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INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN AND DECISION DOCUMENT

881 HILLSIDE AREA
OPERABLE UNIT NO. 1

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

JANUARY, 1990

Volume I - Text

FINAL

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VOLUME II

APPENDIX

GLOSSARY OF ACRONYMS

ACRONYM	MEANING
ARAR	Applicable or Relevant and Appropriate Requirements
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BDL	Below Detection Limits
CAA	Clean Air Act
CCl_4	carbon tetrachloride
CCR	Colorado Code of Regulations
CDH	Colorado Department of Health
CEARP	Comprehensive Environmental Assessment and Response Program
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
$CHCl_3$	chloroform
CMS/FS	Corrective Measures Study/Feasibility Study
CWA	Clean Water Act
1,1 DCA	1,1 dichloroethane
1,2 DCA	1,2 dichloroethane
1,1 DCE	1,1 dichloroethene
1,2 DCE	1,2 dichloroethene
DEHP	bis (2-ethylhexyl) phthalate
DOE	Department of Energy
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
ER	Environmental Restoration Program
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FWPCA	Federal Water Pollutant Control Act
GAC	Granular Activated Carbon
GOCO	Government Owned, Contractor Operated
GPM	Gallons Per Minute
GWPS	Ground Water Protection Standards
HDPE	High Density Polyethylene
HEC	Health Effects Criterion
HS&E	Health, Safety and Environment

ACRONYM	MEANING
HSWA	Hazardous and Solid Waste Amendments of 1984
IM/IRA	Interim Measures/Interim Remedial Action
JSA	Job Safety Analysis
KW-HR	Kilowatt-Hour
LDR	Land Disposal Restrictions
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MCLG	Maximum Contaminant Level Goal
NCP	National Contingency Plan
NEPA	National Environmental Policy Act of 1969
NPDES	National Pollutant Discharge Elimination System
OSA	Operational Safety Analysis
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PEL	Permissible Exposure Limits
POTW	Publicly Owned Treatment Works
PPM	Parts Per Million
PVC	polyvinyl chloride
PWF	Present Worth Factor
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act of 1976
RfD	Reference Dose
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RFP	Rocky Flats Plant
RI/FS	Remedial Investigation/Feasibility Study
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SWMU	Solid Waste Management Unit
TBC	To Be Considered
1,1,1 TCA	1,1,1 trichloroethane
TCL	Target Compound List
TCE	trichloroethene
TDS	Total Dissolved Solids
TSCA	Toxic Substances Control Act
USC	United States Code
USFWS	United States Fish and Wildlife Service
UV/peroxide	Ultraviolet/peroxide
VOCS	Volatile Organic Compounds

SECTION 1.0

INTRODUCTION

1.1 BACKGROUND

The Department of Energy (DOE) wishes to pursue an Interim Measures/Interim Remedial Action (IM/IRA) at the High Priority Sites (881 Hillside Area) at the Rocky Flats Plant (RFP). Pursuant to the Resource Conservation and Recovery Act of 1976 (RCRA) as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of' 1986 (SARA) this interim action is to be conducted to minimize the release of hazardous substances from this Area that pose a potential long-term threat to the public health and environment. Due to the presence of contaminated ground water and it's proximity to Woman Creek, DOE would like to implement this IM/IRA Plan because of the length of time it typically takes to finalize a RCRA Facility Investigation/Remedial Investigation (RFI/RI), and Corrective Measures Study/Feasibility Study (CMS/FS).

This IM/IRA Plan has been prepared to identify, screen, and evaluate appropriate interim remedial action alternatives, and select the preferred interim remedial action for the Area. This IM/IRA Plan has been prepared to conform with the requirements for an Engineering Evaluation/Cost Analysis (EE/CA) as defined in the proposed National Contingency Plan [40 CFR 300.415(b)(4)].

In March 1987, a remedial investigation under the Environmental Restoration (ER) Program [formerly known as the Comprehensive Environmental Assessment, and Response Program (CEARP)] began at the twelve sites comprising the 881 Hillside Area. The investigation consisted of the preparation of detailed topographic maps, radiometric and organic vapor screening surveys, surface geophysical surveys, a soil gas survey, a boring and well completion program, soil sampling and ground and surface water sampling. The results of this remedial investigation are presented in the Draft Final Remedial Investigation Report for High Priority Sites (Rockwell International, 1988a). A feasibility study was also conducted for the 881 Hillside Area, the results of which are presented in the Draft Feasibility Study Report for High Priority Sites (Rockwell International, 1988b). Rockwell has also prepared a detailed response to EPA comments on the RI and FS reports (Rockwell International, 1989). The final RFI/RI and CMS/FS reports will address the nature and extent of soils and ground water contamination, and final remediation of 881 Hillside Area. The final RFI/RI and CMS/FS reports will evaluate the effectiveness of the IM/IRA.

1.2 IM/IRA PLAN ORGANIZATION

Volume I or this IM/IRA Plan is divided into six sections addressing the details of the plan. Section 2.0 of this IM/IRA Plan describes the results of previous investigations of the 881 Hillside. Most of the information included in Section 2.0 has been derived from the RI report, although chemical data has been updated to include all data received to date.

Section 3.0 identifies the objectives of the IM/IRA. The objectives will define criteria used to identify and evaluate IM/IRA options.

Section 4.0 identifies technically feasible ground water treatment technologies, screens these technologies based on implementability, effectiveness, and costs, integrates the preferred ground water treatment technology into alternative IM/IRA options that address the objectives, and screens these alternatives based on implementability, effectiveness, and costs. Most of the information included in Section 4.0 has been derived from the FS report, however, this document expands upon the FS report by addressing treatment of inorganic contaminants in the alluvial ground water.

Section 5.0 summarizes the detailed analysis performed in Section 4.0, and Section 6.0 presents the preferred IM/IRA. Volume II of this IM/IRA Plan contains the alluvial ground-water quality data for the 881 Hillside Area.

SECTION 2.0

SITE CHARACTERIZATION

2.1 SITE DESCRIPTION AND BACKGROUND

2.1.1 Location and Facility Type

The Rocky Flats Plant (RFP) is located in northern Jefferson County, Colorado, approximately 16 miles northwest of downtown Denver (Figure 2-1). The Plant site consists of approximately 6,550 acres of federally owned land in Sections 1 through 4, and 9 through 15, of T2S, R70W, 6th principal meridian. Major buildings are located within an area of approximately 400 acres, known as RFP security area. The security area is surrounded by a buffer zone of approximately 6,150 acres.

The RFP is a government-owned, contractor-operated (GOCO) facility. It is part of a nation-wide nuclear weapons research, development, and production complex administered by the Albuquerque Operations Office of the U.S. Department of Energy. The operating contractor for the Rocky Flats Plant is Rockwell International. The facility manufactures components for nuclear weapons and has been in operation since 1951. RFP fabricates components from plutonium, uranium, beryllium, and stainless steel. Production activities include metal fabrication, machining, and assembly. Both radioactive and nonradioactive wastes are generated in the process. Current waste handling practices involve on-site and off-site recycling of hazardous materials and off-site disposal of solid radioactive materials at other DOE facilities.

The RFP is currently an interim status Resource Recovery and Conservation Act (RCRA) hazardous waste treatment/storage facility. In the past, both storage and disposal of hazardous and radioactive wastes occurred at on-site locations.

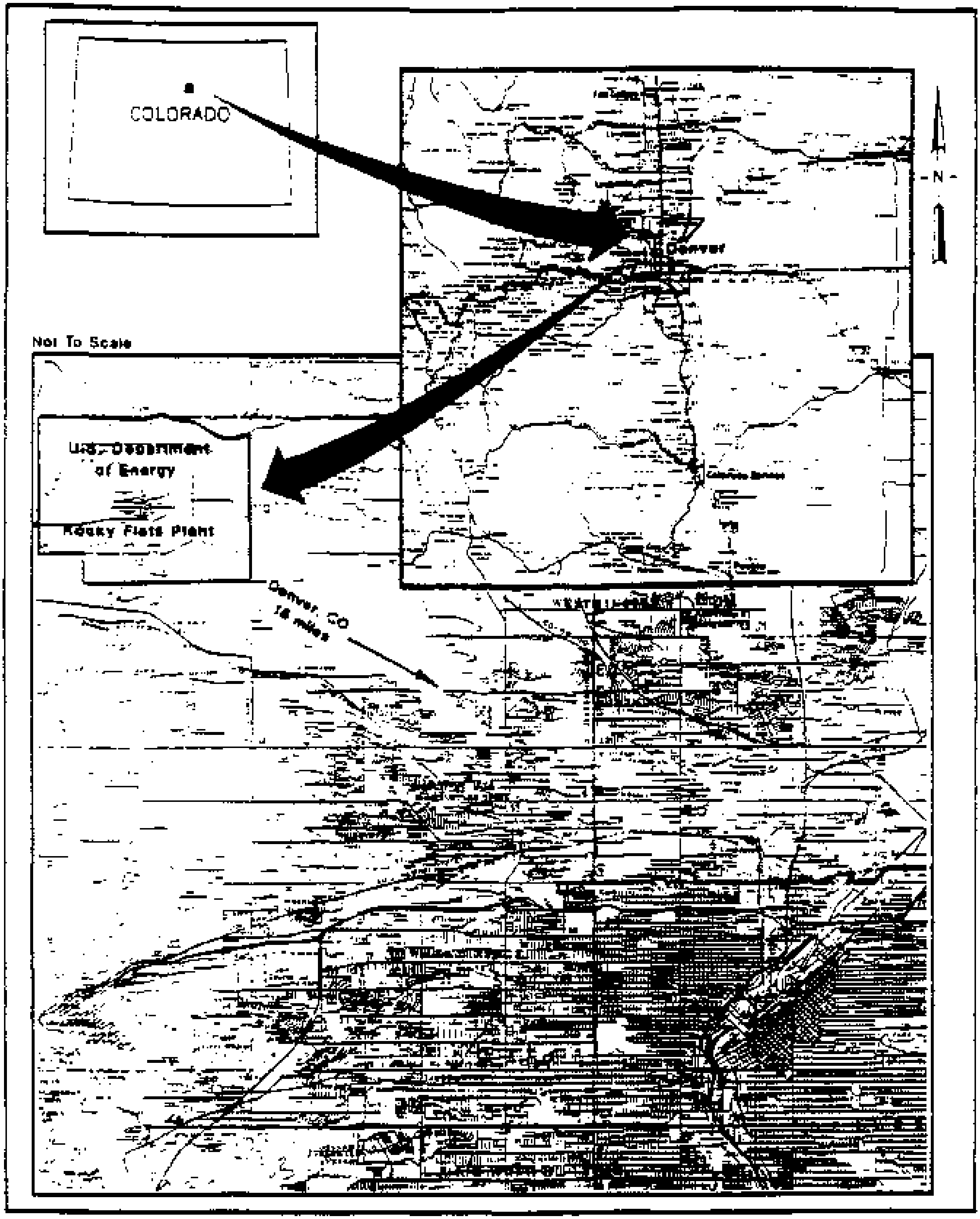


Figure 2-1: LOCATION OF ROCKY FLATS PLANT

Preliminary assessments conducted under Phase 1 of the ER Program identified some of the past on-site storage and disposal locations as potential sources of environmental contamination.

2.1.2 881 Hillside Area Description

There are twelve sites, designated as solid waste management units (SWMUs), which comprise the 881 Hillside Area. These sites were investigated as high priority sites because of elevated concentrations of volatile organic compounds in the ground water and the proximity of the sites to a surface drainage. The 881 Hillside Area is located at the southeast corner of RFP (Figure 2-2). A brief description of each site in the 881 Hillside Area is presented below.

1. **Oil Sludge Pit (SWMU 102)** -- A small pond located south of Building 881 was used for disposal of oil sludges in the late 1950s.

2. **Chemical Burial Site (SWMU 103)** -- A small pit was used for disposal of liquid wastes southeast of Building 881 in the early 1960s.

3. **Liquid Dumping (SWMU 104)** -- An area east of Building 881 was reportedly used for disposal of unknown liquids prior to 1969. This was not substantiated by results of drilling the area in 1987. Therefore, this site may not exist and its location is not shown on the map.

4,5. **No. 6 Fuel Oil Tanks (SWMUs 105.1 & 105.2)** -- Two fuel oil tanks are located south of Building 881; they are out of service and filled with concrete.

6. **Outfall Site (SWMU 106)** -- An overflow line from the sanitary sewer sump south of Building 881 daylights on the slope below the Building.

7. **Hillside Oil Leak (SWMU 107)** -- Oil was discovered flowing from the Building 881 footing drain in early 1973. The source of the oil was never positively identified but the oil was collected in a skimming pond and transported off site. There is an ongoing discharge of water from the footing drain.

8,9. **Multiple Solvent Spills (SWMUs 119.1 & 119.2)** -- Two areas east of Building 881 were used for barrel storage between 1969 and 1972.

10. **Radioactive Site (SWMU 130)** -- Soils contaminated with low levels of radionuclides were placed on the hillside cast of Building 881 and covered with soil between 1969 and 1972.

11. **Sanitary Sewer Line Leak (SWMU 145)** -- The sanitary sewer line leaked on the hillside southwest of Building 881 in early 1981.

12. **Drum Storage Area (SWMU 177)** -- Building 885 is currently used for satellite collection and 90-day accumulation of RCRA-regulated wastes. The building will be closed and soil remediation addressed under RCRA Interim Status (6 CCR 1007-3). Ground-water contamination will be addressed as part of the 881 Hillside Area RI/FS performed under CERCLA.

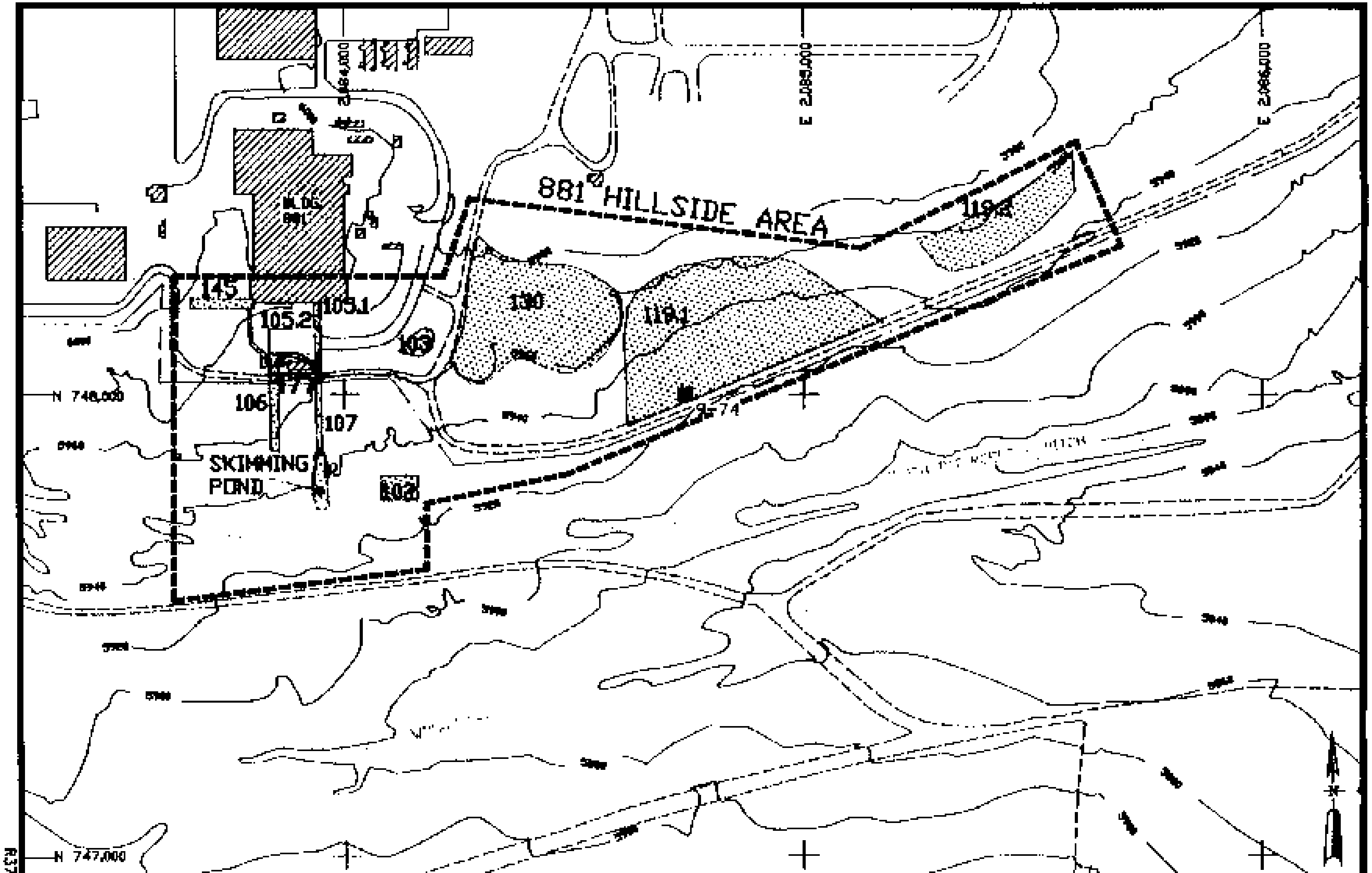


FIGURE 2-2
881 HILLSIDE AREA SITE MAP

2.1.3 Surrounding Land Use and Population Density

The Rocky Flats Plant is located in a rural area. There are eight public schools, within six miles of RFP. The nearest educational facility is the Witt Elementary School, which is approximately 2.7 miles east of the RFP buffer zone. The closest hospital to RFP is Centennial Peaks Hospital located approximately seven miles northeast. The closest park and recreational area is the Standley Lake area, which is approximately five miles southeast of the RFP site. Boating, picnicking, and limited overnight camping are permitted. Several other small parks exist in communities within ten miles of RFP. The closest major park, Golden Gate Canyon State Park, located approximately 15 miles to the southwest, provides 8,400 acres of general camping and outdoor recreation. Other national and state parks are located in the mountains west of RFP, but all are more than 15 miles away.

Some of the land adjacent to RFP is zoned for industrial development. Industrial facilities within five miles of RFP include the TOSCO laboratory (40-acre site located two miles south), the Great Western Inorganics Plant (two miles south), the Frontier Forest Products yard (two miles south), the Idealite Lightweight Aggregate Plant (2.4 miles northwest), and the Jefferson County Airport and Industrial Park (990-acre site located 4.8 miles northeast).

Several ranches are located within ten miles of RFP, primarily in Jefferson and Boulder Counties. They are operated to produce crops, raise beef cattle, supply milk, and breed and train horses. According to the 1987 Colorado Agricultural Statistics, 20,758 acres of crops were planted in Jefferson County (total land area of approximately 475,000 acres) and 68,760 acres of crops were planted in Boulder County (total land area of 405,760 acres). Crops consisted of winter wheat, corn, barley, dry beans, sugar beets, hay, and oats. Livestock consisted of 5,314 head of cattle, 113 hogs, and 346 sheep in Jefferson County, and 19,578 head of cattle, 2,216 hogs, and 12,133 sheep in Boulder County (Post, 1989).

Approximately 50 percent of the area within ten miles of RFP is in Jefferson County. The remainder is located in Boulder County (40 percent) and Adams County (10 percent).

According to the 1973 Colorado Land Use Map, 75 percent of this land was unused or was used for agriculture. Since that time, portions of this land have been converted to housing, with several new housing subdivisions being started within a few miles of the buffer zone. One such subdivision is located south of the Jefferson County Airport and several are located, southeast of RFP.

A demographic study using 1980 census data shows that approximately 1.8 million people lived within 50 miles of RFP in 1980 (Rockwell International, 1987b). Approximately 9,500 people lived within five miles of RFP in 1980. The most populous sector was to the southeast, toward the center of Denver. This sector had a 1980 population of about 555,000 people living between 10 and 50 miles from RFP. Recent population estimates registered by the Denver Regional Council of Governments for the eight county Denver Metro region have shown distinct patterns of growth between the first and second halves or the decade. Between 1980 and 1985, the population of the eight county region increased by 197,890, a 2.4 percent annual growth rate. Between 1985 and 1989 a population gain of 71,575 was recorded, representing a 1.0 percent annual increase (the national average). The 1989 population showed an increase of 2,225 (or 0.1 percent) from the same date in 1988 (DRCOG, 1989).

2.1.4 Site Topography and Geology

2.1.4.1 Topography

The Rocky Flats Plant is located at an elevation of approximately 6,000 feet above mean sea level. The site is on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province. The piedmont represents an old erosional surface along the eastern margin of the Rocky Mountains. It is underlain by gently dipping sedimentary rocks (Paleozoic to Cenozoic in age) which are abruptly upturned at the Front Range (just west of RFP) to form hogback ridges parallel to the mountain front. The piedmont surface is broadly rolling and slopes gently to the east with n topographic relief of only several hundred feet. This relief is due both to resistant bedrock units that locally rise landscape and to the presence of incised stream valleys.

2.1.4.2 881 Hillside Area Geology

The following geologic information is based on the RI Report (Rockwell International 1988a), and the reader is referred to this report for additional details.

Surficial Materials

Surficial materials at the 881 Hillside Area consist of the Rocky Flats Alluvium, colluvium, valley fill alluvium, and artificial fill overlying bedrock. In addition, there are a few isolated exposures of claystone bedrock. The study area is located on the south-facing hillside which slopes down from the Rocky Flats terrace surface toward Woman Creek on the south side of RFP. Rocky Flats Alluvium caps the top of the slope, and colluvium (slope wash) covers the hillside. Artificial fill and disturbed surficial materials are present around Building 881 and south of the building to the South Interceptor Ditch. Artificial fill overlies colluvium at SWMU 130, and surficial materials arc disturbed in the vicinity of SWMUs 119.1 and 119.2. Valley fill alluvium is present along the drainage of Woman Creek south of the 881 Hillside Area, and terrace alluvium occurs on the north side of the Woman Creek valley fill alluvium.

Of particular significance with respect to contaminant transport in alluvial ground water are the presence of gravel layers in colluvial materials overlying bedrock and near surface. These gravels were likely deposited in a south (downslope) direction by creep and slope wash erosion of the Rocky Flats Alluvium and can be expected to be elongated in the north-south direction with rather limited extent in the east-west. The gravel layers range between 1.3 feet to 5.5 feet in thickness.

Bedrock Material

The Cretaceous Arapahoe Formation underlies surficial materials at the 881 Hillside Area. Six wells were completed in various zones of the bedrock in the 1986 and 1987 drilling programs. The Arapahoe Formation beneath the 881 Hillside Area consists of claystones with interbedded lenticular sandstones, siltstones, and occasional lignite deposits. The Arapahoe Formation was deposited by meandering streams flowing generally from west to cast off the Front Range. Sandstones were deposited in stream channels and as overbank splays, and claystones were deposited in back swamp and floodplain areas. Leaf fossils, organic matter, and lignite beds were encountered within the claystones during drilling at the 881 Hillside. Contacts between various lithologies are both gradational and sharp. Bedrock is estimated to dip approximately 7 degrees to the east.

Claystone bedrock was the most frequently encountered lithology or tile Arapahoe Formation immediately below the bedrock contact. Weathered bedrock was encountered directly beneath surficial materials in all of the boreholes and wells, and weathering appears to penetrate as much as 60 feet below ground surface. The weathered claystone is also characterized by moderate fracturing and thus exhibits higher hydraulic conductivities than unweathered claystone.

Arapahoe sandstones were encountered beneath the 881 Hillside Area. These sandstones range from poorly-sorted to well-sorted, subrounded to rounded, very fine- to medium-grained, poorly- to moderately-well-cemented quartz sand with up to 10% lithic fragments. The thickness of individual sandstone beds ranged between 5 to 12 feet.

2.1.5 Sensitive Environments, Surface Water, and Ground Water

2.1.5.1 Sensitive Environments

The Endangered Species Act of 1973 (Public Law 93-0205), as amended, provides that all federal agencies shall carry out programs for the conservation of listed endangered and threatened species. Federal agencies must ensure that actions authorized, funded, or carried out by them will not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitats as determined by the Secretary of the Interior.

The 881 Hillside Area is not used, nor intended for use, as a public or recreational area, nor for the development of any unique natural resource. No unique ecosystems were found at RFP during extensive biological studies. Communication with the U.S. Fish and Wildlife Service resulted in a finding of no affect on endangered species due to activities at the 881 Hillside Area.

There are no flood plains, natural wetlands, or historical /archaeological features at the 881 Hillside Area. A small wetland area has been created in the South Interceptor Ditch as a result of the discharge from the Building 881 footing drain (SWMU 107).

2.1.5.2 Surface Water

Woman Creek is an eastward-flowing, ephemeral stream located to the south of the 881 Hillside. The stream drains the southern portion of the Rocky Flats Plant site, and delivers water to Mower Reservoir and Standley Lake which are respectively used for agricultural and domestic water supply (see Figure 2-3). The South Interceptor Ditch, located between the 881 Hillside and Woman Creek, extends from south of the inner west gate entrance to Pond C-2 in the Woman Creek drainage. The ditch isolates runoff from the south side of RFP (including

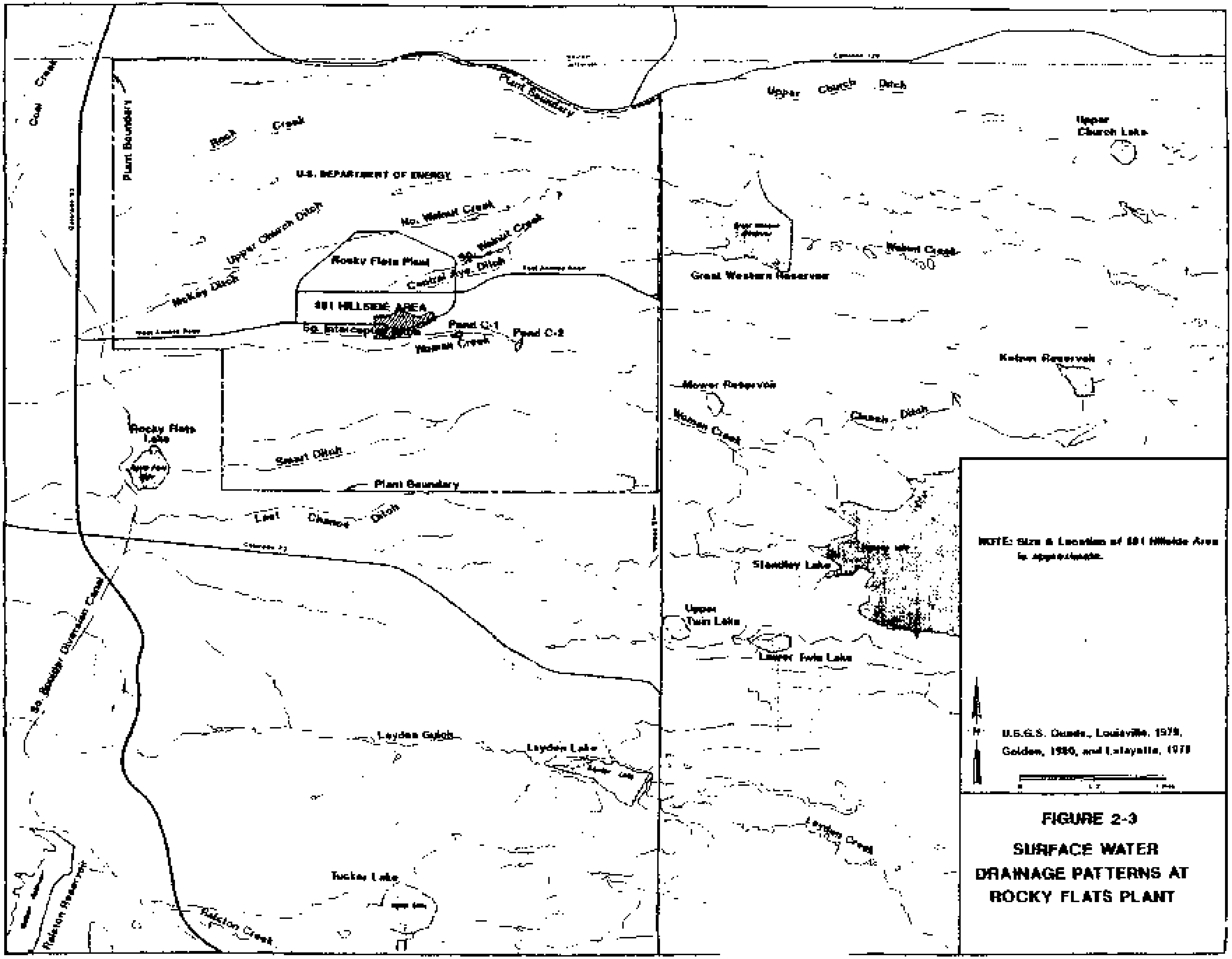


FIGURE 2-3

SURFACE WATER DRAINAGE PATTERNS AT ROCKY FLATS PLANT the 881 Hillside) from Woman Creek. Surface water flowing in an easterly direction along the South Interceptor Ditch is collected in Pond C-2, from which it is discharged to Woman Creek in accordance with the RFP National Pollutant Discharge Elimination System (NPDES) permit. The permitted discharge point is designated as 007. Pond C-1 receives flow from Woman Creek. A diversion structure located upstream of Pond C-2 diverts flow in Woman Creek around Pond C-2 and into the Woman Creek channel downstream. Along Woman Creek and the South Interceptor Ditch, retention ponds C-1 and C-2, and the associated diversion structures, control surface water discharge from the RFP site.

2.1.5.3 Ground Water

Ground water occurs in surficial materials (Rocky Flats Alluvium, colluvium, terrace alluvium, valley fill alluvium, and artificial fill) and in Arapahoe sandstones and claystones at the 881 Hillside Area. These two hydraulically connected flow systems are discussed separately below.

Ground Water in Surficial Materials

Ground water is present in surficial materials at the 881 Hillside under unconfined conditions. Recharge to the water table occurs as infiltration of incident precipitation and as seepage from ditches and creeks. The shallow ground-water flow system is quite dynamic, with large water level changes occurring in response to precipitation events and to stream and ditch flow.

Ground water flows from the Rocky Flats Alluvium at the top of the 881 Hillside south through colluvial materials toward Woman Creek. Ground water in Rocky Flat Alluvium or colluvium is hereinafter referred to as alluvial ground-water. Flow through colluvial materials primarily occurs in the gravel within the colluvium. At the Rocky Flats terrace edges, ground water emerges as seeps and springs at the contact between the alluvium and claystone bedrock (contact seeps), is consumed by evapotranspiration, or flows through colluvial materials following topography toward the valley fill and terrace alluviums. The maximum and mean ground-water velocities through colluvial materials are estimated at 780 ft/yr and 150 ft/yr, respectively. Once ground water reaches the valley, it either flows down-valley in the alluvium, is consumed by evapotranspiration, or discharges to Woman Creek. The maximum and mean ground-water velocities in Woman Creek valley fill have been estimated at 650 ft/yr and 145 ft/yr, respectively.

Bedrock Ground-Water Flow System

Ground-water flow in the Arapahoe Formation occurs primarily in the sandstones contained within the claystones. Ground-water recharge to sandstones occurs as infiltration from an alluvial ground water where sandstones subcrop beneath the alluvium and by leakage through the claystones overlying the sandstones.

There is a strong downward gradient between ground water in surficial materials and bedrock. Vertical gradient data are provided in the RI report (Rockwell International, 1988a). Calculated vertical gradients ranging from about 2 to 0.3 ft/ft indicate a hydraulic potential for downward flow. The presence of unsaturated conditions in some locations and high vertical gradients where subsurface materials arc continuously saturated indicates that the intervening material (claystone) has a very low hydraulic conductivity. Ground-water flow within individual sandstones is from west to east. The maximum horizontal ground-water velocity in sandstone is estimated at about 36 ft/yr while the mean velocity is estimated to be 12 ft/yr. Ground water moves at these rates only if the sandstone unit is continuous or has good interconnection with an adjacent unit. To date, lateral continuity of sandstone units along strike has been demonstrated to be small and only a few correlations have been made along dip.

Usable ground water occurs in the Arapahoe Aquifer. Water from the sandstones of the Arapahoe Aquifer is used for irrigation, livestock watering, and domestic purposes east of RFP.

2.1.6 Contaminants -- Description and Sources

2.1.6.1 Ground-Water Contamination

Organic contamination of alluvial ground-water at the 881 Hillside Area is evident. However, the existence of inorganic contamination in alluvial ground-water is uncertain at this time. This uncertainty is due to the limited data on background chemical conditions for alluvial ground-water. Water-quality data from well 55-86, located southwest of the plant and upgradient of all known SWMUs, is the only current data available for characterizing background ground-water chemistry. Over two years of quarterly data exist for this well.

This data has been used to preliminarily determine which constituents in ground water at the 881 Hillside Area are contaminants. Constituent concentrations in ground water at the 881 Hillside Area that exceed the upper limit of the range of concentrations in well 55-86 are presumed to represent contaminants.

A background characterization study is currently underway to provide more definitive information of the spatial and temporal variability of alluvial, colluvial, valley fill, and bedrock ground-water quality. These data will be used to better evaluate the nature and extent of inorganic contamination at the 881 Hillside and remedial action alternatives that address this contamination for the final RFI/RI and CMS/FS reports. For this interim remedial action, clean-up criteria are defined by applicable or relevant and appropriate requirements (ARARs) or proposed requirements to be considered (TBC) as discussed in Section 3. Variances from ARARs may be appropriate in the future when background chemical conditions arc adequately characterized.

Alluvial ground water is contaminated with various volatile organic compounds (VOCs) and possibly various metals, major ions, and uranium. Alluvial ground water at the 881 Hillside Area has been divided into three groups on the basis of contaminant migration pathway or nature of the contamination as follows:

1) The Building 881 footing drain discharge (SWMU 107), i.e., alluvial groundwater discharging to a surface water pathway.

2) Alluvial ground water beneath or in the immediate vicinity of the 881 Hillside Area characterized by the presence of VOCs in many of the wells.

3) Alluvial ground water downgradient of the 881 Hillside Area beyond the limits of VOC contamination.

For each of these groups, the nature of contamination is summarized in Tables 2-1, 2-2, and 2-3. Well locations are identified on Figure 2-4. Each table identifies the maximum, minimum, and average concentrations of VOCs, metals, major ions and radionuclides that were detected above estimated background concentrations. The chemical-specific ARARs are also identified in the tables.

The VOC maximum, minimum, and average concentrations reported in Tables 2-1, 2-2, and 2-3 are based on data from the first and second quarter 1989 groundwater sampling as this is the only validated VOC data available to date that was categorized acceptable. All other analytes reported in Tables 2-1, 2-2 and 2-3 use 1987 and 1988 quarterly data. The grouping of alluvial ground water wells, averaging of data, and comparison to ARAR's is only intended to provide the reader with an overview of the magnitude of ground-water contamination at and in the vicinity of the 881 Hillside Area. Clean-up of the ground water to achieve chemical-specific ARARs will be determined on a SWMU-specific basis.

The footing drain discharge is characterized by low concentrations of VOCs, and above estimated background concentrations of a few metals, major ions, and uranium. Of the VOCs, only tetrachloroethene (TCE) exceeded ARAR in 1989. Average values for total dissolved solids and mercury exceeded ARAR for the inorganic constituents; however, the high average mercury concentration is considered an artifact of including an apparent erroneous data point (0.9 ug/l). Subsequent analyses show mercury concentrations to be below ARAR. The dissolved plutonium concentration is also considered an erroneous data point because the total plutonium concentration for that sample was less than the Minimum Detectable Activity (MDA).

TABLE 2-1
VOLATILE ORGANIC COMPOUND CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR BUILDING 881 FOOTING DRAIN DISCHARGE
ALL CONCENTRATIONS IN ug/1

Analyte	Background Value		ARAR Value		Maximum Value (Reported when the maximum value exceeds Background)	Minimum Value		Average of All Values [ii]	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U							
Bromomethane	10	U							
Vinyl Chloride	10	U							
Chloroethane	10	U							
Methylene Chloride	5	U	5	U					
Acetone	10	U	50						
Carbon Disulfide	5	U	5	U					
1,1-Dichloroethene	5	U	7						
1,1-Dichloroethane	5	U	5	U [i]					
1,2-Dichloroethene (total)	5	U							
Chloroform	5	U							
1,2-Dichloroethane	5	U	5						
2-Butanone	10	U							
1,1,1-Trichloroethane	5	U	200						
Carbon Tetrachloride	5	U	5						
Vinyl Acetate	10	U							
Bromodichloromethane	5	U							
1,2-Dichloropropane	5	U							
cis-1,3-Dichloropropene	5	U							
Trichloroethene	5	U	5						
Dibromochloromethane	5	U							
1,1,2-Trichloroethane	5	U	5	U					
Benzene	5	U							
Trans-1,3-Dichloropropene	5	U							
2-Chloroethylvinylether	10	U							
Bromoform	5	U							
4-Methyl-2-pentanone	10	U							
2-Hexanone	10	U							
Tetrachloroethene	5	U	5	U	8 +	2	J	5	SW45
1,1,2,2-Tetrachloroethane	5	U							
Toluene	5	U	2000						
Chlorobenzene	5	U							
Ethylbenzene	5	U							
Styrene	5	U							
Total Xylenes	5	U							

[i] No standard, RCRA Appendix IX constituent, therefore background value is TBC. + - Value exceeds ARAR.
[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank. - Average exceeds background.

Notes: Minimum, Maximum, and Average based on 1989 first and second quarter data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: SW45

TABLE 2-1 (Continued)
INORGANIC CONSITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR BUILDING 881 FOOTING DRAIN DISCHARGE
ALL CONCENTRATIONS IN MG/L

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values[ii]	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Total Dissolved Solids	167	400	464 +	456 +	460 *	SW45
Chloride	19	250	77	74.1	76	SW45
Nitrate+Nitrite as N	1.5	10	8.50	8	8.250	SW45
Sulfate	27	250	56	44.0	50	SW45
HCO3- as CaCO3	79	NS	232 +	216 +	224	SW45

+ - Value exceeds ARAR; ______ - Average exceeds background.

[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.

NS - No Standard. U - Detection Limit. J - Present below Detection Limit. B - Present in Blank

Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values, based on upper limit of values found in well 55-86.
Wells/Stations in this group: SW45

TABLE 2-1 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR BUILDING 881 FOOTING DRAIN DISCHARGE
ALL CONCENTRATIONS IN mg/1

Analyte		Detec. Limit	Background Value		ARAR Value		Maximum Value	Minimum Value		Average of All Values[ii]	Wells/Stations in which Background Value was exceeded
							Reported when the maximum value exceeds Background				
Aluminum	(Al)	0.0290	0.223		5.0						
Antimony	(Sb)	0.0600	0.06	U	0.06	U					
Arsenic	(As)	0.0100	0.01	U	0.05						
Barium	(Ba)	0.0100	0.071		1.0		0.1547	0.1547		0.0799	SW45
Beryllium	(Be)	0.0050	0.005	U	0.1						
Cadmium	(Cd)	0.0050	0.005	U	0.01						
Calcium	(Ca)	0.7500	33.8		NS		85.342	78.0		82	SW45
Cesium	(Cs)	0.0200	0.02	U	NS						
Chromium	(Cr)	0.0100	0.026		0.05						
Copper	(Cu)	0.0063	0.046		0.2						
Iron	(Fe)	0.0069	0.162		0.3						
Lead	(Pb)	0.0050	0.016		0.05						
Lithium	(Li)	0.1000	0.1	U	2.5						
Magnesium	(Mg)	0.0500	5.9		NS		21.0	19.021		20	SW45
Manganese	(Mn)	0.0051	0.066		0.05						
Mercury	(Hg)	0.0002	0.0002	U	0.002		0.90 +	0.0002	U	0.3001 +	SW45
Molybdenum	(Mo)	0.0220	0.022	U	0.1						
Nickel	(Ni)	0.0370	0.037	U	0.20						
Potassium	(K)	0.5000	0.8		NS		3.8	3.8		1.4333	SW45
Selenium	(Se)	0.0050	0.005	U	0.01		0.018 +	0.005	U	0.0077	SW45
Silver	(Ag)	0.0076	0.083		0.05						
Sodium	(Na)	2.1000	13.1		NS		46	41.461		44	SW45
Strontium	(Sr)	0.0200	0.15		NS		0.7	0.6411		0.6705	SW45
Thallium	(Tl)	0.0100	0.01	U	0.01	U					
Vanadium	(V)	0.0240	0.024		0.1						
Zinc	(Zn)	0.0200	0.164		2.0		0.6	0.0426		0.2175	SW45

\+ - Value exceeds ARAR; ______ - Average exceeds background.

[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.

NS-No Standard. U-Detection Limit. J Present below Detection Limit. B Present in Blank

Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: SW45

TABLE 2-1 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR BUILDING 881 FOOTING DRAIN DISCHARGE
ALL CONCENTRATIONS IN pCi/1

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values [ii]	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Gross Alpha	5	15	13.4	13.4	13	SW45
Gross Beta	14	50	15.1	15.1	15	SW45
Strontium 89, 90	1.0 [iii]	8				
Plutonium 239, 240	.01 [iii]	15	2.57	2.57	2.6	SW45
Americium 241	.01 [iii]	4				
Tritium	400 [iii]	20000				
Total Uranium	1.8 [iii]	40	10.2	10.2	10	SW45

\+ - Value exceeds ARAR/; ______ - Average exceeds background.
[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates a less than (<) value, or the counting error for a datum is greater than the datum, the value used in the computation is one half the minimum detectable activity (MDA).
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank [iii] MDA Minimum Detectable Activity

Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background value based on upper limit of values found in well 55-86.
Wells/Stations in this group: SW45

TABLE 2-2
VOLATILE ORGANIC COMPOUND CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS AT THE 881 HILLSIDE
ALL CONCENTRATIONS IN ug/l

Analyte	Background Value		ARAR Value		Maximum Value (Reported when the maximum value exceeds Background)		Minimum Value		Average of All Values [ii]	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U								
Bromomethane	10	U								
Vinyl Chloride	10	U								
Chloroethane	10	U								
Methylene Chloride	5	U	5	U						
Acetone	10	U	50							
Carbon Disulfide	5	U	5	U						
1,1-Dichloroethene	5	U	7		7900	J +	5	U	2177 +	0974, 4387
1,1-Dichloroethane	5	U	5	U [i]	180	J +	5	U	40 +	0974, 4387
1,2-Dichloroethene (total)	5	U								
Chloroform	5	U								
1,2-Dichloroethane	5	U	5		17	J +	5	U	7 +	0974, 4387
2-Butanone	10	U								
1,1,1-Trichloroethane	5	U	200		15000 +		5	U	3310 +	0974, 1074, 4387
Carbon Tetrachloride	5	U	5		2400	J +	5	U	203 +	1074, 0487
Vinyl Acetate	10	U								
Bromodichloromethane	5	U								
1,2-Dichloropropane	5	U								
cis-1,3-Dichloropropene	5	U								
Trichloroethene	5	U	5		11000 +		5	U	2943 +	0974, 1074, 0487, 4387
Dibromochloromethane	5	U								
1,1,2-Trichloroethane	5	U	5	U	47	J +	5	U	15 +	0974, 4387
Benzene	5	U								
Trans-1,3-Dichloropropene	5	U								
2-Chloroethylvinylether	10	U								
Bromoform	5	U								
4-Methyl-2-pentanone	10	U								
2-Hexanone	10	U								
Tetrachloroethene	5	U	5	U	5900	J +	2	J	1076 +	0974, 1074, 0487, 4387
1,1,2,2-Tetrachloroethane	5	U								
Toluene	5	U	2000							
Chlorobenzene	5	U								
Ethylbenzene	5	U								
Styrene	5	U								
Total Xylenes	5	U								

[i] No standard, RCRA Appendix IX constituent, therefore background value is TBC. + - Value exceeds ARAR.
[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank. Average exceeds background.

