 mg/L
Tier 1 Action Level = 50000 mg/L

Note: No values above Tier 1 Action Level

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

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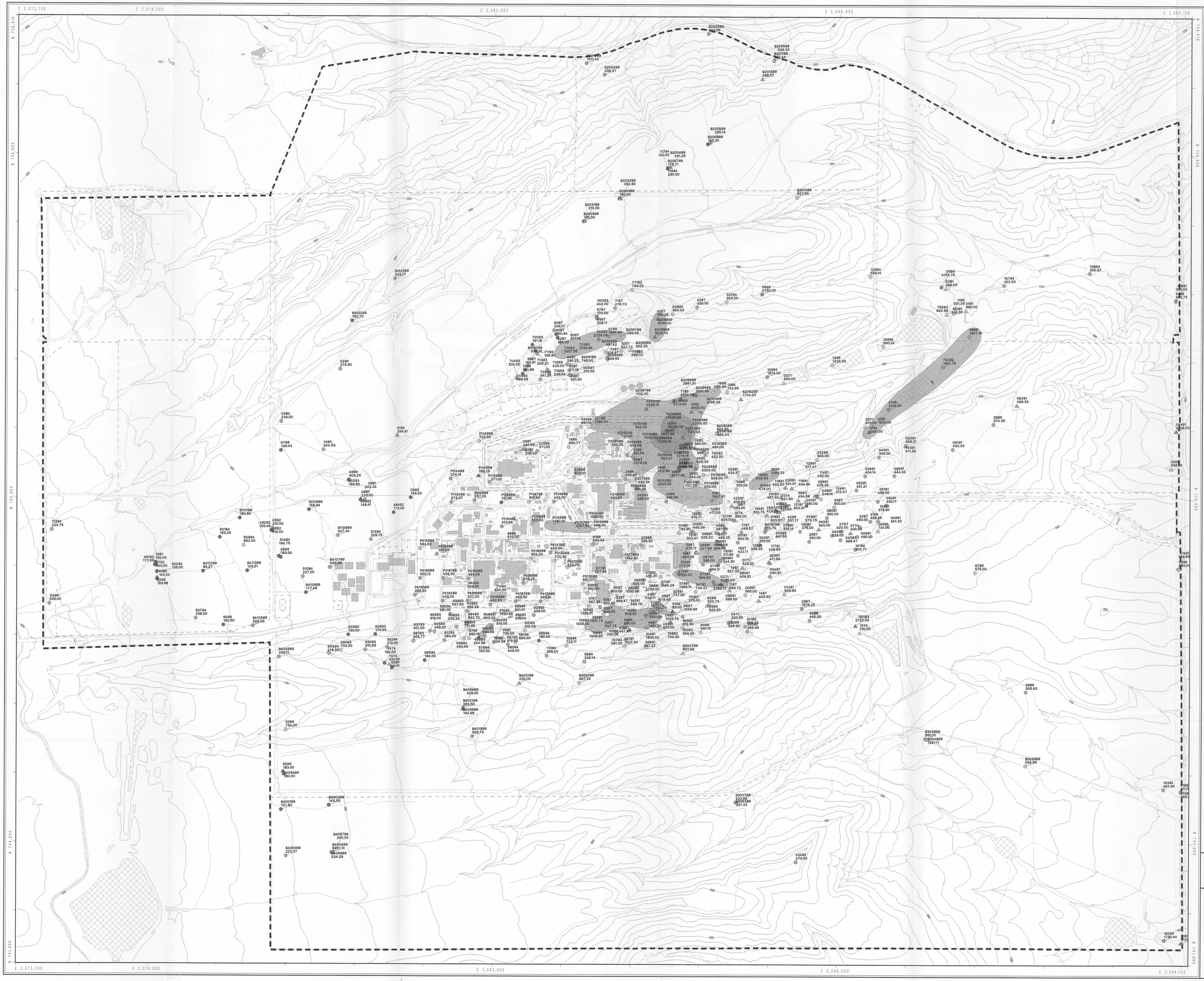

Plate 17
Total Dissolved Solids Concentration in Groundwater, 1991-1997 (Avg.)

TDS concentration equal to or greater than 980 mg/L

TDS concentration equal to or greater than 10000 mg/L

TDS Concentration (mg/L)

- 0 - 200
- 200 - 500
- 500 - 980
- 980 - 1500
- 1500 - 2000
- > 2000

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Background Level = 980 mg/L

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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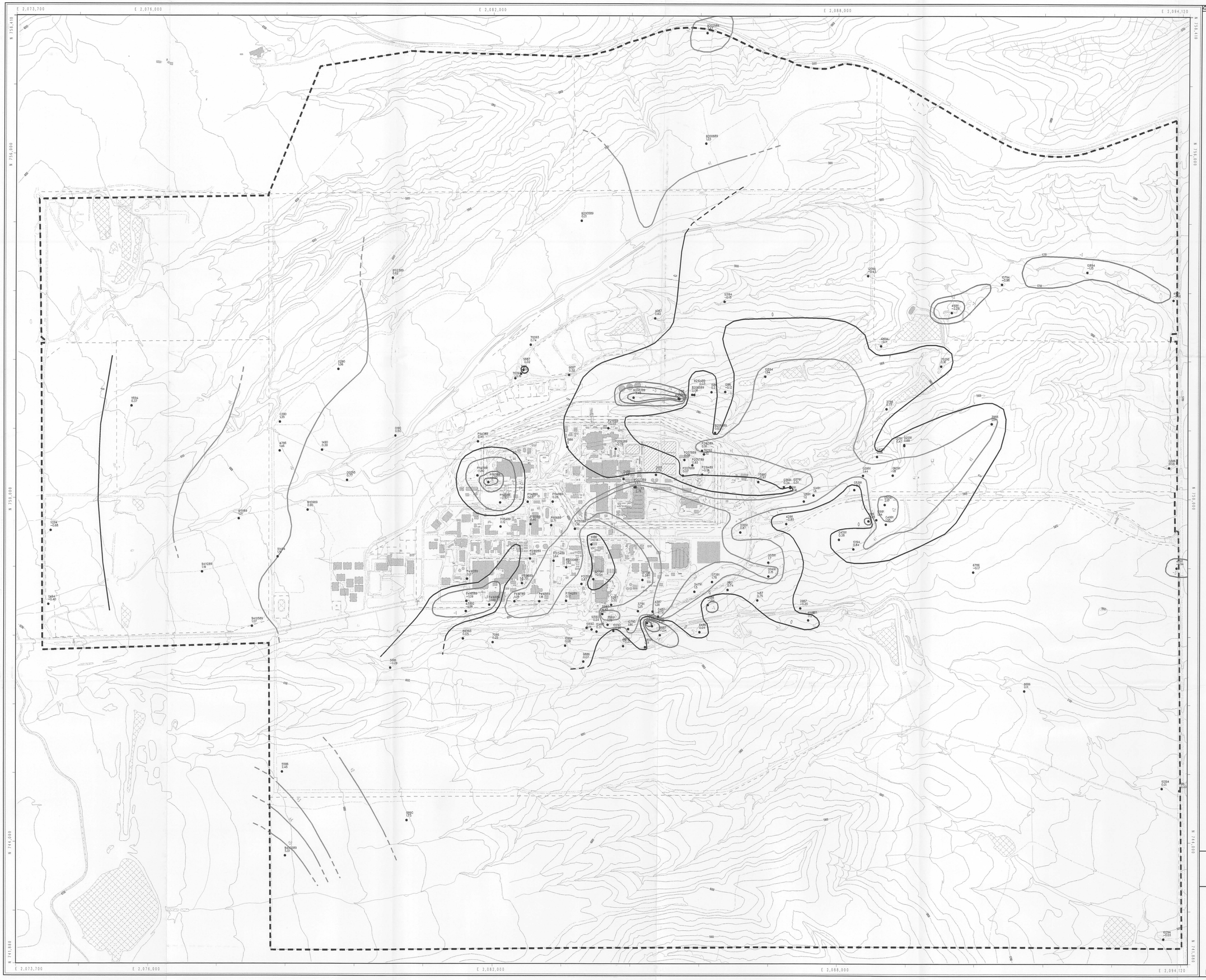

Plate 18
Water Level Change Map
1996 - 1997
Second Quarter Data

- Groundwater Monitoring Well (with change in water level)
- Contour depicting Positive Change In Water Level
- Contour depicting Negative Change In Water Level
- Contour depicting Zero Change In Water Level

Note: A dashed line denotes an inferred water level change

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20′ Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0195

September 25, 1998

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Plate 19
Water Level Change Map
1996 - 1997
Fourth Quarter Data