Notes: Minimum, Maximum, and Average based on 1989 first and second quarter data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: 0974, 1074, 0187, 0487, 0687, 4387, 4987, 5087, 5187, 5287, 5387, 5487

TABLE 2-2 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS AT THE 881 HILLSIDE
ALL CONCENTRATIONS IN mg/1

Reported when the maximum value exceeds Background

Analyte		Detec. Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values[ii]	Wells/Stations in which Background Value was exceeded
Aluminum	(Al)	0.0290	0.223	5.0				
Antimony	(Sb)	0.0600	0.06 U	0.06 U	0.0798 %	0.006 J	0.0387	0974, 1074, 0487, 5287
Arsenic	(As)	0.0100	0.01 U	0.05				
Barium	(Ba)	0.0100	0.071	1.0	0.1774	0.0382	0.0922	0974, 0487, 0687, 4387, 5287
Beryllium	(Be)	0.0050	0.005 U	0.1				
Cadmium	(Cd)	0.0050	0.005 U	0.01				
Calcium	(Ca)	0.7500	33.8	NS	355.99	85.697	184	0974, 1074, 0487, 0687, 4387, 5287
Cesium	(Cs)	0.0200	0.02 U	NS	0.04 J	0.02 U	0.0111	0487
Chromium	(Cr)	0.0100	0.026	0.05	0.0782 %	0.0100 U	0.0086	0487
Copper	(Cu)	0.0063	0.046	0.2	0.9515 %	0.0063 U	0.0937	4387
Iron	(Fe)	0.0069	0.162	0.3	0.1739	0.0063 U	0.0322	0687
Lead	(Pb)	0.0050	0.016	0.05				
Lithium	(Li)	0.1000	0.1 U	2.5	0.7	0.02	0.1289	0974
Magnesium	(Mg)	0.0500	5.9	NS	73.274	19.547	44	0974, 1074, 0487, 0687, 4387, 5287
Manganese	(Mn)	0.0051	0.066	0.05	0.9586 %	0.0051 U	0.2405 +	0487, 0687, 4387, 5287
Mercury	(Hg)	0.0002	0.0002 U	0.002	0.0003	0.0002 U	0.0001	0687
Molybdenum	(Mo)	0.0220	0.022 U	0.1	0.0265	0.0220 U	0.0122	1074, 4387
Nickel	(Ni)	0.0370	0.037 U	0.20	0.8644 %	0.0370 U	0.1899	0487, 0687, 4387, 5287
Potassium	(K)	0.5000	0.8	NS	12.3	0.5	2.3500	0974, 1074, 0487, 0687, 4387, 5287
Selenium	(Se)	0.0050	0.005 U	0.01	3.2 +	0.003 J	0.5962 +	0974, 1074, 0487, 0687, 4387
Silver	(Ag)	0.0076	0.083	0.05				
Sodium	(Na)	2.1000	13.1	NS	341.74	124.79	196	0974, 1074, 0487, 0687, 4387, 5287
Strontium	(Sr)	0.0200	0.15	NS	2.4291	0.7136	1.4372	0974, 1074, 0487, 0687, 4387, 5287
Thallium	(Tl)	0.0100	0.01 U	0.01 U				
Vanadium	(V)	0.0240	0.024	0.1	0.0302	0.0240 U	0.0125	0487
Zinc	(Zn)	0.0200	0.164	2.0	2.4500 %	0.0200 U	0.3067	1074, 4387, 5287

+ - Value exceeds ARAR; ______- Average exceeds background.

[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.

NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank

Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: 0974, 1074, 0187, 0487, 0687, 4387, 4487, 4987, 5087, 5187, 5287, 5387, 5487

TABLE 2-2 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS AT THE 881 HILLSIDE
ALL CONCENTRATIONS IN MG/L

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values ¡¡	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Total Dissolved Solids	167	400	2374 +	700 +	1345 +	0974, 1074, 0487, 0687, 4387, 5287
Chloride	19	250	458 +	2.90	2 51 +	0974, 1074, 0487, 0687, 4387, 5287
Nitrate+Nitrite as N	1.5	10	55 +	0.02 U	11 +	0974, 1074, 0487, 4387
Sulfate	27	250	700 +	133	297 +	0974, 1074, 0487, 0687, 4387, 5287
HCO3- as CaCO3	79	NS	502 +	112 +	317	0974, 1074, 0487, 0687, 4387, 5287

+ - Value exceeds ARAR; _____ - Average exceeds background.
ùù The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank
Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: 0974, 1074, 0187, 0487, 0687, 4387, 4487, 4987, 5087, 5187, 5287, 5387, 5487

TABLE 2-2 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS AT THE 881 HILLSIDE
ALL CONCENTRATIONS IN pCi/1

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values [ii]	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Gross Alpha	5	15	319 +	< 2.00	43 +	0974, 1074, 0187, 0487, 0687, 4387, 5287
Gross Beta	14	50	286 +	< 4.00	25	0974, 0487, 0687, 4387, 5287
Strontium 89, 90	1.0 [iii]	8	2.1	< 1.00	1.2	0487, 0687
Plutonium 239, 240	.01 [iii]	15				
Americium 241	.01 [iii]	4				
Tritium	400 [iii]	20000	777	<400.00	222	0487
Total Uranium	1.8 [iii]	40	54.6 +	8.7	29	0974, 1074, 0187, 0487, 0687, 4387, 5287

+ - Value exceeds ARAR/; ______- Average exceeds background.

[ûû] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates a less than (<) value, or the counting error for a datum is greater than the datum, the value used in the computation is one half the minimun detectable activity (MDA).

NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank ***MDA-Minimum Detectable Activity

Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper Limit of values found in well 55-86.
Wells/Stations in this group: 0974, 1074, 0187, 0487, 0687, 4387, 4487, 4987, 5087, 5187. 5287, 5387, 5487

TABLE 2-3
VOLATILE ORGANIC COMPOUND CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE
ALL CONCENTRATIONS IN ug/1

Analyte	Background Value		ARAR Value		Maximum Value (Reported when the maximum value exceeds Background)		Minimum Value		Average of All Values [ii]	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U								
Bromomethane	10	U								
Vinyl Chloride	10	U								
Chloroethane	10	U								
Methylene Chloride	5	U	5	U	17	B +	5	U	3	0287
Acetone	10	U	50		19		2	J	7	5587
Carbon Disulfide	5	U	5	U						
1,1-Dichloroethene	5	U	7							
1,1-Dichloroethane	5	U	5	U [i]						
1,2-Dichloroethene (total)	5	U								
Chloroform	5	U								
1,2-Dichloroethane	5	U	5							
2-Butanone	10	U								
1,1,1-Trichloroethane	5	U	200							
Carbon Tetrachloride	5	U	5							
Vinyl Acetate	10	U								
Bromodichloromethane	5	U								
1,2-Dichloropropane	5	U								
cis-1,3-Dichloropropene	5	U								
Trichloroethene	5	U	5							
Dibromochloromethane	5	U								
1,1,2-Trichloroethane	5	U	5	U						
Benzene	5	U								
Trans-1,3-Dichloropropene	5	U								
2-Chloroethylvinylether	10	U								
Bromoform	5	U								
4-Methyl-2-pentanone	10	U								
2-Hexanone	10	U								
Tetrachloroethene	5	U	5	U	35	J +	5	U	5 +	6486, 0287
1,1,2,2-Tetrachloroethane	5	U								
Toluene	5	U	2000							
Chlorobenzene	5	U								
Ethylbenzene	5	U								
Styrene	5	U								
Total Xylenes	5	U								

[i] No standard, RCRA Appendix IX constituent, therefore background value is TBC. + - Value exceeds ARAR.
[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank. ___ Average exceeds background.
Notes: Minimum, Maximum, and Average based on 1989 first and second quarter data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: 6486, 6586, 6686, 6986, 0287, 4787, 4887, 5587

TABLE 2-3 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE
ALL CONCENTRATIONS IN mg/1

Analyte		Detec. Limit	Background Value	ARAR Value	Reported when the maximum value exceeds Background: Maximum Value	Minimum Value	Average of All Values[ii]	Wells/Stations in which Background Value was exceeded
Aluminum	(Al)	0.0290	0.223	5.0	0.2600	0.0290 U	0.0441	6586, 0287
Antimony	(Sb)	0.0600	0.06 U	0.06 U	0.0618 %	0.02 U	0.0321	6986
Arsenic	(As)	0.0100	0.01 U	0.05				
Barium	(Ba)	0.0100	0.071	1.0	0.3110	0.0411	0.1326	6486, 6586, 6686, 6986. 0287, 4887
Beryllium	(Be)	0.0050	0.005 U	0.1				
Cadmium	(Cd)	0.0050	0.005 U	0.01				
Calcium	(Ca)	0.7500	33.8	NS	299.33	24.184	114	6486, 6586, 6686, 6986, 0287, 4887
Cesium	(Cs)	0.0200	0.02 U	NS				
Chromium	(Cr)	0.0100	0.026	0.05				
Copper	(Cu)	0.0063	0.046	0.2	0.3270 %	0.0063 U	0.0621	4887
Iron	(Fe)	0.0069	0.162	0.3	0.4065 %	0.0069 U	0.0446	6586, 0287
Lead	(Pb)	0.0050	0.016	0.05	0.024	0.001 J	0.0039	6586, 6686
Lithium	(Li)	0.1000	0.1 U	2.5				
Magnesium	(Mg)	0.0500	5.9	NS	95.507	5.4617	34	6486, 6586, 6686, 6986, 0287, 4887
Manganese	(Mn)	0.0051	0.066	0.05	0.5431 %	0.0051 U	0.1788 +	6486, 6586, 6686, 0287, 4887
Mercury	(Hg)	0.0002	0.000 U 2	0.002	0.006 %	0.0001 J	0.0004	6486, 6986, 0287
Molybdenum	(Mo)	0.0220	0.022 U	0.1	0.0533	0.0220 U	0.0204	6486, 0287, 4887
Nickel	(Ni)	0.0370	0.037 U	0.20	1.1827 %	0.0370 U	0.2377 +	6486, 6586, 6686, 6986, 4887
Potassium	(K)	0.5000	0.8	NS	7.0	0.7	2.2887	6486, 6586, 6686, 6986, 0287, 4887
Selenium	(Se)	0.0050	0.005 U	0.01	0.24 +	0.002 J	0.0297 +	6486, 6986, 4887
Silver	(Ag)	0.0076	0.083	0.05				
Sodium	(Na)	2.1000	13.1	NS	211.34	21.123	114	6486, 6586, 6686, 6986, 0287, 4887
Strontium	(Sr)	0.0200	0.15	NS	2.9066	0.1450	1.0202	6486, 6586, 6686, 6986, 0287, 4887
Thallium	(Tl)	0.0100	0.01 U	0.01 U				
Vanadium	(V)	0.0240	0.024	0.1	0.0368	0.0240 U	0.0130	6486
Zinc	(Zn)	0.0200	0.164	2.0	2.4559 %	0.02	0.4357	4887

+ - Value exceeds ARAR; _____ - Average exceeds background.
[ii] The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank
Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper limit of values found in well 55-86.
Wells/Stations in this group: 6486, 6586, 6686, 6986, 0287, 4787, 4887, 5587

TABLE 2-3 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE
ALL CONCENTRATIONS IN MG/L

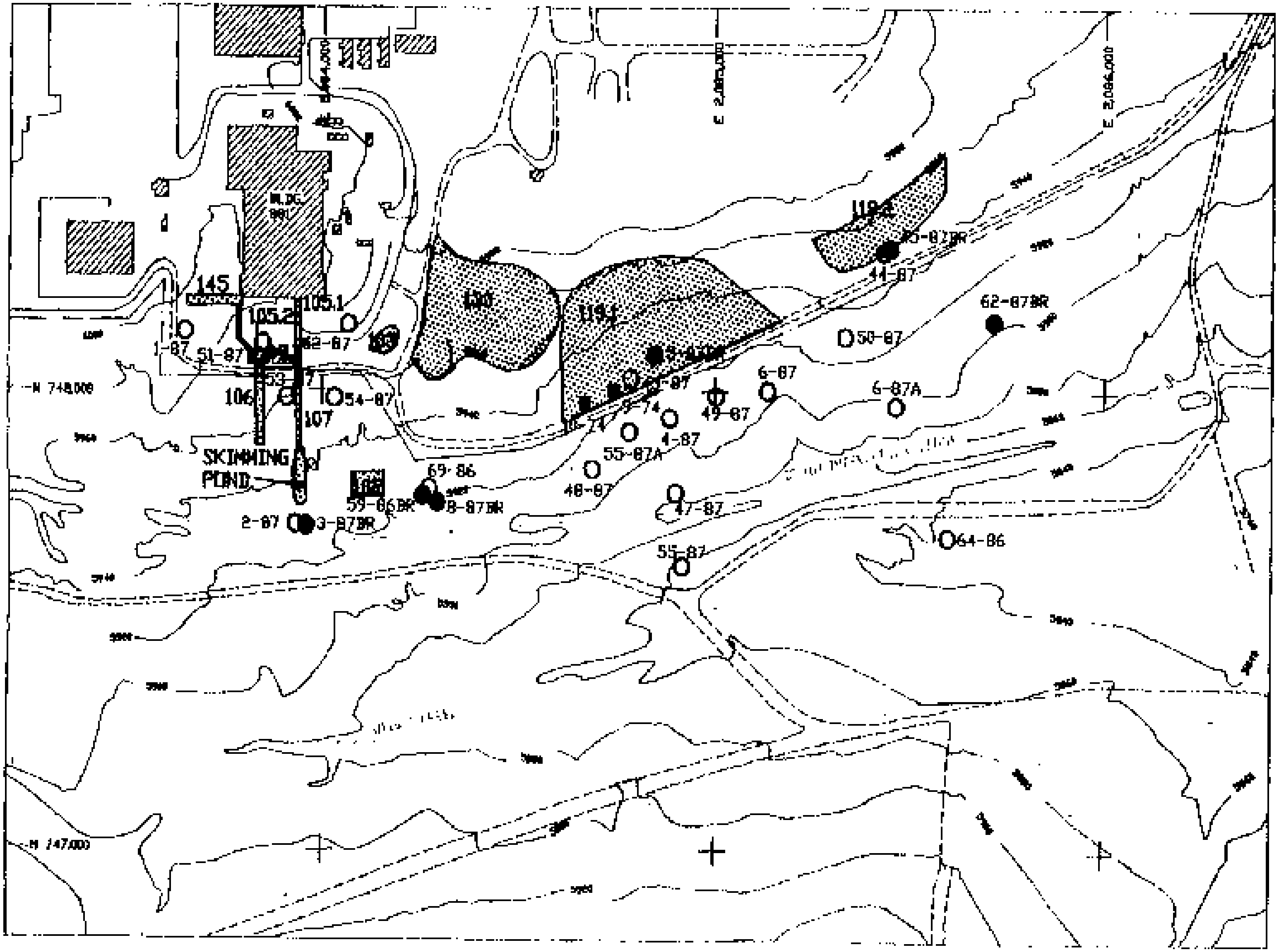
Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values ⁱⁱ	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Total Dissolved Solids	167	400	2081 +	163	816 +	6486, 6586, 6686, 6986, 0287, 4887
Chloride	19	250	838 +	17.0	188	6486, 6586, 6686, 6986, 0287, 4887
Nitrate+Nitrite as N	1.5	10	4.29	0.02 U	0.674	6986, 0287
Sulfate	27	250	270 +	24.8	139	6486, 6586, 6686, 6986, 0287, 4887
HCO3- as CaCO3	79	NS	401 +	73.9 +	245	6486, 6586, 6686, 6986, 0287, 4887

+ - Value exceeds ARAR; _____ - Average exceeds background.
ùù The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank
Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper Limit of values found in well 55-86.
Wells/Stations in this group: 6486, 6586, 6686, 6986, 0287, 4787, 4887, 5587

TABLE 2-3 (continued)
DISSOLVED RADIOCHEHISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE
ALL CONCENTRATIONS IN pCi/1

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values ⁱⁱ		Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background				
Gross Alpha	5	15	100 +	< 2.00	19	+	6486, 6586, 6686, 6986, 0287, 4887,
Gross Beta	14	50	254 +	< 4.00	18		6986, 0287
Strontium 89, 90	1.0 ⁱⁱⁱ	8	5.6	< 1.00	3.3		6586, 6986, 0287
Plutonium 239, 240	.01 ⁱⁱⁱ	15	0.211	< 0.01	0.014		0287
Americium 241	.01 ⁱⁱⁱ	4					
Tritium	400 ⁱⁱⁱ	20000	510	<400.00	211		6986
Total Uranium	1.8 ⁱⁱⁱ	40	19.0	< 1.80	9.3		6486, 6586, 6986, 0287, 4887

+ - Value exceeds ARAR; _____ - Average exceeds background.
ⁱⁱ The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group. If a datum indicates non-detected, the value used in the computation is one-half the detection limit.
NS-No Standard. U-Detection Limit. J-Present below Detection Limit. B-Present in Blank ⁱⁱⁱMDA-Minimum Detectable Activity
Notes: Minimum, Maximum, and Average based on 1987/1988 Quarterly Data.
Background values based on upper Limit of values found in well 55-86.
Wells/Stations in this group: 6486, 6586, 6686, 6986, 0287, 4787, 4887, 5587



EXPLANATION

62-87BR ●	BEDROCK MONITOR WE
64-86 O	ALLUVIAL MONITOR WE
9-74 ■	PRE-1986 WELL
119.1	SOLID WASTE MANAGE UNITS

FIGURE 2-4

WELL LOCATIONS AT 88 HILLSIDE AREA

Alluvial ground water at the 881 Hillside Area is characterized by significant VOC contamination. High concentrations of VOCs are notably present in the vicinity of SWMU 119.1 at well 9-74. The maximum concentration for most of the metals exceed estimated alluvial ground-water background concentrations and ARARs. However, only the ARARs for manganese and selenium are exceeded for the average concentrations. Total dissolved solids, chloride, nitrate-nitrite, and sulfate have average values that exceed ARARs. Average dissolved strontium and uranium concentrations exceed background, but not ARAR.

Downgradient of the 881 Hillside Area, the alluvial ground-water chemistry is characterized by the absence of VOC contamination, with the exception of low concentrations of methylene chloride, acetone, and tetrachloroethene. The methylene chloride and acetone are suspected laboratory contaminants because of their presence in laboratory blanks. The tetrachloroethene was detected only in the first quarter 1989 in wells 64-86 and 2-87 at estimated concentrations below detection limits, and was not detected in these wells during second quarter 1989. Average concentrations of several metals, major ions, and strontium (89 + 90) and uranium are above the estimated background for alluvial ground water. Concentrations of these inorganic constituents are somewhat lower than at the 881 Hillside Area, and nitrate, chloride, and sulfate do not exceed ARAR on the average. Inorganic constituents have apparently migrated from the 881 Hillside Area, but organic contaminants have not migrated to any appreciable extent. There was only one occurrence of plutonium at a concentration above the minimum detectable activity (MDA). This occurred in well 2-87. Of the six plutonium concentrations measured at well 2-87, all except this one were below the MDA.

Volatile organic compounds are at high concentrations in the proximity of SWMU 119.1, but decrease to non-detcctable concentrations within approximately 300 feet (Rockwell International, 1988a). This rapid reduction in concentrations is in good agreement with the results of the soil gas surveys. The analysis of bedrock ground water for possible contamination is under investigation. A detailed sampling and analysis program of existing bedrock monitoring wells and background monitoring wells is currently being conducted.

2.1.6.2 Soil Contamination

Volatile organics data previously collected from the 881 Hillside Area have been rejected during the data validation process. Although these data cannot be used to definitely determine the extent of volatile organics contamination in this area, the data is summarized here because they likely provide some indication of the spatial distribution of organic contamination in the soils and the relative magnitude of the contamination.

Methylene chloride, acetone, and phthalates were generally ubiquitous contaminants in the samples collected from the 881 Hillside Area. There has been considerable debate as to whether they are truly contaminants of the soils. Methylene chloride and acetone may be laboratory contaminants because of the relatively high levels in many of the laboratory blanks. It is believed that the phthalate contamination may have resulted from sample handling with plastic gloves, however, no testing has been performed to verify this hypothesis.

Volatile chlorinated hydrocarbon contamination is apparently not extensive. It occurred above detection limits in soils from only 3 of the 23 boreholes. The highest concentrations detected were tetrachloroethene (PCE) at 190 micrograms per kilogram (Fg/kg), trichloroethene (TCE) at 150 Fg/kg, and 1,1,1-TCA at 110 Fg/kg. The actual maximum concentration of these compounds is unknown because they occurred in composite samples.

2.1.6.3 Surface-Water Contamination

Surface waters of Woman Creek and the South Interceptor Ditch flow to Ponds C-1 and C-2, respectively. Discharge from the ponds to Woman Creek is monitored in accordance with RFP's NPDES permit. Recently collected valid analytical data for the ponds indicates no VOCs are present, and radionuclides, metals, and major ions are within the estimated background levels identified in Section 6 of the 881 Hillside Area Draft Final Remedial Investigation Report for High Priority Sites (Rockwell International, 1988a). VOCs are present in the 881 Building footing drain which flows to Pond C-2; however VOCs are not found in

Pond C-2. Elevated levels of uranium-238 occur in the South Interceptor Ditch upgradient of the 881 Hillside Area, but concentrations decrease to background levels at Pond C-2. As part of the final RFI/RI, additional data will be gathered to re-evaluate the presence of contaminants in the surface water.

2.1.6.4 Sediment Contamination

Due to the presence of acetone and methylene chloride in laboratory blanks run with the sediment analyses, the presence of volatiles in the sediment samples cannot be confirmed. Additional sampling and analysis will be performed and evaluated as part of the final RFI/RI report.

2.2 ANALYTICAL DATA

Organic and inorganic contaminants exist in the ground water beneath the 881 Hillside Area. Appendix 1 lists the results of volatile organic and inorganic analyses from alluvial ground-water samples collected at the 881 Hillside Area from 1987 and 1988. Volatile organic analysis for the first and second quarter 1989 are also included.

2.3 SITE CONDITIONS THAT JUSTIFY AN IRA

There is no immediate threat to the public health and environment posed by groundwater contaminants at the 881 Hillside Area because the affected water is contained within the plant boundary. However, an unacceptable risk would be posed to the public by consumption of the contaminated alluvial ground water at or immediately downgradient of the 881 Hillside Area. Although consumption of this water is not likely, an IM/IRA will be implemented in order to prevent further contaminant migration from the 881 Hillside Area that could otherwise exacerbate final cleanup efforts at the site.

SECTION 3.0

IDENTIFICATION OF INTERIM REMEDIAL ACTION OBJECTIVES

3.1 DETERMINATION OF REMEDIAL ACTION SCOPE

The overall objective of the IM/IRA at the 881 Hillside Area is prevention of release and migration of alluvial ground-water contaminants downgradient, and the cleanup of alluvial ground-water contamination to within acceptable levels. The effort is to be performed in the interest of protecting public health as well as the environment.

Specific objectives of the IM/IRA are:

- Contain, reduce, and/or eliminate site contaminants identified as posing potential threats to human health or the environment.
- Reduce or eliminate exposure to site contaminants for potential receptors by controlling potential contaminant pathways.
- Demonstrate technical feasibility and environmental and cost effectiveness of the interim remedial action.

3.2 INTERIM REMEDIAL ACTON SCHEDULE

ACTIVITY	TIME FRAME
IM/IRA Plan	
Draft IM/IRA Plan	1 July 89 - 15 September 89
EPA/CDH Review	15 September - 22 September 89
Proposed IM/IRA Plan	25 September 89 - 6 October 89
IM/IRA Plan Public Review	12 October 89 - 27 November 89
Respond to Public Comments and Finalize Plan	28 November 89 - 5 January 90
Design	
Building Foundation & Slab (Phase I)	1 November 88 - 25 August 89
Tanks	1 November 88 - 7 August 89
UV/Peroxide Treatment System	1 November 88 - 18 August 89
Ion Exchange System	7 August 89 - 2 February 90
Building and Tank Foundations (Phase II)	14 August 89 - 10 November 89
Subsurface Investigation	15 January 90 - 10 May 90
Collection System	14 May 90 - 15 October 90

ACTIVITY	TIME FRAME
Procurement	
Influent Storage Tanks	7 August 89 - 27 October 89
UV/Peroxide System	18 August 89 - 10 August 90
Effluent Storage Tanks	15 January 90 - 23 April 90
Ion Exchange System	2 February 90 - 10 August 90
Construction	
Building Foundation and Slab Construction Contracting	2 January 90 - 15 January 90
Building Foundation and Slab Construction	15 January 90 - 7 May 90
Building and Tank Foundations Construction Contracting	12 February 90 - 6 April 90
Building and Tank Foundations Construction	7 May 90 - 24 August 90
Treatment System Construction Contracting	4 June 90 - 27 July 90
Treatment System Construction	24 August 90 - 18 December 90
Ground-Water Collection and Treatment *	19 December 90 - 21 January 91
Drain Collection System Construction Contracting	29 October 90 - 21 December 90
Drain Collection System Construction**	22 January 91 - 26 April 91
Drain Water Collection and Treatment (complete system)	26 April 91

* Ground water will be withdrawn from a well at SWMU 119.1 and treated as part of start-up and testing.

**Ground water collected from trench dewatering will be treated.

3.3 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Response actions at Superfund sites must meet two fundamental clean-up requirements. First, they must attain a level of cleanup which, at a minimum, ensures protection of human health and the environment [CERCLA Section 121(d)(2), 42 U.S.C. Section 9621(d)(2)]. Second, it is EPA policy that CERCLA cleanups attain or exceed the requirements of all applicable or relevant and appropriate federal and state health and environmental requirements (ARARs). This section identifies and analyzes ARARs relevant to the IM/IRA at the 881 Hillside Area. This remedial action is considered an on-site IM/IRA; therefore, only substantive and not administrative requirements apply.

"Applicable standards" may be defined as substantive environmental protection requirements, criteria, or limitations, promulgated under federal or state law, that specifically address a hazardous substance, pollutant, contaminant, response action, location, or other circumstances at a Superfund site. "Relevant and appropriate requirements" are those substantive environmental protection requirements, promulgated under federal or state law, that, while not jurisdictionally applicable to circumstances at the site, address problems sufficiently similar to those encountered at the site that their use is well suited to the particular site. ARARs must be identified on a site-specific, case-by-case basis.

In general, there are three categories of potential ARARs at any Superfund site. These categories are:

- Ambient or chemical-specific requirements.
- Locational requirements.
- Performance, design, or other action-specific requirements. Each category is discussed in more detail below.

3.3.1 Ambient or Chemical-Specific Requirements

Ambient or chemical-specific requirements set health- or risk-based concentration limits in various environmental media for specific hazardous substances or pollutants. These requirements set protective clean-up levels for the chemicals of concern in the designated media, or indicate a safe level of air emission or wastewater discharge.

Chemical-specific ARARs are derived primarily from federal and state health and environmental statutes and regulations. Health Effects Assessments, Health Advisories, Chemical Advisories, and Guidance Documents may also be considered when establishing clean-up standards, but are not considered to be ARARs. These and any proposed standards are classified as items to be considered, or TBCs. Where background concentrations for constituents are above the chemical-specific ARAR for that constituent, a variance from the ARAR is appropriate. A summary of chemical-specific ARARs for the contaminants found at the 881 Hillside Area is presented in Table 3-1. When more than one chemical-specific ARAR has been identified for a contaminant, a screening process is used to determine the specific ARAR to be applied. This screening process involves three steps as outlined below:

TABLE 3-1.1
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT THE 881 HILLSIDE AREA

Chemical	Maximum In 881 Hillside Area Alluvial Ground Water[a]	ARAR (ug/l)	Standard Criteria or Guidance	Comment
Organic Compounds				
Acetone	19	50	RCRA LDR is relevant and appropriate (R&A)	ARAR is not exceeded
Carbon Tetrachloride	2400J	5	CDH Surface Water; Drinking Water Standard is applicable	ARAR is exceeded
1,1 Dichloroethane	180J	5U	RCRA Subpart F, Appendix IX Substance is TBC	TBC is exceeded
1,2 Dichloroethane	17J	5	CDH Surface Water; Drinking Water Standard is applicable	ARAR is exceeded
1,1 Dichloroethene	7900J	7	CDH Surface Water; Drinking Water Standard is applicable	ARAR is exceeded
Methylene Chloride	17B	5U	RCRA Subpart F is R&A	ARAR is exceeded
Tetrachloroethene	5900J	5U	CDH Surface Water; Fish and Water Ingestion Standard is applicable	ARAR is exceeded
Toluene	5J	2000	SDWA MCLG is R&A	ARAR is not exceeded
1,1,1 Trichloroethane	15,000	200	CDH Surface Water; Drinking Water Standard is applicable	ARAR is not exceeded
1,1,2 Trichloroethane	47J	5U	CDH Surface Water; Fish and Water Ingestion Standard is applicable	ARAR is exceeded
Trichloroethene	11,000	5	CDH Surface Water; Drinking Water Standard is applicable	ARAR is exceeded
Carbon Disulfide	3J	5U	CDH Surface Water; Drinking Water Standard is applicable	ARAR is not exceeded

TABLE 3.1-2
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT THE 881 HILLSIDE AREA

Chemical	Maximum In 881 Hillside Area Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Metals				
Aluminum	0.26	5.0	CDH Agriculture Standard is applicable	ARAR is not exceeded
Antimony	0.0798	0.06U	RCRA Subpart F is R&A	ARAR is exceeded
Arsenic	0.010	0.05	CDH Surface Water; Drinking Water Standard is applicable	ARAR is not exceeded
Barium	0.3110	1.0	CDH Surface Water; Drinking Water Standard is applicable	ARAR is not exceeded
Beryllium	0.003J	0.1	CDH Agriculture Standard is applicable	ARAR is not exceeded
Cadmium	0.0017	0.01	CDH Surface Water; Drinking Water Standard is applicable	ARAR is not exceeded
Calcium	355.99	NS	No Standard	--
Cesium	0.04J	NS	No Standard	Background is TBC
Chromium III	0.0782	.05	CDH Surface Water; Drinking Water Standard is applicable	Analytical result is total chromium. ARAR may be exceeded
Chromium VI	0.0782	.05	CDH Surface Water; Drinking Water Standard is applicable	Analytical result is total chromium. ARAR may be exceeded
Copper	0.9515	0.2	CDH Agriculture Standard is applicable	ARAR is exceeded

TABLE 3-1.2 (cont.)
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT THE 881 HILLSIDE AREA

Chemical	Maximum In 881 Hillside Area Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Metals (cont.)				
Iron	0.4065	0.3	CDH Surface Water; Drinking Water Standard is applicable	Analytical results are soluble Iron; soluble iron exceeds ARAR
Lead	0.024	0.05	CDH Surface Water; Drinking Water Standard is applicable	ARAR is not exceeded not exceeded
Lithium	0.7	2.5	CDH Ground Water Standard is applicable	ARAR is not exceeded
Magnesium	95.507	NS	No Standard	--
Manganese	0.9586	0.05	CDH Surface Water; Drinking Water Standard is applicable	Analytical results are soluble manganese; ARAR is exceeded
Mercury	0.9	0.002	CDH Surface Water; Drinking Water Standard is applicable	ARAR is exceeded
Molybdenum	0.0533	0.1	CDH Agriculture Standard is applicable	ARAR is not exceeded
Nickel	1.1827	0.2	CDH Agriculture Standard is applicable	ARAR is exceeded
Potassium	12.3	NS	No Standard	--
Selenium	3.2	0.01	CDH Surface Water; Drinking Water Standard is applicable	ARAR is exceeded

TABLE 3-1.2 (cont.)
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT THE 881 HILLSIDE AREA

Chemical	Maximum In 881 Hillside Area Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Metals (cont.)				
Silver	0.0094	0.05	CDH Surface Water; Drinking Water Standards is applicable	ARAR is not exceeded
Sodium	341.74	NS	No Standard	–
Strontium	2.9066	NS	No Standard	Background is TBC
Thallium	0.01	0.01U	RCRA Subpart F is R&A	ARAR is exceeded
Vanadium	0.0368	0.1	CDH Agriculture Standard is applicable	ARAR is not exceeded
Zinc	2.4559	2.0	CDH Agriculture Standard is applicable	ARAR is exceeded

TABLE 3-1.3
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT THE 881 HILLSIDE AREA

Chemical	Maximum In 881 Hillside Area Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Conventional Pollutants				
pH	5.6-8.5	6.5-9.0	CDH Ground Water Standard is applicable	ARAR is exceeded
Nitrite	-	1.0	CDH Ground Water Standard is applicable	Analytical results are total nitrate plus nitrate nitrogen. Reanalysis required to determine if nitrite ARAR is exceeded.
Nitrate	55	10.0	CDH Ground Water Standard is applicable	Analytical results are total nitrate nitrogen. Results indicate that nitrate ARAR is exceeded.
Chloride	838	250	CDH Ground Water Standard is applicable	ARAR is exceeded
Sulfate	700	250	CDH Ground Water Standard is applicable	ARAR is exceeded
Bicarbonate as $CaCO_3$	502	NS	No Standard	
T.D.S.	2374	400	CDH Ground Water Standard is applicable	ARAR is exceeded

TABLE 3-1.4
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT THE 881 HILLSIDE AREA

Chemical	Maximum In 881 Hillside Area Alluvial Ground Water[b] (pCi/l)	ARAR (pCi/l)	Standard Criteria or Guidance	Comment
Radionuclides				
Gross Alpha	319	15	CDH Ground Water Standard is is applicable	ARAR is exceeded
Gross Beta	286	50[d]	SDWA MCL is applicable	ARAR is exceeded
$_{Pu}$ 238,239,240	<0.1[c]	15	CDH Surface Water Standard is applicable	ARAR is not exceeded
$_{Am}$241	<0.1[c]	4	CDH Surface Water Standard is applicable	ARAR is not exceeded
$_{H}$3	777	20,000	CDH Surface Water Standard is applicable	ARAR is not exceeded
$_{Sr}$ 89,90	5.6	8	CDH Surface Water Standard is applicable	ARAR is not exceeded
$_{Uranium}$total	58.9	40	CDH Surface Water Standard is applicable	ARAR is exceeded

(a) - Maximum compound concentrations determined from first and second quarter 1989 data.
(b) - Maximum compound concentrations determined from 1987 and 1988 database.
U - Detection limit
J - Estimated below detection limit
B - Compound also present in blank
TBC - To be considered
(c) - Below minimum detectable activity (MDA)
(d) - Actual Standard is 4 millirem per year. 50 pCi/l is the criterion where it is necessary to analyze specific man-made beta emitting isotopes to determine compliance with standard.

1. The most stringent human health or agricultural-based promulgated standard among the Safe Drinking Water Act (SDWA), Maximum Contaminant Level (MCL), and CDH ground and surface water standards is first applied (applicable).

2. For a RCRA Appendix VIII hazardous constituent, in the absence of any promulgated standard in step 1 above, the most stringent RCRA Land Disposal Restriction or RCRA Subpart F limit is applied (relevant and appropriate).

3. In the absence of an ARAR in steps 1 or 2 above, the most stringent of the Clean Water Act Water Quality Criteria, or the proposed CDH ground water and surface water standards is applied (TBC).

Screening for these ARARs is presented in Table 3-2. The screening process includes consideration of both ground water and surface water standards because in the proposed IM/IRA (see Section 6.0), treated ground water is discharged to the South Interceptor Ditch (SID). The surface water in the SID often infiltrates the alluvium and recharges the alluvial ground water. Of the elements/compounds detected in alluvial ground water at the 881 Hillside Area, there are no ARARs for calcium, magnesium, potassium, sodium, bicarbonate, cesium, and strontium. However, the total dissolved solids ARAR establishes the acceptable aggregate concentration for the above major ions (excludes cesium and strontium). Until an acceptable risk based concentration is established for cesium and strontium, their background concentrations are TBC.

3.3.1.1 Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and MCL Goals

Because ground water beneath the 881 Hillside Area is a potential source of drinking water, Maximum Contaminant Levels (MCLs) are applicable for all phases of the IM/IRA. MCLs are derived from the Safe Drinking Water Act (PL 93-523). They represent the maximum permissible level of a contaminant in water which is delivered to the free-flowing outlet of the ultimate user of a public water system [40 CFR 141.2(C)]. Maximum Contaminant Level Goals (MCLGs) have also been considered in developing clean-up standards. Section 121(d) of CERCLA as amended by SARA suggests that MCLGs may be appropriate under certain circumstances of the release or threatened release of hazardous substances. This is reinforced in EPA's document entitled, Draft CERCLA Compliance with Other Laws Manual,

TABLE 3-2.1
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/l)	CDH Ground Water Quality Standards [b] (ug/l)	SDWA Maximum Contaminant Level (MCL)[c] (ug/l)	For Use In Special Circumstances SDWA/MCLG[d] (ug/l)	RCRA Land Disposal Restrictions (ug/l)[k]	CWA Ambient Water Quality Criteria for Protection of Aquatic Life: Freshwater Acute/Chronic (ug/l)	CDH Surface Water Quality Standards[e] (ug/l)	ARAR (ug/l)	Comment
Organic Compounds									
Acetone	10U[m]	-	-	-	50	-	-	50	RCRA LDR is relevant and appropriate (R&A)
Carbon Tetrachloride	5U	5	5	0	50	35,000/	5	5	CDN Surface Water Drinking Water Standard is applicable
1,1 Dichloroehane	5U[m]	-	-	-	-	-	-	5u	RCRA Subpart F TBC[i]
1,2 Dichloroethane	5U[m]	5	5	0	-	110,000/20,000[g]	5	5	CDH Surface Water Drinking Water Standard is applicable
1,1 Dichloroethene	5U	7	7	7	-	11,000[g]/	7	7	CDH Surface Water; Drinking Water Standard is applicable
Methylene Chloride	5U	-	-	-	200	-	-	5U	RCRA Subpart F is R&A
Tetrachloroethene	5U	0.8	-	0[g]	79	5,200/840[g]	0.8	5U	CDH Surface Water; Fish and Water Ingestion Standard (0.8 ug/l) is BDL, so detection limit of 5 ug/l is applicable

TABLE 3-2.1 (cont.)
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/L)	CDH Ground Water Quality Standards [b] (ug/L)	SDWA Maximum Contaminant Level (MCL) (ug/L)	For Use In Special Circumstances SDWA/MCLG[d] (ug/L)	RCRA Land Disposal Restrictions (ug/L)[k]	CWA Ambient Water Quality Criteria for Protection of Aquatic Life — Freshwater Acute/Chronic (ug/L)	CDH Surface Water Quality Standards[e] (ug/L)	ARAR (ug/L)	Comment
Organic Compounds (cont.)									
Tolune	5U	14,300	-	2,000	1,120	17,000[g/]	2,420	2000	SDWA MCLG is R&A
1,1,1 Trichloroethane	5U[m]	200	200	200	1,050	-	200	200	CDM Surface Water; Drinking Water Standard is applicable
1,1,2 Trichloroethane	5U	0.6	-	-	-	-	0.6	5U	CDM Surface Water; fish and Water Ingestion Standard (0.6 ug/l) is BDL, so detection limit of 5 ug/l is applicable
Trichloroethene	5U	5	5	0	62	45,000/21,000[g]	5	5	CDH Surface Water; Drinking Water Standard is applicable
Carbon Disulfide	5U	-	-				-	5U	RCRA Subpart F is R&A

U - Detection Limit
(a) - 40 CFR Part 264.92 Subpart F releases from solid waste management units. (40 CFR 261, Appendix VIII, List of Hazardous Constituents)
(b) - 5 CCR 1002-8, Section 3.11.5, Basic Standards for Ground Water August 17, 1989.
(c) - 40 CFR Part 141.61 National Primary Drinking Water Standards.
(d) - 40 CFR Part 141.50 National Primary Drinking Water Standards.
(e) - 5 CCR 1002-8, Section 3.8.29, Temporary Rule Adopted July 11, 1989.
(g) - Lowest observed effect level.
(h) - Proposed value Federal Register 46936 (Nov. 13, 1985).
(i) - To be considered, The most recent EPA Guidance on the identification of ARARs states that existing criteria, advisories, guidance, or proposed standards should be considered for a chemical in the absence of a promulgated standard.
(j) - Proposed value Oct. 1986.
(k) - 40 CFR Part 268.41 subpart D - Treatment Standards.
(m) - RCRA 40 CFR, Appendix IX Ground Water Monitoring List Substance Not Included in 40 CFR 261, Appendix VIII, List of Hazardous Constituents

TABLE 3-2.2
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/l)	CDH Ground Water Quality Standards[b] (ug/l)	SDWA Maximum Contaminant Level (MCL) (ug/l)	For Use In Special Circumstances SDWA/MCLG[d] (ug/l)	CWA Ambient water Quality Criteria for Protection of Aquatic Life — Freshwater Acute/Chronic (ug/l)	CDH Surface Water Quality Standards[e] Drinking Water/ Agriculture (mg/l)	ARAR (ug/l)	Comment
Metals								
Aluminum	-	/5.0	-	-	-	-	5.0	CDN Agriculture Standard is applicable
Antimony	0.06U	-	-	-	9.0/1.6	-	0.06U	RCRA Subpart F is R&A
Arsenic	0.05	0.05/0.1	0.05	-	0.8[g]/.048[g]	0.05/0.1	O.05	CDH Surface Water; Drinking Standards applicable
Barium	1.0	1.0/	1.0	1.5[f]	-	-	1.0	CDH Surface Water; Drinking Standards applicable
Beryllium	0.005U	/0.1	-	-	0.1[g]/.0053[g]	/0.1	0.1	CDH Agriculture Standard is applicable
Cadmium	0.01	0.01/0.01	0.01	0.005	0.0039[h]/0.0011[h]	0.01/0.01	0.01	No standard
Calcium	-	-				-	NS	No standard
Cesium	-	-				-	NS	Background is TBC
Chromium III	0.05 (tot)	0.05/0.1	-	-	1.7[h]/0.2[h]	0.05/0.1	.05	CDH Surface Water; Drinking Water Standard is applicable
Chromium VI	0.05 (tot)	0.05/0.1	0.05	0.0012	0.016/.011	0.05/0.1	.05	CDH Agriculture Standard is applicable
Copper	0.046	1.0/0.2	1.0	1.3[f]	0.018[h]/0.012[h]	1.0/0.2	0.2	CDH Agriculture Standard is applicable
Iron	-	0.3/5.0	0.3	-	-	0.3/	0.3	CDH Surface Water; Drinking Water Standard is applicable

TABLE 3-2.2 (cont.)
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/l)	CDH Ground Water Quality Standards [b] (ug/l)	SDWA Maximum Contaminant Level (MCL) (ug/l)	For Use In Special Circumstances SDWA/MCLG[d] (ug/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life — Freshwater Acute/Chronic (ug/l)	CDH Surface Water Quality Standards[d] Drinking Water/ Agriculture (mg/l)	ARAR (ug/L)	Comment
Metals (cont.)								
Lead	0.05	0.05/0.1	0.05	0.002[f]	.0082[h]/.0032	0.05/0.1	0.05	CDN Surface Water; Drinking Water Standard is applicable;
Lithium	-	2.5				-	2.5	CDH Ground Water Standard is applicable
Magnesium	-	-				-	NS	No Standard
Manganese	-	0.05/0.2	0.05	-	-	0.05/0.2	0.05	CDN Surface Water; Drinking Water Standard is applicable
Mercury	0.002	0.002/0.01	0.002	0.003	.0024/.000012	0.002	0.002	CDH Surface Water; Drinking Water Standard is applicable
Molybdenum	-	/0.1	-	-	-	-	0.1	CDH Agriculture Standard is applicable
Nickel	0.0185	/0.20	-	-	1.8[h]/.096[h]	/0.2	0.2	CDH Agriculture Standard is applicable
Potassium	-	-				-	NS	No Standard
Selenium	0.01	0.01/0.02	0.01	0.045[f]	0.26/0.35	0.01/0.02	0.01	CDN Surface Water; Drinking Water Standard is applicable
Silver	0.05	0.05/	0.05	-	.0041[h]/.00014	0.05/	0.05	CDN Surface Water; Drinking Water Standard is applicable
Sodium	-	-				-	NS	No Standard

TABLE 3-2.2 (cont.)
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (mg/l)	CDH Ground Water Standards Human Health/ Agriculture[b] (mg/l)	SDWA Maximum Contaminant Level (MCL) (mg/l)	For Use In Special Circumstances SDWA/MCLG[d] (mg/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life — Freshwater Acute/Chronic (mg/l)	CDH Surface Water Quality Standard[d] Drinking Water/ Agriculture (mg/l)	ARAR (mg/l)	Comment
Metals (cont.)								
Strontium	-	-				-	NS	Background in TBC
Thallium	0.01U	-	-	-	$1.4^{g}/.04^{g}$	-	0.01U	RCRA Subpart F is R&A
Vanadium	0.024	/0.1	-	-	-	-	0.1	CDH Agriculture Standard is applicable
Zinc	0.0517^{J}	5.0/2.0	5.0	-	$0.32^{h}/0.047^{h}$	5.0/2.0	2.0	CDN Agriculture Standard is applicable

TBC - To be considered
BDL - Below Detection Limit
(a) - 40 CFR Part 264,92 Subpart F Released from solid waste management units
(b) - 5 CCR 1002-8, Selection 3.11.5, Ground Water Quality Standards
(c) - 40 CFR Part 141.11 National Primary Drinking Water Standards
(d) - 5 CCR 1002-8, Selection 3.8.29, Temporary Rule adopted July 11, 1989 (Total Recoverable Concentrations)
(f) - Proposed value as of October 1986
(g) - Lowest Observed Effect Level
(h) - Hardness dependent criteria (100 mg/L)
(j) - RCRA 40 CFR 264, Appendix IX, Ground Water Monitoring List Substance not Included in 40 CFR 261, Appendix VIII, List of Hazardous Constituents

TABLE 3-2.3
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/l)	CDH Ground Water Standards Human Health/ Agriculture[b] (mg/l)	SDWA Maximum Contaminant Level (MCL)[c] (mg/l)	For Use In Special Circumstances SDWA/MCLG[d] (mg/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life — Freshwater Acute/Chronic (mg/l)	CDH Surface Water Quality Standard[d] Drinking Water/ Agriculture (mg/l)	ARAR (mg/l) unless otherwise noted	Comment
Conventional Pollutants								
pH	-	6.5-8.5	6.5-8.5[f]	-	-	65-9.0 units	6.5-9.0	CDH Surface Water Quality Standard is applicable
Nitrite	-	1.0 as N/ 10.0 as N	-	-	-	1[g]/10[h]		CDH Ground Water Standard is applicable
Nitrite	-	10.0 as N/ 100 as NO_2+NO_3-N	10	-	-	10[i]/100[h]	10.0	CDH Ground Water Standard is
applicable								
Chloride	-	250/	250		-	250/	250	CDH Ground Water Standard is applicable
Sulfate	-	250/	250[f]		-	250/	250	CDH Ground Water Standard is applicable
Bicarbonate	-	-				-	NS	No Standard
T.D.S.	-	400 mg/l or 1.25 times background, whichever is least restrictive	500[f]	-	-	-	400	CDH Ground Water Standard is applicable

(a) - 40 CFR Part 264,92 Subpart F releases from solid waste management units
(b) - 5 CCR 1002-8, Section 3.11,5, Groundwater Quality Standards
(c) - 40 CFR Part 141.11 (b,c) National Primary Drinking Water Standards
(d) - 5 CCR 100.2-8, Section 3.8.29, Temporary Rule Adopted July 11, 1989.
(f) - 40 CFR Part 143.3 National Secondary Drinking water Standards
(g) - To be applied at the point of water supply intake
(h) - In order to provide such a reasonable margin of safety to allow for unusual situations such as extremely high water ingestion or nitrite formation in slurries, the NO_3-N plus NO_2-N content in drinking waters for livestock and poultry should be lilmited to 100 ppm or less, and the no_2-N content alone be limited to 10 ppm or less.
(i) - A combined total of Nitrite and Nitrite at the point of intake to the domestic water supply shall not exceed 10 mg/l^2.

TABLE 3-2.4
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO 881 HILLSIDE AREA IN/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (pCi/l)	CDH Ground Water Quality Standards[b] (pCi/l)	SDWA Maximum Contaminant Level (MCL)[c] (pCi/l)	For Use In Special Circumstances SDWA/MCLG[d] (pCi/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (pCi/)	CDH Surface Water Quality Standard[e] (pCi/l)	ARAR (pCi/l)	Comment
Radionuclides								
#Gross Alpha	-	15	15	-	-	-	15	CDH Ground Water Standard is applicable
Gross Beta		4mrem/yr[e]	50	-	-	-	50	SDWA MCL is applicable
$_{Pu}238,239,240$	-	15	40[f]	-	-	15	15	CDH Surface Water Standard is applicable
$_{Am}241$	-	-	4[f]	-	-	30	4	CDH Surface Water Standard is applicable
H^3	-	20,000	20,000	-	-	20,00	20,000	CDH Surface Water Standard is applicable
Sr^{90}	-	8	8	-	-	8	8	CDH Surface Water Standard is applicable
$Uranium^{total}$	-	-	-	-	-	40	40	CDH Surface Water Standard is applicable

(a) - 5 CCR 1002-8, Section 3.11.5(B), Basic Standards Applicable to Ground Waters of the State
(b) - 40 CFR Parts 141.5, 16, National Primary Drinking Water Standards
(c) - 5 CCR 1002-8, Section 3.8.29, Temporary Rule Adopted July 11, 1989.
(e) - For Beta and photon emitters, if two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem per year. Except for Tritium and Strontium 90 the concentration of man-made radionuclides including 4 mrem total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burden and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69, as amended, August 1963, US Department of Commerce.
(f) - Proposed value in drinking water yielding a risk equal to that from a dose rate of 4 mrem/year, September 30, 1986 (51 CFR 34859).

Volume II. Maximum Contaminant Level Goals, (EPA, June 1987, that identifies the special circumstances where MCLGs should be considered as ARAR. These circumstances generally occur when there are multiple contaminants in ground water, or where multiple pathways of exposure present extraordinary risks. According to the guidance document, the use of MCLGs should be determined on a site-specific basis in consultation with EPA headquarters.

The clean-up criteria for the interim remedial action at the 881 Hillside Area consider MCLs and MCLGs as ARAR wherever such standards have been promulgated for the contaminants of concern. Proposed MCLs and MCLGs are considered TBCs in theis analysis.

3.3.12 Ambient Water Quality Criteria

The Ambient Water Quality Criteria are nonenforceable guidance developed under the Clean Water Act. Guidance is set for surface waters for the protection of aquatic life and for the protection of human health, based on both drinking water and consuming aquatic organisms from that water. Since the IM/IRA proposed here involves the treatment and subsequent discharge to surface water, the Water Quality Criteria are TBC.

3.3.1.3 Colorado Surface and Ground-Water Quality Standards

The Colorado department of Health (CDH) has adopted interim ground-water quality standards for many organic compounds. These are considered applicable for the constituents where they exist Some of the standards are lower than the current standard detection limits for the compounds of concern. When this occurs, the detection limit will be considered as ARAR.

The CDH has also promulgated ground-water quality standards for many inorganic compounds for both human health and agricultural uses. These standards are considered applicable since future or down gradient use of the aquifer is not restricted. Where standards exist for both human health and agriculture uses, the more stringent standards is considered to be the ARAR.

On July 11, 1989, the CDH adopted temporary surface-water quality standards for Walnut Creek and Woman Creek. These include standards for many organic, inorganic and radionuclide parameters. These temporary standards are in effect until March 30, 1990 (unless permanent standards are adopted at and earlier date) and are considered applicable.

3.3.1.4 RCRA Ground-Water Protection Standards

Owners or operators of facilities that treat, store, or dispose of hazardous waste must ensure that hazardous constituents identified in 6 CCR 1007-3 and 40 CFR 261, Appendix VIII, entering the ground water from a regulated unit do not exceed concentration limits under 6 CCR 1007-3 and 40 CFR 264.94. The concentration limits include standards for fourteen compounds,. with background used as the standard for the other RCRA Appendix VIII constituents. These concentration limits apply to RCRA-regulated units subject to permitting (landfills, surface impoundments, waste piles, and land treatment units) that recieved RCRA hazardous waste after July 26,1982, Although this area does not contain RCRA-regulated units, it does contain Solid Waste Management Units. Therefore, the RCRA clean-up criteria for Appendix VIII constituents are relevant and appropriate and are used to define ARARs in the absence of any human-health based standards. Background concentrations for 40 CFR 264, Appendix IX constituents not listed in Appendix VIII are TBC.

RCRA land disposal restrictions (LDRs) for certain organic contaminants (40 CFR 268.40) are considered relevant and appropriate effort the discharge of treated ground water to either surface water or ground water. The LDRs are technology based standards and are considered relevant and appropriate in the absence of a health based standard.

3.3.2 Locational Requirements

Locational requirements are statutes or regulations which set restrictions on activities of limits on contaminant levels, depending on the characteristics of a site or its immediate environs. Examples of locational requirements are federal and state siting laws for hazardous waste facilities, or sites on the National Register of Historic Places. Also included are the Wilderness Protection Act and floodplain regulations promulgated pursuant to the Federal Emergency Management Agency's National Flood Insurance Program.

Location-specific ARARs that are relevant and appropriate are the State of Colorado siting criteria for RCRA treatment units, and for surface-water discharges, the CDH Water Quality Division's regulations pertaining to pre-approval of treatment facility location.

3.3.3 Performance, Design, or Other Action-Specific Requirements

Performance, design, or other action-specific requirements set controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are not triggered gy the specific chemicals present at a site, but rather by the particular IM/IRA alternatives that are evaluated as part of this plan. Action-specific ARARs are technology-based performance standards, such as the Best Available Technology standard of the Federal Water Pollution Control Act. Other examples include RCRA treatment, storage, and disposal standards, Clean Water Act pretreatment standards for discharges to publicly-owned treatment wor4ks 9POTWs) and the Colorado Hazardous Waste Regulations. Action specific ARARs for the interim remedial actions evaluated here are included in Table 3-3.

TABLE 3-3
SCREENING OF PROBABLE ACTION SPECIFIC ARARS
FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Treatment	**BDAT** standards for spent solvent wastes and dioxin-containing wastes are based on one of four technologies or combinations; for waste water, (1) steam stripping, (2) biological treatment, or (3) carbon absorption [alone or in combination with (1) or (2); and for all other wastes, incineration. Any technology may be used, however, if it will achieve the concentration levels specified.	Effective November 8, 1988, disposal of contaminated soil or debris resulting from CERCLA response action or RCRA corrective actions is subject to land disposal prohibitions and/or treatment standards established for spent solvent wastes, dioxin containing wastes, and "California List" waste.	RCRA Sections 3004 (d)(3), (e)(3) 42 U.S.C. 6924(d)(3),(e)(3)	Applicable	Movement of excavated soil onsite or transportation of soil offsite for disposal must be treated to attain levels achievable by best demonstrated available treatment technologies before being land-disposed.
Capping	Placement of a cap over waste (e.g., closing a landfill, or closing a surface impoundment or waste pile as a landfill, or similar action) requires a cover designed and constructed to: N Provided long-term minimization migration of liquids through the capping area; N function with minimum maintenance: N Promote drainage and minimize erosion or abrasion of the cover;	RCRA hazardous waste placed at site after November 19, 1980, or movement of hazardous waste from one unit, area of contamination, or location into another unit or area of contamination will make requirements applicable. Capping without such movement will not make requirements applicable, but technical requirements are likely to be relevant and appropriate.	40 CFR 264.258(b) 40 CFR 264.310(a)	R&A	Capping of waste in place using RCRA technical requirements R&A

TABLE 3-3 (continued)
SCREENING OF PROBABLE ACTION SPECIFIC ARARS
FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Capping (continued)	N Accommodate settling and subsidence so that the cover's integrity is maintained; and				
	N Have a permeablitity less than or equal to the permeability of any bottom liner system or natural sub-soils prevent				
	N Eliminate free liquids, stabilize wastes before capping (surface impoundments).		40 CFR 264.22B(a)		
	N Restrict post-closure use of property as necessary to prevent damage to the cover.		40 CFR 264.117(c)		
	N Present run-on and run-off from damaging cover.		40 CFR 264.228(b) 40 CFR 264.310(b)		
	N Protect and maintain surveyed benchmarks used to locate waste cells and (landfills, waste piles).		40 CFR 264.310(b)		
	N Eliminate free liquids by removal or solidification.		40 CFR 264.228 (a)(2)		
	N Stabilization of remaining waste and waste residues to support cover.		40 CFR 264.228 (a)(2) and 40 CFR 264.258(b)		

TABLE 3-3 (continued)
SCREENING OF PROBABLE ACTION SPECIFIC ARARS
FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Capping (continued)	Installation of final cover to provide long-term minimization of infiltration		40 CFR 264.310		
	Post-closure care and ground-water monitoring		40 CFR 264.310		
Clean Closure (Removal	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products. Disposal or decontamination of equipment, structures, and soils	RCRA hazardous waste (listed or characteristic) placed at site after November 19, 1980, or movement of hazardous waste from one unit, area of contamination, or location into another unit or area of contamination. Not applicable to material undisturbed since November 19, 1980	40 CFR 264.111	R&A	Applicable to soil excavation for offsite disposal.
		May apply to surface impoundment; contaminated soil, including soil from dredging or soil disturbed in the course of drilling or excavation, and returned to land	40 CFR 264.111		
	Removal or decontamination of all waste residues, contaminated containment system components (e.g. liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste.		40 CFR 264.228(a)(1) and 40 CFR 264.258		
	Meet health based levels at unit		40 CFR 244.11		

TABLE 3-3 (continued)
SCREENING OF PROBABLE ACTION SPECIFIC ARARS
FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Excavation/ Consolidation	Area from which materials are excavated may required cleanup to levels establishing by closure requirements	Movement of hazardous waste(listed or characteristic) from one unit or area of contamination into another. Consolidation with a unit or area of contamination does not trigger applicability.	See Clean Closure	R&A	RCRA requirements for clean closure are R&A to remedial action involving soil excavation.
	Consolidation in storage piles/storage tanks will trigger storage requirements.			R&A	RCRA requirements for storage in waste piles or tanks are relevant and appropriate for interim storage of excavated soil destined for consolidation or offsite disposal.
	Placement on or in land outside unit boundary or area of contamination will trigger land disposal requirements and restrictions.		40 CFR 268 (Subpart D)	R&A	Soil excavation during installation of french drains in subject to land disposal restrictions for solvent containing waste. Requirements are are applicable for RCRA hazardous waste; R&A if not RCRA hazardous waste.
Ground-Water Diversion	Excavation of soil for construction of slurry well may trigger cleanup or land disposal restrictions.	RCRA hazardous waste placed at site after November 19, 1980, or movement hazardous waste from one unit, area of contamination, or location into another unit or area of contamination	See Excavation/ Consolidation	R&A	See Excavation/Consolidation
Treatment or Storage in Tanks	Tanks must have sufficient shell strength (thickness), and, for closed tanks, pressure controls, to assure that they do not collapse or rupture.	RCRA hazardous waste (listed or characteristic), held for temporary period before treatment, disposal, or storage elsewhere, (40 CFR 264.10) in a tank.	40 CFR 264.190	R&A	Relevant and Appropriate for treatment and storage tanks used in treating contaminated groundwater
	Waste must not be incompatible with the tank material unless the tank is protected by a liner or by other means.		40 CFR 264.191		

TABLE 3-3 (continued)
SCREENING OF PROBABLE ACTION SPECIFIC ARARS
FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Treatment or Storage in Tanks (continued)	New tanks or components must be provided with secondary containment.		40 CFR 264.193		
	Tanks must be provided with controls to prevent overfilling, and sufficient freeboard maintained in open tanks to prevent over topping by wave action or precipitation.		40 CFR 264.194		
	Inspect following: overfilling control, control equipment, monitoring data, waste level (for uncovered tanks), tanks condition, above-ground portions of tanks, (to assess their structural integrity) and the area surrounding the tank (to identify signs of leakage).		40 CFR 264.195		
	Repair any corrosion, crack, or leak.		40 CFR 264.196		
	At closure, remove all hazardous waste and hazardous residues from tanks, discharge control equipment, and discharge confinement structures.		40 CFR 264.197		
	Store ignitable and reactive waste so as to prevent the waste from igniting or reacting. Ignitable or reactive wates in covered tanks must comply with buffer zone requirements in “Flammable and Combustible Liquids Code,” Tables 2-1 through 2-6 (National fire Protection Association, 1976 or 1981).		40 CFR 264.198		

TABLE 3-3 (continued)

SCREENING OF PROBABLE ACTION SPECIFIC ARARS

FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Container Storage (On-Site)	Containers of hazardous waste must be:	RCRA hazardous waste(listed or characteristic) held for a temporary period before treatment, disposal, or storage elsewhere, in a container (i.e., any portable device in which a material is stored, transported, disposed of, or handled) (40 CFR 264.10)		R&A	RCRA containers storage requirements are R&A
	N Maintained in good condition		40 CFR 264.171		
	N Compatible with hazardous waste to be stored; and		40 CFR 264.172		
	N Closed during storage (except to add or remove waste).		40 CFR 264.173		
	Inspect container storage areas weekly for determination		40 CFR264.174		
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10% of the volume of containers of free liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.		40 CFR 264.175		
	Keep containers of ignitable or reactive waste at least 50 feet from the facility's property line.		40 CFR 264.176		
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		40 CFR 264.177		

TABLE 3-3 (continued)
SCREENING OF PROBABLE ACTION SPECIFIC ARARS
FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Container Storage (On-Site) (continued)	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners.		40 CFR 264.178		
Off-Site Treatment Storage or Disposal	In case of any removal or remedial action involving the transfer of hazardous substance or pollutant or contaminant offsite, such hazardous substance or pollutant or contaminant shall only be transferred to a facility which is operating in compliance with section 3004 and 3005 of the Solid Waste Disposal Act (or where applicable, in compliance with the toxic Substances Control Act or other applicable Federal law) and all applicable State requirements. Such substance or pollutant or contaminant may be transferred to a land disposal facility only if the President determines that both of the following requirements are met:		SARA section 121 (d)(2)(c)	Applicable	Applicable to the offsite treatment, storage, or disposal of waste generated during onsite remedial action.

Action	Requirement	Prerequisite	Citation	ARARS	Comments
Off-Site Treatment Storage or Disposal (continued)	N The unit to which the hazardous substances or pollutant or contaminant is transferred is not releasing any hazardous waste, or constituent thereof, into the groundwater or surface water or soil . N All such releases from other units at the facility are being controlled by a corrective action program approved by the Administrator under subtitle C of the Solid Waste Disposal Act.				
Hazardous Waste Operation	As mandated by SARA, OSHA has promulgated regulations that required employers to develop and implement a written safety/ health program designed to regulate employee safety and health during hazardous waste operations. The safety and health program must include: N <u>Organizational structure</u>- Establish and implement chain of command and specify the responsibilities of key personnel.	Regulations apply to hazardous substance response operations under CERCLA; Corrective cleanup under RCRA; hazardous waste operations that have been designated for cleanup by state or local authorities; most operations involving the treatment, storage or disposal of hazardous wastes regulated under RCRA; and emergency response operations for releases or threats of releases of hazardous substances.	29 CFR Part 1910.120		

Action	Requirement	Prerequisite	Citation	ARARS	Comments
Hazardous Waste Operation (continued)	N Comprehensive Work Plan - Identify anticipated activities, define work tasks, establish personnel requirements, and provide for the implementation of medical surveillance and training programs as required by these regulations.				
	N Site Specific Health and Safety Plans A site health and safety plan must be prepared for each phase of operation that addresses key personnel; hazard recognition; training assignments; personnel protective equipment to be used; medical surveillance; frequency and type of monitoring, including air and personnel monitoring; site control measure; decontamination procedures; emergency contingency plans				
	General Requirements of these regulation:				
	N Site characterization and analysis - Identify site hazards to determine levels of personnel protection		29 CFR 1910.120(c)	Applicable	Site hazardous have been characterized through the RI/FS process.
	N Site Control - Implement site control zones to minimize employee exposure to hazardous substances.		29 CFR 1910.120(c)	Applicable	Site control zones will be defined in site-specific health and safety plans.

TABLE 3-3 (continued)

SCREENING OF PROBABLE ACTION SPECIFIC ARARS

FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARARS	Comments
Hazardous Waste Operation (continued)	N Training - Initial training and refresher training required before employee is permitted to engaged in site activities.		29 CFR 1910.120(e)	Applicable	Personnel engaged in remedial actions at the 881 Hillside area are required to meet minimum training requirements as specified in the OSHA standard
	N Medical Surveillance Employers must implement medical surveillance for employees potentially exposed to hazardous substances.		29 CFR 1910.120(f)	Applicable	
	N Engineering Controls, work practices and personnel protective equipment One or all of these shall be used to minimize exposure of employees to hazardous substances and health hazards.		29 CFR 1910.120(g)	Applicable	
	N Monitoring - Monitoring of exposure of employees to hazardous substances is required to determine the efficacy of protective equipment and engineering controls.		29 CFR 1910.120(h)	Applicable	
	N Informational Program Employees, contractors, and subcontractors shall be informed of the degree and nature of hazardous associated with site activities.		29 CFR 1910.120(i)	Applicable	All personnel involved in site activities will be required to read and comply with the site safety plan. The safety plan will outline the anticipated physical and chemical hazards.

TABLE 3-3 (continued)

SCREENING OF PROBABLE ACTION SPECIFIC ARARS

FOR REMEDIAL ACTIONS AT THE 881 HILLSIDE AREA

Action	Requirement	Prerequisite	Citation	ARARS	Comments
Hazardous Waste Operation (continued)	N Material Handling Hazardous substances, contaminated solids, liquids or other residues shall be handled, transported, and labeled according to subsection (j) of the OSHA standard		29 CFR 1910.120(j)	Applicable	D. O.T. Specification containers will be used to handle, store, or transport.
	N Decontamination - Decontamination procedures outlined in subsection (k) of the standard must be compiled with during onsite remedial action.		29 CFR 1910.120(k)	Applicable	Decontamination procedures will be presented in the site health and safety plan.
	N Emergency Response Contingency plans must be developed as part of site health and safety planning		29 CFR 1910.120 (l)	Applicable	Contingency plans will developed for the site health and safety plan.
	N Illumination/Sanitation Minimum illumination and sanitation facilities must be provided for employees involved in hazardous waste operations		29 CFR 1910.120(m)(n)	Applicable	
	N Site Excavation Site excavations must be stored or sloped to prevent collapse.		29 CFR 1910.120/1926	Applicable	
	N Contractors and Subcontractors Employees must inform contractors or subcontractors of potential hazards associated with site activities		29 CFR 1910.120	Applicable	

SECTION 4.0

IDENTIFICATION AND SCREENING OF POTENTIAL IRA OPTIONS

4.1 SUMMARY OF THE ES TECHNOLOGY AND REMEDIAL ALTERNATIVE SCREENING PROCESS

The 881 Hillside Area FS Report (Rockwell International, 1988b) was prepared according to the EPA Feasibility Study Guidance (EPA, 1985) available at the time. The initial screening process eliminated infeasible, inappropriate or environmentally unacceptable technologies. The following technologies were retained after screening:

1. No remedial action - monitoring only (not considered here)
2. Off-site RCRA landfill
3. Well arrays
4. Subsurface drains
5. Soil-bentonite slurry wall
6. Multi-layer cap
7. Grading and vegetation
8. Surface water diversion
9. In situ immobilization (grouting)
10. Soil flushing
11. UV/Peroxide water treatment
12. Air stripping water treatment
13. Activated carbon adsorption water treatment
14. Discharge to surface-water
15. Re-injection to ground-water

Technologies were then combined that are complementary and interrelated, to form alternatives that address the site issues and control contaminant pathways. The three water treatment technologies were subjected to a more detailed evaluation to determine the most cost-effective, reliable treatment system for inclusion with the alternatives requiring water treatment. Provisions of the Superfund Amendments and Reauthorization Act of 1986 (SARA) also require that alternatives be developed that consider:

- Elimination of long term site management;
- Reduction of waste toxicity, mobility, or volume;
- Waste containment with little or no treatment ;
- Use of innovative technologies.

The developed alternatives are as follows:

1. Collection of ground water using a line of downgradient wells and a source well at SWMU 119.1, collection of footing drain flow, and reinjection of treated water downgradient of the 881 Hillside Area in the Valley Fill Alluvium of the Woman Creek drainage.

2. Collection of ground water using a french drain and a source well at SWMU 119.1, collection of footing drain flow, and reinjection of treated water downgradient of the 881 Hillside Area in the Valley Fill Alluvium of the Woman Creek drainage.

3. Collection of ground water using a french drain and a source well at SWMU 119.1, collection of footing drain flow from, and discharge of treated water to the surface, and in situ treatment of soils using soil flushing.

4. Total encapsulation of source areas using a multi-layer cap and slurry wall with control of gradients by pumping an internal sump (dewatering fluids to be treated at an existing treatment plant).

5. Pump a Source well at SWMU 119.1, collect footing drain flow, and reinjection of treated water downgradient of the 881 Hillside Area in the Valley Fill Alluvium of the Woman Creek drainage.

6. Immobilization of contaminants using a chemical grout.

7. Collection of ground water using a french drain and a source well at SWMU 119.1, collection of footing drain flow, reinjection of treated m-water downgradient of the 881 Hillside in the Valley Fill Alluvium of the Woman Creek drainage, and partial removal of soils to a RCRA-permitted disposal facility.

Three broad considerations, consistent with the National Contingency Plan, were used as the basis for the preliminary screening of developed alternatives:

- Cost - The cost of implementing the remedial action was considered including operating and maintenance costs. An alternative whose cost far exceeds that of others being evaluated without providing significantly greater protection was eliminated.

- Acceptable Engineering Practices - Alternatives which do not provide a proven and reliable means of addressing the problem were eliminated.

- Effectiveness - Alternatives which do not effectively contribute to the protection of public health, welfare, and the environment were eliminated. Alternatives posing significant adverse environmental effects and only limited benefits were also excluded from further consideration.

Of the seven remedial action alternatives developed, four of the alternatives were eliminated because they did not provide adequate protection of public health, welfare, and the environment, or were much more costly without providing significantly greater protection. The 881 Hillside Area Feasibility Study Report (Rockwell International, 1988b) provides the details of the screening process to this point.

The remaining three alternatives from the FS Report were retained for a further detailed evaluation based on additional treatment requirements imposed by the DOE agreement with the State of Colorado in June 1989. This agreement additionally requires the treatment of collected ground-water for removal of inorganic contaminants including radionuclides until the background ground water study is completed at which time the treatment requirement for inorganics and radionuclides will be re-evaluated. In addition, the treated water will be discharged to surface water as opposed to ground-water reinjection, as originally proposed in the FS. The reinjection of treated ground water downgradient of the french drain is deemed not to be necessary because of the interaction between surface-water and alluvial ground-water. The three alternatives remaining are:

1. Collection of ground water using a french drain and a source well, collection of footing drain flow, treatment of collected water in a new treatment plant and discharge to surface water.

2. Total encapsulation of source areas using a multi-layer cap and slurry wall with control of gradients by pumping an internal sump (dewatering fluids to be treated at an existing treatment plant).

3. Pump a source well at SWMU 119.1, collect footing drain flow, treat collected water at a new treatment plant, and discharge to surface water.

The detailed analysis of the three remaining alternatives is presented in this document and is based on the Match 30, 1988 EE/CA Guidance. Each alternative is evaluated individually based on effectiveness, implementablity, and cost.

4.2 IM/IRA PLAN SCREENING PROCESS

4.2.1 Effectiveness

The criteria for evaluation of effectiveness of removal alternatives includes protectiveness and use of alternatives to land disposal. Protectiveness includes protection of the community and workers during the removal action; threat reduction (mitigation of identified threats); determination of the length of time until protection is achieved; compliance with chemical- and location-specific ARARs; compliance with criteria, advisories and guidances; description of potential exposure to residuals remaining on-site; and long-term reliability for providing continued production. The effectiveness criteria also includes use of alternatives to land disposal, thus promoting utilization of treatment or recycling instead of land disposal.

4.2.2 Implementability

The criteria for evaluation of implementability of removal alternatives includes technical feasibility, availability, and administrative feasibility. Technical feasibility includes the ability to construct the technology and to maintain its operation; compliance with action-specific ARARs; ability to meet process efficiencies or performance goals; demonstrated performance; evaluation of impact of environmental conditions; and compliance with the SARA requirement that removal actions should contribute to the efficient performance of long-term remedial action to the extent practicable. Availability includes the availability of necessary equipment, materials and personnel; availability of adequate off-site treatment. storage, and disposal capacity, if appropriate; and description of post-removal site controls which will be required at the completion of the action. Administrative feasibility includes the likelihood of public acceptance of the alternative, including state and local concern; coordination of activities with other agencies; and ability to obtain any necessary approvals or permits.

4.2.3 Cost

The criteria for evaluation of cost of removal alternatives includes total cost and statutory limits. Total cost includes direct capital costs, indirect capital costs, and any post-removal site control costs. Since the IRA at the 881 Hillside Area is not an EPA-financed removal action, the $2 million statutory cost limit does not apply.

4.3 GROUND-WATER TREATMENT TECHNOLOGIES EVALUATION

The ground-water treatment technologies that were selected for detailed evaluation include carbon adsorption, UV/peroxide (chemical oxidation), and air stripping for organic compounds, and ion exchange, electrodialysis, and reverse osmosis for inorganic compounds. The specific treatment systems listed are provided as examples of systems that can provide the level of treatment needed to meet chemical-specific ARARs for the organic and inorganic contaminants of concern. It is recognized that many companies provide similar treatment systems, and the system ultimately selected for installation will be required to provide the same level of efficiency as that specified here.

The treatment system selected must be capable of treating 30 gpm of contaminated ground water with influent characteristics as shown in Table 4- 1. The effluent quality must meet the chemical-specific ARARs.

The location- and action-specific ARARs are similar for each of the treatment technologies, and are discussed in Section 3. Only air stripping has unique action specific requirements because it is subject to the Colorado Department of Health Air Quality regulations for the air emissions.

TABLE 4-1

BASIS FOR DESIGN OF
881 HILLSIDE TREATMENT PLANT

ORGANICS	UNITS	INFLUENT [a] CONCENTRATION	TREATMENT REQUIREMENTS
Methylene Chloride	ug/l	<5[b]	5
Acetone	ug/l	<10[b]	50
Carbon Disulfide	ug/l	<5[b]	5
1,1 Dichloroethene	ug/l	622	7
1,1 Dichlorocthane	ug/l	11	5
1,2 Dichloroethane	ug/l	2.0	5
1,1,1 Trichloroethane	ug/1	945	200
Carbon Tetrachloride	ug/l	65	5
Trichloroethene	ug/1	845	5
1.1.2 Trichloroethane	ug/l	<5[b]	5
Tetrachloroethene	ug/l	311	5
Toluene	ug/l	<5[b]	2000

METALS	UNITS	INFLUENT [a] CONCENTRATIONS	TREATMENT REQUIREMENTS
Aluminum	mg/1	0.0703	5
Antimony	mg/1	0.0264	.06
Arsenic	mg/1	0.0049	.05
Barium	mg/1	0.1076	1.0
Beryllium	mg/1	0.0022	0.1
Cadmium	mg/1	0.0021	0.01
Cesium	mg/1	0.1515	NS
Chromium	mg/1	0.0071	0.05
Copper	mg/1	0.0355	0.2
Iron	mg/1	0.0410	0.3
Lead	mg/1	0.0026	0.05
Lithium	mg/l	0.0450	2.5
Manganese	mg/l	0.0738	0.05
Mercury	mg/l	0.1290	0.002
Molybdenum	mg/l	0.0085	0.1
Nickel	mg/l	0.0683	0.2
Selenium	mg/1	0.1743	0.01
Silver	mg/1	0.0145	0.05
Strontium	mg/1	0.8287	NS
Thallium	mg/l	0.0072	0.01
Vanadium	mg/1	0.0391	0.1
Zinc	mg/l	0.1883	2.0

TABLE 4-1
(continued)

BASIS FOR DESIGN OF 891 HILLSIDE TREATMENT PLANT

MAJOR IONS	UNITS	INFLUENT [a] CONCENTRATION	TREATMENT REQUIREMENTS
Calcium	mg/l	109.7	NS
Magnesium	mg/l	26.1	NS
Potassium	mg/1	2.7	NS
Sodium	mg/1	87.4	NS
Total Dissolved Solids	mg/1	718	400
Chloride	mg/1	128	250
Nitrite & Nitrate	mg/1	8.29	10
Sulfate	mg/1	122	250
Bicarbonate As ($CaCO_3$)	mg/1	274	NS

RADIONUCLIDES	UNITS	INFLUENT [a] CONCENTRATION	TREATMENT REQUIREMENTS
Gross Alpha	pCi/1	21.5	15
Gross Beta	pCi/1	17.8	50
Uranium (Total)	pCi/1	15.4	40
Strontium (89, 90)	pCi/1	< 1.0[b]	8
Plutonium (239, 240)	pCi/1	<0.0 1	15
Americum (241)	pCi/1	<0.01	4
Tritium	pCi/1	<400[b]	20,000

a Based on a flow weighted average of the 881 Building footing drain flow (5 gpm) and alluvial groundwater at the 881 Hillside that would be collected in the french drain (2 gpm). Averages computed from the 1987 and 1988 data base, except organics. Organic compound concentrations determined from first and second quarter .1989 data.

b Detectable concentrations in some wells; however, blend should have non-detectable concentrations.

NS No standard.

4.3.1. Activated Carbon Adsorption (Organic Contaminant Removal)

4.3.1.1 Description

For the granular activated carbon (GAC) adsorption system, the ground water will be pumped through two GAC columns in series operated in downflow fixed-bed mode (Figure 4-1). A second set of GAC columns for stand-by operation are in parallel to the first set. Each carbon column is 44 inches in diameter and 89 inches high, and contains 1,800 pounds of carbon. Based on a peak flow rate of 30 gpm, the hydraulic loading to each column will be approximately 1.4 gpm/ft^2. Contact time for each column will be approximately 25 minutes. To completely utilize the carbon, columns are arranged in series allowing the lead column to become fully exhausted before regeneration while the second (polishing) column ensures effluent quality. Periodic samples will be taken f rom the effluent of each unit, and when the lead unit effluent exceeds chemical-specific ARARs, the lead carbon column will be removed, the polishing (second) column will become the lead column, and a stock carbon column carbon will be put in service as the polishing unit. The carbon column with the exhausted carbon will then be shipped to an off-site location for regeneration.

4.3.1.2 Effectiveness

GAC adsorption systems have been shown to remove VOCs from contaminated ground water to levels that comply with the chemical-specific ARARs. The EPA (*Federal Register*, Vol. 52, No. 130, page 25698) has designated carbon adsorption a "Best Available Technology" for the removal of seven specific volatile organic compounds (including TCE and 1,1,1-TCA) from drinking water. The GAC adsorption system that is proposed here for the treatment of the 881 Hillside ground water will be in continuous operation until the concentrations of VOCs in the ground water decrease to chemical-specific ARAR concentrations, at which time further treatment will be unnecessary. The probability of equipment failure will be minimized in this system because of the redundancy of having two (2) parallel on-line units, each of which could treat the design flow. Two stock units on site add to the system reliability.

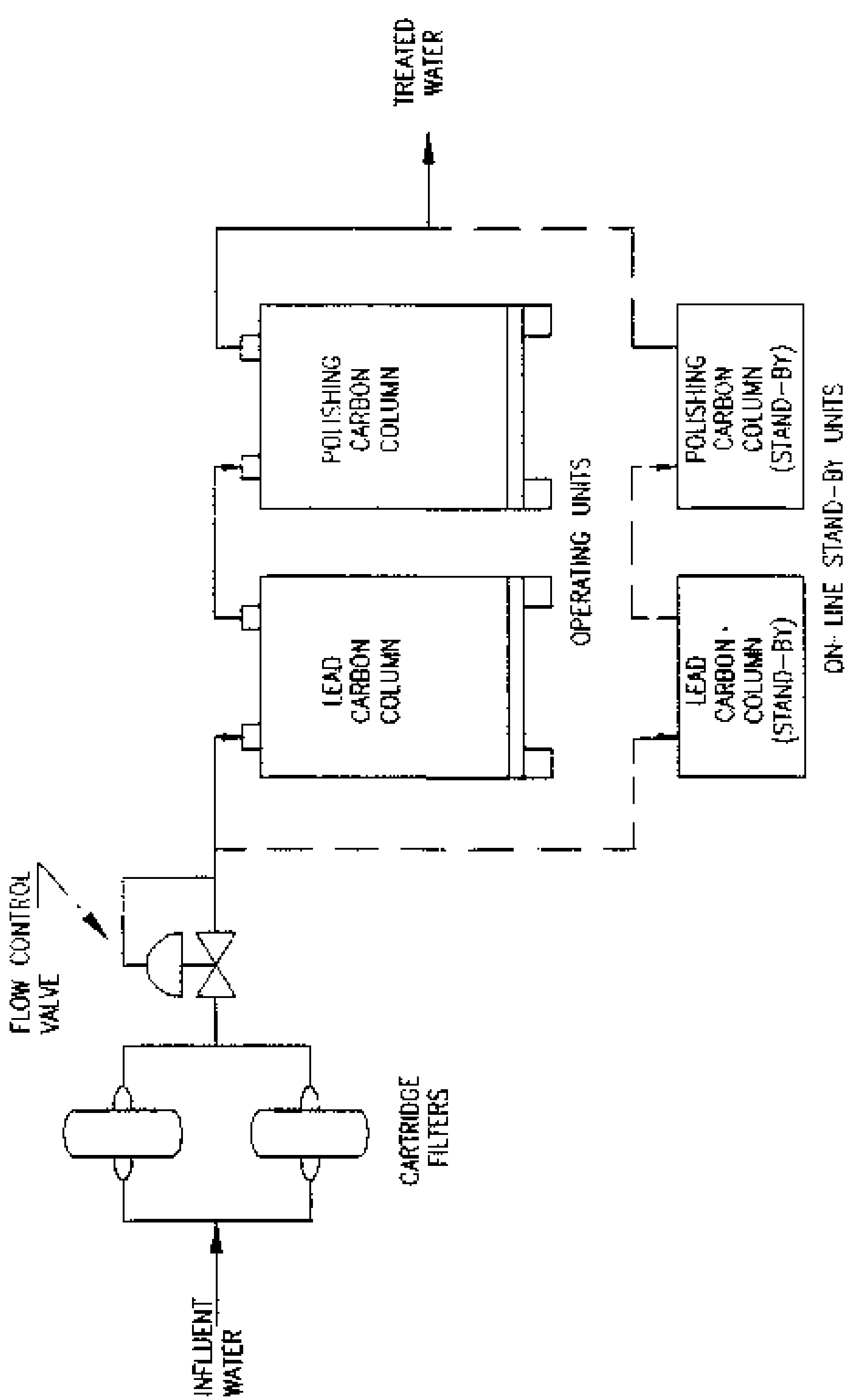


FIGURE 4-1
CARBON ADSORPTION TREATMENT UNIT

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Appropriate safety measures required when moving and installing large equipment will be complied with during installation. The operation and maintenance of the system will be by personnel who are trained in the handling of hazardous and radioactive wastes. Because carbon will remove oxygen from the air, any time personnel are working in confined areas where oxygen may be limited, special care must be taken to ensure that an adequate air supply is available.

The operators of the GAC system will not be exposed to VOCs-laden carbon because the use of the containerized and transportable carbon contractors allows removal and replacement of the exhausted carbon at a remote carbon reactivation site. Carbon will not be handled at the site. Transporting the entire exhausted carbon column to the regeneration facility ensures operators are protected from the carbon, and the operators need only follow routine safety procedures when handling heavy equipment.

The exhausted carbon is generally regenerated through a thermal treatment process which strips the volatile organics from the carbon. The organics are subsequently destroyed via incineration. During this regeneration process, a small quantity of ash may be generated which requires disposal at a landfill. Thus, this process can be considered an alternative to land disposal since the carbon is continuously recycled. However, if the spent carbon was determined to be a mixed waste, then it would require land disposal at the Nevada Test Site.

GAC adsorption treatment in scaled, fixed-bed contractor vessels does not produce any waste streams or vapor emissions. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased. This treatment process will effectively remove organic contaminants from the ground water. Treated water will be monitored at the effluent and also at an intermediate point in the system to ensure contaminants are below the chemical-specific ARAR concentrations before being released to the environment during implementation of the process.

4.3.1.3 Implementability

GAC adsorption is a proven technology for removing
(VOC.) from ground water. Testing performed by Calgon
demonstrated that activated carbon can remove VOCs to m
second carbon unit connected in series with the lead unit wo
will ensure removal of the VOCs to these levels. The carbon columns
readily installed in the treatment building. The system should be ready to operate a
capacity, after initial adjustments and test runs, within a day.

It is estimated that approximately 2 man-hours of operator time will be needed daily, primarily for start up, shutdown, and system monitoring. Periodic change-out of the carbon units and maintenance of the equipment will require approximately 16 hours per month, thus the total labor requirement will be 76 hours/month.

4.3.1.4 Costs

Results of the treatability study indicate the carbon usage rate will be 3.1 pounds per 1,000 gallons of ground water, based on breakthrough of methylene chloride (Rockwell International, 1988b). At a cost of approximately $1.15 per pound for regenerated carbon, the annual costs are estimated to be $18,600 for carbon (based on an average flow rate of 10 gpm). The cost of shipping contaminated carbon (as a manifested hazardous waste) for regeneration is estimated to be $2,500 and $500 for receiving regenerated carbon, for a total of $3,000 per exchange. If the spent carbon requires disposal at the Nevada Test Site as a mixed waste, this cost could change substantially. Annual operation and maintenance costs are based on 76 hours per month at a labor rate of $61/hour.

Using the preceding information, the estimated capital costs for installing a carbon adsorption system and the estimated annual operating costs are shown in Table 4-2. Total cost

TABLE 4-2

ESTIMATED COSTS FOR CARBON ADSORPTION SYSTEM

ITEM	CAPITAL COST (Dollars)	ANNUAL COST (Dollars)
Building [1]	162,500	
Carbon Treatment System	79,000	
Operating Costs [2]		
Carbon Purchases[3]		18,600
Shipping[4]		27,000
Powers[5]		600
Operation and Maintenance [6]		55,600
TOTAL	$241,500	$101,800

[1] Volatile organic treatment system assigned 1/2 of building cost
[2] Based on a flowrate of 30 gpm, 8 hr/d
[3] 9 loads/yr @ $1.15/lb
[4] 9 units/yr @ $3,000 each
[5] 4 HP, 8 hr/d @ $0.07/k Wh
[6] 76 hr/month @ $61/hr

<u>PRESENT WORTH:</u>

Present Worth Factor (PWF) = 9.427 (for annual operating costs)

$101.800/year x 9.427=	$ 960,000
1989 Capital Cost =	$ 241,500
	$1,201,500

(Present Worth) of the GAS adsorption system based on 10 percent simple interest, a 30-year duration of operation, and no salvage value, is estimated to be about $1,201,500.

4.3.2 Ultraviolet (UV) Peroxide Oxidation (Organic Contaminant Removal)

4.3.2.1 Description

The UV/peroxide treatment unit as designed by one manufacturer, consists of an 80-gallon stainless-steel oxidation chamber, which provides for a maximum ground-water retention time of 2.66 minutes at a peak system flowrate of 30 gpm (Figure 4-2).

The oxidation chamber contains 4 medium pressure UV lamps, which are mounted horizontally in quartz sheaths. A hydrogen peroxide feed system is used to inject approximately 50 mg/l (per ppm of organic contaminants) of a 50 percent H_20_2 solution into the ground-water feed line. The ground-water/peroxide mixture then passes through an in-line static mixer before entering the bottom of the oxidation chamber. The ground water then flows through the reaction chamber, passing the UV lamps, before it exits the top of the oxidation chamber.