- Groundwater Monitoring Well (with change in water level)
- Contour depicting Positive Change In Water Level
- Contour depicting Negative Change In Water Level
- Contour depicting Zero Change In Water Level

Note: A dashed line denotes an inferred water level change

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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MAP ID: 98-0195

November 09, 1998

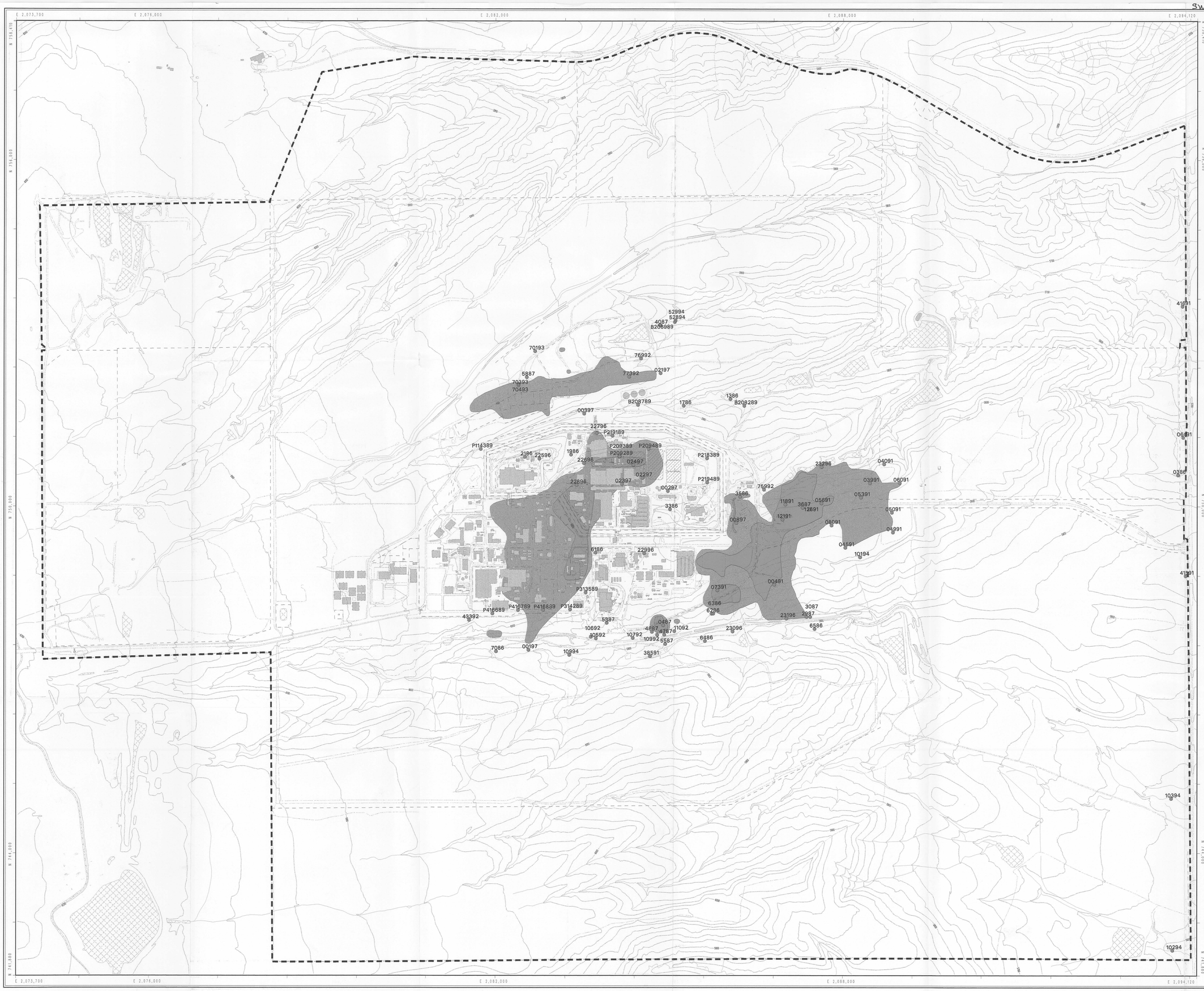

Plate 20
VOCs Composite Plume Map

- IMP Water Quality Monitoring Wells
- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)

Standard Map Features

- Buildings & other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95

Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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