4.3.2.2 Effectiveness

The UV/peroxide system is capable of removing all of the volatile organics from the ground water to levels below the chemical-specific ARARs. Bench- scale studies, using 881 Hillside Area water, were conducted by Peroxidation Systems, Inc. (Rockwell International, 1988b). The bench-scale testing unit provided a dynamic flow simulation of the process to evaluate the parameters necessary to assure treatment effectiveness and unit sizing. Parameters investigated during the testing included hydrogen peroxide (H_20_2) dosage and power requirements, retention time, system pH, and influent/effluent chemical conditions. Alluvial groundwater from monitoring well 9-74 was blended with footing drain water to

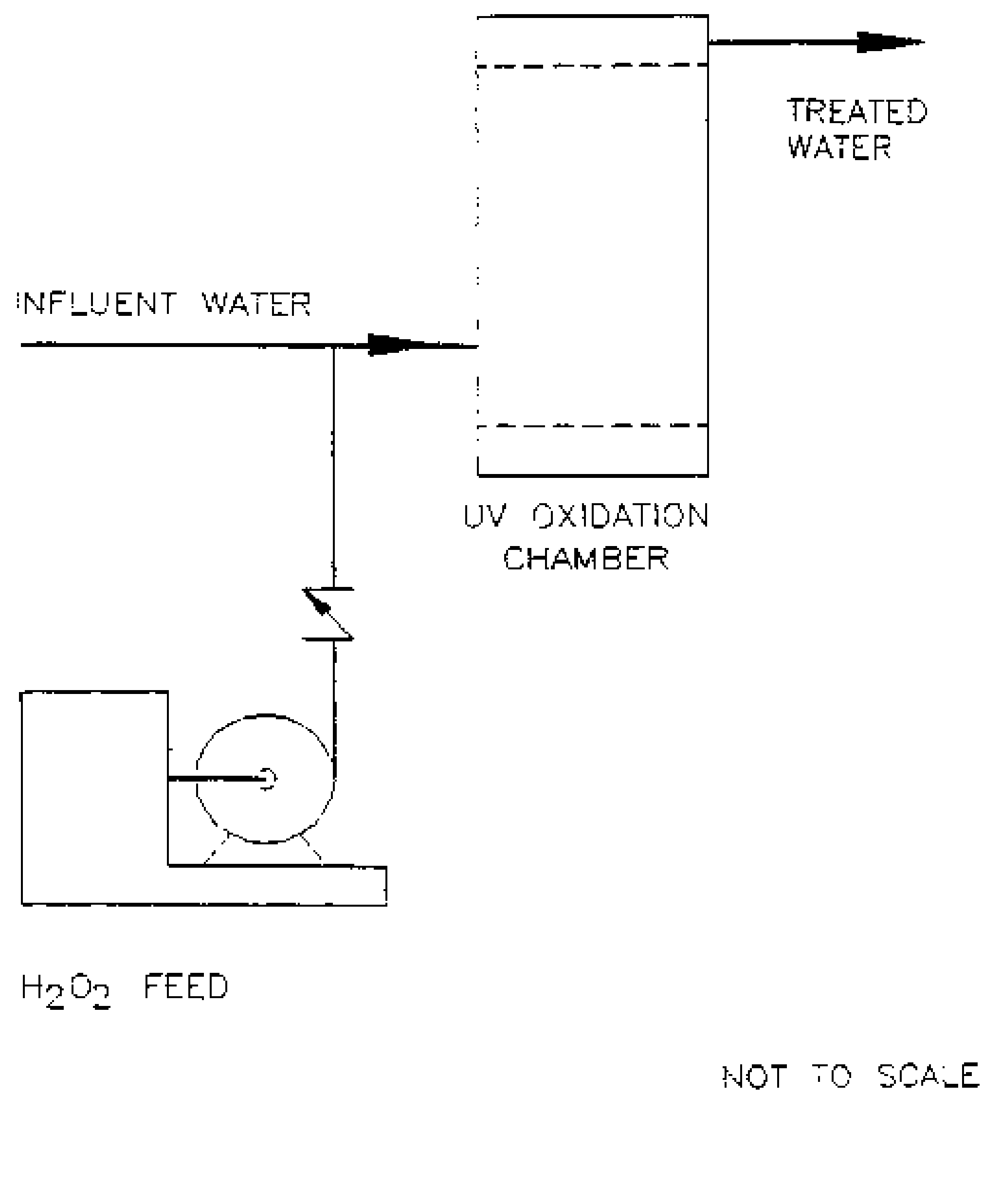

FIGURE 4-2
UV/PEROXIDE SYSTEM

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simulate the expected influent chemical conditions. Results from this testing provided information on H_2O_2 dosage. However, to establish the reaction rates essential to sizing the treatment unit, an unblended sample was tested. Contaminant concentrations were reduced to non-detectable levels for initial ground-water influent total VOCs concentrations of 1 ppm. These results indicate that the UV/peroxide ground-water treatment process is capable of achieving the effluent criteria f or all of the volatile organics listed in Table 4-1. The volatile organics will be completely oxidized to carbon dioxide, water, and chloride, and no organic degradation products will be produced. The system will remain in operation until the ground water has been fully treated to these levels. The system requires periodic UV lamp replacement and routine maintenance, but is expected to have long-term reliability in terms of operation and performance. The risk of failure of the system at any time is highly unlikely. Since the volatile organics are destroyed in the UV/peroxide system, no wastes are produced which require ultimate disposal. While the presence of ferrous iron can impede the effectiveness of the UV/peroxide treatment system due to the precipitation of ferric iron, the manufacturer has indicated that this will not be a problem at the iron concentrations expected. However, should ferric iron precipitation problems arise, appropriate pretreatment such as aeration will be implemented to correct this problem.

During operation of the UV/peroxide ground-water treatment unit, the use of hydrogen peroxide, a strong oxidizer, will require that operators are aware of this potential hazard. The H_20_2 bulk storage tank will be properly vented to assure no pressure buildup and minimize handling exposure. Existing DOE and Rockwell health and safety guidelines at Rocky Flats regarding operator safety while working with strong oxidizers will be followed. UV lamps operate utilizing high voltage and thus caution must be used when working with the system and during the periodic replacement of the UV lamps.

The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased as this treatment process will effectively destroy ground-water contaminants. Treated water will be monitored to ensure contaminants are within regulatory guidelines before being released to the environment.

4.3.2.3 Implementability

UV/peroxide oxidation is an innovative technology for the complete destruction and detoxification of hazardous organic compounds in aqueous solutions. Although the technology is relatively new and has had limited application in the field, SARA requires EPA to prefer remedial actions that significantly and permanently reduce the toxicity, mobility, or volume of hazardous wastes by employing innovative technologies that result in the destruction or detoxification of the wastes.

Demonstrated performance the UV/peroxide ground-water treatment system has been somewhat limited due to the relatively new development of the process. However. Peroxidation Systems, Inc. has 6 UV/peroxide units currently operational or on-line and ready for operation. One of these units is located at Rocketdyne's Santa Susana facility in California. Pilot scale operations were performed by Peroxidation Systems, Inc., on ground water containing VOCs (TCA, TCE, etc.) at system flow rates of approximately 20-40 gpm. Results from the pilot scale testing were favorable, and a UV/peroxide ground-water treatment unit has been purchased, set-up, and site tested. Another UV/peroxide groundwater treatment system, located locally, was visited and appeared to be a low maintenance, highly effective ground-water treatment unit. This system was treating ground water with TCA concentrations significantly lower than those found at the 881 Hillside (approximately 7 ppb). However, the treatment process had initially and effectively treated ground water with much higher concentrations. Based upon actual bench scale results using 881 Hillside ground water and information received regarding currently operating treatment systems, the innovative UV/peroxide ground-water treatment system appears to be a reliable treatment technology.

Operating and maintenance requirements for the UV/peroxide treatment system arc relatively minor. The system will require approximately 180 kW of power and 6,100 pounds/year of 50 percent H_20_2 solution for normal operation. Routine maintenance of the equipment is required and the UV lamps will require replacement approximately every 3-6 months. Routine system maintenance is estimated to be approximately 16 hours/month. An additional two hours per day will be required for system start up, shutdown, and monitoring. All four system UV lamps can be exchanged in about an hour. The system requires only occasional observation to ensure the system is operating properly, although system alarms will notify operators if a problem does occur.

4.3.2.4 Costs

Estimated costs for the UV/peroxide ground-water treatment unit are shown in Table 4-3. Capital cost for the UV/peroxide ground-water treatment system is approximately $382,500. Operational costs include procurement of hydrogen peroxide (6,100 pounds/year), power utilization (180 kW), labor (76 hours/month), and lamp replacement (every 3-6 months at a cost of $300/lamp). Operational costs are based on a system flow rate of 30 gpm, 8 hours per day. Assuming a 10% interest rate and a 30 year operating life, the present worth of the system is $1,329,500.

4.3.3 Air Stripping with Off-Gas Treatment (Organic Contaminant Removal)

4.3.3.1 Description

During air stripping, VOCs are transferred from the water to a continuously flowing airstream which is in direct contact with the water (Figure 4-3). Influent contaminated ground water will enter the top of a 22-inch diameter, 34-foot air stripping column and subsequently contact clean air supplied through the bottom of the column (column sizes are approximate). Appropriate air-to-water flow rates will be utilized to provide for the optimum (99+%) transfer of the contaminants from the ground water to the air stream. The treated ground water will then be pumped through a 1,800-pound liquid phase carbon treatment polishing unit (identical to the one described in Section 4.3.1). The relative humidity of the air stripper emissions will be reduced by use of a heater, and then passed through a vapor phase carbon

TABLE 4-3

OVERALL COSTS FOR THE UV/PEROXIDE

GROUND-WATER TREATMENT UNIT

ITEM	CAPITAL COST (Dollars)	ANNUAL COST (Dollars)
Building [1]	$162,500	
Treatment Unit & Equipment	220,000	
Operating Costs [2]		
-Hydrogen Peroxide[3]		3,000
-Power[4]		36,800
-Lamp Replacement[5]		5,000
-Operation and Maintenance [6]		55,600
TOTAL: UV/Peroxide	$382,500	$100,400

[1] Volatile organic treatment system assigned 1/2of building cost
[2] Operating costs based upon a flowrate of 30 gpm, 8 hr/d
[3] $0.52/lb x 6100 lb/yr
[4] 180 kW, 8 hr/d @ $0.07/kWh
[5] 4 times/year
[6] 76 hrs/month @ $61/hr

PRESENT WORTH

Present Worth Factor (PWF) = 9.427 (for annual operating costs)

$100.400/year x 9.427 =	$ 947,000
1989 capital cost =	$ 382,500
	$1,329,500

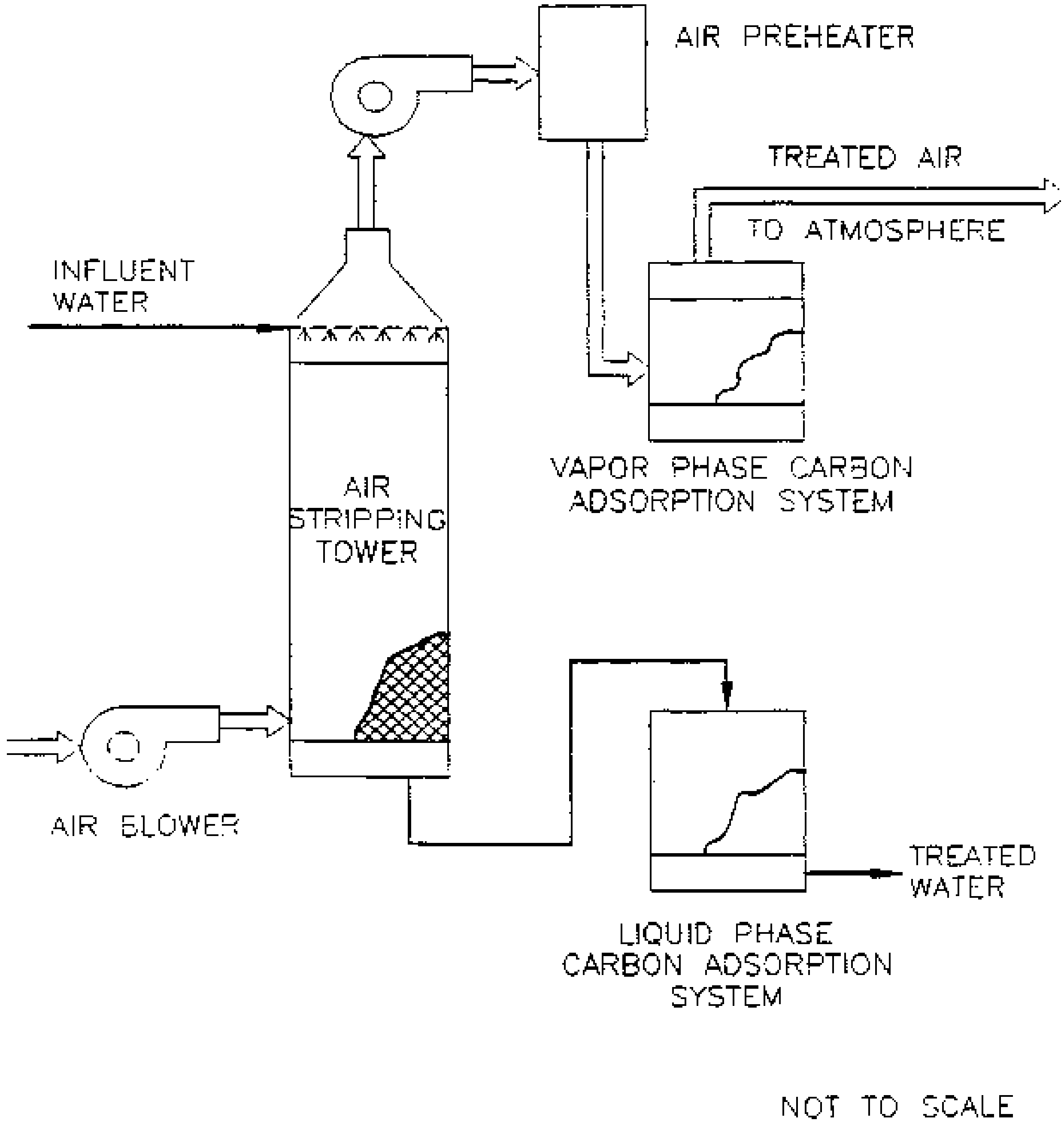

FIGURE 4-3
AIR STRIPPING WITH VAPOR PHASE
AND LIQUID PHASE CARBON ADSORPTION

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system to remove the organics before being released to the environment. The vapor phase carbon unit will contain 2,000 pounds of carbon.

4.3.3.2 Effectiveness

The use of an air stripper is a highly effective method of removing hazardous volatile organic compounds (VOC.) from ground water. The efficiency of the process is well documented. The Environmental Protection Agency (Federal Register), Vol. 52, No. 130, page 25698) has designated packed tower aeration along with granular activated carbon, as a Best Available Technology (BAT) for the removal of VOC. from drinking water.

An air stripper coupled with liquid and vapor phase carbon adsorption is a proven system that has a dependable record of use. It is expected that this treatment process, with proper maintenance, will provide the desired level of contaminant control until complete remediation of the 981 Hillside Area has been achieved.

The probability of equipment failure will be minimized because the system is oversized for the intended maximum flow of 30 gpm and includes two vapor phase carbon units - one installed and one stock. The stock on site unit adds to the system reliability. All appropriate safety measures required when moving and installing large equipment will be complied with during installation. The operation and maintenance of the system will be performed personnel properly trained in the handling of hazardous and radioactive wastes. Because carbon will remove oxygen from the air, whenever personnel are working in confined areas (i.e., tanks), special care must be taken to ensure that an adequate air supply is available.

The operators of the system will not be exposed to VOC-laden carbon from the vapor phase or liquid phase carbon units because the use of containerized and transportable carbon contractors allows removal and replacement of the exhausted carbon at a remote carbon reactivation site. Carbon will not be handled at the site. Transporting the entire exhausted carbon column itself to the regeneration facility ensures operators are protected from the carbon itself, and need only follow routine safety procedures when handling heavy equipment.

The exhausted carbon is generally regenerated through a thermal treatment process which strips the volatile organics from the carbon. The organics are subsequently destroyed via incineration. During this regeneration process, a small quantity of ash may be generated which requires disposal at a landfill. Thus, this process can be considered an alternative to land disposal since the carbon is continuously recycled. However, if the spent liquid phase carbon was determined do be a mixed waste, then it would require land disposal at the Nevada Test site. The vapor phase carbon adsorption system will remove the organics from the air stripper emissions before being released to the environment. Therefore, the vapor phase carbon adsorption system will eliminate the impact of any air stripper emissions on the public health. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased. Treated water and air will be monitored to ensure contaminant levels are within regulatory guidelines before being released to the environment.

4.3.3.3 Implementability

The air stripper will remove greater than 99% of the contaminants in the ground water. Because the air stripper performance is sensitive to changes in flow and contaminant concentrations, a liquid phase carbon adsorption unit is in series with the air stripper to enhance system performance and to ensure that the treated effluent meets chemical-specif ic ARARs for volatile organic compounds. Based on a flow rate of 30 gpm, 8 hours per day, liquid phase carbon usage will be approximately 9 pounds/day and each 1,800-pound carbon unit will require replacement approximately every six months. Vapor phase carbon usage will be approximately 10 pounds/day and each 2,000-pound carbon unit will require replacement approximately every six months.

Operation of the treatment process is relatively simple, requiring occasional cleaning of the air stripping column and replacement of carbon. The air stripper will require cleaning to remove scale buildup on the packing material in order to maintain optimum removal efficiency. Effluent from the cleaning operation will require treatment in the Building 374 Process Waste Treatment System. Transportation and regeneration of the liquid phase and vapor phase carbon units at a remote carbon reactivation site will be required. The air stripping with off-gas treatment system for remediating VOCs contaminated ground water is available commercially and could be implemented quickly. No difficulties are anticipated during the installation and start-up of this treatment system. Replacement of the spent carbon and other maintenance activities are expected to require approximately 16 hours per month, Daily operation of the system will require two hours per day.

4.3.3.4 Costs

Estimated costs for the air stripping ground-water treatment system are shown in Table 4-4. The total capital cost for the system is $257,500. The liquid phase carbon unit is the same unit described in Section 4.3.1. The majority of the operating costs result from the replacement of spent vapor phase and liquid phase carbon. These costs were derived from the same treatability study results and unit pricing presented in Section 4.3.1.4. It should be noted that these operating costs are based on regeneration of the spent carbon as a hazardous waste. If the spent carbon requires disposal at the Nevada Test Site as a mixed waste, these costs could change substantially.

The total present worth cost of the system based on 10% simple interest, a 30 year period of operation, and no salvage is estimated to be approximately $960,000. These costs do not include any capital or operating costs for the Building 374 Process Waste Treatment System associated with the treatment of the air stripper cleaning effluent.

TABLE 4-4

OVERALL COSTS FOR THE AIR STRIPPER GROUND-WATER TREATMENT UNIT

ITEM	CAPITAL COST (Dollars)	ANNUAL COST (Dollars)
Building[1]	$162,500	
Treatment Unit & Equipment		
- Air Stripper Column	25,000	
- Liquid Phase Carbon System	45,000	
- Vapor Phase Carbon System	25,000	
Operating Costs[2]		
- Liquid phase carbon[3]		$ 4,200
- Vapor phase carbon[4]		4,000
- Shipping[5]		12,000
- Power[4]		800
- Operation and Maintenance[7] (76 hr/mo)		55,600
TOTAL	$ 257,500	$ 74,500

[1] Volatile organic treatment system assigned 1/2 of building cost
[2] Operating costs are based upon flowrate of 30 gpm, 8 hr/d.
[3] 2 loads/year @ $1.15/lb
[4] 2 loads/year @ $1.00/lb
[5] 4 units/year @ $3.000 each
[6] 5HP, 8 hr/d @ $0.07/kWh
[7] 76 hr/month @ $61/hr

PRESENT WORTH

Present Worth Factor (PWF) = 9.427 (for annual operating costs)

$74,500/year x 9.427 =	$703,000
1989 capital cost =	$257,000
	$960,500

4.3.4 Ion Exchange Treatment (Inorganic Contaminant Removal)

4.3.4.1 Description

The ion exchange treatment system consists of multiple units staged to remove the inorganic contaminants from the ground-water (Figure 4-4). In the first stage, uranium is removed in a strong base anion unit. Next, heavy metals including strontium and manganese are removed with a weak acid cation unit. This unit also removes the total dissolved solids (TDS) associated with carbonate hardness with subsequent production of carbonic acid. The carbonic acid formed is removed by decarbonation (air stripping). Following decarbonation the flow is split between a two-bed demineralizer for TDS removal and an activated alumina unit for selenium removal. The two-bed demineralizer consists of a strong acid cation exchanger and an anion exchanger arranged in series to further reduce TDS. The treated waters from the demineralizerand activated alumina units will be blended, resulting in a final effluent which will meet all chemical-specific ARARs. A split flow is cost effective as it is unnecessary to completely demineralize the entire flow. The ion exchange and activated alumina resins both require periodic regeneration using HCl or NaOH. Rocky Flats' potable water supply will provide the water for regeneration of all the units. The regeneration wastes would be sent to the Building 374 Process Waste Treatment System for final treatment and disposal.

4.3.4.2 Effectiveness

Ion exchange treatment technology has been proven to remove inorganic contaminants from groundwater to levels that comply with the chemical- specific ARARs. Resins used to adsorb contaminants require regeneration to maintain treatment levels.

All appropriate safety measures required when moving and installing large equipment will be complied with during installation. Use of acids and caustics will require that operators are aware of this potential hazard. The operation of the system will be by personnel that are

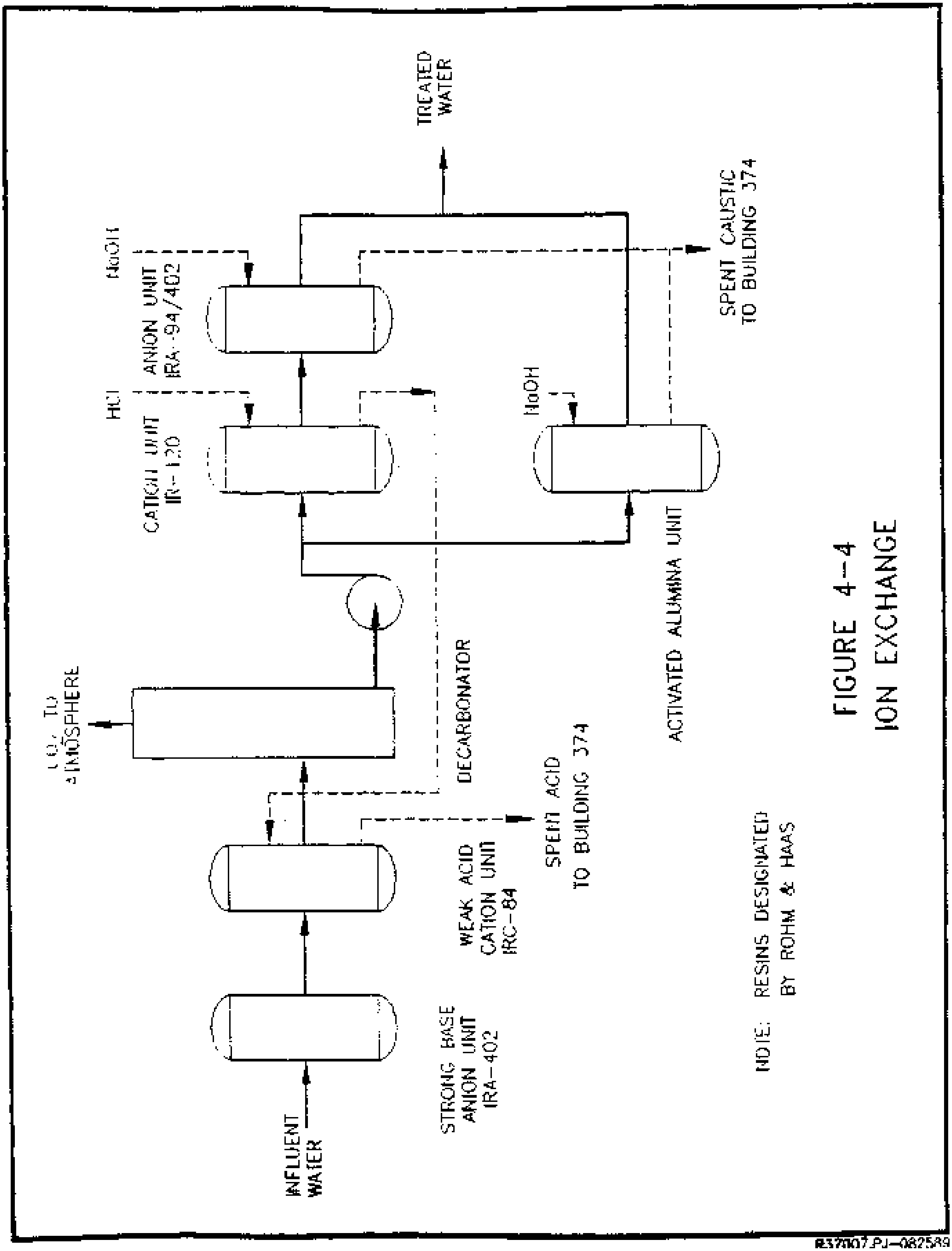

FIGURE 4-4
ION EXCHANGE

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properly supervised and trained. Treated water will be monitored to ensure that the removal of inorganic contaminants is maintained prior to discharge to the environment.

Over 99% of the uranium passing through the system will be removed in the strong base anion exchange unit containing Rohm and Haas IRA-402 in the chloride form. This unit will selectively remove uranium, while allowing the other metals and major ions to pass through. This is very advantageous because only this unit will be accumulating the radioactivity. This unit will not be regenerated because uranium is not readily desorbed from the resin. Instead, the unit will be shipped off-site and disposed as a low level radioactive waste when its activity reaches a predetermined level. Based on an influent uranium concentration of 16 pCi/l and resin volume of 28 ft^3, this unit could be run for more than 30 years without exhausting the resin.

The second exchange unit is a weakly acidic cation exchanger operated in the hydrogen form. The use of a weakly acidic resin has several advantages for this application, including high regeneration efficiency, high operating capacity for carbonate hardness, and a strong affinity for heavy metals. Rohm & Haas IRC-84 is the resin selected f or its ability to remove all heavy metals of interest. In addition, the hardness associated with bicarbonate alkalinity is transformed by the exchange of hydrogen ions into carbonic acid which is removed in a decarbonator where carbon dioxide is vented to the atmosphere.

Reduction of dissolved solids is effected by a two-bed demineralizer designed to work in conjunction with the weak acid cation exchanger and decarbonator. Rohm & Haas IR-120 is the resin of choice for the strong acid cation resin exchange. The anion portion of the twobed demineralizer will be composed of both strong base and weak base anion resins in a “stratified bed” configuration. While a weak base resin alone would normally suffice here, the acidity of the weak base resin would require subsequent caustic addition for PH control. The inclusion of about 30% of a strong base resin in the anion exchange unit results in a neutral pH with only a small penalt y in caustic consumption. The resins of choice here are Rohm & Haas Stratabed quality IRA-94 and IRA-402, respectively. The weak acid cation unit preceding the decarbonator will be regenerated with the regenerate from the strong acid unit to effectively utilize the acid regenerate. The two-bed demineralizer is capable of removing TDS to as low as 10 to 20 ppm.

To lower capital costs by reducing the equipment sizes, only one-third of the flow need be demineralized to obtain the ARAR for TDS. The other two- thirds of the flow would be fed through the activated alumina unit for selenium removal. Actual design conditions have been selected for a 50/50 flow spilt, to be conservative. This design reduces the volume of regenerate chemicals needed as well as waste water produced, compared with sending all of the flow through the demineralizer. Activated alumina regenerated with caustic soda and operating on the slightly acidic effluent from the decarbonator provides the conditions to optimize the selective adsorption of selenium. With a 50/50 flow split, the ARARs for both TDS and selenium would be easily achieved in the final effluent. This system will include a conductivity controller on the final plant effluent to automatically maintain the desired TDS level.

The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased as this treatment process will effectively remove inorganic contaminants from the ground water.

4.3.4.3 Implementability

Ion exchange technology utilizes specific resins to remove by adsorption the groundwater contaminants including heavy metals and total dissolved solids. Resins are selected based on contaminants to be removed. Ion exchange units are commercially available off the-shelf systems that can be purchased and installed readily. The operation of ion exchangers require the resins to be periodically regenerated before treatment can resume. The regenerated waste products will require additional treatment in the Building 374 Process Waste Treatment System.

The proposed system is designed for ease of operation and minimizes the volume of regeneration wastes requiring treatment in the Building 374 Process Waste Treatment System. Based on a flow rate of 30 gpm, 8 hours per day, and the influent characteristics indicated in Table 4-1, regeneration of the exchange resins will be needed once every three days. A total of approximately 6,000 gallons of waste water will be produced each regeneration period. This is equivalent to 14,000 gallons per week. It is estimated that the system will require 40 man-hours per month for operating, maintenance, and monitoring. The majority of this time is required during the regeneration periods.

4.3.4.4 Costs

Estimated capital and operational costs for the ion exchange treatment unit are shown in Table 4-5. The capital cost for the ion exchange system is $287,500. The operational costs include labor, power consumption, annual replacement of the strong base anion unit, and the procurement of hydrochloric acid and sodium hydroxide used for regeneration of the ionic resins.

Assuming 10% interest rate, a 30-year operating life, and no salvage value, the present worth of the system is $699,500. These costs do not include any capital or operating costs associated with the treatment and final disposal of the ion exchange and activated alumina regeneration wastes. These waste streams will be treated in the Building 374 Process Waste Treatment System. The other two inorganic treatment systems being considered for use (electrodialysis and reverse osmosis) also will be utilizing Building 374 for treatment of waste products.

TABLE 4-5

OVERALL COSTS FOR THE ION EXCHANGE GROUND-WATER TREATMENT UNIT

ITEM	CAPITAL COST (Dollars)	ANNUAL COST (Dollars)
Building [1]	$162,500	
Treatment Unit & Equipment	125,000	
Operating Costs[2]		
- Acid[3]		2,300
- Caustic[4]		1,600
- Power[5]		1,800
- Strong Base Anion Unit Replacement[6]		9,000
- Operation and Maintenance[7]		29,000
TOTAL	$287,500	$ 43,700

[1] Inorganic treatment system assigned 1/2 of building cost
[2] Based on a flowrate of 30 gpm, 8 hr/d with a recycle stream 24 hr/d
[3] 3.08 lb/1000 gal @ $0.14/lb for 100% HC1
[4] 2.45 lb/1000 gal @ $0.125/lb for 100% NaOH
[5] 4 HP, 24/d @ $0.07/k Wh
[6] 1/year
[7] 40 hrs/month @ $61/hour

PRESENT WORTH

Present Worth Factor (PWF) = 9.427 (for annual operating costs)

$43,700/year x 9.427 =	$412,000
1989 capital cost =	$287,500
	$699,500

4.3.5 Electrodialysis (Inorganic Contaminant Removal)

4.3.5.1 Description

In the electrodialysis process, the application of an electrical potential between a cathode and anode causes the separation of ionic components of a solution. This is accomplished by alternately placing anionic and cationic semipermeable membranes across the current pathway. When a current is applied, the cations migrate toward the negative electrode and the anions migrate toward the positive electrode. Because of the alternate spacing of cation- and anion-permeable membranes, cells of concentrated and dilute salts are formed. The electrodialysis process is shown in Figure 4-5. Because electrodialysis will not meet ARAR-based performance standards for selenium, ion exchange will also be required for effective treatment. Furthermore, to avoid uranium loading on the selenium-specific exchange unit (which would ultimately render it non-regenerable), a uranium-specific exchange unit is necessary. Thus, the first unit used is a strong base anion exchanger designed selectively for uranium removal. The ground water is then passed through an activated alumina unit prior to electrodialysis to achieve selenium removal. This is necessary since vendors have indicated that electrodialysis may not be capable of removing selenium to the ARAR of 0.01 mg/l. The activated alumina would be sized to require regeneration once every three days. Rocky Flats' potable water supply will be used to provide the water for regenera tion. Following the activated alumina unit, ground water to be treated is pumped through the electrodialysis membranes which are separated by spacers and assembled into stacks. As the water passes through, the salinity becomes more concentrated in one space, and less concentrated in the adjacent space. The water is passed through several stacks until the desired salinity concentrations are achieved. The water is usually retained for about 10 to 20 seconds in a single stack or stage. This process may be operated in either a continuous or batch mode. Multiple units can be arranged either in parallel to provide the necessary hydraulic capacity or in series to effect the desired degree of dernineralization. Makeup water is used to continuously clean the semipermeable membranes during operation.

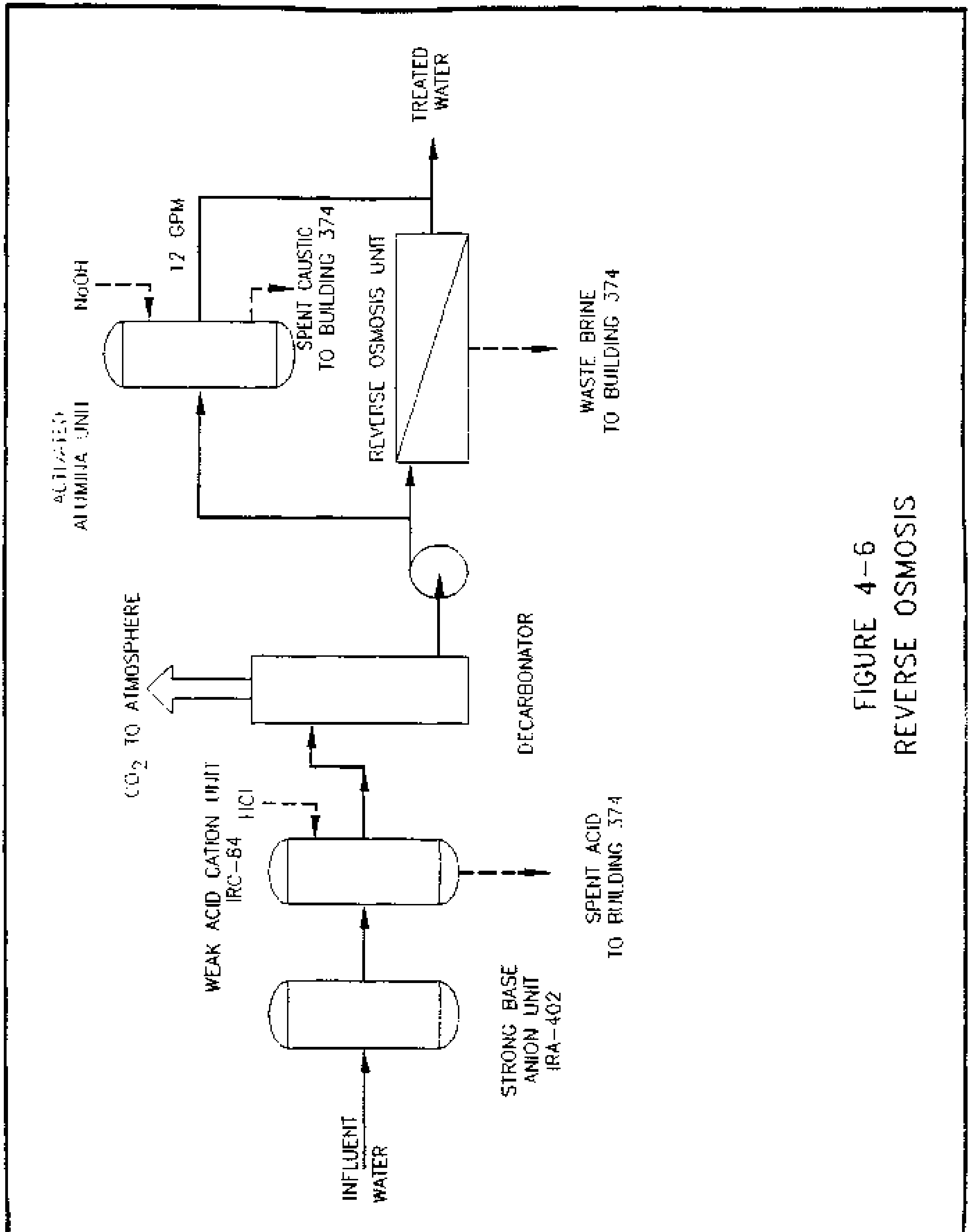


FIGURE 4-6
REVERSE OSMOSIS

4.3.5.2 Effectiveness

Electrodialysis is capable of removing all of the inorganics to below the chemical-specific ARARs except for selenium. To accomplish the selenium removal, the activated alumina unit is used. Total dissolved solids (TDS) reduction can be controlled by adjusting the current level in the electrodialysis unit. The system would be operated until the inorganic chemical-specific ARARs in the ground water are all met, at which time further treatment will be unnecessary. A strong base anion unit is used to remove the uranium. This unit will not be regenerated, but will be periodically disposed as a low-level radioactive waste and replaced. In this way, no radioactive regenerate wastes will be produced, and only one unit need be handled and disposed as a radioactive waste.

Appropriate safety measures required when moving and installing large equipment will be complied with during construction. The operation and maintenance of the system will be by personnel who are trained in the handling of hazardous chemicals as well as hazardous and radioactive wastes. The operators will not be exposed to any chemical hazards during routine system operation. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased.

The only other waste generated from the process requiring ultimate landfill disposal will be the salts produced in the Building 374 Process Waste Treatment System. Thus, this alternative minimizes the amount of waste requiring land disposal.

4.3.5.3 Implementability

While no treatability studies have been performed, process modeling indicates that the activated alumina, strong base cation, and electrodialysis units would meet all of the performance goals. A discussion of the performance efficiency and implementability of the activated alumina and strong base anion units is given in Section 4.3.4.3. Electrodialysis is not a widely used technology for this type of application, and the number of case studies available for comparison is limited.

One problem associated with the use of the electrodialysis process involves the use of the semipermeable membranes. These membranes are non-chemical- specific and cannot be designed to selectively remove the metals of concern from the ground water. As with other membrane processes, scaling and clogging of the membranes with salts of low solubility is a potential problem. Precise process control and system monitoring are required to ensure proper membrane operation. The concentrate f rom the electrodialysis unit and the activated alumina regeneration waste will both be treated in the Building 374 Process Waste Treatment System.

Approximately 10% of the influent flow to the electrodialysis unit will be rejected as concentrate. This concentrate, along with the activated alumina regeneration waste, will total approximately 15,000 gallons per week. Since the concentrate will be sent to Building 374, only 90% of the influent flow will be returned as treated effluent to the South Interceptor Trench (see Section 4.5). The consumptive use of ground-water potentially tributary to the South Platte River normally requires an approved augmentation plan from the Colorado State Engineer; however, an augmentation plan will not be required for the IRA because it is a CERCLA action. Nevertheless the 10% return flow deficit will be replaced by the addition of water from the Rocky Flats Plant potable water supply prior to discharge.

It is estimated that 60 man-hours per month will be required for operation, maintenance, and system monitoring. Most of this time will be required during the activated alumina regeneration periods, and for monitoring of proper membrane function.

4.3.5.4 Costs

Estimated costs for the electrodialysis treatment unit are shown in Table 4- 6. Capital costs f or the electrodialysis system are approximately $307,500. Operational costs include the procurement of acid and caustic for activated alumina regeneration, replacement of resins and

TABLE 4-6

OVERALL COSTS FOR THE ELECTRODIALYSIS GROUND-WATER TREATMENT UNIT

ITEM	CAPITAL COST (Dollars)	ANNUAL COST (Dollars)
Building [1]	$162.500	
Treatment Unit & Equipment	145,000	
Operating Costs [2]		
S Acid [3]		500
S Caustic [4]		500
S Power [5]		1,800
S Membranes [6]		1,100
S Strong Base Anion Unit Replacement [7]		9,000
S Operation and Maintenance [8]		44,000
TOTAL	$307,500	$ 56.900

[1] Inorganic treatment system assigned 1 / 2 of building cost
[2] Based on a f lowrate of 30 gpm, 8 hr / d
[3] 0.67 lb/1000 gal @ $ 0.14/lb or 100% HCI
[4] 0.76 lb/1000 gal @ $ 0.125/lb for 100% NaOH
[5] 4.8 kWh/1000 gal @ $ 0.07/kWh
[6] $ 0.02/1000 gal
[7] 1/yr
[8] 60 hrs/ month @ $ 61 /hour

PRESENT WORTH

Present Worth Factor (PWF) - 9.427 (for annual operating costs)

$56,900/year x 9.427 =	$ 537,000
1989 capital cost =	$ 307,500
	$ 844,500

membranes, labor, and power consumption. The present worth for the system based on a 10% simple interest rate, a 30-year duration of operation, and no salvage value, is estimated to be $844,500.

These costs do not include any capital or operating costs associated with the treatment and final disposal of the activated alumina regeneration waste and electrodialysis waste brine. These waste streams will be treated in the Building 374 Process Waste Treatment System. The other two inorganic treatment systems being considered for use (ion exchange and reverse osmosis) also will be utilizing Building 374 for treatment of waste products. The disposal costs of the strong base anion unit as a low-level radioactive waste have not been included.

4.3.6 Reverse Osmosis (Inorganic Contaminant Removal)

4.3.6.1 Description

The reverse osmosis (RO) treatment system shown in Figure 4-6 is similar in concept to the ion exchange alternative described in 4.3.4. Ground water is first treated with a strong anion exchange to remove uranium. The water is next passed through a weak acid cation exchange unit for the removal of heavy metals, including strontium and manganese. This unit also removes the TDS associated with carbonate hardness with subsequent production of carbonic acid. The carbonic acid formed is removed by decarbonation. Following decarbonation, the flow is split between a reverse osmosis treatment unit (for TDS removal) and an activated alumina unit for selective selenium removal.

The reverse osmosis unit separates dissolved salts from water by filtering water through a semi-permeable membrane at a pressure greater than the osmotic pressure caused by the dissolved salts. The operating pressure required can approach 10,000 kN/m^2 (1,000 lb/in^2). The treated water that passes through the membrane is called the permeate while the reject solution is called the concentrate. As the permeate is typically 10 to 15% of the influent, several membranes must be staged in series for treatment of the concentrate to maximize

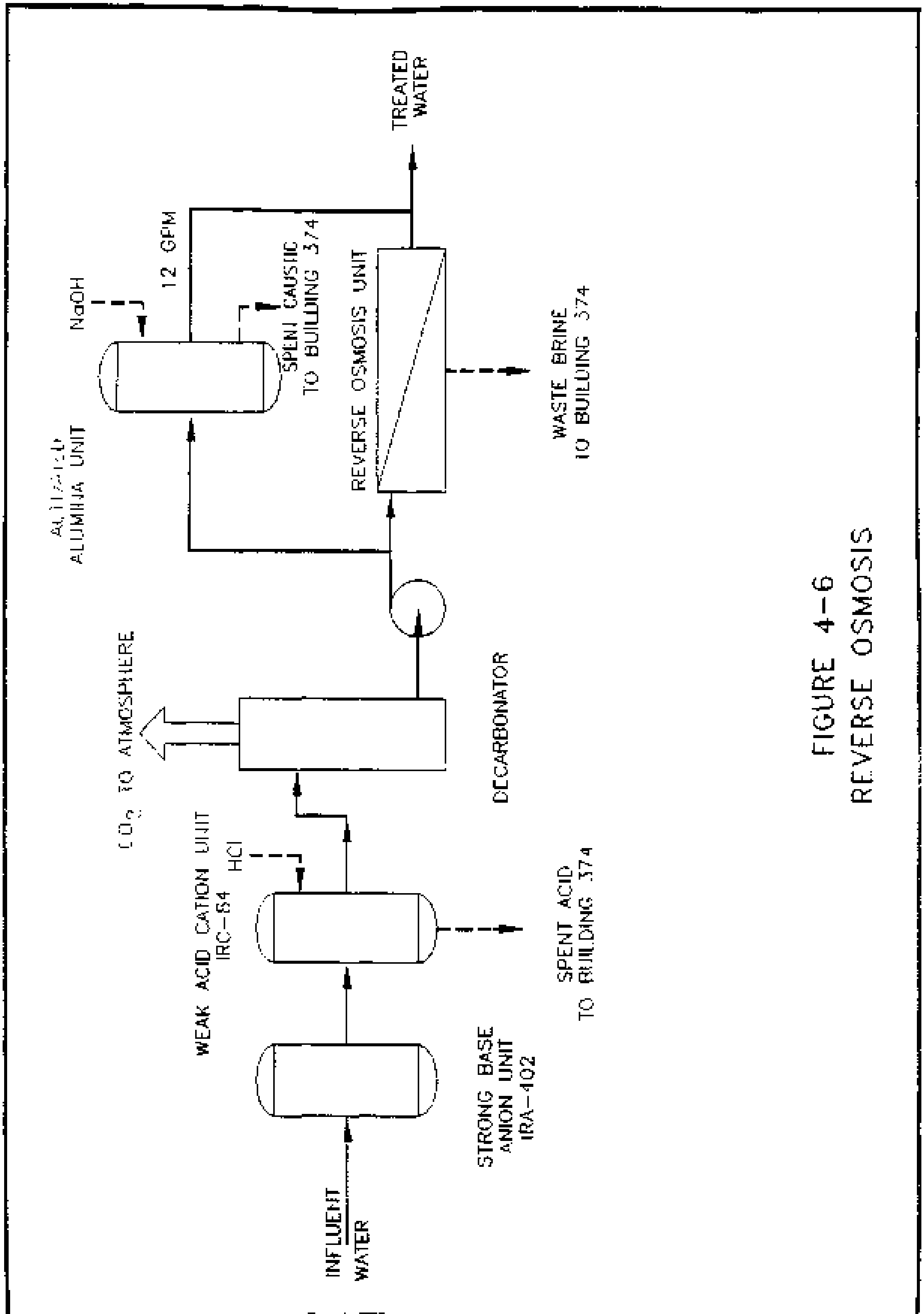


FIGURE 4-6
REVERSE OSMOSIS

permeate output and minimize concentrate rejected. Concentrate rejected from the RO unit and wastes from regeneration of the resins will be treated in the Building 374 Process Waste Treatment System. Rocky Flats' potable water supply will be used to provide the regeneration water for the weak acid cation unit and the activated alumina unit.

4.3.6.2 Effectiveness

Reverse osmosis treatment technology has been proven to remove inorganic contaminants from ground water to levels that comply with the chemical- specific ARARs. This technology does have several problems associated with fouling of the filter membrane which can be mitigated by pretreatment to extend the membrane life.

Pretreatment with a strong acid anion exchange unit is used for selective uranium removal. This confines the buildup of radioactivity to this unit, which is advantageous from a health and safety and operational viewpoint. The performance of this unit is described more fully in Section 4.3.4.3. The ground water is then passed through a weak acid cation exchange unit followed by decarbonation for the removal of iron and manganese. This yields an acidic feed which reduces the potential for scaling within the reverse osmosis unit. Based on the influent design criteria indicated in Table 4-1, one vendor of reverse osmosis has indicated that 12 membranes in series are required to achieve a permeate flow of 75% of the total flow including recycle.

To lower the capital cost by reducing the reverse osmosis equipment sizes, only one-third of the total flow need be sent through the reverse osmosis unit to obtain the ARAR for TDS and metals other than selenium. The other two-thirds of the flow would be fed through the activated alumina unit for selenium removal. With such a split flow, all of the inorganic chemical- specific ARARs would be achieved in the final effluent.

Approximately 25% of the influent flow to the reverse osmosis unit will be rejected as concentrate. This concentrate, as well as the regeneration wastes from the ion exchange units, will total approximately 21,000 gallons per week. Since these wastes would be sent to Building 374, only 75% of the influent flow would be returned as treated effluent to the South Interceptor Trench (see Section 4.5). The consumptive use of ground-water potentially tributary to the South Platte River normally requires an approved augmentation plan from the Colorado State Engineer; however, an augmentation plan will not be required for the IRA because it is a CERCLA action. Nevertheless the 25% return flow deficit will be replaced by the addition of water from the Rocky Flats Plant potable water supply prior to discharge.

The weak acid cation resin and activated alumina will have to be regenerated using acid and caustic soda to maintain the treatment efficiency. The use of acids and caustics will require that operators are aware of this potential hazard. The operation of the system will be by personnel that are properly supervised and trained in the system operation and potential hazards.

Treated water will be monitored to ensure that the removal of inorganic contaminants is maintained prior to discharge to the environment.

Nearby communities and the environment should realize no safety concerns as this treatment process will effectively remove inorganic contaminants from the ground water. No short term safety concerns for nearby communities and the environment are anticipated during implementation of this process.

4.3.6.3 Implementability

As with ion exchange, reverse osmosis units are commercially available and routinely used to desalinate water supplies. The unit can be readily purchased and installed.

It is estimated that 60 man-hours per month will be required for operation, maintenance, and system monitoring. The majority of this time will be required for the regeneration periods, and for monitoring the reverse osmosis membrane operation.

4.3.6.4 Costs

Estimated capital and operational costs for the reverse osmosis treatment alternative are shown in Table 4-7. The capital cost for the reverse osmosis system is $302,500. The operational costs include the costs of power, labor, membrane and resin replacement, and the procurement of hydrochloric acid and sodium hydroxide for regeneration of the cation resin and activated alumina.

Assuming a 10% interest rate, a 30-year operating life, and no salvage value, the present worth of the system is $853,500. These costs do not include any capital or operating costs associated with the treatment and final disposal of the reverse osmosis concentrate and regeneration wastes. These waste streams will be treated in the Building 374 Process Waste Treatment System. The other two inorganic treatment systems being considered for use (ion exchange and electrodialysis) also will be utilizing Building 374 for treatment of waste products. The disposal costs of the strong base anion unit as a low-level radioactive waste have not been included.

4.4 COMPARATIVE ANALYSIS OF THE GROUND WATER TREATMENT TECHNOLOGIES

4.4.1 Organic Contaminant Treatment Technologies

Based on performance, reliability, implementability, safety, and environmental and institutional impacts, there is not a substantial difference between the three processes. The present worth of each of the three alternatives has been estimated assuming a simple interest rate of 10% over a 30-year period of operation with no salvage value. For activated carbon adsorption, the present worth is $1,201,500; for UV/peroxide oxidation, $1,329,500; and for air stripping with both liquid and vapor phase activated carbon, $960,500. The UV/peroxide oxidation system is more expensive than the other two treatment systems.

TABLE 4-7

OVERALL COSTS FOR THE REVERSE OSMOSIS GROUND-WATER TREATMENT UNIT

ITEM	CAPITAL COST (Dollars)	ANNUAL COST (Dollars)
Building [1]	$162,500	
Treatment Unit & Equipment	140,000	
Operating Costs [2]		
S Acid [3]		1,300
- Caustic [4]		300
- Power [5]		1,600
- Membranes [6]		2,200
- Strong Base Anion Unit Replacement [7]		9,000
- Operation and Maintenance [8]		44,000
TOTAL	$302,500	$ 58.400

[1] Inorganic treatment system assigned 1 / 2 of building cost
[2] Based on a f lowrate of 30 gpm, 8 hr / d
[3] 1.74 lb/1000 gal @ $ 0.14/lb or 100% HC1
[4] 0.39 lb/1000 gal @ $ 0.125/lb for 100% NaOH
[5] 10 HP, 8 hr/d @ $ 0.07/kWh
[6] $ 6/day
[7] 1/yr
[8] 60 hrs/ month @ $ 61 /hour

PRESENT WORTH

Present Worth Factor (PWF) = 9.427 (for annual operating costs)

$58,400/year x 9.427 =	$ 551.000
1989 capital cost =	$ 302.500
	$ 853.500

Since all three processes will effectively decontaminate the ground-water, the ultimate destruction of ground-water contaminants has become a factor in the choice of treatment. The air stripping and activated carbon adsorption systems both use activated carbon, and with regeneration, the contaminants that have adsorbed onto the carbon would eventually be destroyed. However, this assumes that the carbon is not radioactively contaminated, thereby requiring shipment to the Nevada Test Site for disposal. Uranium, either naturally occurring or resulting from past waste disposal, will likely adsorb to the activated carbon but would pass through the UV/ peroxide system. Although use of an ion exchange unit before activated carbon treatment would obviate this issue, adsorption of organics on the exchange resin would reduce resin performance and render this treatment scheme inefficient. SARA favors innovative treatment technologies that destroy contaminants, and UV/peroxide meets this objective. Therefore, the advantage provided by a UV/peroxide system of directly destroying the volatile organic ground-water contaminants is the deciding factor in selecting UV/peroxide as the preferred process for ground-water treatment.

4.4.2 Inorganic Contaminant Treatment Alternatives

Based on effectiveness and cost, there is not a substantial difference between the three inorganic treatment processes. All three are capable of meeting the chemical-specific ARARs, and they compare favorably in terms of operational safety and environmental considerations. The present worth of each alternative has been estimated assuming a simple interest rate of 10% over a 30-year period of operation with no salvage value. For ion exchange, the present worth is $862,000; for electrodialysis, $1,007,000; and for reverse osmosis, $1,016,000. The capital costs of the three alternatives are within roughly 10% of each other and are all considered competitive.

The electrodialysis and reverse osmosis processes are both membrane processes which require a high degree of process control for effective operation. The membranes are very sensitive to fouling, and proper pretreatment is needed to ensure steady performance over time. The ion exchange process utilizes resin beds in place of membranes and is considered more reliable for long term operation.

All these processes produce wastes which would be treated in the Building 374 Process, Waste Treatment System. Electrodialysis and ion exchange produce nearly equal volumes of waste (14,000-15,000 gallons per week). The reverse osmosis system produces roughly 50% more, or 24,000 gallons per week.

In both the electrodialysis and reverse osmosis alternatives, a portion of the water being treated is discharged to Building 374 as process waste. This requires that a supplemental water source is needed to augment the treated effluent prior to discharge in order to ensure complete recharge. Since this interim remedial action is being executed under CERCLA, it would not be necessary to obtain a ground-water augmentation permit. However, Rockwell would be required to maintain records documenting the augmentation and would have to sample the supplemental water source periodically to ensure compliance with the ARARs. These tasks represent an institutional requirement and cost (not included here) which ion exchange would not be subject to. For this reason and reasons discussed above, ion exchange has been selected as the preferred alternative for the removal of the inorganic contaminants from the ground water.

44.3 Preferred Ground Water Treatment System

As summarized above, the UV/ peroxide treatment system has been selected for the removal of organic contaminants, and ion exchange for the removal of inorganic contaminants. In order to maximize the overall system performance, the ground water will be treated as shown in the flow diagram in Figure 4-7.

As shown in this figure, the ground water will be pumped into two surge tanks. The surge tanks insure that the treatment system will receive a constant flow of 30 GPM, 8 hours

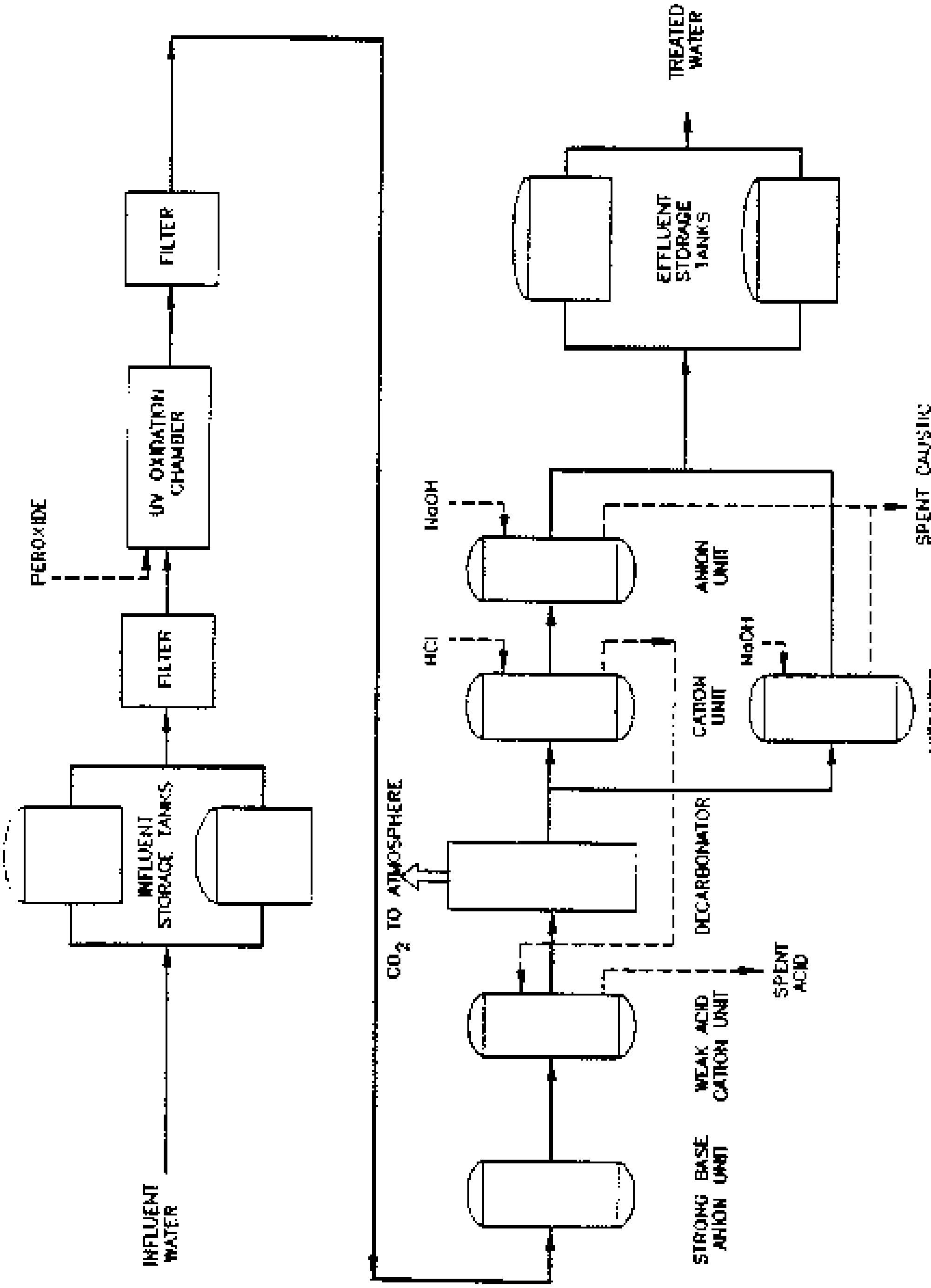


FIGURE 4-7 – TREATMENT SYSTEM PROCESS FLOW DIAGRAM per day. These tanks also provide approximately two days of collection potential when the treatment system is not operating.

From the surge tanks, the water is pumped through filters to remove suspended solids. The water next is sent to the UV/peroxide unit where the volatile organic contaminants are destroyed. While iron may be oxidized by the peroxide, the concentrations of ferric iron formed will not adversely affect performance of the unit. Should the ferric iron precipitate from solution within the resin bed of the weak acid cation unit, it will be removed during the regeneration cycle with HCI.

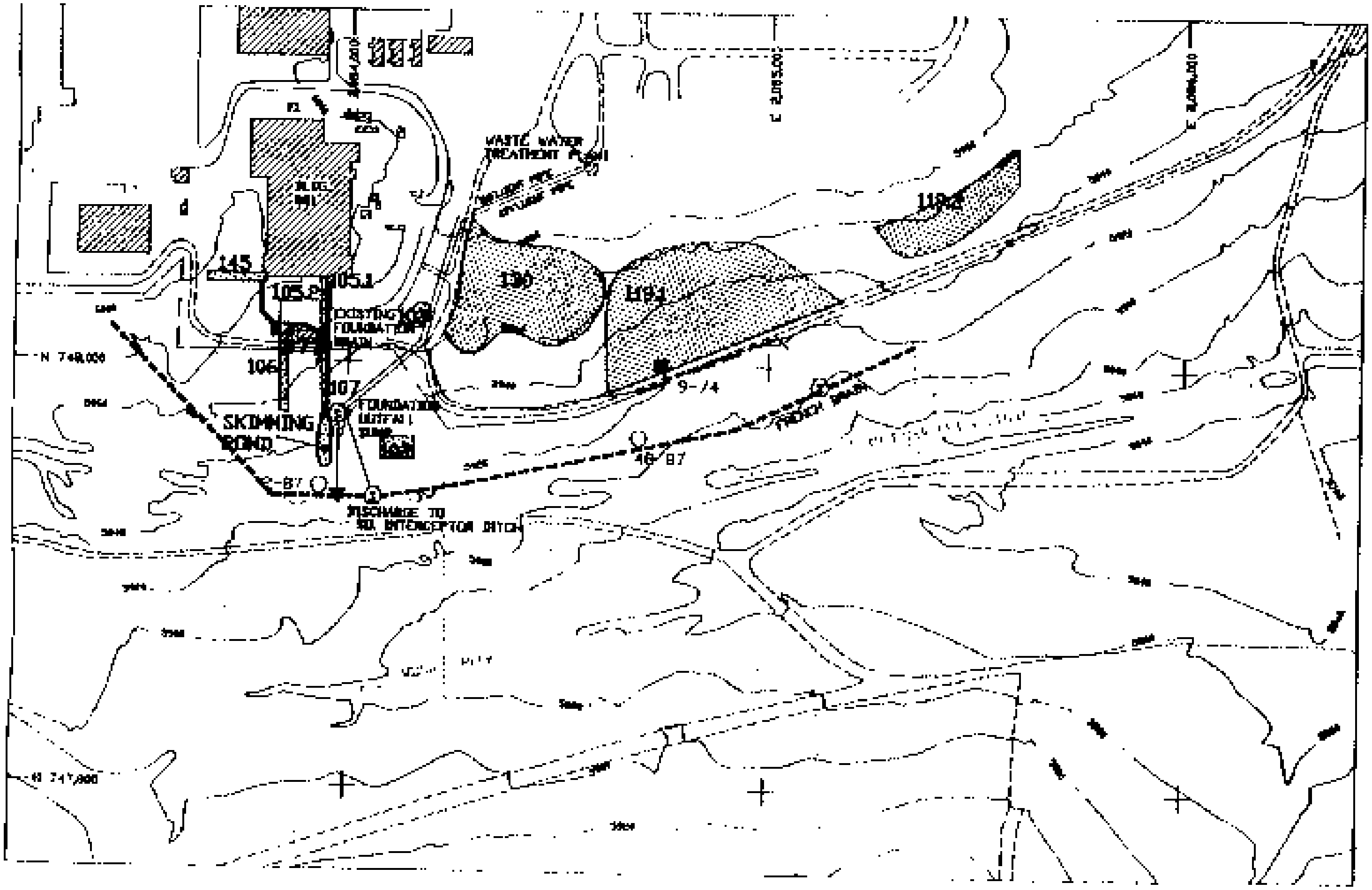
Finally, the water is passed through the ion exchange units for the removal of uranium and inorganic contaminants. With the exception of the uranium removal unit which is not regenerated, the regenerate wastes from the other ion exchange resins are sent to Building 374 for final treatment. Treated water is pumped to the effluent storage tanks for analysis prior to discharge. Should the effluent quality be unacceptable for discharge, the water will be returned to the influent storage tanks for further treatment.

4.5 DETAILED EVALUATION OF REMEDIAL ACTION ALTERNATIVES

4.5.1 Alternative 1: Collect Ground Water from Footing Drain. Source Well and French Drain, and Discharge to the South Interceptor Trench Downgradient of the 881 Hillside Area

4.5.1.1 Description

This alternative involves construction of a french drain (trench) at the location shown on Figure 4-8. The drain is located downgradient of the 881 Hillside SWMUs and monitoring wells 2-87 and 48-87, and upgradient of the South Interceptor Ditch. This location is downgradient of VOC contaminated alluvial ground water. The french drain will extend along the entire length of the saturated alluvium. The drain will be keyed at least two feet into bedrock of a hydraulic conductivity of 1×10^{-6} centimeters/second (cm/sec) in order to



EXPLANATION

SOLID WASTE MANAGI UNITS

FRENCH DRAIN SYSTI

SUMPS (location to finalized during detail design)

9-74 RECOVERY WELL

48-87 ALLUVIAL MONI WELLS

FIGURE 4-8

ALTERNATIVE 1:
FRENCH DRAIN COLLECTI
WITH TREATMENT

fully penetrate the soils, and will be approximately 2,100 feet long. As such, the drain will intercept and contain all alluvial ground-water flowing from the area. A PVC drainage pipe will direct flow under gravity to two 3-root diameter concrete collection sumps. Each sump will be equipped with a submersible sump pump to deliver water from the drain to the new treatment plant (see Section 4.4). Each of the two pumps will have sufficient capacity to deliver the entire discharge of the drain to the treatment plant. The downgradient face and bottom of the french drain and drain sump will be covered with a synthetic membrane to limit flow from the clean side of the trench (Figure 4-9). The upgradient face of the french drain will be covered with a geotextile filter fabric to minimize the intrusion of soils into the drain rock. The fabric will be of a size that prevents clogging. The inclusion of the downstream synthetic membrane coupled with the continuity of the drain is expected to provide positive cutoff of the ground water. Water collected from a source well at SWMU 119.1 (a new well near well 9-74) will also be treated in the new treatment plant. In addition, a sump will be built to collect the flow from the Building 881 footing drain. Two sump pumps will be used to transfer the footing drain flow to the treatment plant in a separate piping system. Effluent from the treatment plant will be discharged to the South Interceptor Trench which flows into Pond C-2. Pond C-2 discharges to Woman Creek under provision of RFP's NPDES Permit.

Flow from the trench could be on the order of 10 gpm initially, but is expected to drop to less than 5 gpm within a few days. The combined steady state flow from the trench and source well is estimated to be as low as 2 gpm. Flow from the Building 881 footing drain is expected to be 5 gpm or less.

4.5.1.2 Effectiveness

The proposed interim action will collect ground water from the soils on the 881 Hillside Area in a french drain with a downstream impermeable membrane. The french drain that will be constructed Figure 4-8 on the 881 Hillside is intended to collect ground water containing volatile organics from the colluvium/alluvium system. The drain will be keyed two feet into bedrock of a hydraulic conductivity of 1 x 10^{-6} centimeters/second (cm/s) to fully penetrate

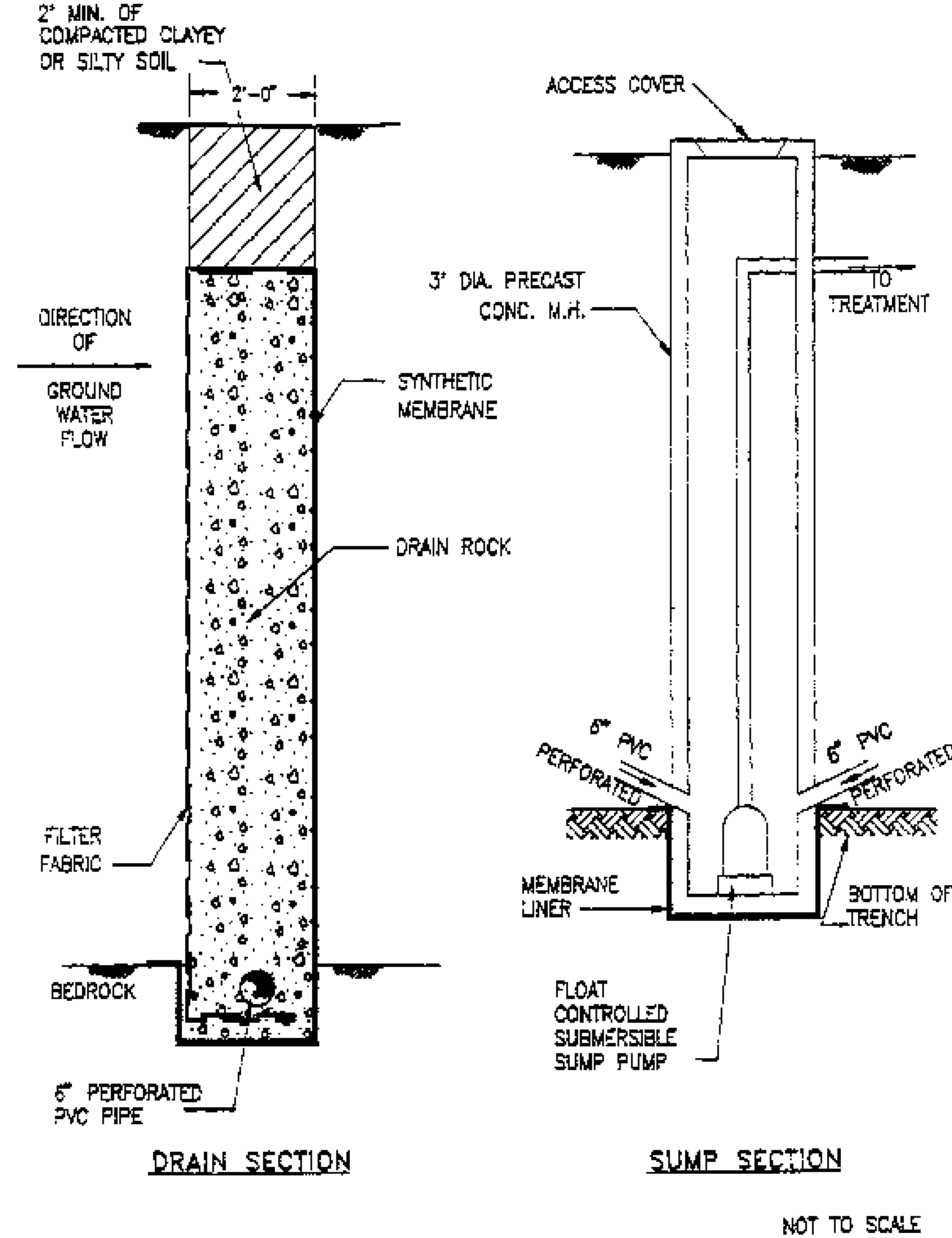


FIGURE 4-9
FRENCH DRAIN SECTION

the colluvium so that ground water will not flow under the drain in the colluvium. The bedrock has a hydraulic conductivity more than two orders of magnitude smaller than the colluvium. Therefore, the drain will be effective in collecting colluvial ground water.

The penetration into bedrock is not intended to reduce the migration of contaminants into bedrock. However, the installation and operation of the drain will have two beneficial impacts on the bedrock ground-water flow system. First, the drain will slightly decrease the rate of downward movement of colluvial ground water because the potentiometric surface in the colluvium will gradually be lowered and, as a consequence, the gradient between the colluvium and the bedrock will be slightly less. Second, the drain will remove the contaminated colluvial/alluvial ground water that is a potential source for contamination of bedrock ground water. The interim action is intended to remove volatile organics form the colluvial/alluvial ground-water and is anticipated that the french drain will be effective in both collecting the colluvial/alluvial ground water and limiting releases from the 881 Hillside Area.

The proposed treatment system will remove both the organic and inorganic groundwater contaminants to below the chemical-specific ARARs given in Section 3.3.1. A complete analysis of chemical-specific ARARs pertinent to subsurface discharge is presented in Section 3.3. Location-specific ARARs are discussed in Section 3.3.2.

The interim action at the 881 Hillside Area is expected to have minimal impacts on Woman Creek. Although the french drain is expected to intercept all of the colluvial flow from the hillside area, the water will be returned to the hillside by means of surface discharge (after treatment) to the South Interceptor Ditch. The point of discharge will be at the west end of the hillside area (upstream) and the discharged water will flow along the ditch to Pond C-2. This should maintain the artificial wetland that exists in the South Interceptor Ditch. The treated water is expected to return to the ground-water system by infiltration from the South Interceptor Ditch and Pond C-2.

Losses from the ground-water system resulting from the interim action are expected to be as follows:

- It is possible that a certain diminution of flow in the creek will occur directly downhill of the area because not all of the discharge will infiltrate from the South Interceptor Ditch. However, this possible diminution is expected to be negligible because the hillside area only amounts to about 10 percent of the recharge area to the creek (total length of both banks is approximately 20,000 feet from the hillside to the headwaters of the creek, while the cut-off length at the hillside is approximately 2,000 feet). In any event, the creek will be nearly fully recharged by infiltration from Pond C-2.

- Some evaporation will occur from both the South Interceptor Ditch and Pond C-2.

The impacts of the losses are expected to be negligible because the total flow currently recharging the ground-water system of the Woman Creek Valley Fill Alluvium is a small proportion of the total flow and most of the intercepted ground water will return to the system in any event. The losses are expected to have no noticeable impact on the availability of ground water off-site because the vast majority of the ground water in the Alluvium is currently consumed by evapotranspiration within the plant boundary.

Worker safety precaution will be required during construction of this alternative because of the potential for encountering contaminated soil or water in the excavation. However, at the location of the drain it is expected that contamination in both soil and water will not be detected. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased from the construction or operation of this remedial action alternative. Treated water will be monitored to ensure contaminants are within regulatory guidelines prior to discharge.

4.5.1.3 Implementability

French drains have been used successfully for many years for control of ground water. French drains are almost always effective, except when ground water can flow over, under or around the drain, or when the drain becomes clogged. The drain proposed for the 881 Hillside will fully penetrate the colluvium and be keyed into claystone bedrock, precluding the possibility of flow under or over the drain. It extends uphill on the west side to an elevation equal to that of SWMU 107 and is keyed into a dry ridge on the east end. This should preclude flow around the drain. Clogging is not expected to be a problem based on past experience of the footing drain at Building 881, which has been in service since the early. 1950's without clogging. Replacement of the pumps in the sumps should be expected as part of routine operation.

Operation and maintenance requirements are small for a french drain. Flow to the sump is by gravity. Liquid level controllers switch on a submersible pump in the central sump whenever there is sufficient water present. A high level alarm will provide an indication of pump failure although inspection of the french drain and pumping records on a weekly basis will ensure that the collection system is functioning. Any necessary repairs will be undertaken immediately. In addition, pairs of ground-water monitoring wells will be installed along the trench upgradient and downgradient at locations where the colluvium is found to be saturated or where subcropping sandstones are encountered (based on trench excavation) to monitor the effectiveness of the french drain in intercepting contaminated ground-water. Changes in ground-water quality upgradient and downgradient of the french drain will also be monitored by existing ground-water monitoring wells.

A large diameter withdrawal well will provide efficient dewatering of the alluvium in the vicinity of well 9-74 and reduce pump cycling. The well will be surrounded by monitoring wells so that an evaluation of the efficiency of the well can be easily made. It appears likely that pumping of this well will be continuous for the first several years of remediation, but may not be required later. This is due to the small amount of ground water in the vicinity of SWMU 119.1. In contrast; the footing drain at SWMU 107 has already been functioning satisfactorily for thirty years and there is no reason to believe that this will change. Collection of the footing drain flow will likely be required for the full thirty years if the source of the contaminants cannot be identified and removed. A source characterization study is currently in progress as part of the final RFI/RI and CMS/FS investigation process.

Operation and maintenance requirements for collection of the footing drain flow are minimal. Discharge from the drain will be pumped to the treatment plant based on liquid level switches. Two Pumps will be provided to protect against pump failure. Operation and maintenance of the dewatering well are similar. It too will be operated with a liquid level controller and requires little more than routine inspection. The system is highly implementable because the withdrawal well and associated pumps and mechanical connections are standard items.

Action-specific ARARs relating to soil excavation which may be pertinent to this alternative include the requirements under RCRA that address the storage of RCRA wastes in waste piles, and restrictions on the land disposal of solvent-containing wastes that exceed treatment-based standards for those constituents. Soils removed during excavation of the french drain are downgradient of all 881 Hillside Area SWMUs and are not expected to contain hazardous constituents. Also, influent and effluent piping is aligned to be outside all SWMUs. As discussed in Section 6, soil sampling and analysis will be conducted to determine if the excavated soils must be handled as a RCRA hazardous waste. Of particular relevance to the handling and storage of contaminated soil is the requirement, under RCRA, of diverting run-on away from waste piles, preventing wind dispersal of wastes, and collecting free liquids or leachate for treatment as a hazardous waste. RCRA requirements for the storage of contaminated soil in containers (roll-off boxes or drums) would also be relevant and appropriate if containers are used for storage. With respect to RCRA restrictions on the land disposal of solvent-containing wastes, after November 8, 1990 contaminated soils may not be disposed off-site in a RCRA landfill unless they have been analyzed and found to contain levels of contamination below Best Demonstrated Available Technology (BDAT) for those contaminants, or treated to BDAT standards. Soils contaminated above the BDAT levels can only be stored in containers and tanks for a period not to exceed one year. Only non-contaminated soils will be used as backfill material for the trenches.

Action-specific ARARs pertinent to surface discharge are the relevant and appropriate requirements under RCRA for the storage and treatment of hazardous waste in containers and tanks prior to surface discharge.

The design, operation, and maintenance of the treatment plant will meet chemical-specific ARARs identified for the contaminants of concern and action-specific ARARs related to the subsurface discharge of the treatment system effluent. A complete ARARs analysis for treatment operations is given in Table 3-3.

Highlights of these action-specific ARARs are listed below:

- Applicable federally approved state water quality standards must be complied with for discharges to surface or ground waters of the state. These standards may be in addition to or more stringent than other federal standards under the Clean Water Act.

- General requirements for treatment and storage of RCRA hazardous waste in containers and tanks are relevant and appropriate. Recordkeeping requirements under these sections are not ARARs.

Implementation of this alternative involves only routine construction procedures. Construction of the drain can be completed in a period of approximately three months. Ground water will be effectively contained at the beginning of construction when the excavation is dewatered. The system will be operational immediately upon completion.

4.5.2 Alternative 2: Total Encapsulation

4.5.2.1 Description

This alternative involves total encapsulation of the contaminant sources near SWMU 107 and within SWMU 119.1 using RCRA caps and slurry walls at the locations shown on Figure 4-10. Each area will be covered with a three- layer cap consisting of six-inches of vegetated topsoil, a minimum of six inches of drain rock, and a composite synthetic the cover membrane/compacted soil cover of at least two-foot thickness (Figure 4-11). The surface of

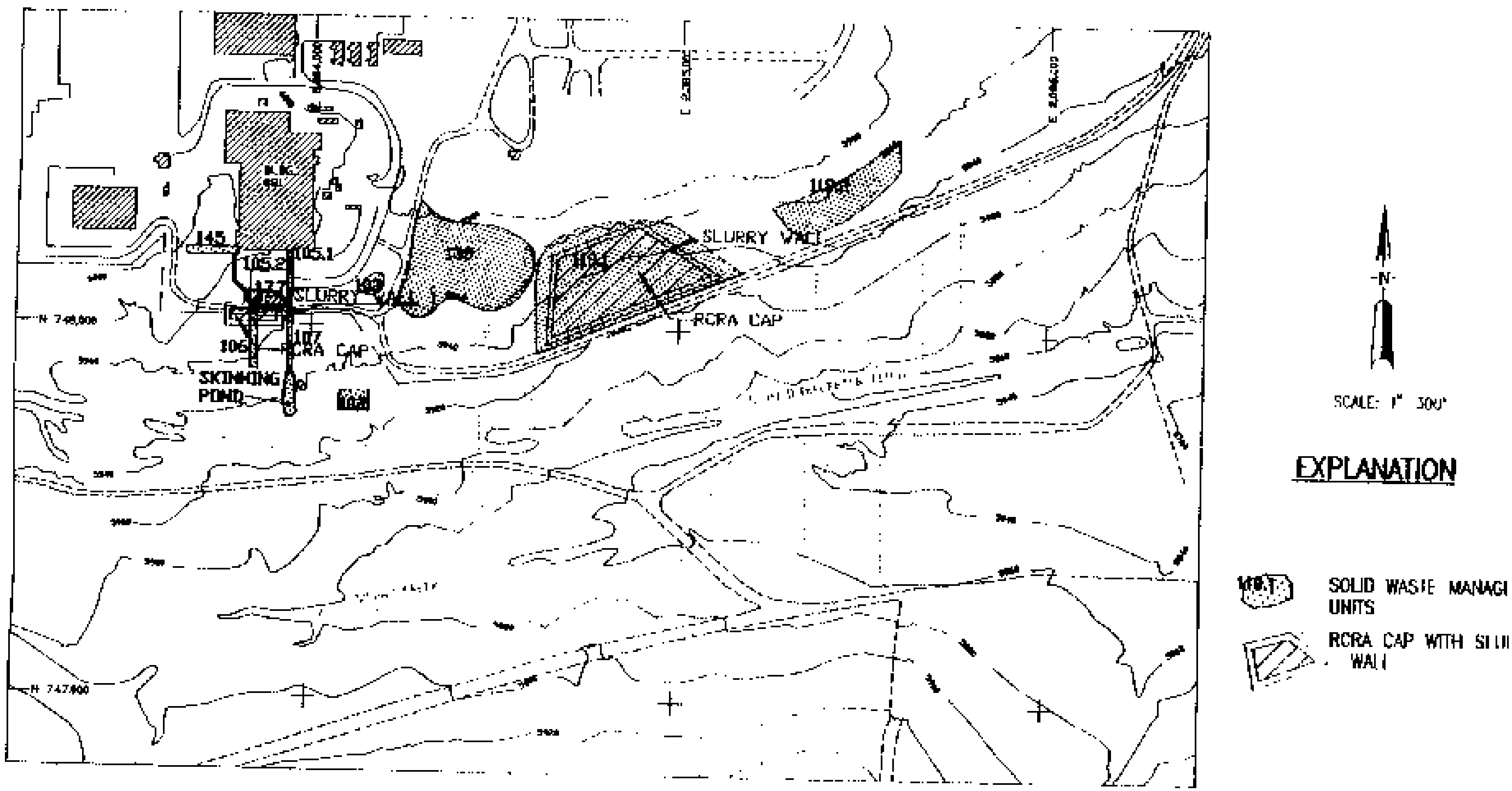


FIGURE 4–10

ALTERNATIVE 2:
TOTAL ENCAPSULATION

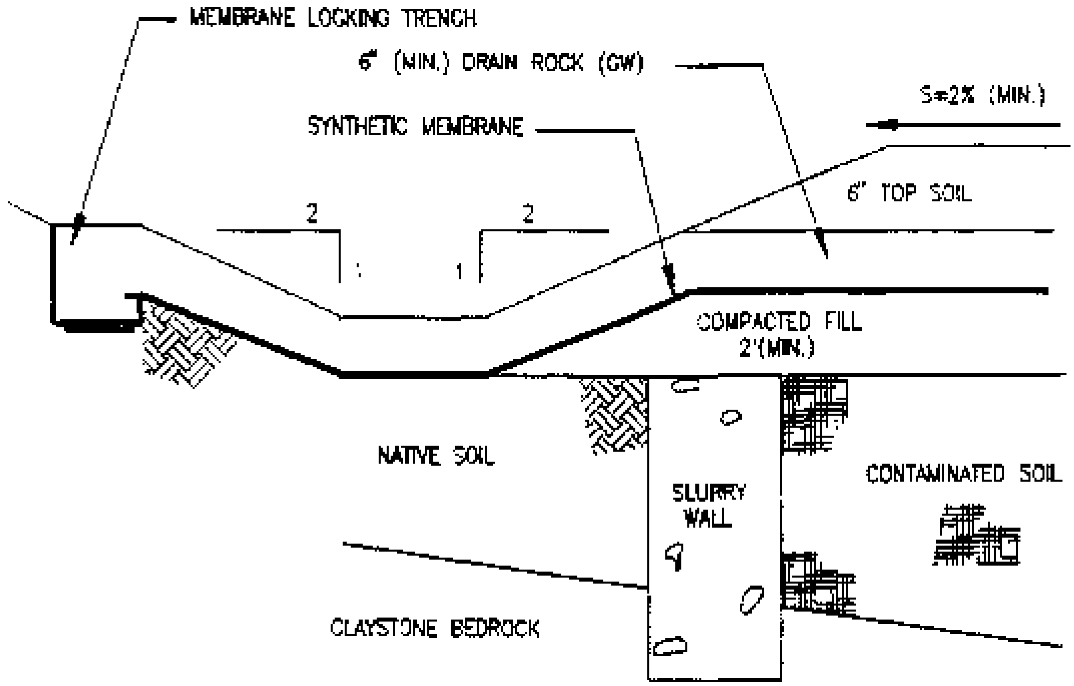


FIGURE 4-11
TOTAL ENCAPSULATION SECTION

NOT TO SCALE

R37012.PJ-09'139

will be sloped at a minimum of 2% to drain toward peripheral ditches. The peripheral ditches will discharge to the South Interceptor Trench. The cover at SWMU 107 is estimated to consist of approximately 6,000 square feet; the cover at SWMU 119.1, approximately 80,000 square feet. The covers will extend a minimum of five feet beyond the slurry walls.

Peripheral containment will be achieved by construction of soil-bentonite slurry walls to completely encircle the contaminated soils. The walls will be keyed at least two feet into claystone bedrock of a hydraulic conductivity of 1 $x10^{-6}$ cm/s. The SWMU 107 slurry wall is estimated to be approximately 320 feet long and depths are anticipated to range from about 4 to 17 feet. It is estimated that the SWMU 119.1 wall will not exceed about 20 feet in depth (15 feet average) and that it will be approximately 1,000 feet long. In addition, ground water inside the containment systems will be removed using internal sumps. This will result in hydraulic gradients toward the encapsulated soil and will reduce the potential for any releases. The small volume of water produced from the sumps will be stored in tanks on site and be transferred to a suitable treatment facility. No capital or operating costs for this treatment have been included.

The cap and perimeter ditches will be inspected on a semi-annual basis and repaired as necessary. The ditches will be maintained in clean and properly graded condition so that collected runoff is rapidly removed from the area.

4.5.2.2 Effectiveness

This alternative will adequately contain and immobilize the sources of contamination. As discussed in Section 2, ground water contamination is known to exist downgradient of SWMU 119.1 and may exist downgradient of SWMU 107. These waters will be released to the environment. This is expected to nominally impact the quality of the ground water within the Valley Fill Alluvium. Therefore, this alternative minimizes future contaminant migration from the sources and thus minimizes future public exposure to contaminants off-site while the Final RFI/RI and CMS/FS activities are completed.

Partial control of the SWMUs will be achieved as soon as the peripheral containment structures are constructed. Full control will not be achieved until the entire system is complete and pumping of the sumps begins.

Worker safety precaution will be required during construction of this alternative and during monitoring and dewatering operations. In addition, safety precautions will be required during excavation for and construction of the compacted soil barrier walls. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased during construction or operation of this alternative.

4.5.2.3 Implementability

Infiltration and ground-water flow through the SWMUs is expected to be practically eliminated by the total encapsulation system. As a consequence, the release of contaminants from the SWMUs is also expected to be eliminated. It is noted that the system will not be as effective if the SWMU areas are not underlain by continuous claystone.

The useful life of the total encapsulation system is expected to exceed thirty years. The containment features involving geologic materials (slurry wall and compacted soil cover) should function indefinitely, particularly given that flow through them will be from the non-contaminated to the contaminated side. The synthetic membrane can be expected to function adequately for at least twenty years, and it is backed-up by the compacted soil layer. The vegetated cover and peripheral ditches will require regular maintenance, and the internal sump will require regular operation.

The technologies proposed in this alternative are all proven technologies. The multi-layer cap system has been used for nearly ten years with good success at many sites. Soil-bentonite slurry walls have also been used for many years to effectively control ground-water flow. The gradient control provided by the sump is a modification of the standard encapsulation system and should provide an extra level of protection.

Operation and maintenance requirements are very small for the total encapsulation alternative. There are essentially no operational requirements, with the exception of routine pumpage of the sump. This is expected to be required no more frequently than annually after the initial dewatering. Maintenance will involve inspection and cleaning of peripheral ditches, inspection and repair of the vegetated cover, and inspection and replacement of the sump pump. In addition, ground-water and surface water conditions in the vicinity of the 881 Hillside Area will be monitored.

This alternative can be implemented using standard construction practices. Seaming of synthetic membranes has become common enough that a qualified local contractor can be used.
Construction of the encapsulation systems will require about three months.

Construction of a slurry wall at SWMU 119.1 may prove impractical where the wall runs parallel to the grade (slope may be too steep). For the two legs of the wall running up the hill, it is recommended that a compacted soil cutoff wall be constructed in an excavated trench. The trench will probably vary from about 15 feet deep at the downhill end to about 2 feet deep at the uphill end. The trench can be excavated with standard earth-moving equipment. Some of the excavated material may be suitable for use in constructing the wall. The length of compacted wall is estimated to be 600 feet, while the remaining slurry portion is about 400 feet long. A compacted soil wall is expected to provide performance characteristics equivalent to a slurry wall.

Material for construction of the compacted soil cover and wall can be obtained from the Arapahoe Formation. The Arapahoe is covered by a thin veneer of colluvium along Woman Creek and could be excavated from a number of nearby areas; however, in order to avoid oversteepening the slopes, the borrow area should be established on the south side of Woman Creek.

ARARs pertinent to the total encapsulation alternative include the relevant and appropriate requirements under RCRA that address the technical specifications of capping closure and post-closure care. In addition, soil that is excavated must be handled as a hazardous waste until sampling and analysis are performed (see Section 4.5.1.3).

Wastewater that is recovered from the source well within the encapsulated area must be treated in a facility operating in compliance with the substantive requirements of RCRA. If recovered ground-water is to be treated on site in a treatment facility, specific RCRA requirements for the treatment of hazardous waste are relevant and appropriate. If wastewater is transported off site, both the substantive and administrative requirements of RCRA will apply to the wastewater management. A complete analysis of chemical-, location-and action-specific ARARs is presented in Section 3.3.

4.5.3 Alternative 3: Collect Ground Water from Source Well and Footine Drain, and Discharge to the South Interceptor Trench

4.5.3.1 Description

This alternative involves pumping a new source well (located near 9-74) at SWMU 119.1 and collection of the footing drain discharge in a new sump near SWMU 107 (Figure 4-12). The collected water will be treated in the new treatment plant (see Section 4.4) and discharged to the South Interceptor Trench which flows into Pond C-2. Pond C-2 discharges to Woman Creek under provisions of a NPDES Permit.

It is estimated that flow from a completely dewatered 9-74 will initially be about 1 gpm but will rapidly fall to a steady flow of about 0.04 gpm. It is anticipated that the flow from the drain will be five gpm or less.

4.5.3.2 Effectiveness

Removal of the majority of contamination in the vicinity of well 9-74 will significantly minimize off-site migration of contaminants. Future off-site public exposure to the

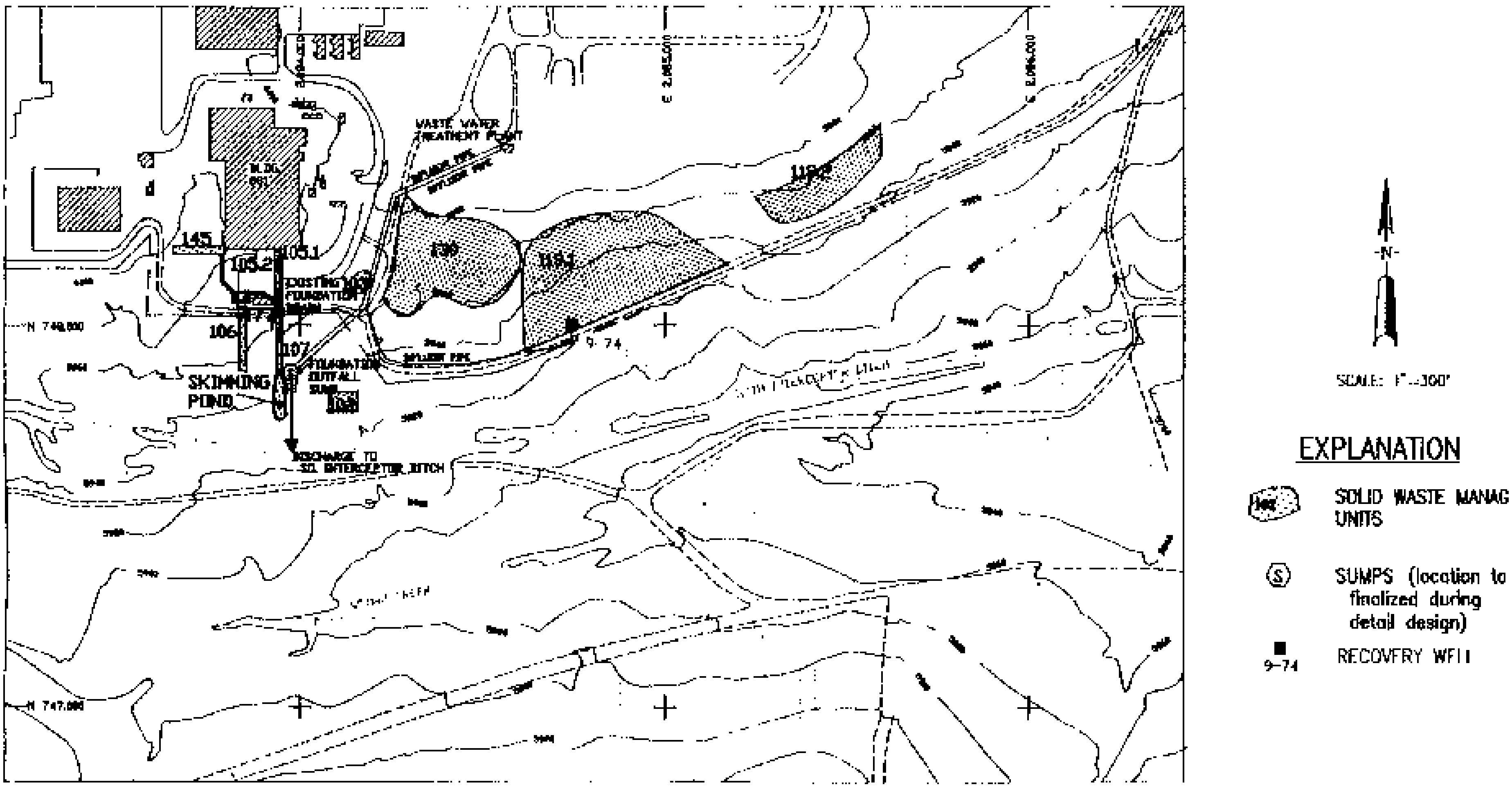


FIGURE 4-12

ALTERNATIVE 3:
FOUNDATION DRAIN & WELL 9-74
COLLECTION WITH TREATMENT

contaminants is unlikely. However, the migration of contaminated alluvial ground water beyond the 881 Hillside Area is more probable than that expected for Alternative 1which utilizes a french drain for ground water collection.

The proposed treatment system will remove both the organic and inorganic groundwater contaminants to below the chemical-specific ARARs given in Section 3.3.1. A complete analysis of chemical-specific ARARs pertinent to surface discharge is presented in Section 3.3. Location-specific ARARs are discussed in Section 3.3.2.

The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased from the construction or operation of this interim action alternative. Treated water will be monitored to ensure contaminants are within regulatory guidelines prior to discharge.

4.5.3.3 Implementability

The useful life of this alternative is expected to exceed thirty years. A large diameter withdrawal well will provide efficient dewatering of the alluvium in the vicinity of well 9-74. The well will be surrounded by monitoring wells so that an evaluation of the efficiency of the well can be easily made. It appears likely that pumping of this withdrawal well will be continuous for the first several years of remediation, but may not be required later. This is due to the small amount of ground water in the vicinity of SWMU 119.1.

The footing drain at SWMU 107 has already been functioning satisfactorily for thirty years and there is no reason to believe that this will change. Collection of the footing drain flow will likely be required for the full thirty years if the source of the contaminants cannot be identified and removed.

Operation and maintenance requirements for collection of the footing drain flow are minimal. Discharge from the drain will be pumped to the treatment plant based on liquid level controls. Two pumps will be provided to protect against pump failure. Operation and maintenance of the dewatering well are similar. It too will be operated with a liquid level controller and requires little more than routine inspection. The system is highly implementable because the withdrawal well and associated pumps and mechanical connections are standard items.

The design, operation, and maintenance of the treatment plant will meet chemical-specific ARARs identified for the contaminants of concern and action-specific ARARs related to the surface discharge of the treatment system effluent. A complete ARARs analysis for treatment operations is given in Table 3-3.

Highlights of these action-specific ARARs are listed below.

- General requirements for treatment and storage of RCRA hazardous waste in containers and tanks are relevant and appropriate. Recordkeeping requirements under these sections are not ARARs.

- Applicable federally approved state water quality standards must be complied with for discharges to surface or ground water of the state. These standards may be in addition to or more stringent than other Federal Standards under the Clean Water Act.

Implementation of this alternative involves only routine construction procedures. The system will be operational immediately upon completion.

4.6 ESTIMATED COSTS FOR ALTERNATIVES

Cost estimates were prepared using in-house computer software and unit rates. In-house unit rates are based upon Rocky Flats Plant experience in planning and managing similar construction projects at this site. Other recognized references were used where site specific unit rates were unavailable and for comparison or checking. These documents include: “Compendium of Remedial Technologies at Hazardous Waste Sites,” U.S. EPA, September 1985; “Treatability Manual, Volume IV. Cost Estimating”, U.S. EPA, April 1983; and “Building Construction Data,” R.S. Means Co., Inc., 1987.

Costs are reported in 1989 dollars for both initial and future costs. Future costs include replacement of capital cost items (e.g., monitor wells or non-expendable items) and cyclic costs, such as operation and maintenance (O&M) costs, energy costs, and expendable supplies. Life cycle costs for each alternative have been presented, in 1989 dollars, as present worth cons assuming a discount rate of 10%, a duration of active remedy of thirty years, and no salvage value for purchased equipment.

Costs were analyzed by first identifying capital items common to one or more remedial alternatives. These capital items and associated costs are presented for each alternative in Table 4-8. Similarly, identified cyclic costs for each alternative are presented in Table 4-9.

Present worth analyses are performed by using the total costs presented in Tables 4-8 and 4-9, and assuming the duration of the remedy is thirty years. Year "0" begins upon initiation of design and construction activities, and system operations will continue through the end of year 30. A thirty-year period was selected as the expected duration of the IRA for use in cost analyses for two principal reasons, 40 CFR 264.117 requires a minimum of 30 years post-closure monitoring, and beyond 30 years present value costs are less than 6% of their future worth and thus become insignificant with respect to these analyses. These schedule assumptions are made to facilitate comparisons between alternatives and do not supersede any existing schedules created as a result of any administrative rule, statute, or agreement with agencies authorized to regulate remedial activities at this site. The present worth analysis (in 1989 dollars) is presented for each alternative in Table 4-10.

Rigorous sensitivity analyses demonstrating the effect of possible variations or inaccuracies in assumptions or estimates have not been performed. Only one parameter, the duration of active remedial measures, was identified as being significant with respect to sensitivity analyses. However, uncertainties in the rates of reclamation of the alternatives prevents performance of more rigorous analyses.

TABLE 4-8

CAPITAL COST COMPONENT WORKSHEET

Component Description	Alternative Number 1	Alternative Number 2	Alternative Number 3
Ground Water Collection			
Foundation Drain Sump with Pump	17,800		17,800
Withdrawal Well	5,800	5,800	5,800
2,100 lf French Drain with Sumps	364,100		
2,500 lf Influent/Effluent Piping and Manholes	50,000		50,000
Influent/Effluent Tanks	158,000	175,000	
Ground Water Treatment			
Building	325,000		325,000
Treatment Units	345,000		345,000
Parking Pad	4,300		4,300
Electrical	117,100		117,100
Mechanical	122,600		122,600
Instrumentation	40,500		40,500
Ground Water Isolation			
86,000 sf RCRA Cap		167,500	
19,800 sf Slurry Wall		138,600	
7,500 gal. Tank Wagon		32,000	
Subtotal:	1,470,200	343,900	1,106,100
Design at 15%	220,500	51,600	165,900
Construction Management at 5%	73,500	17,200	55,300
Contingency at 20%	294,000	68,000	221,200
TOTAL CAPITAL COST:	**$2,155,200**	**$481,500**	**$1,645,500**

TABLE 4-9

CAPITAL COST COMPONENT WORKSHEET
(DOLLAR PER YEAR)

Component Description	Alternative Number 1	Alternative Number 2	Alternative Number 3
Ground Water Collection			
1 Foundation Drain Sump with Pump	200		200
1 Well Pump	200	200	200
2 French Drain Sumps Pumps	400		
1 7,500 Gallon Tank Wagon		2,500	
Ground Water Treatment[1]			
Chemicals Replacement Parts	19,100		19,100
Power	38,600		38,600
Operation and Maintenance[2]	84,600		84,600
Monitoring[3]	72,000		72,000
Subtotal:	215,100		214,700
Contingency at 20%	43,000		43,000
TOTAL CAPITAL COST:	**$258,100**	**$2,700**	**$257,700**

[1] Based on a slow rate of 30 gpm. 8 hr/day
[2] 116 hrs/ month @ $61/hr
[3] 4 samples/month @ $1,500/sample

TABLE 4-10
SUMMARY OF ALTERNATIVE COSTS

Component Description	Alternative Number 1	Alternative Number 2	Alternative Number 3
Annual Costs	$ 258,100	$ 2,700	$ 257,700
Annual Cost x PWF*	2,433,000	26,000	2,429,000
Capital Cost	2,155,200	481,500	1,645,500
Present Worth	$4,588,200	$507,500	$4,074,500

* Present Worth Factor = 9.427 (for annual operating costs)

A discussion of benefits of individual alternatives is presented in Section 5, Summary of Alternatives.

SECTION 5.0
COMPARATIVE ANALYSIS

5.1 INTRODUCTION

This section summarizes the three screened alternatives and presents a tabular comparison of them (Table 5-1). A recommendation is made for appropriate removal action using the comparative analysis.

5.2 COMPARISON OF ALTERNATIVES

The following alternatives were retained in the screening process and evaluated in detail in Section 4.

1. Collection of ground water using a french drain and a source well, collection of footing drain flow from SWMU 107, treatment of collected water in a new treatment plant and discharge of the treated water to the South Interceptor Trench downgradient of the 881 Hillside.

2. Total encapsulation of source areas using a multi-layer cap and slurry well with control of gradients by pumping an internal sump (dewatering fluids to be treated at an existing treatment plant).

3. Collection of ground water using a source well, collection of footing drain flow from SWMU 107, treatment of collected water at a new treatment plant, and discharge of the treated water to the South Interceptor Trench downgradient of the 891 Hillside.

Alternative 1 is the most extensive interim action considered and will result in effective collection of the contaminated 881 Hillside Area ground water. The french drain will significantly reduce contaminant releases to the alluvial ground water downgradient of the 981 Hillside Area. Collection of the Building 881 footing drain flow and pumping of a new well at SWMU 119.1 will result in collection of any contaminated water from these areas. The ground-water treatment system will effectively remove both the organic and inorganic contaminants in the ground water to below the chemical-specific ARARs. Discharge of the treated water into the South Interceptor Trench allows for the water to be combined with Pond C-2 water before final discharge off-site in accordance with Rocky Flats Plant NPDES Permit.

TABLE 5-1

SUMMARY OF ALTERNATIVES

Alternatives & Present Worth	Implementability	Effectiveness	Comments
1. French Drain, Source Well, and Footing Drain with Ground-water Treatment $4,588,200	The alternative relys on proven technologies for collection and treatment of ground water. There are no site conditions that render construction difficult.	The french drain will provide positive collection of contaminated alluvial groundwater flow from the Hillside and will therefore significantly reduce contaminant release to downgradient alluvial ground water.	Complies with action and location specific ARARs, and meets or exceeds chemical specific ARAR for contaminants.
2. Total Encapsulation $507,500	The encapsulation system uses proven technology and is expected to perform well. Routine maintenance of the cover and ditches, and long-term security and monitoring are requires.	Encapsulation will minimize future contaminant releases from the SWMUs. A small quantity of contaminated ground water will be allowed to flow toward Woman Creek. The impact to downgradient alluvial water is expected to be nominal	Complies with action and location specific ARARs, and meets chemical specific ARARs with the exception of water immediately downgradient of SWMU 119.1 that will be released.
3. Source Well & Footing Drain with Ground-water Treatment $4,074,500	The alternative relys on proven technologies for groundwater treatment. Site earthwork is not required.	Pumping of a well at SWMU 119.1 and collection of footing drain flow, followed by treatment of the collected water, will result in immediate improvement of ground-water quality conditions at SWMU 119.1 and provide added protection against detectable VOC released, but this is expected to nominally impact the quality of downgradient alluvial ground water.	Does not meet chemical specific ARARs for organic contaminants but will significantly minimize future hazards to the public health.

Total encapsulation (Alternative 2) will not destroy the contaminants present, but will contain them in place. It will significantly reduce future contaminant releases from the encapsulated SWMUs. However, a small quantity of ground water with concentrations of VOCs less than 150 ug/l will be released. The portion of this water that is not consumed by evapotranspiration will ultimately reach the Woman Creek Valley Fill Alluvium and flow east toward the property boundary. It is unlikely that volatile organics will ever be detected at the boundary from this release. This alternative uses proven technology intended for much higher contamination levels than are present on the 881 Hillside. However, public reception of this may be unfavorable due to the contaminant releases to the Valley Fill Alluvium.

Collection of the footing drain flow and pumping of a new well at SWMU 119.1 with treatment of collected water (Alternative 3) is a limited-scope response that should make a significant impact on releases from the two SWMUs. However, this alternative is not as effective as Alternative 1 in capturing contaminated ground water. Although volatiles currently are not detectable in the surface waters receiving flow from the footing drain, collection and treatment of the footing drain flow will provide an extra level of assurance that significant releases will not occur in the future. Pumping the well completed in the center of SWMU 119.1 will clearly improve conditions by removing the most contaminated ground water. Continued pumping may result in complete dewatering of the colluvial materials beneath the SWMU because of limited recharge to the area. As with Alternative 1, the ground-water treatment system will effectively remove both the organic and inorganic contaminants to below the chemical-specific ARARs.

SECTION 6.0

PROPOSED IM/IRA

6.1 SUMMARY

Alternative 1 has been chosen as the proposed interim remedial action. This alternative involves construction of a french drain (trench) to intercept contaminated alluvial/colluvial ground water from the 881 Hillside Area. The drain will be located downgradicnt of the 881 Hillside SWMUs, will be keyed into bedrock in order to fully penetrate the soils, and will be 2,100 feet long.

The bedrock lithology and hydraulic conductivity will be verified before construction of the french drain begins. This verification program will consist of drilling the drain alignment on 100-foot centers (22 holes along the approximately 2,100 foot long drain). This boring program will be extended to include SWMU 119.2 to confirm the absence of a saturated colluvial zone. If saturated colluvial material is encountered, the french drain will be extended to collect ground water from the SWMU 119.2 area.

The holes will be drilled using hollow stem augers to the top of bedrock. Discrete samples will be collected every two feet for VOC analysis, and four foot composite samples will be collected for analysis of metals, inorganics and radionuclides. The proposed french drain alignment will be re-evaluated if VOCs are detected in the samples. This information will also be used to determine the final disposition of soils excavated during french drain construction. Boreholes on 100-foot centers will also be drilled along the influent and effluent piping alignment. Boreholes will be drilled to the proposed piping depth, and soils will be sampled and analyzed as above to determine the final disposition of this excavated soil.

In order to confirm the hydraulic conductivity of the bedrock material and to determine the presence of sandstone units which could adversely affect the performance of the french drain, the bedrock will be cored, using the augers as a surface casing. Penetration of the bedrock will be sufficient (l5 feet) to find sandstone units that might subcrop between borings on 100-foot centers. This is based on the 7 degree estimated dip of the sandstone lenses (Rockwell International, 1988a). The hydraulic conductivity of the bedrock will be verified by injection tests on five foot intervals using a single packer injection apparatus as the cored hole advances.

Data collected in this program will be used to develop the detailed design of the drain. Required penetration into bedrock, and trench alignment, bottom slopes, and sump locations will be selected based on the results of volatile organic analysis, the depth to bedrock and the hydraulic conductivity of the bedrock materials. The drain will penetrate a minimum of two feet into bedrock with a hydraulic conductivity of $1x10^{-6}$ centimeters per second (cm/s) or lower. The penetration requirement may result in deeper penetration of the drain into bedrock containing sandstones and additional sumps to collect drain inflow at these and other low points.

A Job Safety Analysis (JSA) will be prepared before construction that will specify dust control measures to limit dust inhalation exposures. These measures include the premoistening of the excavation area with a sprinkler system for three days prior to start-up, and the continued moistening of the site throughout the excavation. Ambient air high volume air samplers will be used to measure radiation and wind velocity. These will be installed before commencement of construction. Operations will be suspended by requirements in the Occupational Safety Analysis (OSA) if wind velocity exceeds 15 mph or alpha radiation exceeds 0.03 pCi/m^3 as measured by a high volume sampler located immediately downgradient of the construction activities. Furthermore, construction traffic will be carefully routed to further minimize release of any plutonium contaminated dust. A Health and Safety Plan will also be prepared for construction activities that will supplement the JSA.

During construction of the french drain, the excavation will be inspected by a Colorado registered geotechnical engineer to verify and document the suitability of the materials into which the drain is keyed. Ground-water monitoring wells will be installed upgradient and downgradient of the french drain at locations where the colluvial material is saturated or subcropping sandstones are encountered to monitor the effectiveness of the ground water collection system.

A PVC drainage pipe inside the drain will direct flow under gravity to two 3-foot diameter collection sumps. Each sump will be equipped with a submersible sump pump to deliver the water from the drain to the new treatment plant. The downstream face of the french drain will be covered with a synthetic membrane to limit flow from the clean side of the drain. The inclusion of the downstream synthetic membrane coupled with the continuity of the drain will provide positive cutoff of the ground water. The upgradient face of the french drain will be covered with a geotextile filter fabric to minimize intrusion of soils into the drain rock. The fabric pores will be of a size that prevents clogging.

Water collected from a source well at SWMU 119.1 (a new withdrawal well near well 9-74) will also be treated in the new treatment plant. In addition, a sump will be built to collect the flow from the Building 881 footing drain. Two sump pumps will be used to transfer the footing drain flow to the treatment plant in a separate piping system.

The ground water collected will be treated using a UV peroxide system (for organics removal) and an ion exchange system (for inorganics removal). A new building will be erected for enclosure of the water treatment system to protect weather or temperature sensitive components. External water pipes will be buried approximately four feet to protect against freezing.

Fire protection within the building will be provided by two wall mounted 25 pound dry chemical type fire extinguishers. The building and all treatment units are constructed of non-combustibles. Other than minimal files and records, no combustible materials will be maintained within the building. Major components of the treatment system include:

Exterior to Building

- Two 15,000-gallon influent surge tanks.
- Two 115,000-gallon effluent tanks.
- Piping.
- Associated pumps, gages, and valves.

Interior to Building

- UV/peroxide equipment.
- Ion exchange system equipment.
- Parallel system of filters.
- Sump pump.
- Associated pumps, piping, gages, and valves.
- Support equipment for treatment units, including a hydrogen peroxide supply tank and feed system for the UV/peroxide process, and chemical feed tanks for the ion exchange system.

As shown in Figure 6-1, all of the collected ground water will be pumped into the surge tanks. As the flows from the different sources are expected to vary, the surge tanks will ensure a constant flow through the treatment unit at 30 gpm, 8 hours per day. These tanks will also provide approximately two days collection potential when the treatment unit is down for repairs, cleaning, etc.

When the treatment is initiated, the water will be pumped from the surge tanks through filters to remove suspended materials. The filters will be placed in descending order of size to remove progressively smaller particulates. The water will next enter the UV/peroxide treatment unit.

The UV/peroxide treatment unit consists of an 80-gallon stainless steel oxidation chamber, which provides for a maximum ground-water retention time of 2.66 minutes at a system flowrate of 30 gpm. The oxidation chamber contains four medium pressure UV lamps, which are mounted horizontally in quartz sheaths. A hydrogen peroxide feed system is used to inject approximately 140 mg/l (50 mg/l per ppm of organic contaminants) of a 50 percent H_20_2 solution into the ground-water feed line. The ground-water/peroxide mixture then passes through an in-line static mixer before entering the bottom of the oxidation chamber.

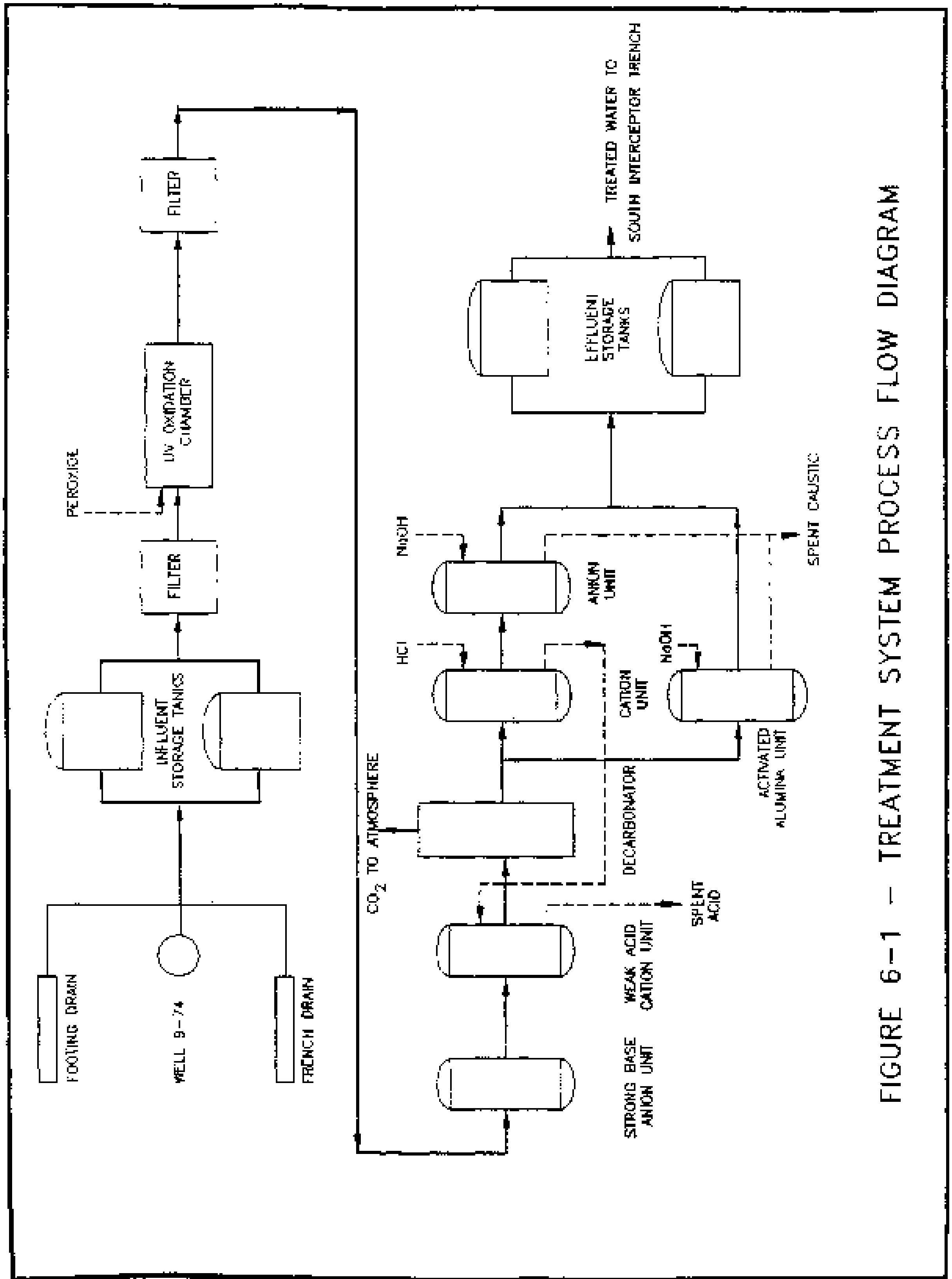


FIGURE 6–1 – TREATMENT SYSTEM PROCESS FLOW DIAGRAM

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The ground water then flows through the reaction chamber, passing the UV lamps, before it exits the top of the oxidation chamber. As the ground water passes the UV lamps, the organic contaminants will be effectively destroyed to comply with chemical- specific ARARs.

The water is then sent to the ion exchange system for inorganic contaminant removal. The water first passes through a strong base anion exchanger where uranium is selectively removed, to prevent contamination of downstream treatment units. The water then passes through a weak acid cation exchanger, where heavy metals are removed. This unit also transforms the total dissolved solids (TDS) associated with carbonate hardness into carbonic acid. The carbonic acid is subsequently removed by decarbonation. Following decarbonation, the flow is split between a two-bed demineralizer for TDS removal, and an activated alumina unit for selenium removal. The effluent from these two units are blended to produce a final effluent which will meet or exceed all chemical-specific ARARs.

The ion exchange resins and activated alumina require periodic regeneration to maintain treatment effectiveness. However, the strong base anion exchanger for uranium removal will not be regenerated, but instead will be periodically disposed of as low-level radioactive waste and replaced with a new unit. Rocky Flats' potable water supply will be used to provide the water for the regeneration of all the units. The regeneration wastes will be sent to the Building 374 Process Waste Treatment System for final treatment and disposal.

Following treatment, the water will be directed to an effluent storage tank sized for one week's flow. Sufficient tankage will be provided to allow the continued operation of the treatment facility while waiting for analytical results on effluent quality prior to discharging to the South Interceptor Ditch. Effluent of unacceptable quality will be returned to the influent storage tanks for additional treatment. Effluent will always be analyzed prior to discharge.

All tanks, piping and sumps will be equipped with secondary containment to comply with 6 CCR 1007-3 and 40 CFR 264.193.

Water discharged from the treatment system will pass through Pond C-2 and eventually into Woman Creek. This discharge is monitored, according to the Rocky Flats Plant NPDES Permit which was modified on 11 July 1989 on a temporary basis by the Colorado Water Quality Control Commission. The modification calls for analysis of organic and inorganic contaminants in ground water at the RFP, which include promulgated in-stream standards for Walnut and Woman Creek.

Alternatives to direct discharge of treated effluent that were evaluated during the FS include ground-water reinjection downgradient of the french drain in the Valley Fill Alluvium, and ground-water reinjection upgradient of the 881 Hillside Area to facilitate soil washing. Ground-water reinjection for soil washing can hasten the removal of volatile organics from contaminated soils and ground water. However, the effectiveness of this technology in the clayey soils of the 881 Hillside Area is uncertain. The technology may be an appropriate addition to this remedial action in the future if cleanup is deemed to be proceeding slower than expected. The reinjection of treated ground water downgradient of the french drain is deemed not to be necessary because of the interaction between surface water and alluvial ground water.

6.2 ADDITIONAL DOCUMENTS

In addition to this IM/IRA Plan, the following documents will be prepared:

- health and safety plan for construction of the IM/IRA;
- community relations plan;
- detailed design plans and specifications;
- detailed "as-built" drawings incorporating all field changes to accurately reflect the constructed ground water collection and treatment system; and
- an operation and maintenance manual for the IM/IRA.

SECTION 7.0
REFERENCES

DRCOG, 1989. "DRCOG makes 1989 Estimates of Metro Population and Households". Denver Regional Council of Governments, September 1989.

U.S. EPA, 1983. Treatability Manual, Volume IV: Cost Estimating.

U.S. EPA, 1985. Compendium of Remedial Technologies at Hazardous Waste Sites.

R. S. Means Co., 1987. Building Construction Data.

Rockwell International, 1988a. Draft Final Remedial Investigation Report for High Priority Sites (881 Hillside Area), March 1988.

Rockwell International, 1988b. Draft Feasibility Study Report for High Priority Sites (881 Hillside Area), March 1988.

Rockwell International, 1989. 881 Hillside Remedial Investigation and Feasibility Study Responses to EPA Comments, February 1999.

INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN AND DECISION DOCUMENT

881 HILLSIDE AREA
OPERABLE UNIT NO. 1

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

JANUARY, 1990

VOLUME II - Appendix

FINAL

Volume II

Appendix

SECTION 1 — Volatile Organic Compound, Dissolved Metals, Inorganic Compound, and Radiochemistry Analytical Results for Alluvial Wells at the 881 Hillside

Wells/Stations in this group: 09-74, 10-74, 01-87, 04-87, 06-87, 43-87, 44-87, 49-87, 50-87, 51-87, 52-87, 53-87, 54-87.

SECTION 2 — Volatile Organic Compound, Dissolved Metals, Inorganic Compound, and Radiochemistry Analytical Results for the Building 881 Footing Drain Discharge

Wells/Stations in this group: SW-45.

SECTION 3 — Volatile Organic Compound Dissolved Metals, Inorganic Compound, and Radiochemistry Analytical Results for Alluvial Wells Downgradient of the 881 Hillside

Wells/Stations in this group: 64-86, 65-86, 66-86, 69-86, 02-87, 47-87, 48-87, 55-87.

SECTION 1

VOLATILE ORGANIC COMPOUND, DISSOLVED METALS, INORGANIC COMPOUND, AND RADIOCHEMISTRY ANALYTICAL RESULTS

FOR ALLUVIAL WELLS AT THE 881 HILLSIDE

WELL/STATIONS IN THIS GROUP:

09-74
10-74
01-87
04-87
06-87
43-87
44-87
49-87
50-87
51-87
52-87
53-87
54-87

ALLUVIAL WELLS AT THE 881 HILLSIDE
VOLATILE ORGANIC RESULTS

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
09-74	03/09/87	1	NR	NR	NR	NR	NR	NR	NR
09-74	04/09/87	1	NR	NR	NR	NR	NR	NR	NR
09-74	05/21/87	2	NR	NR	NR	NR	NR	NR	NR
09-74	07/02/87	3	NR	NR	NR	NR	NR	NR	NR
09-74	08/11/87	3	DRY						
09-74	10/28/87	4	NR	NR	NR	NR	NR	NR	NR
09-74	10/28/87	4	10U	10U	10U	10U	1. J	7. JB	5U
09/74	11/17/87	4	10 U	10 U	10 U	10 U	48	10 U	5 U
09-74	02/25/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
09-74	04/14/88	2	10 U	10 U	10 U	10 U	5 U	9 J	5 U
09-74	04/15/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
09-74	07/20/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
09-74	10/25/88	4	10 U	10 U	10 U	10 U	23	10 U	5 U
09-74	01/25/89	1	10 U	10 U	10U R	10 U	5 U	10 U	5 U
09-74	04/24/89	2	10 U	10 U	10 U	10 U	5 J	10U R	5 U
09-74	05/15/89		Data not yet received						
09-74	05/15/89		Data not yet received						
09-74	05/15/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
09-74	05/16/89		Data not yet received						
09-74	08/22/89		Data not yet received						
09-74	08/22/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethane ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ehene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
09-74	03/09/87	1	12400	NR	NR	4 U	75	NR	13800
09-74	04/09/87	1	9600	NR	NR	4 U	126	NR	12600
09-74	05/21/98	2	48000	NR	NR	4 U	16000	NR	4 U
09-74	07/02/87	3	703	NR	NR	4 U	5262	NR	20285
09-74	08/11/87	3	DRY						
09-74	10/20/87	4	28530	NR	NR	5 U	34	NR	30250
09-74	10/28/87	4	5 U	5U	5U	5U	5U	10U	5 U
09/74	11/17/87	4	23056	54	NR	5 U	4J	10 U	21692
09-74	02/25/88	1	4470	15	NR	5 U	15	10 U	3020
09-74	04/14/88	2	3820	5 U	NR	5 U	5 U	10 U	3130
09-74	04/15/88	2	3390	5 U	NR	5 U	5 U	10 U	3110
09-74	07/20/88	3	3380	5 U	NR	5 U	5 U	10 U	5 U
09-74	10/25/88	4	4800	23	NR	4 JB	5 U	10 U	8200
09-74	01/25/89	1	5300	180 J	NR	5 U	17 J	10U R	10000
09-74	04/24/89	2	6600 J	14 J	NR	5 U	17 J	10 U	5700 J
09-74	05/15/89		Data not yet received						
09-74	05/15/89		Data not yet received						
09-74	05/15/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
09-74	05/16/89		Data not yet received						
09-74	08/22/89		Data not yet received						
09-74	08/22/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Brono dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibrono chloro methane ug/l
09-74	03/09/87	1	4 U	NR	NR	NR	NR	20000	NR
09-74	04/09/87	1	4 U	NR	NR	NR	NR	20800	NR
09-74	05/21/87	2	28000	NR	NR	NR	NR	72000	NR
09-74	07/02/87	3	4 U	NR	NR	NR	NR	11768	NR
09-74	08/11/87	3	DRY						
09-74	10/20/87	4	5 U	NR	NR	NR	NR	12760	NR
09-74	10/28/87	4	5U	10U	5U	5U	5U	24. B	5U
09/74	11/17/87	4	3522	10 U	5 U	5 U	5 U	17538	5 U
09-74	02/25/88	1	990	10 U	5 U	*5 U	5 U	6810	5 U
09-74	04/14/88	2	1200	10 U	5 U	5 U	5 U	5840	5 U
09-74	04/15/88	2	1140	10 U	5 U	5 U	5 U	5860	5 U
09-74	07/20/88	3	5 U	10 U	5 U	5 U	5 U	4380	
09-74	10/25/88	4	5 U	10 U	5 U	5 U	5 U	9500	
09-74	01/25/89	1	5 U	10 U	5 U	5 U	5 U	79	
09-74	04/24/89	2	5 U	10U R	5 U	5 U	5 U	6	
09-74	05/15/89		Data not yet received						
09-74	05/15/89		Data not yet received						
09-74	05/15/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
09-74	05/16/89		Data not yet received						
09-74	08/22/89		Data not yet received						
09-74	08/22/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
09-74	03/09/87	1	96	NR	NR	NR	NR	NR	NR
09-74	04/09/87	1	4 U	NR	NR	NR	NR	NR	NR
09-74	05/21/87	2	4 U	NR	NR	NR	NR	NR	NR
09-74	07/02/87	3	4 U	NR	NR	NR	NR	NR	NR
09-74	08/11/87	3	DRY						
09-74	10/20/87	4	5 U	NR	NR	NR	NR	NR	NR
09-74	10/28/87	4	5U	5U	5U	10U	5U	10U	10U
09/74	11/17/87	4	139	5 U	5 U	NR	5 U	10 U	10 U
09-74	02/25/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
09-74	04/14/88	2	14740	5 U	5 U	10 U	5 U	10 U	10 U
09-74	04/15/88	2	14190	5 U	5 U	10 U	5 U	10 U	10 U
09-74	07/20/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
09-74	10/25/88	4	73	5 U	5 U	10 U	5 U	10 U	10 U
09-74	01/25/89	1	39 J	5 U	5 U	NR	5 U	10 U	10 U
09-74	04/24/89	2	47 J	5 U	5 U	NR	5 U	10 U	10 U
09-74	05/15/89		Data not yet received						
09-74	05/15/89		Data not yet received						
09-74	05/15/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
09-74	05/16/89		Data not yet received						
09-74	08/22/89		Data not yet received						
09-74	08/22/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
09-74	03/09/87	1	6400	NR	NR	NR	NR	NR	NR
09-74	04/09/87	1	2400	NR	NR	NR	NR	NR	NR
09-74	05/21/87	2	13200	NR	NR	NR	NR	NR	NR
09-74	07/02/87	3	3393	NR	NR	NR	NR	NR	NR
09-74	08/11/87	3	DRY						
09-74	10/20/87	4	5840	NR	NR	NR	NR	NR	NR
09-74	10/28/87	4	5U	5U	5 U	5U	5U	5U	5U
09/74	11/17/87	4	6322	5 U	19	5 U	5 U	5 U	5 U
09-74	02/25/88	1	1800	5 U	5 U	5 U	5 U	5 U	5 U
09-74	04/14/88	2	1940	5 U	5 U	5 U	5 U	5 U	5 U
09-74	04/15/88	2	1920	5 U	5 U	5 U	5 U	5 U	5 U
09-74	07/20/88	3	1180	5 U	5 U	5 U	5 U	5 U	5 U
09-74	10/25/88	4	2500	5 U	2 J	5 U	5 U	5 U	5 U
09-74	01/25/89	1	780E	5 U	5 U	5 U	5 U	5 U	5 U
09-74	04/24/89	2	2800 J	5 U	5 J	5 U	5 U	5 U	5 U
09-74	05/15/89		Data not yet received						
09-74	05/15/89		Data not yet received						
09-74	05/15/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
09-74	05/16/89		Data not yet received						
09-74	08/22/89		Data not yet received						
09-74	08/22/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
10-74	05/21/87	2	NR	NR	NR	NR	NR	NR	NR
10-74	07/01/87	3	DRY						
10-74	10/20/87	4	NR	NR	NR	NR	NR	NR	NR
10-74	10/20/87	4	100U	100U	100U	100 U	10. J	120. B	50U
10-74	02/25/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
10-74	07/19/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
10-74	10/25/88	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
10-74	01/16/89	1	10U R	10U R	10 U	10 U	6 U	10 U	5 U
10-74	04/24/89	2	10 U	10 U	10 U	10 U	5 J	10U R	5 U
10-74	06/09/89		Data not yet received						
10-74	06/09/89		Data not yet received						
10-74	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
10-74	06/12/89		Data not yet received						
10-74	08/23/89		Data not yet received						
10-74	08/23/89		Data not yet received						
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
01-87	04/11/88	1	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
10-74	05/21/87	2	4 U	NR	NR	4 U	140	NR	4 U
10-74	07/01/87	3	DRY						
10-74	10/20/87	4	5 U	NR	NR	30	5 U	NR	5 U
10-74	10/20/87	4	50U	50U	50U	32. J	50 U	100U	50U
10-74	02/25/88	1	5 U	5 U	NR	42	5 U	10 U	312
10-74	07/19/88	3	5 U	5 U	NR	51	5 U	10 U	5 U
10-74	10/25/88	4	5 U	5 U	NR	30 B	5 U	10 U	5 U
10-74	01/16/89	1	5 U	5 U	NR	22 U	5 U	10U R	5 U
10-74	04/24/89	2	5 U	5 U	NR	5 U	5 U	10 U	8 J
10-74	06/09/89		Data not yet received						
10-74	06/09/89		Data not yet received						
10-74	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
10-74	06/12/89		Data not yet received						
10-74	08/23/89		Data not yet received						
10-74	08/23/89		Data not yet received						
01-87	10/12/87	4	DR Y						
01-87	02/10/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
01-87	04/11/88	1	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
10-74	05/21/87	2	1400	NR	NR	NR	NR	3600	NR
10-74	07/01/87	3	DRY						
10-74	10/20/87	4	441	NR	NR	NR	NR	258	NR
10-74	10/20/87	4	50 U	100U	50U	50U	50U	580. B	50U
10-74	02/25/88	1	1219	10 U	5 U	5 U	5 U	625	5 U
10-74	07/19/88	3	3370	10 U	5 U	5 U	5 U	850	5 U
10-74	10/25/88	4	1600	10 U	5 U	5 U	5 U	600	5 U
10-74	01/16/89	1	660E U	10 U	5 U	5 U	5 U	410E U	5 U
10-74	04/24/89	2	2400 J	10U R	5 U	5 U	5 U	1200 J	5 U
10-74	06/09/89		Data not yet received						
10-74	06/09/89		Data not yet received						
10-74	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
10-74	06/12/89		Data not yet received						
10-74	08/23/89		Data not yet received						
10-74	08/23/89		Data not yet received						
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
01-87	04/11/88	1	DRY						

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R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Trichloroethane ug/l	Benzene ug/l	Trans-1,3-Dichloropropene ug/l	2-Chloroethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-pentanone ug/l	2-Hexanone ug/l
10-74	05/21/87	2	4 U	NR	NR	NR	NR	NR	NR
10-74	07/01/87	3	DRY						
10-74	10/20/87	4	5 U	NR	NR	NR	NR	NR	NR
10-74	10/20/87	4	50U	50U	50U	100U	50U	100U	100U
10-74	02/25/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
10-74	07/19/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
10-74	10/25/88	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
10-74	01/16/89	1	5 U	5 U	5 U	NR	5 U	10 U	10 U
10-74	04/24/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
10-74	06/09/89		Data not yet received						
10-74	06/09/89		Data not yet received						
10-74	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
10-74	06/12/89		Data not yet received						
10-74	08/23/89		Data not yet received						
10-74	08/23/89		Data not yet received						
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
01-87	04/11/88	1	DRY						

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
10-74	05/21/87	2	4 U	NR	NR	NR	NR	NR	NR
10-74	07/01/87	3	DRY						
10-74	10/20/87	4	5 U	NR	NR	NR	NR	NR	NR
10-74	10/20/87	4	50U	50U	50U	50U	50U	50U	50U
10-74	02/25/88	1	17	5 U	5 U	5 U	5 U	5 U	5 U
10-74	07/19/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
10-74	10/25/88	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
10-74	01/16/89	1	2 J	5 U	5 U	5 U	5 U	5 U	5 U
10-74	04/24/89	2	17 J	5 U	5 J	5 U	5 U	5 U	5 U
10-74	06/09/89		Data not yet received						
10-74	06/09/89		Data not yet received						
10-74	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
10-74	06/12/89		Data not yet received						
10-74	08/23/89		Data not yet received						
10-74	08/23/89		Data not yet received						
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
01-87	04/11/88	1	DRY						

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
01-87	10/26/88	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
01-87	06/06/89		Data not yet received						
01-87	08/17/89		Data not yet received						
04-87	05/20/87	1	NR	NR	NR	NR	NR	NR	NR
04-87	05/26/87	2	10U	10U	10U	10U	15 B	4 J	5U
04-87	07/09/87	3	NR	NR	NR	NR	NR	NR	NR
04-87	10/14/87	4	NR	NR	NR	NR	NR	NR	NR
04-87	10/14/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	02/15/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
04-87	04/13/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
04-87	07/14/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
04-87	10/20/88	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
04-87	01/12/89	1	10U R	10U R	10 U	10U R	5 U	10 U	5 U
04-87	04/17/89	2	10 U	10 U	10 U	10 U	5 U	10 U	10 U
04-87	06/09/89		Data not yet received						
04-87	06/09/89		Data not yet received						

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E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	5 U	5 U	NR	5 U	5 U	10 U	5 U
01-87	10/26/88	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
01-87	06/06/89		Data not yet received						
01-87	08/17/89		Data not yet received						
04-87	05/20/87	1	8	NR	NR	4 U	32	NR	4 U
04-87	05/26/87	2	3 J	5U	5U	6	5U	10U	5
04-87	07/09/87	3	4 U	NR	NR	4 U	4 U	NR	4 U
04-87	10/14/87	4	5 U	NR	NR	5 U	5 U	NR	5 U
04-87	10/14/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	02/15/88	1	5 U	5 U	NR	5 U	5 U	10 U	11
04-87	04/13/88	2	3 J	5 U	NR	5 U	5 U	10 U	20
04-87	07/14/88	3	5 U	5 U	NR	5 U	5 U	10 U	5 U
04-87	10/20/88	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
04-87	01/12/89	1	5 U	5 U	NR	5 U	5 U	10U R	5 U
04-87	04/17/89	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
04-87	06/09/89		Data not yet received						
04-87	06/09/89		Data not yet received						

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di- chloro propane ug/l	Cis-1,3- Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	5 U	10 U	5 U	5 U	5 U	5 U	5 U
01-87	10/26/88	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
01-87	06/06/89		Data not yet received						
01-87	08/17/89		Data not yet received						
04-87	05/20/87	1	5	NR	NR	NR	NR	525	NR
04-87	05/26/87	2	21	10U	5U	5U	5U	230	5U
04-87	07/09/87	3	4 U	NR	NR	NR	NR	23	NR
04-87	10/14/87	4	10	NR	NR	NR	NR	44	NR
04-87	10/14/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	02/15/88	1	5 U	10 U	5 U	5 U	5 U	32	5 U
04-87	04/13/88	2	5 U	10 U	5 U	5 U	5 U	37	5 U
04-87	07/14/88	3	5 U	10 U	5 U	5 U	5 U	26	5 U
04-87	10/20/88	4	5 U	10 U	5 U	5 U	5 U	56	5 U
04-87	01/12/89	1	11 J	10 U	5 U	5 U	5 U	99	5 U
04-87	04/17/89	2	5 U	10U R	5 U	5 U	5 U	110 J	5 U
04-87	06/09/89		Data not yet received						
04-87	06/09/89		Data not yet received						

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Trichloroethane ug/l	Benzene ug/l	Trans-1,3-Dichloropropene ug/l	2-Chloroethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-pentanone ug/l	2-Hexanone ug/l
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
01-87	10/26/88	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
01-87	06/06/89		Data not yet received						
01-87	08/17/89		Data not yet received						
04-87	05/20/87	1	4 U	NR	NR	NR	NR	NR	NR
04-87	05/26/87	2	5U	5U	5U	10U	5U	10U	10U
04-87	07/09/87	3	4 U	NR	NR	NR	NR	NR	NR
04-87	10/14/87	4	5 U	NR	NR	NR	NR	NR	NR
04-87	10/14/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	02/15/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
04-87	04/13/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
04-87	07/14/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
04-87	10/20/88	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
04-87	01/12/89	1	5 U	5 U	5 U	NR	5 U	10 U	10 U
04-87	04/17/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
04-87	06/09/89		Data not yet received						
04-87	06/09/89		Data not yet received						

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
01-87	10/26/88	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
01-87	06/06/89		Data not yet received						
01-87	08/17/89		Data not yet received						
04-87	05/20/87	1	84	NR	NR	NR	NR	NR	NR
04-87	05/26/87	2	14	5U	5U	5U	5U	5U	5U
04-87	07/09/87	3	4 U	NR	NR	NR	NR	NR	NR
04-87	10/14/87	4	6	NR	NR	NR	NR	NR	NR
04-87	10/14/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	02/15/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
04-87	04/13/88	2	12	5 U	5 U	5 U	5 U	5 U	5 U
04-87	07/14/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
04-87	10/20/88	4	3 J	5 U	5 U	5 U	5 U	5 U	5 U
04-87	01/12/89	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
04-87	04/17/89	2	6 J	5 U	5 U	5 U	5 U	5 U	5 U
04-87	06/09/89		Data not yet received						
04-87	06/09/89		Data not yet received						

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
04-87	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	06/12/89		Data not yet received						
04-87	07/26/89		Data not yet received						
06-87	07/30/87	3	NF	NF	NF	NF	NF	NF	NF
06-87	08/25/87	3	NR	NR	NR	NR	NR	NR	NR
06-87	10/14/87	4	NR	NR	NR	NR	NR	NR	NR
06-87	10/14/87	4	10U	10U	10U	10U	3 JB	4JB	5U
06-87	02/17/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
06-87	04/13/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
06-87	07/14/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
06-87	10/26/88	4	DRY						
06-87	04/17/89	2	10 U	10 U	10 U	10 U	5 U	10U R	5 U
06-87	06/10/89		Data not yet received						
06-87	07/26/89		Data not yet received						
43-87	12/18/87	4	10 U	10 U	10 U	10 U	36	9J	5 U
43-87	02/22/88	1	10 U	10 U	10 U	10 U	40	25	5 U

NR = Analyte not reported
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U = Analyzed but not detected
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N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri-chloro ethane ug/l
04-87	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	06/12/89		Data not yet received						
04-87	07/26/89		Data not yet received						
06-87	07/30/87	3	NF	NF	NF	NF	NF	NF	NF
06-87	08/25/87	3	5 U	NR	NR	5 U	5 U	NR	5 U
06-87	10/14/87	4	5 U	NR	NR	5 U	5 U	NR	5 U
06-87	10/14/87	4	5U	5U	5U	5U	5U	10U	5U
06-87	02/17/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
06-87	04/13/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
06-87	07/14/88	3	5 U	5 U	NR	5 U	5 U	10 U	5 U
06-87	10/26/88	4	DRY						
06-87	04/17/89	2	5 U	5 U	NR	5 U	5 U	10U	5 U
06-87	06/10/89		Data not yet received						
06-87	07/26/89		Data not yet received						
43-87	12/18/87	4	32687	342	NR	5 U	5 U	10 U	12734
43-87	02/22/88	1	8855	192	NR	5 U	18	10 U	5920

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
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* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
04-87	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	06/12/89		Data not yet received						
04-87	07/26/89		Data not yet received						
06-87	07/30/87	3	NF	NF	NF	NF	NF	NF	NF
06-87	08/25/87	3	5 U	NR	NR	NR	NR	20	NR
06-87	10/14/87	4	5 U	NR	NR	NR	NR	12	NR
06-87	10/14/87	4	5U	10U	5U	5U	5U	16B	5U
06-87	02/17/88	1	5 U	10 U	5 U	5 U	5 U	14	5 U
06-87	04/13/88	2	5 U	10 U	5 U	5 U	5 U	16	5 U
06-87	07/14/88	3	5 U	10 U	5 U	5 U	5 U	12	5 U
06-87	10/26/88	4	DRY						
06-87	04/17/89	2	5 U	10U R	5 U	5 U	5 U	5 U	5 U
06-87	06/10/89		Data not yet received						
06-87	07/26/89		Data not yet received						
43-87	12/18/87	4	2170	10 U	5 U	5 U	5 U	6999	5U
43-87	02/22/88	1	2995	10 U	5 U	5 U	5 U	12920	5 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
04-87	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	06/12/89		Data not yet received						
04-87	07/26/89		Data not yet received						
06-87	07/30/87	3	NF	NF	NF	NF	NF	NF	NF
06-87	08/25/87	3	5 U	NR	NR	NR	NR	NR	NR
06-87	10/14/87	4	5 U	NR	NR	NR	NR	NR	NR
06-87	10/14/87	4	5U	5U	5U	10U	5U	10U	10U
06-87	02/17/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
06-87	04/13/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
06-87	07/14/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
06-87	10/26/88	4	DRY						
06-87	04/17/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
06-87	06/10/89		Data not yet received						
06-87	07/26/89		Data not yet received						
43-87	12/18/87	4	48	5 U	5 U	NR	5 U	10 U	10 U
43-87	02/22/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethane ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
04-87	06/10/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
04-87	06/12/89		Data not yet received						
04-87	07/26/89		Data not yet received						
06-87	07/30/87	3	NF	NF	NF	NF	NF	NF	NF
06-87	08/25/87	3	5 U	NR	NR	NR	NR	NR	NR
06-87	10/14/87	4	5 U	NR	NR	NR	NR	NR	NR
06-87	10/14/87	4	5U	5U	5U	5U	5U	5U	5U
06-87	02/17/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
06-87	04/13/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
06-87	07/14/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
06-87	10/26/88	4	DRY						
06-87	04/17/89	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
06-87	06/10/89		Data not yet received						
06-87	07/26/89		Data not yet received						
43-87	12/18/87	4	4259	5 U	67	5 U	5 U	5 U	5 U
43-87	02/22/88	1	7590	5 U	24	5 U	5 U	5 U	5 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
43-87	04/11/88	2	10 U	10 U	10 U	10 U	19	10 U	5 U
43-87	07/20/88	3	10 U	10 U	10 U	10 U	61	10 U	5 U
43-87	10/17/88	4	10 U	10 U	10 U	10 U	31	5 J	5 U
43-87	01/25/89	1	10 U	10 U	10U R	10 U	5 U	10 U	5 U
43-87	04/24/89	2	10 U	10 U	10 U	10 U	5 U	10U R	5 U
43-87	06/10/89		Data not yet received						
43-87	06/10/89		Data not yet received						
43-87	06/11/89		Data not yet received						
43-87	06/11/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANAYSIS						
43-87	08/18/89		Data not yet received						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
44-87	06/10/89		DRY						
44-87	08/17/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Dichloroethene ug/l	1,1-Dichloroethane ug/l	Trans-1,2-Dichloroethene ug/l	Chloroform ug/l	1,2-Dichloroethane ug/l	2-Butanone ug/l	1,1,1-Trichloroethane ug/l
43-87	04/11/88	2	3525	100	NR	5 U	5 U	10 U	5 U
43-87	07/20/88	3	13390	344	NR	5 U	5 U	10 U	5 U
43-87	10/17/88	4	11000	350E	NR	3 JB	5 U	10 U	25000E
43-87	01/25/89	1	6300	150 J	NR	5 U	16 J	10U R	15000
43-87	04/24/89	2	7900 J	110 J	NR	5 U	14 J	10U R	9000 J
43-87	06/10/89		Data not yet received						
43-87	06/10/89		Data not yet received						
43-87	06/11/89		Data not yet received						
43-87	06/11/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
43-87	08/18/89		Data not yet received						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
44-87	06/10/89		DRY						
44-87	08/17/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dischloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
43-87	04/11/88	2	5 U	10 U	5 U	5 U	5 U	7343	5U
43-87	07/20/88	3	5 U	10 U	5 U	5 U	5 U	15540	5U
43-87	10/17/88	4	310E	10 U	5 U	5 U	5 U	17000	5U
43-87	01/25/89	1	5 U	10 U	5 U	5 U	5 U	11000	5U
43-87	04/24/89	2	5 U	10U R	5 U	5 U	5 U	8500 J	5U
43-87	06/10/89		Data not yet received						
43-87	06/10/89		Data not yet received						
43-87	06/11/89		Data not yet received						
43-87	06/11/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
43-87	08/18/89		Data not yet received						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
44-87	06/10/89		DRY						
44-87	08/17/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
43-87	04/11/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
43-87	07/20/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
43-87	10/17/88	4	5 U	83	5 U	10 U	5 U	10 U	10 U
43-87	01/25/89	1	29 J	5 U	5 U	NR	5 U	10 U	10 U
43-87	04/24/89	2	44 J	5 U	5 U	NR	5 U	10 U	10 U
43-87	06/10/89		Data not yet received						
43-87	06/10/89		Data not yet received						
43-87	06/11/89		Data not yet received						
43-87	06/11/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
43-87	08/18/89		Data not yet received						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
44-87	06/10/89		DRY						
44-87	08/17/89		DRY						

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J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethane ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
43-87	04/11/88	2	4495	5 U	5 U	5 U	5 U	5 U	5 U
43-87	07/20/88	3	6970	5 U	227	5 U	5 U	5 U	5 U
43-87	10/17/88	4	8100	5 U	180 B	5 U	4 J	5 U	5 U
43-87	01/25/89	1	3400 J	5 U	5 U	5 U	5 U	5 U	5 U
43-87	04/24/89	2	5900 J	5 U	5 U	5 U	5 U	5 U	5 U
43-87	06/10/89		Data not yet received						
43-87	06/10/89		Data not yet received						
43-87	06/11/89		Data not yet received						
43-87	06/11/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
43-87	08/18/89		Data not yet received						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
44-87	06/10/89		DRY						
44-87	08/17/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bronmo methane ug/l	Vinyl Choride ug/l	Chloro ehtane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
49-87	06/10/89		DRY						
49-87	07/26/89		DRY						
50-87	11/18/87	4	10 U	10 U	10 U	10 U	5 U	10	5 U
50-87	11/18/87	4	10 U	10 U	10 U	10 U	2 JB		
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						
50-87	06/09/89		DRY						
50-87	07/25/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di chloro ethane ug/l	1,1-Di chloro ethane ug/l	Trans-1,2-Dichloro ethane ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri Chloro ethane ug/l
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
49-87	06/10/89		DRY						
49-87	07/26/89		DRY						
50-87	11/18/87	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
50-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	10 U	5 U
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						
50-87	06/09/89		DRY						
50-87	07/25/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Brono dichloro methane ug/l	1,2-di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	dibrono chloro methane ug/l
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
49-87	06/10/89		DRY						
49-87	07/26/89		DRY						
50-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
50-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						
50-87	06/09/89		DRY						
50-87	07/25/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2,-Tri Chloro ethane ug/l	Benzene ug/l	Trans-1,3- Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bronoform ug/l	4-Methyl- 2-penta none ug/l	2-Hexanone ug/l
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	08/18/88	3	DRY						
49-87	10/21/88	4	DRY						
49-87	06/10/89		DRY						
49-87	07/26/89		DRY						
50-87	11/18/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
50-87	11/18/87	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						
50-87	06/09/89		DRY						
50-87	07/25/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr	Tetra chloro ethene ug/l	1,1,2,2-Tetra chloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
49-87	06/10/89		DRY						
49-87	07/26/89		DRY						
50-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
50-87	11/18/87	4	3 J	5 U	5 U	5 U	5 U	5 U	5 U
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						
50-87	06/09/89		DRY						
50-87	07/25/89		DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
51-87	06/12/89		Data not yet received						
51-87	08/14/89		Data not yet received						
52-87	11/23/87	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
52-87	11/23/87	4	50 U	50 U	50 U	50 U	21 JB	130 B	25 U
52-87	02/12/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
52-87	04/18/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
52-87	07/18/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
52-87	10/18/88	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
52-87	01/16/89	1	10U R	10U R	10 U	10 U	6 U	10 U	5 U
52-87	04/17/89	2	10 U	10 U	10 U	10 U	5 U	10U R	5 U
52-87	06/12/89		Data not yet received						
52-87	06/12/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
51-87	06/12/89		Data not yet received						
51-87	08/14/89		Data not yet received						
52-87	11/23/87	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
52-87	11/23/87	4	25 U	25 U	25 U	25 U	25 U	50 U	25 U
52-87	02/12/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
52-87	04/18/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
52-87	07/18/88	3	5 U	5 U	NR	5 U	5 U	10 U	5 U
52-87	10/18/88	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
52-87	01/16/89	1	5 U	5 U	NR	5 U	5 U	10U R	5 U
52-87	04/17/89	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
52-87	06/12/89		Data not yet received						
52-87	06/12/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon tetra chloride ug/l	VinyL Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
51-87	06/12/89		Data not yet received						
51-87	08/14/89		Data not yet received						
52-87	11/23/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
52-87	11/23/87	4	25 U	50 U	25 U	25 U	25 U	25 U	25 U
52-87	02/12/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
52-87	04/18/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U
52-87	07/18/88	3	5 U	10 U	5 U	5 U	5 U	5 U	5 U
52-87	10/18/88	4	5 U	10 U	5 U	5 U	2 J	5 U	5 U
52-87	01/16/89	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
52-87	04/17/89	2	5 U	10U R	5 U	5 U	5 U	5 U	5 U
52-87	06/12/89		Data not yet received						
52-87	06/12/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
51-87	06/12/89		Data not yet received						
51-87	08/14/89		Data not yet received						
52-87	11/23/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
52-87	11/23/87	4	25 U	25 U	25 U	50 U	25 U	50 U	50 U
52-87	02/12/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
52-87	04/18/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
52-87	07/18/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
52-87	10/18/88	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
52-87	01/16/89	1	5 U	5 U	5 U	NR	5 U	10 U	10 U
52-87	04/17/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
52-87	06/12/89		Data not yet received						
52-87	06/12/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
51-87	06/12/89		Data not yet received						
51-87	08/14/89		Data not yet received						
52-87	11/23/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
52-87	11/23/87	4	25 U	25 U	25 U	25 U	25 U	25 U	25 U
52-87	02/12/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
52-87	04/18/88	2	2 J	5 U	5 U	5 U	5 U	5 U	5 U
52-87	07/18/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
52-87	10/18/88	4	2 J	5 U	0.9 JB	5 U	5 U	5 U	5 U
52-87	01/16/89	1	2 J	5 U	5 U	5 U	5 U	5 U	5 U
52-87	04/17/89	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
52-87	06/12/89		Data not yet received						
52-87	06/12/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
52-87	08/14/89		Data not yet received						
53-87	11/18/97	4	10 U	10 U	10 U	10 U	21	10 U	5 U
53-87	11/18/87	4	10 U	10 U	10 U	10 U	2 JB	9 JB	5 U
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
53-87	06/08/89		Data not yet received						
53-87	07/25/89		Data not yet received						
54-87	11/18/87	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
54-87	11/18/87	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
54-87	11/18/87	4	10 U	10 U	10 U	10 U	2 JB	13 B	5 U
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
54-87	07/18/88	3	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,2-Di chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
52-87	08/14/89		Data not yet received						
53-87	11/18/97	4	21	5 U	NR	5 U	5 U	10 U	18
53-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	10 U	2 J
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
53-87	06/08/89		Data not yet received						
53-87	07/25/89		Data not yet received						
54-87	11/18/87	4	5 U	5 U	NR	8	5 U	10 U	5 U
54-87	11/18/87	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
54-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	10 U	2 J
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
54-87	07/18/88	3	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
52-87	08/14/89		Data not yet received						
53-87	11/18/97	4	6	10 U	5 U	5 U	5 U	23	5 U
53-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	5 U	10 U	5 U	5 U	5 U	3 J	5 U
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
53-87	06/08/89		Data not yet received						
53-87	07/25/89		Data not yet received						
54-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
54-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
54-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U
54-87	07/18/88	3	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromofo rm uglL	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
52-87	08/14/89		Data not yet received						
53-87	11/18/97	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
53-87	11/18/87	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
53-87	06/08/89		Data not yet received						
53-87	07/25/89		Data not yet received						
54-87	11/18/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
54-87	11/18/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
54-87	11/18/87	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
54-87	07/18/88	3	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra Chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
52-87	08/14/89		Date not yet received						
53-87	11/18/87	4	5 U	5 U	11	5 U	5 U	5 U	5 U
53-87	11/18/87	4	3 J	5 U	5 U	5 U	5 U	5 U	5 U
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	3 J	5 U	5 U	5 U	5 U	5 U	5 U
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
53-87	06/08/89		Data not yet received						
53-87	07/25/89		Data not yet received						
54-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
54-87	11/18/87	4	3 J	5 U	5 U	5 U	5 U	5 U	5 U
54-87	11/18/87	4	4 J	5 U	5 U	5 U	5 U	5 U	
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
54-87	07/18/88	3	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
54-87	10/21/88	4	DRY						
54-87	06/08/89		Data not yet received						
54-87	07/26/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-Chloro ethene ug/l	1,1-Di-Chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-Chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
54-87	10/21/88	4	DRY						
54-87	06/08/89		Data not yet received						
54-87	07/26/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methene ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propane ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
54-87	10/21/88	4	DRY						
54-87	06/08/89		Data not yet received						
54-87	07/26/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propane ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
54-87	10/21/88	4	DRY						
54-87	06/08/89		Data not yet received						
54-87	07/26/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethane ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
54-87	10/21/88	4	DRY						
54-87	06/08/89		Data not yet received						
54-87	07/26/89		Data not yet received						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

ALLUVIAL WELL AT THE 881 HILLSIDE
DISSOLVED METAL RESULTS

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l		Antimony (Sb), diss. mg/l		Arsenic (As), diss. mg/l		Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l		Cadmium (Cd, diss. mg/l		Calcium (Ca), diss. mg/l
09-74	03/09/87	1	0.0290	U	0.0660	U	0.01	U	0.0840	0.005	U	0.005	U	263.4966
09-74	04/09/87	2	0.0321		0.0600	U	0.01	U	0.1371	0.005	U	0.005	U	199.7978
09-74	05/21/87	2	0.0290	U	0.06	U	0.01	U	0.0693	0.005	U	0.005	U	211.0518
09-74	07/02/87	3	0.0481		0.02	U	0.008	J	0.0918	0.005	U	0.001	U	262.2745
09-74	08/11/87	3	DRY											
09-74	10/20/87	4	0.0515		0.006	J	0.005	U	0.0896	0.001	J	0.001	U	218.1526
09-74	10/28/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS											
09-74	11/17/87	4	0.0690		0.02	U	0.008		0.0994	0.005	U	0.0013		206.2095
09-74	02/25/88	1	0.0290	U	0.02	U	0.005		0.0707	0.05	U	0.001	U	168.2300
09-74	04/14/88	2	0.0290	U	0.0340	U	0.003	J	0.0578	0.0010	U	0.0050	U	170.7388
09-74	04/15/88	2	0.0316		0.0340	U	0.003	J	0.0564	0.0010	U	0.0050	U	169.9513
09-74	07/20/88	3	0.0290	U	0.0647		0.003	J	0.0684	0.0010	U	0.0050	U	185.6921
09-74	10/25/88	4	0.0387		0.0707		0.003	J	0.0849	0.0010	U	0.0050	U	223.2724
10-74	05/21/87	2	0.0469		0.06	U	0.01	U	0.0545	0.005	U	0.005	U	295.0586
10-74	07/04/87	3	DRY											
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METAL ANALYSIS											
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METAL ANALYSIS											
10-74	02/25/88	1	0.0290	U	0.02	U	0.005	U	0.0451	0.005	U	0.001	U	221.8247
10-74	07/19/88	3	0.0290	U	0.0674		0.005	U	0.0436	0.0010	U	0.0050	U	230.7856

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
09-74	03/09/87	1	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.005 U	NR
09-74	04/09/87	1	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.005 U	NR
09-74	05/21/87	2	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.016	NR
09-74	07/02/87	3	0.02 U	0.0100 U	0.0220 U	0.0184	0.0069 U	0.005 U	NR
09-74	08/11/87	3	DRY						
09-74	10/20/87	4	0.02 U	0.0192	0.0220 U	0.0144	0.0447	0.005 U	0.6
09-74	10/28/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
09-74	11/17/87	4	0.02 U	0.0139	0.0220 U	0.0165	0.0634	0.0003 J	0.7
09-74	02/25/88	1	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.005 U	0.44
09-74	04/14/88	2	0.02 U	0.0101	0.0220 U	0.0063 U	0.0069 U	0.005 U	0.44
09-74	04/15/88	2	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.0063 U	0.005 U	0.45
09-74	07/20/88	3	0.020 U	0.0100 U	0.0220 U	0.0063 U	0.0252	0.005 U	NR
09-74	10/25/88	4	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.0173	0.005 U	NR
10-74	05/21/87	2	0.2 U	0.0100 U	0.0200 U	0.0063 U	0.0069 U	0.006	NR
10-74	07/01/87	3	DRY						
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
10-74	02/25/88	1	0.02 U	0.0118	0.0220 U	0.0063 U	0.0069 U	0.005 U	0.1 U
10-74	07/19/88	3	0.020 U	0.0100 U	0.0220 U	0.0063 U	0.0229	0.005 U	NR

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l		Mercury (Hg), diss. mg/l		Molybdenum (Mo), diss. mg/l		Nickel (Ni), diss. mg/l		Potassium (K) diss. mg/l		Selenium (Se), diss. mg/l
09-74	03/09/87	1	55.3301	0.0051	U	0.0002	U	0.0220	U	0.0370	U	5.0	U	0.95
09-74	04/09/87	1	47.0034	0.0075		0.0002	U	0.0220	U	0.0370	U	5.0	U	0.46
09-74	05/21/87	2	44.8732	0.0134		0.0002	U	0.0220	U	0.0370	U	5.0	U	0.39
09-74	07/02/87	3	56.1795	0.0261		0.0002	U	0.0220	U	0.0370	U	2.2		0.9
09-74	08/11/87	3	DRY											
09-74	10/20/87	4	55.1443	0.0394		0.0002	U	0.0220	U	0.0370	U	1.9		0.8
09-74	10/28/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS											
09-74	11/17/87	4	44.2873	0.0145		0.0002	U	0.0220	U	0.0370	U	2.1		0.09
09-74	02/25/88	1	33.0280	0.0051	U	0.0002	U	0.0220	U	0.0370	U	1.1		0.65
09-74	04/14/88	2	40.3688	0.0051	U	0.0002	U	0.0220	U	0.0370	U	1.0		0.568
09-74	04/15/88	2	40.8359	0.0051	U	0.0002	U	0.0220	U	0.0370	U	1.0		0.595
09-74	07/20/88	3	37.0310	0.0051	U	0.0002	U	0.0220	U	0.0370	U	1.0		0.48
09-74	10/25/88	4	50.6784	0.0107		0.0002	U	0.0220	U	0.0370	U	1.7		NR
10-74	05/21/87	2	73.2748	0.0051	U	0.0002	U	0.0252		0.0370	U	5.0	U	2.1
10-74	07/01/87	3	DRY											
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS											
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS											
10-74	02/25/88	1	55.9821	0.0051	U	0.0002	U	0.0220	U	0.0370	U	0.8		1.94
10-74	07/19/88	3	54.5000	0.0051	U	0.0002	U	0.0220	U	0.0370	U	0.5		2.24

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Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l		Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l		Vanadium (V) diss. mg/l		Zinc (Zn), diss. mg/l	
09-74	03/09/87	1	0.0094		183.9774	NR	1.9806	0.01	U	0.0240	U	0.06	
09-74	04/09/87	1	0.0076	U	142.7789	NR	1.6165	0.01	U	0.0240	U	0.08	
09-74	05/21/87	2	0.0076	U	152.3863	NR	1.3926	0.01	U	0.0240	U	0.0298	
09-74	07/02/87	3	0.0076	U	187.4977	NR	2.0519	0.01	U	0.0240	U	0.0330	
09-74	08/11/87	3	DRY										
09-74	10/20/87	4	0.0076	U	158.4178	NR	1,8471	0.01	U	0.0240	U	0.0270	
09-74	10/28/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS										
09-74	11/17/87	4	0.0076	U	164.4335	NR	1.6738	0.01	U	0.0240	U	0.0384	
09-74	02/25/88	1	0.0076	U	169.7297	NR	1.2577	0.01	U	0.0240	U	0.0200	U
09-74	04/14/88	2	0.0076	U	153.7531	NR	1.2361	0.01	U	0.0360	U	0.0200	U
09-74	04/15/88	2	0.0076	U	152.4721	NR	1.2363	0.01		0.0360	U	0.0200	U
09-74	07/20/88	3	0.0076	U	171.3543	NR	1.3406	0.010	U	0.0360	U	0.0244	
09-74	10/25/88	4	0.0076	U	173.4861	NR	1.9120	0.01	U	0.0360	U	0.0263	
10-74	05/21/87	2	0.0076	U	204.3915	NR	1.9586	0.01	U	0.0240	U	0.0515	
10-74	07/01/87	3	DRY										
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS										
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS										
10-74	02/25/88	1	0.0076	U	178.2349	NR	1.7584	0.01	U	0.0240	U	0.0851	
10-74	07/19/88	3	0.0076	U	184.1220	NR	1.7378	0.0100	U	0.0360	U	0.1618	

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E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
10-74	10/25/88	4	0.0385	0.0798	0.005 U	0.0477	0.0010 U	0.0050 U	220.1902
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	04/11/88	1	DRY						
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	10/26/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
04-87	05/20/87	1	NR	0.06 U	0.01 U	NR	NR	0.005 U	NR
04-87	05/26/87	2	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	07/09/87	3	0.0417	0.02 U	0.005 U	0.0941	0.005 U	0.0005 J	355.9960
04-87	10/14/87	4	0.0712	0.02 U	0.005 U	0.0594	0.001 J	0.001 U	235.0496
04-87	10/14/87	4	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	02/15/88	1	0.0290 U	0.02 U	0.003 J	0.0579	0.005 U	0.001	229.9842
04-87	04/13/88	2	0.0431	0.0340 U	0.005 U	0.0382	0.0010 U	0.0050 U	244.3146
04-87	07/14/88	3	0.0290	0.0731	0.005 U	0.0403	0.0010 U	0.0050 U	198.5473
04-87	10/20/88	4	0.0562	0.0636	0.005 U	0.0546	0.0010 U	0.0050 U	121.7639

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E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
10-74	10/25/88	4	NR	0.0100 U	0.0220 U	0.0063 U	0.0069 U	NR	NR
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	04/11/88	1	DRY						
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	10/26/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
04-87	05/20/87	1	0.2 U	NR	NR	NR	NR	0.005 U	0.02
04-87	05/26/87	2	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	07/09/87	3	0.02 U	0.0100 U	0.0220 U	0.0190	0.0069 U	0.005 U	NR
04-87	10/14/87	4	0.04 J	0.0782	0.0220 U	0.0063 U	0.1119	0.005 U	0.03 J
04-87	10/14/87	4	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	02/15/88	1	0.02 U	0.0114	0.0220 U	0.0069	0.0069 U	0.005 U	0.1 U
04-87	04/13/88	2	0.02 U	0.0111	0.0220 U	0.0063 U	0.0238	0.005 U	0.1 U

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N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
10-74	10/25/88	4	56.0077	0.0051 U	0.0002 U	0.0220 U	0.0370 U	1.2	3.2
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	04/11/88	1	DRY						
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	10/26/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
04-87	05/20/87	1	NR	NR	0.0002 U	NR	NR	5.0 U	0.193
04-87	05/26/87	2	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	07/09/87	3	69.8038	0.5871	0.0002 U	0.0220 U	0.2536		.23
04-87	10/14/87	4	49.5140	0.9586	0.0002 U	0.0220 U	0.3334	1	
04-87	10/14/87	4	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	02/15/88	1	52.0792	0.3658	0.0002 U	0.0220 U	0.2025		
04-87	04/13/88	2	61.3284	0.2400	0.0002 U	0.0220 U	0.1800		
04-87	07/14/88	3	38.8750	0.7619	0.0002* U	0.0220 U	0.4037		
04-87	10/20/88	4	25.6060	0.7016	0.0002 U	0.0220 U	0.3093		

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Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr),diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
10-74	10/25/88	4	0.0076 U	185.9507	NR	1.8795	NR	0.0360 U	0.2376
01-87	10/12/87	4	DRY						
01-87	02/10/88	1	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	04/11/88	1	DRY						
01-87	04/11/88	2	DRY						
01-87	07/20/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
01-87	10/26/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
04-87	05/20/87	1	NR	NR	NR	NR	0.01 U	NR	0.16
04-87	05/26/87	2	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	07/09/87	3	0.0076 U	341.7467	NR	2.4291	0.01 U	0.0302	0.0780
04-87	10/14/87	4	0.0076 U	281.9918	NR	1.6890	0.01 U	0.0240 U	0.0314
04-87	10/14/87	4	INSUFFICIENT SAMPLE METALS ANALYSIS						
04-87	02/15/88	1	0.0076 U	265.3521	NR	1.6772	0.01 U	0.0240 U	0.0359
04-87	04/13/88	2	0.0076 U	258.3427	NR	1.5743	0.01 U	0.0360 U	0.0426 U
04-87	07/14/88	3	0.0076 U	239.5536	NR	1.3338	0.010 U	0.0360 U	0.0496
04-87	10/20/88	4	0.0076N U	202.3517	NR	0.9184	0.01 U	0.0360 U	0.0285

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Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
06-87	07/30/87	3	0.0290 U	0.02 U	0.005 U	0.1634	0.005 U	0.001 U	148.9176
06-87	08/25/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	02/17/88	1	0.0304	0.02 U	0.005 U	0.1047	0.005 U	0.001 U	156.2052
06-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	07/14/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/26/88	4	DRY						
43-87	12/18/87	4	0.0765	0.02 U	0.009	0.1129	0.003 J	0.001 U	157.5883
43-87	02/22/88	1	0.0290 U	0.02 U	0.003 J	0.0898	0.005 U	0.001 J	168.2474
43-87	04/11/88	2	0.0367	0.0340 U	0.005 U	0.0581	0.0010 U	0.0050 U	158.8623
43-87	07/20/88	3	0.0290 U	0.0496	0.005 U	0.0733	0.0010 U	0.0050 U	177.2322
43-87	10/17/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						

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E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
06-87	07/30/87	3	0.02 U	0.100 U	0.0220 U	0.0078	0.1739	0.005 U	NR
06-87	08/25/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	02/17/88	1	0.02 U	0.0100 U	0.0220 U	0.0081	0.0069 U	0.005 U	0.06 J
06-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	07/14/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/26/88	4	DRY						
43-87	12/18/87	4	0.02 U	0.0127	0.0220 U	0.0364	0.0526	0.005 U	0.1 U
43-87	02/22/88	1	0.02 U	0.0100 U	0.0220 U	0.9515	0.0181	0.003 U	0.05 J
43-87	04/11/88	2	0.02 U	0.0100 U	0.0220 U	0.9053	0.0113	0.005 U	0.05 J
43-87	07/20/88	3	0.020 U	0.0100 U	0.0220 U	0.1612	0.0171	0.005 U	NR
43-87	10/17/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						

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Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (k), diss. mg/l	Selenium (Se), diss. mg/l
06-87	07/30/87	3	40.7284	0.0465	0.0003	0.0220 U	0.2691	2.4	0.02
06-87	08/25/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	02/17/88	1	48.0232	0.2698	0.0002 U	0.0220 U	0.2847	2.5	0.015
06-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	07/14/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/26/88	4	DRY						
43-87	12/18/87	4	30.8697	0.1097	0.0002 U	0.0220 U	0.1579	7.2	0.51
43-87	02/22/88	1	35.2978	0.0918	0.0002 U	0.0220 U	0.6079	5.5	0.5
43-87	04/11/88	2	37.5773	0.0843	0.0002 U	0.0265	0.8644	4.5	0.424
43-87	07/20/88	3	34.4470	0.2523	0.0002 U	0.0220 U	0.3607	2.8	0.395
43-87	10/17/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						

NR = Analyte not reported
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E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
06-87	07/30/87	3	0.0076 U	211.6911	NR	1.3294	0.01 U	0.0240 U	0.0200 U
06-87	08/25/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/14/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	02/17/88	1	0.0076 U	218.7943	NR	1.5303	0.01 U	0.0240 U	0.0200
06-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	07/14/88	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
06-87	10/26/88	4	DRY						
43-87	12/18/87	4	0.0076 U	180.9535	NR	1.3286	0.01 U	0.0240 U	0.5827
43-87	02/22/88	1	0.0076 U	191.2084	NR	1.4910	0.01 U	0.0240 U	2.1306
43-87	04/11/88	2	0.0076 U	165.6124	NR	1.2759	0.01 U	0.0360 U	2.4500
43-87	07/20/88	3	0.0076 U	180.0329	NR	1.3836	0.010 U	0.0360 U	0.8048
43-87	10/17/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
44-87	11/14/87	4	DRY						
44-87	02/22/88	1	DRY						

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* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
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B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
44-87	04/18/88	2	DRY						
44-87	07/20/88	3	DRY						
44-87	10/26/88	4	DRY						
49-87	11/18/87	4	DRY						
49-87	02/17/88	1	DRY						
49-87	04/13/88	2	DRY						
49-87	04/13/88	2	DRY						
49-87	07/18/88	3	DRY						
49-87	10/21/88	4	DRY						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
50-87	02/17/88	1	DRY						
50-87	04/13/88	2	DRY						
50-87	07/18/88	3	DRY						
50-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
52-87	11/23/87	4	0.0503	0.02 U	0.005 U	0.1774	0.005 U	0.003 J	85.6972
52-87	11/23/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
52-87	02/12/88	1	0.0290 U	0.02 U	0.003 J	0.1561	0.005 U	0.001 U	104.3593
52-87	04/18/88	2	0.0321	0.0340 U	0.005 U	0.1202	0.0010 U	0.0050 U	110.5478
52-87	07/18/88	3	0.0290 U	0.0463	0.005 U	0.1405	0.0010 U	0.0050 U	113.3889
52-87	10/18/88	4	0.0377	0.0627	0.005 U	0.1436	0.0010 U	0.0050 U	106.9126
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
52-87	11/23/87	4	0.02 U	0.0100 U	0.0220 U	0.0244	0.0209	NR	NR
52-87	11/23/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
52-87	02/12/88	1	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.005 U	0.01 U
52-87	04/18/88	2	0.02 U	0.0100 U	0.0220 U	0.0087	0.0187	0.005 U	0.01 U
52-87	07/18/88	3	0.020 U	0.0100 U	0.0220 U	0.0310	0.0215	0.005 U	NR
52-87	10/18/88	4	0.02 U	0.0100 U	0.0220 U	0.0366	0.0291	0.005 U	NR
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
52-87	11/23/87	4	19.5478	0.2171	0.0002 U	0.0220 U	0.0401	NR	0.005 U
52-87	11/23/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
52-87	02/12/88	1	25.0742	0.7556	0.0220 U	0.0220 U	0.0370 U	3.2	0.005 U
52-87	04/18/88	2	31.2190	0.4838	0.0220 U	0.0220 U	0.0370 U	2.3	0.003 U
52-87	07/18/88	3	31.6869	0.5079	NR	0.0220 U	0.1102	1.8	0.005 U
52-87	10/18/88	4	26.1864	0.7057	0.0220 U	0.0220 U	0.0504	1.6	0.005 U
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), Diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (TL), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn),diss. mg/l
51-87	11/23/87	4	DRY						
51-87	02/12/88	1	DRY						
51-87	04/18/88	2	DRY						
51-87	07/18/88	3	DRY						
51-87	10/21/88	4	DRY						
52-87	11/23/87	4	0.0076 U	124.7997	NR	0.7136	0.01 U	0.0240 U	0.0252
52-87	11/23/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
52-87	02/12/88	1	0.0076 U	166.3747	NR	0.8222	0.01 U	0.0240 U	0.0414
52-87	04/18/88	2	0.0076 U	164.5510	NR	0.8149	0.01 U	0.0360 U	0.0717
52-87	07/18/88	3	0.0076 U	173.5700	NR	0.8154	0.010 U	0.0360 U	0.2643
52-87	10/18/88	4	0.0076N U	184.7438	NR	0.7910	0.01 U	0.0360 U	0.1537
53-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	11/18/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
53-87	02/10/88	1	DRY						
53-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (AL), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	07/18/88	3	DRY						
54-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Data Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (C0), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	07/18/88	3	DRY						
54-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Ground Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Data Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	07/18/88	3	DRY						
54-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Data Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
53-87	07/18/88	3	DRY						
53-87	10/21/88	4	DRY						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	02/10/88	1	DRY						
54-87	04/11/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
54-87	07/18/88	3	DRY						
54-87	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

ALLUVIAL WELLS AT THE 881 HILLSIDE

INORGANIC COMPOUND RESULTS

Groundwater Inorganic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Wells Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L	Sulfate MG/L	HC03- MG/L
09-74	03/09/87	1	1536	378	34.0	173	231
09-74	04/09/87	1	1176	294	8.80	180	244
09-74	05/21/87	2	1313	276	7.60	235	253
09-74	07/02/87	3	1445	304	10.0	300	258
09-74	08/11/87	3	DRY				
09-74	10/20/87	4	1588	449	26.8	213	256
09-74	10/28/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
09-74	11/17/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
09-74	02/25/88	1	1253	250	8.67	230	161
09-74	04/14/88	2	1189	221	7.57	273	264
09-74	04/15/88	2	1188	224	7.62	268	241
09-74	07/20/88	3	1231	290	9.78	300	272
09-74	10/25/88	4	1516	369	32.7	239	226
10-74	05/21/87	2	1833	355	55	358	284
10-74	07/01/87	3	DRY				
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
10-74	10/20/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
10-74	02/25/88	1	1646	314	36.7	311	165
10-74	07/19/88	3	1530	325	44.7	313	269
10-74	10/25/88	4	1462	302	40.3	282	255

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed not detected
B = Present in laboratory blank

Groundwater Inorganic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Wells Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L	Sulfate MG/L	HCO3- MG/L
01-87	10/12/87	4	DRY				
01-87	02/10/88	1	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
01-87	04/11/88	1	DRY				
01-87	04/11/88	2	DRY				
01-87	07/20/88	3	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
01-87	10/26/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
04-87	05/20/87	1	1318	200	5.80	310	309
04/87	05/26/87	2	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
04-87	07/09/87	3	2374	458	6.0	700	390
04-87	10/14/87	4	1735	324	3.76	435	421
04-87	10/14/87	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
04-87	02/15/88	1	1756	313	2.60	500	456
04-87	04/13/88	2	1836	269	3.86	518	432
04-87	07/14/88	3	1264	189	4.99	449	411
04-87	10/20/88	4	943	98.8	9.53	236	399
06-87	07/30/87	3	1195	263	0.34	283	367
06-87	08/25/87	3	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				

Notes: NR = Analyte not reported; J = Present below detection limit; U = Analyzed not detected; B = Present in laboratory blank

Groundwater Inorganic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Wells Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L	Sulfate MG/L	HCO3- MG/L
06-87	10/14/87	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
06-87	10/14/87	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
06-87	02/17/87	1	1430	332	0.02 U	285	413
06-87	04/13/88	2	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
06-87	07/14/88	3	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
06-87	10/26/88	4	DRY				
43-87	12/18/87	4	1207	239	3.27	295	263.0
43-87	02/22/88	1	1770	259	3.00	243	139
43-87	04/11/88	2	1251	271	3.70	303	249
43-87	07/20/88	3	1232	246	4.29	332	356
43-87	10/17/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
44-87	11/14/87	4	DRY				
44-87	02/22/88	1	DRY				
44-87	04/18/88	2	DRY				
44-87	07/20/88	3	DRY				
44-87	10/26/88	4	DRY				

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed not detected
B = Present in laboratory blank

Groundwater Inorganic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Wells Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L	Sulfate MG/L	HCO3- MG/L
49-87	11/18/87	4	DRY				
49-87	02/17/88	1	DRY				
49-87	04/13/88	2	DRY				
49-87	04/13/88	2	DRY				
49-87	07/18/88	3	DRY				
49-87	10/21/88	4	DRY				
50-87	11/18/87	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
50-87	11/18/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
50-87	02/17/88	1	DRY				
50-87	04/13/88	2	DRY				
50-87	07/18/88	3	DRY				
50-87	10/21/88	4	DRY				
51-87	11/23/88	4	DRY				
51-87	02/12/88	1	DRY				
51-87	04/18/88	2	DRY				
51-87	07/18/88	3	DRY				

Notes: NR = Analyte not reported; U = Analyzed not detected
J = Present below detection limit; B = Present in laboratory blank

Groundwater Inorganic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Wells Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L		Sulfate MG/L	HCO3- MG/L
51-87	10/21/88	4	DRY					
52-87	11/23/87	4	700	59.5	0.02	U	133	112
52-87	11/23/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS					
52-87	02/12/88	1	814	67.3	0.02		186	502
52-87	04/18/88	2	936	76.9	0.02	U	241	359
52-87	07/18/88	3	878	85.6	0.06		225	460
52-87	10/18/88	4	799	2.90	0.02	U	197	443
53-87	11/18/87	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS					
53-87	11/18/87	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS					
53-87	11/18/88	1	DRY					
53-87	04/11/88	2	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
53-87	07/18/88	3	DRY					
53-87	10/21/88	4	DRY					
54-87	11/18/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS					

Notes: NR = Analyte not reported; J = Present below detection limit; U = Analyzed not detected; B = Present in laboratory blank

Groundwater Inorganic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS AT THE 881 HILLSIDE

Wells Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate + Nitrite-Nitrogen MG/L	Sulfate MG/L	HCO3- MG/L
54-87	11/18/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
54-87	11/18/88	4	INSUFFICIENT SAMPLES FOR INORGANIC ANALYSIS				
54-87	02/10/88	1	DRY				
54-87	04/11/88	2	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
54-87	07/18/88	3	DRY				
54-87	10/21/88	4	DRY				

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed not detected
B = Present in laboratory blank

ALLUVIAL WELLS AT THE 881 HILLSIDE

TOTAL RADIOCHEMISTRY RESULTS

TOTAL RADIOCHEMISTRY RESULTS SUMMARY
FOR GROUND WATER AT Rockwell (Rocky Flats)

Analyte	Maximum Value	Minimum Value	Number of Samples: Above Detection	Below Detection	Not Reported	Mean Value*
ALLUVIAL WELLS AT THE 881 HILLSIDE						
Gross Alpha (pci/l)	220 ± 10	21 ± 10	5	0	0	85
Gross Beta (pci/l)	134 ± 15	-3 ± 8	5	0	0	77
Uranium 233, 234 (pci/l)	22 ± 3	6.0 ± 1.3	5	0	0	10
Uranium 235 (pci/l)	.81 ± .71	0.0 ± 0.36	5	0	0	0.334
Uranium 238 (pci/l)	14 ± 3	2.9 ± 2.1	5	0	0	6.760
Strontium 89, 90 (pci/l)	4.50 ±	<0.6 ±	5	0	0	1.814
Plutonium 239, 240(pci/l)	0.28 ± 0.59	0.0 ± 1.1	5	0	0	0.098
Americium 241 (pci/l)	0.0 ± 2.6	0.0 ± 3.5	4	0	1	0.000
Cesium 137 (pci/l)	3.1 ±	3.1 ±	1	0	4	3.100
Tritium (pci/l)	<110 ±	<110 ±	5	0	0	0.000

* - For activities above detection only.

Groundwater Total Radiochemisty Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233,234 pCi/l	Uranium 235 pCi/l
09-74	03/09/87	1	100 ± 27	121 ± 21	6.0 ± 1.3	0.26 ± 0.44
09-74	04/09/87	1	28 ± 26	-3 ± 8	6.3 ± 2.3	.52 ± .73
09-74	05/21/87	2	21 ± 10	35 ± 14	8.4 ± 1.4	0.08 ± 0.33
09-74	07/02/87	3	See dissolved radiochemistry.			
09-74	08/11/87	3	DRY			
09-74	10/20/87	4	See dissolved radiochemistry.			
09-74	10/28/87	4	***			
09-74	11/17/87	4	***			
09-74	02/25/88	1	See dissolved radiochemistry.			
09-74	04/14/88	2	See dissolved radiochemistry.			
09-74	04/15/88	2	See dissolved radiochemistry.			
09-74	07/20/88	3	See dissolved radiochemistry.			
09-74	10/25/88	4	See dissolved radiochemistry.			
10-74	05/21/87	2	54 ± 20	97 ± 5	8.2 ± 1.9	0.0 ± 0.36
10-74	07/01/87	3	DRY			
10-74	10/20/87	4	***			
10-74	10/20/87	4	***			
10-74	02/25/88	1	See dissolved radiochemistry.			
10-74	07/19/88	3	See dissolved radiochemistry.			
10-74	10/25/88	4	See dissolved radiochemistry.			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89, 90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
09-74	03/09/87	1	5.0 ± 1.1	<0.6	0.28 ± 0.59	NR
09-74	04/09/87	1	2.9 ± 2.1	.65	0.0 ± 1.1	0.0 ± 3.5
09-74	05/21/87	2	7.7 ± 1.3	1.74	.19 ± .75	0.0 ± 1.2
09-74	07/02/87	3	See dissolved radiochemistry.			
09-74	08/11/87	3	DRY			
09-74	10/20/87	4	See dissolved radiochemistry.			
09-74	10/28/87	4	***			
09-74	11/17/87	4	***			
09-74	02/25/88	1	See dissolved radiochemistry.			
09-74	04/14/88	2	See dissolved radiochemistry.			
09-74	04/15/88	2	See dissolved radiochemistry.			
09-74	07/20/88	3	See dissolved radiochemistry.			
09-74	10/25/88	4	See dissolved radiochemistry.			
10-74	05/21/87	2	4.2 ± 1.3	2.18	0.020 ± 0.79	0.0 ± 1.2
10-74	07/01/87	3	DRY			
10-74	10/20/87	4	***			
10-74	10/20/87	4	***			
10-74	02/25/88	1	See dissolved radiochemistry.			
10-74	07/19/88	3	See dissolved radiochemistry.			
10-74	10/25/88	4	See dissolved radiochemistry.			

Notes: NR = Analyte not reported

*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
09-74	03/09/87	1	NR	<110
09-74	04/09/87	1	NR	<110
09-74	05/21/87	2	NR	<110
09-74	07/02/87	3	See dissolved radiochemistry.	
09-74	08/11/87	3	DRY	
09-74	10/20/87	4	See dissolved radiochemistry.	
09-74	10/28/87	4	***	
09-74	11/17/87	4	***	
09-74	02/25/88	1	See dissolved radiochemistry.	
09-74	04/14/88	2	See dissolved radiochemistry.	
09-74	04/15/88	2	See dissolved radiochemistry.	
09-74	07/20/88	3	See dissolved radiochemistry.	
09-74	10/25/88	4	See dissolved radiochemistry.	
10-74	05/21/87	2	NR	<110
10-74	07/01/87	3	DRY	
10-74	10/20/87	4	***	
10-74	10/20/87	4	***	
10-74	02/25/88	1	See dissolved radiochemistry.	
10-74	07/19/88	3	See dissolved radiochemistry.	
10-74	10/25/88	4	See dissolved radiochemistry.	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
01-87	10/12/87	4	DRY			
01-87	02/10/88	1	See dissolved radiochemistry.			
01-87	04/11/88	1	DRY			
01-87	04/11/88	2	DRY			
01-87	07/20/85	3	***			
01-87	10/26/87	4	***			
04-87	05/20/87	1	220 ± 10	134 ± 15	22 ± 3	.81 ± .71
04-87	05/26/87	2	***			
04-87	07/09/87	3	See dissolved radiochemisty.			
04-87	10/14/87	4	See dissolved radiochemisty.			
04-87	10/14/87	4	***			
04-87	02/15/88	1	See dissolved radiochemisty.			
04-87	04/13/88	2	See dissolved radiochemisty.			
04-87	07/14/88	3	See dissolved radiochemisty.			
04-87	10/20/88	4	See dissolved radiochemisty.			
06-87	07/30/87	3	See dissolved radiochemisty.			
06-87	08/25/87	3	***			
06-87	10/14/87	4	***			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89,90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
01-87	10/12/87	4	DRY			
01-87	02/10/88	1	See dissolved radiochemistry.			
01-87	04/11/88	1	DRY			
01-87	04/11/88	2	DRY			
01-87	07/20/88	3	***			
01-87	10/26/88	4	***			
04-87	05/20/87	1	14 ± 3	4.50	0.0 ± .55	0.0 ± 2.6
04-87	05/26/87	2	***			
04-87	07/09/87	3	See dissolved radiochemistry.			
04-87	10/14/87	4	See dissolved radiochemistry.			
04-87	10/14/87	4	***			
04-87	02/15/88	1	See dissolved radiochemistry.			
04-87	04/13/88	2	See dissolved radiochemistry.			
04-87	07/14/88	3	See dissolved radiochemistry.			
04-87	10/20/88	4	See dissolved radiochemistry.			
06-87	07/30/87	3	See dissolved radiochemistry.			
06-87	08/25/87	3	***			
06-87	10/14/87	4	***			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
01-87	10/12/87	4	DRY	
01-87	02/10/88	1	See dissolved radiochemistry.	
01-87	04/11/88	1	DRY	
01-87	04/11/88	2	DRY	
01-87	07/20/88	3	***	
01-87	10/26/88	4	***	
04-87	05/20/87	1	3.1	<110
04-87	05/26/87	2	***	
04-87	07/09/87	3	See dissolved radiochemistry.	
04-87	10/14/87	4	See dissolved radiochemistry.	
04-87	10/14/87	4	***	
04-87	02/15/88	1	See dissolved radiochemistry.	
04-87	04/13/88	2	See dissolved radiochemistry.	
04-87	07/14/88	3	See dissolved radiochemistry.	
04-87	10/20/88	4	See dissolved radiochemistry.	
06-87	07/30/87	3	See dissolved radiochemistry.	
06-87	08/25/87	3	***	
06-87	10/14/87	4	***	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
06-87	10/14/87	4	***			
06-87	02/17/88	1	See dissolved radiochemistry.			
06-87	04/13/88	2	***			
06-87	07/14/88	3	***			
06-87	10/26/88	4	DRY			
43-87	12/18/87	4	See dissolved radiochemistry.			
43-87	02/22/88	1	See dissolved radiochemistry.			
43-87	04/11/88	2	See dissolved radiochemistry.			
43-87	07/20/88	3	See dissolved radiochemistry.			
43-87	10/17/88	4	***			
44-87	11/14/87	4	DRY			
44-87	02/22/88	1	DRY			
44-87	04/18/88	2	DRY			
44-87	07/20/88	3	DRY			
44-87	10/26/88	4	DRY			
49-87	11/18/87	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89, 90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
06-87	10/14/87	4	***			
06-87	02/17/88	1	See dissolved radiochemistry.			
06-87	04/13/88	2	***			
06-87	07/14/88	3	***			
06-87	10/26/88	4	DRY			
43-87	12/18/87	4	See dissolved radiochemistry.			
43-87	02/22/88	1	See dissolved radiochemistry.			
43-87	04/11/88	2	See dissolved radiochemistry.			
43-87	07/20/88	3	See dissolved radiochemistry.			
43-87	10/17/88	4	***			
44-87	11/14/87	4	DRY			
44-87	02/22/88	1	DRY			
44-87	04/18/88	2	DRY			
44-87	07/20/88	3	DRY			
44-87	10/26/88	4	DRY			
49-87	11/18/87	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
06-87	10/14/87	4	***	
06-87	02/17/88	1	See dissolved radiochemistry.	
06-87	04/13/88	2	***	
06-87	07/14/88	3	***	
06-87	10/26/88	4	DRY	
43-87	12/18/87	4	See dissolved radiochemistry.	
43-87	02/22/88	1	See dissolved radiochemistry.	
43-87	04/11/88	2	See dissolved radiochemistry.	
43-87	07/20/88	3	See dissolved radiochemistry.	
43-87	10/17/88	4	***	
44-87	11/14/87	4	DRY	
44-87	02/22/88	1	DRY	
44-87	04/18/88	2	DRY	
44-87	07/20/88	3	DRY	
44-87	10/26/88	4	DRY	
49-87	11/18/87	4	DRY	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
49-87	02/17/88	1	DRY			
49-87	04/13/88	2	DRY			
49-87	04/13/88	2	DRY			
49-87	07/18/88	3	DRY			
49-87	10/21/88	4	DRY			
50-87	11/18/87	4	***			
50-87	11/18/87	4	***			
50-87	02/17/88	1	DRY			
50-87	04/13/88	2	DRY			
50-87	07/18/88	3	DRY			
50-87	10/21/88	4	DRY			
51-87	11/23/87	4	DRY			
51-87	02/12/88	1	DRY			
51-87	04/18/88	2	DRY			
51-87	07/18/88	3	DRY			
51-87	10/21/88	4	DRY			
52-87	11/23/87	4	See dissolved radiochemistry.			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pci/l	Strontium 89, 90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
49-87	02/17/88	1	DRY			
49-87	04/13/88	2	DRY			
49-87	04/13/88	2	DRY			
49-87	07/18/88	3	DRY			
49-87	10/21/88	4	DRY			
50-87	11/18/87	4	***			
50-87	11/18/87	4	***			
50-87	02/17/88	1	DRY			
50-87	04/13/88	2	DRY			
50-87	07/18/88	3	DRY			
50-87	10/21/88	4	DRY			
51-87	11/23/87	4	DRY			
51-87	02/12/88	1	DRY			
51-87	04/18/88	2	DRY			
51-87	07/18/88	3	DRY			
51-87	10/21/88	4	DRY			
52-87	11/23/87	4	See dissolved radiochemistry.			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
49-87	02/17/88	1	DRY	
49-87	04/13/88	2	DRY	
49-87	04/13/88	2	DRY	
49-87	07/18/88	3	DRY	
49-87	10/21/88	4	DRY	
50-87	11/18/87	4	***	
50-87	11/18/87	4	***	
50-87	02/17/88	1	DRY	
50-87	04/13/88	2	DRY	
50-87	07/18/88	3	DRY	
50-87	10/21/88	4	DRY	
51-87	11/23/87	4	DRY	
51-87	02/12/88	1	DRY	
51-87	04/18/88	2	DRY	
51-87	07/18/88	3	DRY	
51-87	10/21/88	4	DRY	
52-87	11/23/87	4	See dissolved radiochemistry.	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
52-87	11/23/87	4	***			
52-87	02/12/88	1	See dissolved radiochemistry.			
52-87	04/18/88	2	See dissolved radiochemistry.			
52-87	07/18/88	3	See dissolved radiochemistry.			
52-87	10/18/88	4	See dissolved radiochemistry.			
53-87	11/18/87	4	***			
53-87	11/18/87	4	***			
53-87	02/10/88	1	DRY			
53-87	04/11/88	2	***			
53-87	07/18/88	3	DRY			
53-87	10/21/88	4	DRY			
54-87	11/18/87	4	***			
54-87	11/18/87	4	***			
54-87	11/18/87	4	***			
54-87	02/10/88	1	DRY			
54-87	04/11/88	2	***			
54-87	07/18/88	3	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pci/l	Strontium 89, 90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
52-87	11/23/87	4	***			
52-87	02/12/88	1	See dissolved radiochemistry.			
52-87	04/18/88	2	See dissolved radiochemistry.			
52-87	07/18/88	3	See dissolved radiochemistry.			
52-87	10/18/88	4	See dissolved radiochemistry.			
53-87	11/18/87	4	***			
53-87	11/18/87	4	***			
53-87	02/10/88	1	DRY			
53-87	04/11/88	2	***			
53-87	07/18/88	3	DRY			
53-87	10/21/88	4	DRY			
54-87	11/18/87	4	***			
54-87	11/18/87	4	***			
54-87	11/18/87	4	***			
54-87	02/10/88	1	DRY			
54-87	04/11/88	2	***			
54-87	07/18/88	3	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
52-87	11/23/87	4	***	
52-87	02/12/88	1	See dissolved radiochemistry.	
52-87	04/18/88	2	See dissolved radiochemistry.	
52-87	07/18/88	3	See dissolved radiochemistry.	
52-87	10/18/88	4	See dissolved radiochemistry.	
53-87	11/18/87	4	***	
53-87	11/18/87	4	***	
53-87	02/10/88	1	DRY	
53-87	04/11/88	2	***	
53-87	07/18/88	3	DRY	
53-87	10/21/88	4	DRY	
54-87	11/18/87	4	***	
54-87	11/18/87	4	***	
54-87	11/18/87	4	***	
54-87	02/10/88	1	DRY	
54-87	04/11/88	2	***	
54-87	07/18/88	3	DRY	

Notes: NR = Anatyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
54-87	10/21/88	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89, 90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
54-87	10/21/88	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results

for Wells at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
54-87	10/21/88	4	DRY	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

ALLUVIAL WELLS AT THE 881 HILLSIDE DISSOLVED RADIO CHEMISTRY RESULTS

DISSOLVED RADIOCHEMISTRY RESULTS SUMMARY
FOR GROUND WATER AT Rockwell (Rocky Flats)

Analyte	Maximum Value	Minimum Value	Number of Samples: Above Detection	Below Detection	Not Reported	Mean Value*
ALLUVIAL WELLS AT THE 881 HILLSIDE						
Gross Alpha (pci/l)	319 ± 24.1	3 ± 4	24	0	0	49
Gross Beta (pci/l)	286 ± 83	8 ± 27	24	0	0	36
Uranium 233, 234 (pci/l)	29.3 ± 3.9	4.7 ± 0.7	24	0	0	17
Uranium 235, (pci/l)	4.3 ± 0.9	0.0 ± 0.6	24	0	0	0.695
Uranium 238 (pci/l)	25.3 ± 3.4	4.0 ± 0.6	24	0	0	13
Strontium 89, 90 (pci/l)	2.1 ±	<1.0 ±	6	0	18	0.850
Plutonium 239, 240 (pci/l)	.14± .73	-.23 ± .59	24	0	0	0.000
Americium 241 (pci/l)	.70 ± .86	-0.4 ± 1.6	18	0	6	0.022
Cesium 137 ( )			0	0	24	
Tritium (pci/l)	777 ± 333	<515 ±	23	0	1	80

* - For activities above detection only.

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha (PCI/L)	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
09-74	03/09/87	1	See total radiochemistry.							
09-74	04/09/87	1	See total radiochemistry.							
09-74	05/21/87	2	See total radiochemistry.							
09-74	07/02/87	3	6 ± 29	52	6 ± 42	79	12.0 ± 2.1		0.0 ± 0.6	0.9
09-74	08/11/87	3	DRY							
09-74	10/20/87	4	14 ± 7		21 ± 10		9.2 ± 0.9		.48 ± .13	
09-74	10/28/87	4	***							
09-74	11/17/87	4	***							
09-74	02/25/88	1	20 ± 11		14 ± 27		15 ± 2		0.53 ± 0.16	
09-74	04/14/88	2	22 ± 11		14 ± 18	41	12 ± 1		0.42 ± 0.07	
09-74	04/15/88	2	21 ± 12		19 ± 16	35	12 ± 1		0.36 ± 0.06	
09-74	07/20/88	3	15 ± 4		11 ± 3		12 ± 1		.28 ± 0.07	
09-74	10/25/88	4	Data not yet received							
10-74	05/21/87	2	See total radiochemistry.							
10-74	07/01/87	3	DRY							
10-74	10/20/87	4	***							
10-74	10/20/87	4	***							
10-74	02/25/88	1	13 ± 11		8 ± 27		7.3 ± 0.7		0.37 ± 0.12	
10-74	07/19/88	3	3 ± 4		1 ± 3		6.2 ± 0.6		0.21 ± 0.06	
10-74	10/25/88	4	Data not yet received							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 (PCI/L)	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
09-74	03/09/87	1	See total radiochemistry.							
09-74	04/09/87	1	See total radiochemistry.							
09-74	05/21/87	2	See total radiochemistry.							
09-74	07/02/87	3	8.1 ± 1.5		<1.0		0.0 ± 1.1	1.6	NR	
09-74	08/11/87	3	DRY							
09-74	10/20/87	4	7.0 ± .07		1.0		0.00 ± .11	.61	0.00 ± 03	.34
09-74	10/28/87	4	* * *							
09-74	11/17/87	4	* * *							
09-74	02/25/88	1	11 ± 1		NR		0.00 ± 0.41		NR	
09-74	04/14/88	2	9.2 ± 1.2		NR		0.00 ± 0.04	0.25	0.02 ± 0.16	0.50
09-74	04/15/88	2	9.5 ± 1.0		NR		0.00 ± 0.04	0.22	0.00 ± 0.16	0.95
09-74	07/20/88	3	8.6 ± 0.9				0.00 ± 0.04		0.00 ± 0.10	
09-74	10/25/88	4	Data not yet received							
10-74	05/21/87	2	See total radiochemistry.							
10-74	07/01/87	3	DRY							
10-74	10/20/87	4	* * *							
10-74	10/20/87	4	* * *							
10-74	02/25/88	1	5.1 ± 0.5		NR		0.00 ± 0.25		NR	
10-74	07/19/88	3	4.5 ± 0.5		NR		0.00 ± 0.07		0.00 ± 0.08	
10-74	10/25/88	4	Data not yet received							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 (PCI/L)	(MDA)	Tritium PCI/L	(MDA)
09-74	03/09/87	1	See total radiochemistry.			
09-74	04/09/87	1	See total radiochemistry.			
09-74	05/21/87	2	See total radiochemistry.			
09-74	07/02/87	3	NR		<515	
09-74	08/11/87	3	DRY			
09-74	10/20/87	4	NR		<520	
09-74	10/28/87	4	***			
09-74	11/17/87	4	***			
09-74	02/25/88	1	NR		<210	220
09-74	04/14/88	2	NR		<220	220
09-74	04/15/88	2	NR		<220	
09-74	07/20/88	3	NR		230	
09-74	10/25/88	4	Data not yet received			
10-74	05/21/87	2	See total radiochemistry.			
10-74	07/01/87	3	DRY			
10-74	10/20/87	4	***			
10-74	10/20/87	4	***			
10-74	02/25/88	1	NR		<220	
10-74	07/19/88	3	NR		210	
10-74	10/25/88	4	Data not yet received			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha (PCI/L)	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
01-87	10/12/87	4	DRY							
01-87	02/10/88	1	15 ± 11		15 ± 30		8.4 ± 0.7		0.34 ± 0.11	
01-87	04/11/88	1	DRY							
01-87	04/11/88	2	DRY							
01-87	07/20/88	3	***							
01-87	10/26/88	4	***							
04-87	05/20/87	1	See total radiochemistry.							
04-87	05/26/87	2	***							
04-87	07/09/87	3	319 ± 241		286 ± 83		26.8 ± 3.2		0.5 ± 0.4	1.1
04-87	10/14/88	4	133 ± 69		75 ± 54		16 ± 3		.56 ± .30	
04-87	10/14/88	4	***							
04-87	02/15/88	1	50 ± 13		16 ± 13		19 ± 2		1.1 ± 0.2	
04-87	04/13/88	2	59 ± 16		28 ± 18	40	23 ± 2		0.55 ± 0.09	
04-87	07/14/88	3	37 ± 6		30 ± 4		19 ± 2		0.55 ± 0.10	
04-87	10/20/55	4	Data not yet received							
06-87	07/30/87	3	59 ± 33		42 ± 44	76	29.3 ± 3.9		1.3 ± 0.6	
06-87	08/25/87	3	***							
06-87	10/14/87	4	***							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 (PCI/L)	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
01-87	10/12/87	4	DRY							
01-87	02/10/88	1	5.5 ± 0.5		NR		0.0 ± 0.26		0.03 ± 0.25	
01-87	04/11/88	1	DRY							
01-87	04/11/88	2	DRY							
01-87	07/20/88	3	***							
01-87	10/26/88	4	***							
04-87	05/20/87	1	See total radiochemistry.							
04-87	05/26/87	2	***							
04-87	07/09/87	3	17.4 ± 2.3		2.1		.14 ± 73	0.7	.70 ± .86	1.0
04-87	10/14/87	4	12 ± 2		NR		.06 ± .14		.02 ± .07	
04-87	10/14/87	4	***							
04-87	02/15/88	1	15 ± 2		NR		0.00 ± 0.24		0.00 ± 0.14	
04-87	04/13/88	2	17 ± 1		NR		0.00 ± 0.05	0.17	0.00 ± 0.16	0.60
04-87	07/14/88	3	14 ± 1		NR		0.00 ± 0.04		0.00 ± 0.17	
04-87	10/20/88	4	Data not yet recieved							
06-87	07/30/87	3	25.3 ± 3.4		2.0		.23 ± .59	0.6	-0.4 ± 1.6	3.3
06-87	08/25/87	3	***							
06-87	10/14/87	4	***							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 (PCI/L)	(MDA)	Tritium PCI/L	(MDA)
01-87	10/12/87	4	DRY			
01-87	02/10/88	1	NR		NR	
01-87	04/11/88	1	DRY			
01-87	04/11/88	2	DRY			
01-87	07/20/88	3	***			
01-87	10/26/88	4	***			
04-87	05/20/87	1	See total radiochemistry.			
04-87	05/26/87	2	***			
04-87	07/09/87	3	NR		777 ± 333	
04-87	10/14/87	4	NR		<460	
04-87	10/14/87	4	***			
04-87	02/15/88	1	NR		<210	
04-87	04/13/88	2	NR		<220	220
04-87	07/14/88	3	NR		210	
04-87	10/20/88	4	Data not yet received			
06-87	07/30/87	3	NR		<540	
06-87	08/25/87	3	***			
06-87	10/14/87	4	***			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha (PCI/L)	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
06-87	10/14/87	4	***							
06-87	02/17/88	1	48 ± 10		25 ± 13		28 ± 3		0.93 ± 0.23	
06-87	04/13/88	2	***							
06-87	07/14/88	3	***							
06-87	10/26/88	4	DRY							
43-87	12/18/87	4	74 ± 14		82 ± 12		20 ± 4		.51 ± .27	
43-87	02/22/88	1	29 ± 14		14 ± 24		20 ± 3		4.3 ± 09	
43-87	04/11/88	2	29 ± 12		11 ± 18	40	15 ± 1		0.51 ± 0.08	
43-87	07/20/88	3	21 ± 4		21 ± 4		18 ± 2		0.57 ± 0.11	
43-87	10/17/88	4	***							
44-87	11/14/87	4	DRY							
44-87	02/22/88	1	DRY							
44-87	04/18/88	2	DRY							
44-87	07/20/88	3	DRY							
49-87	10/26/88	4	DRY							
49-87	11/18/87	4	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 (PCI/L)	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
06-87	10/14/87	4	***							
06-87	02/17/88	1	24 ± 3		NR		0.0 ± 0.20		0.00 ± 0.11	
06-87	04/13/88	2	***							
06-87	07/14/88	3	***							
06-87	10/26/88	4	DRY							
43-87	12/18/87	4	17 ± 4		<1.0		0.00 ± .16	.68	NR	
43-87	02/22/88	1	20 ± 3		NR		0.00 ± 0.23		NR	
43-87	04/11/88	2	12 ± 1		NR		0.01 ± 0.06	0.17	NR	
43-87	07/20/88	3	16 ± 2		NR		0.00 ± 0.04		0.00 ± 0.09	
43-87	10/17/88	4	***							
44-87	11/14/87	4	DRY							
44-87	02/22/88	1	DRY							
44-87	04/18/88	2	DRY							
44-87	07/20/88	3	DRY							
49-87	10/26/88	4	DRY							
49-87	11/18/87	4	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
06-87	10/14/87	4	***			
06-87	02/17/88	1	NR		<210	
06-87	04/13/88	2	***			
06-87	07/14/88	3	***			
06-87	10/26/88	4	DRY			
43-87	12/18/87	4	NR		<220	
43-87	02/22/88	1	NR		<210	
43-87	04/11/88	2	NR		<220	220
43-87	07/20/88	3	NR		220	
43-87	10/17/88	4	***			
44-87	11/14/87	4	DRY			
44-87	02/22/88	1	DRY			
44-87	04/18/88	2	DRY			
44-87	07/20/88	3	DRY			
49-87	10/26/88	4	DRY			
49-87	11/18/87	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha (PCI/L)	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
49-87	02/17/88	1	DRY							
49-87	04/13/88	2	DRY							
49-87	04/13/88	2	DRY							
49-87	07/18/88	3	DRY							
49-87	10/21/88	4	DRY							
50-87	11/18/87	4	***							
50-87	11/18/87	4	***							
50-87	02/17/88	1	DRY							
50-87	04/13/88	2	DRY							
50-87	07/18/88	3	DRY							
50-87	10/21/88	4	DRY							
51-87	11/23/87	4	DRY							
51-87	02/12/88	1	DRY							
51-87	04/18/88	2	DRY							
51-87	07/18/88	3	DRY							
51-87	10/21/88	4	DRY							
52-87	11/23/87	4	70 ± 13		76 ± 11		21 ± 2		.79 ± .15	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 (PCI/L)	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
49-87	02/17/88	1	DRY							
49-87	04/13/88	2	DRY							
49-87	04/13/88	2	DRY							
49-87	07/18/88	3	DRY							
49-87	10/21/88	4	DRY							
50-87	11/18/87	4	***							
50-87	11/18/87	4	***							
50-87	02/17/88	1	DRY							
50-87	04/13/88	2	DRY							
50-87	07/18/88	3	DRY							
50-87	10/21/88	4	DRY							
51-87	11/23/87	4	DRY							
51-87	02/12/88	1	DRY							
51-87	04/18/88	2	DRY							
51-87	07/18/88	3	DRY							
51-87	10/21/88	4	DRY							
52-87	11/23/87	4	15 ± 2		<1.0		0.00 ± .28	1.1	0.00 ± .33	2.1

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
49-87	02/17/88	1	DRY			
49-87	04/13/88	2	DRY			
49-87	04/13/88	2	DRY			
49-87	07/18/88	3	DRY			
49-87	10/21/88	4	DRY			
50-87	11/18/87	4	***			
50-87	11/18/87	4	***			
50-87	02/17/88	1	DRY			
50-87	04/13/88	2	DRY			
50-87	07/18/88	3	DRY			
50-87	10/21/88	4	DRY			
51-87	11/23/87	4	DRY			
51-87	02/12/88	1	DRY			
51-87	04/18/88	2	DRY			
51-87	07/18/88	3	DRY			
51-87	10/21/88	4	DRY			
52-87	11/23/87	4	NR		<540	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha (PCI/L)	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
52-87	11/23/87	4	***							
52-87	02/12/88	1	40 ± 16		17 ± 23		4.7 ± 0.7		0.19 ± 0.12	
52-87	04/18/88	2	46 ± 13		32 ± 18	40	29 ± 3		0.80 ± 0.14	
52-87	07/18/88	3	39 ± 5		23 ± 4		28 ± 3		0.53 ± 0.22	
52-87	10/18/88	4	Data not yet received							
53/87	11/18/87	4	***							
53/87	11/18/87	4	***							
53/87	02/10/88	1	DRY							
53/87	04/11/88	2	***							
53/87	07/18/88	3	DRY							
53/87	10/21/88	4	DRY							
54/87	11/18/87	4	***							
54/87	11/18/87	4	***							
54/87	11/18/87	4	***							
54/87	02/10/88	1	DRY							
54/87	04/11/88	2	***							
54/87	07/18/88	3	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 PCI/L	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium PCI/L	(MDA)
52-87	11/23/87	4	***							
52-87	02/12/88	1	40 ± 0.6		NR		0.00 ± 0.13		0.00 ± 0.11	
52-87	04/18/88	2	21 ± 2		NR		0.00 ± 0.03	0.15	0.02 ± 0.16	0.79
52-87	07/18/88	3	19 ± 2		NR		0.01 ± 0.08		0.01 ± 0.17	
52-87	10/18/88	4	Data not yet received							
53/87	11/18/87	4	***							
53/87	11/18/87	4	***							
53/87	02/10/88	1	DRY							
53/87	04/11/88	2	***							
53/87	07/18/88	3	DRY							
53/87	10/21/88	4	DRY							
54/87	11/18/87	4	***							
54/87	11/18/87	4	***							
54/87	11/18/87	4	***							
54/87	02/10/87	1	DRY							
54/87	04/11/88	2	***							
54/87	07/18/88	3	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
52-87	11/23/87	4	***			
52-87	02/12/88	1	NR		<210	
52-87	04/18/88	2	NR		<210	
52-87	07/18/88	3	NR		200	
52-87	10/18/88	4	Data not yet received			
53/87	11/18/87	4	***			
53/87	11/18/87	4	***			
53/87	02/10/88	1	DRY			
53/87	04/11/88	2	***			
53/87	07/18/88	3	DRY			
53/87	10/21/88	4	DRY			
54/87	11/18/87	4	***			
54/87	11/18/87	4	***			
54/87	11/18/87	4	***			
54/87	02/10/88	1	DRY			
54/87	04/11/88	2	***			
54/87	07/18/88	3	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha PCI/L	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
54-87	10/21/88	4	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 (PCI/L)	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
54-87	10/21/88	4	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

ALLUVIAL WELLS AT THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
54-87	10/21/88	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

SECTION 2

VOLATILE ORGANIC COMPOUND, DISSOLVED METALS, INORGANIC COMPOUND, AND RADIOCHEMISTRY ANALYTICAL RESULTS

FOR THE 881 FOOTING DRAIN DISCHARGE

WELLS/STATIONS IN THIS GROUP:
SW-45

BUILDING 881 FOOTING DRAIN DISCHARGE
VOLATILE ORGANIC RESULTS

Surface Water Volatile Organic Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
SW-45	05/26/87		NR	NR	NR	NR	NR	NR	NR
SW-45	11/17/87		10 U	10 U	10 U	10 U	21	10 U	5 U
SW-45	06/28/88		10 U	10 U	10 U	10 U	5 U	10 U	5 U
SW-45	04/04/89		10 U	10 U	10 U	10 U	5 U	5 JB	5 U
SW-45	05/18/89		10 U	10 U	10 U	10 U	5 U	10 U	5 U
SW-45	05/30/89		Data not yet received						
SW-45	06/21/89		Data not yet received						
SW-45	07/18/89		Data not yet received						
SW-45	08/16/89		Data not yet received						

NR = Analyte not reported
J = Present below detected limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during vallidation

Surface Water Volatile Organic Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	1,1-Di chloro ethene ug/l	1,1-Di- chloro ethane ug/l	Trans-1,2- Dichloro ethene ug/l	Chloroform ug/l	1,2-Di- chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
SW-45	05/26/87		4 U	NR	NR	4 U	4 U	NR	4 U
SW-45	11/17/87		5 U	5 U	NR	5 U	5 U	10 U	5 U
SW-45	06/28/88		5 U	5 U	5 U	5 U	5 U	10 U	5 U
SW-45	04/04/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
SW-45	05/18/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
SW-45	05/30/89		Data not yet received						
SW-45	06/21/89		Data not yet received						
SW-45	07/18/89		Data not yet received						
SW-45	08/16/89		Data not yet received						

NR = Analyte not reported
J = Present below detected limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during vallidation

Surface Water Volatile Organic Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetone ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
SW-45	05/26/87		4 U	NR	NR	NR	NR	14	NR
SW-45	11/17/87		6	10 U	5 U	5 U	5 U	8	5 U
SW-45	06/28/88		5 U	10 U	5 U	5 U	5 U	5 U	5 U
SW-45	04/04/89		5 U	10 U	5 U	5 U	5 U	5 U	5 U
SW-45	05/18/89		5 U	10 U	5 U	5 U	5 U	5 U	5 U
SW-45	05/30/89		Data not yet received						
SW-45	06/21/89		Data not yet received						
SW-45	07/18/89		Data not yet received						
SW-45	08/16/89		Data not yet received						

NR = Analyte not reported
J = Present below detected limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during vallidation

Surface Water Volatile Organic Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propoene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
SW-45	05/26/87		4 U	NR	NR	NR	NR	NR	NR
SW-45	11/17/87		5 U	5 U	5 U	NR	5 U	10 U	10 U
SW-45	06/28/88		5 U	5 U	5 U	10 U	5 U	10 U	10 U
SW-45	04/04/89		5 U	5 U	5 U	NR	5 U	10 U	10 U
SW-45	05/18/89		5 U	5 U	5 U	NR	5 U	10 U	10 U
SW-45	05/30/89		Data not yet received						
SW-45	06/21/89		Data not yet received						
SW-45	07/18/89		Data not yet received						
SW-45	08/16/89		Data not yet received						

NR = Analyte not reported
J = Present below detected limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during vallidation

Surface Water Volatile Organic Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
SW-45	05/26/87		128	NR	NR	NR	NR	NR	NR
SW-45	11/17/87		16	5 U	12	5 U	5 U	5 U	5 U
SW-45	06/28/88		3 J	5 U	5 U	5 U	5 U	5 U	5 U
SW-45	04/04/89		2 J	5 U	5 U	5 U	5 U	5 U	5 U
SW-45	05/18/89		8	5 U	5 U	5 U	5 U	5 U	5 U
SW-45	05/30/89		Data not yet received						
SW-45	06/21/89		Data not yet received						
SW-45	07/18/89		Data not yet received						
SW-45	08/16/89		Data not yet received						

NR = Analyte not reported
J = Present below detected limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during vallidation

BUILDING 881 FOOTING DRAIN DISCHARGE
DISSOLVED METAL RESULTS

Surface Water Dissolved Metals Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
SW-45	05/26/87		NR	0.06 U	0.01 U	NR	NR	0.005 U	NR
SW-45	11/17/87		0.0436	0.02 U	0.005 U	0.1547	0.005 U	0.0017	85.3425
SW-45	06/28/88		0.200 U	0.060 U	0.010	0.200 U	0.005 U	0.005 U	78.0

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Surface Water Dissolved Metals Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
SW-45	05/26/87		0.2 U	NR	NR	NR	NR	0.005 U	0.01
SW-45	11/17/87		0.02 U	0.0100 U	0.0220 U	0.0111	0.0279	0.005 U	0.01 U
SW-45	06/28/88		NR	0.010 U	0.050 U	0.025 U	0.100 U	0.005 U	NR

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Surface Water Dissolved Metals Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
SW-45	05/26/87		NR	NR	0.0002 U	NR	NR	5.0 U	0.005 U
SW-45	11/17/87		19.0212	0.0060	0.0002 U	0.0220 U	0.0370 U	3.8	0.018
SW-45	06/28/88		21.0	0.015 U	0.90	NR	0.040 U	5.0 U	0.005 U

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Surface Water Dissolved Metals Results
For Stations at Rockwell (Rocky Flats)

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
SW-45	05/26/87		NR	NR	NR	NR	0.01 U	NR	0.05 U
SW-45	11/17/87		0.0076 U	41.7614	NR	0.6411	0.01 U	0.240 U	0.0426
SW-45	06/28/88		0.010 U	46	NR	0.7	0.010 U	0.050 U	0.6

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

BUILDING 881 FOOTING DRAIN DISCHARGE
INORGANIC COMPOUND RESULTS

Surface Water Inorganic Results
For Stations at Rockwell (Rocky Flats)
BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L	Sulfate MG/L	HC03- MG/L
SW45	05/26/87	456	74.1	8.50	44.0	216
SW45	11/17/87	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
SW45	06/28/88	464	77	8	56	232

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank

BUILDING 881 FOOTING DRAIN DISCHARGE
TOTAL RADIOCHEMISTRY RESULTS

TOTAL RADIOCHEMISTRY RESULTS SUMMARY
FOR SURFACE WATER AT Rockwell (Rocky Flats)

Analyte	Maximum Value	Minium Value	Number of Samples: Above Detection	Below Detection	Not Reported	Mean Value*
BUILDING 881 FOOTING DRAIN DISCHARGE						
Gross Alpha (pci/l)	13 ± 18	13 ± 18	1	0	1	13
Gross Beta (pci/l)	14 ± 31	14 ± 31	1	0	1	14
Uranium 233, 234 (pci/l)	5.5 ± 1.9	4.96 ± 0.439	2	0	0	5.230
Uranium 235 (pci/l)	0.0 ± .37	0.0 ± .37	1	0	1	0.000
Uranium 238 (pci/l)	4.7 ± 1.7	3.84 ± 0.416	2	0	0	4.270
Strontium 89, 90 (pci/l)	1.78 ±	1.78 ±	1	0	1	1.780
Plutonium 239, 240 (pci/l)	0.0312 ± 0.0824	0.0 ± .55	2	0	0	0.016
Americium 241 (pci/l)	0.0 ± 1.2	0.0 ± 1.2	1	0	1	0.000
Cesium 137 (pci/l)	<0.3 ±	<0.3 ±	1	0	1	0.000
Tritium (pci/l)	638 ± 315	<110 ±	2	0	0	319

* - For activities above detection only.

Surface Water Total Radiochemistry Results

for Stations Units at Rocky Plant

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled		Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
SW045	05/26/87		13 ± 18	14 ± 31	5.5 ± 1.9	0.0 ± .37
SW045	11/17/87		***			
SW045	06/28/88		NR	NR	4.96 ± 0.439 0.2	NR

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Surface Water Total Radiochemistry Results for Stations Units at Rocky Flats Plant

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled		Uranium 238 pCi/l	Strontium 89, 90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
SW045	05/26/87		4.7 ± 1.7	1.78	0.0 ± .55	0.0 ± 1.2
SW045	11/17/87		***			
SW045	06/28/88		3.84 ± 0.416 0.3	NR	0.0312 ± 0.0824 0.1	NR

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Surface Water Total Radiochemistry Results
for Stations Units at Rocky Flats Plant

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled		Cesium 137 pCi/l	Tritium pCi/l	
SW045	05/26/87		<0.3	<110	
SW045	11/17/87		***		
SW045	06/28/87		NR	638 ± 315	500

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

BUILDING 881 FOOTING DRAIN DISCHARGE
DISSOLVED RADIOCHEMISTRY RESULTS

DISSOLVED RADIOCHEMISTRY RESULTS SUMMARY
FOR SURFACE WATER AT RockweLL (Rocky Flats)

			Number of Samples			
Analyte	Maximum Value	Minimum Value	Above Detection	Below Detection	Not Reported	Mean Value*
BUILDING 881 FOOTING DRAIN DISCHARGE						
Gross Alpha (pci/l)	13.4 ± 5.11	13.4 ± 5.11	1	0	0	13
Gross Beta (pci/l)	15.1 ± 5.38	15.1 ± 5.38	1	0	0	15
Uranium 233, 234 (pci/l)	5.79 ± 0.818	5.79 ± 0.818	1	0	0	5.790
Uranium 235 ( )			0	0	1	
Uranium 238 (pci/l)	4.38 ± 0.735	4.38 ± 0.735	1	0	0	4.380
Strontium 89, 90 ( )			0	0	1	
Plutonium 239, 240 (pci/l)	2.57 ± 0.733	2.57 ± 0.733	1	0	0	2.570
Americium 241 ( )			0	0	1	
Cesium 137 ( )			0	0	1	
Tritium ( )			0	0	1	

* - For activities above detection only.

Surface Water Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled		Gross Alpha PCI/L	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
SW45	05/26/87		***							
SW45	11/17/87		***							
SW45	06/28/88		13.4 ± 5.11	6	15.2 ± 5.38	8	5.79 ± 0.818	0.1	NR	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Surface Water Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled		Uranium 238 PCI/L	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americanum 241 PCI/L(MDA)
SW45	05/26/87		***						
SW45	11/17/87		***						
SW45	06/28/88		4.38 ± 0.735	0.2	NR		2.57 ± 0.733	0.6	NR

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Surface Water Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plant

BUILDING 881 FOOTING DRAIN DISCHARGE

Station Number	Date Sampled		Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
SW45	05/26/87		***			
SW45	11/17/87		***			
SW45	06/28/88		NR		NR	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

SECTION 3

VOLATILE ORGANIC COMPOUND, DISSOLVED METALS,

INORGANIC COMPOUND, AND RADIOCHEMISTRY ANALYTICAL RESULTS

FOR THE ALLUVIAL WELLS DOWNGRADIENT

OF THE 881 HILLSIDE

WELLS/STATIONS IN THIS GROUP:

64-86
65-86
66-86
69-86
02-87
47-87
48-87
55-87

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

VOLATILE ORGANIC RESULTS

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l		Carbon Disulfide ug/l
64-86	04/29/87	1	NR	NR	NR	NR	NR	NR		NR
64-86	05/28/87	2	NR	NR	NR	NR	NR	NR		NR
64-86	07/16/87	3	NR	NR	NR	NR	NR	NR		NR
64-86	10/12/87	4	DRY							
64-86	02/17/88	1	10 U	10 U	10 U	10 U	5 U	10 U		5 U
64-86	04/11/88	2	10 U	10 U	10 U	10 U	5 U	10 U		5 U
64-86	07/13/88	3	DRY							
64-86	10/21/88	4	DRY							
64-86	04/24/89	2	10 U	10 U	10 U	10 U	5 U	10U	R	5 U
64-86	05/31/89		10 U	10 U	10 U	10 U	5 U	2 J		5 U
64-86	07/10/89		Data not yet received							
65-86	05/13/87	1	NR	NR	NR	NR	NR	NR		NR
65-86	05/28/87	2	NR	NR	NR	NR	NR	NR		NR
65-86	07/16/87	3	NR	NR	NR	NR	NR	NR		NR
65-86	09/09/87	3	NR	NR	NR	NR	NR	NR		NR
65-86	10/19/87	4	DRY							
65-86	02/29/88	1	10 U	10 U	10 U	10 U	8	10 U		5 U
65-86	04/18/88	2	10 U	10 U	10 U	10 U	5 U	10 U		5 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
64-86	04/29/87	1	4 U	NR	NR	4 U	4 U	NR	4 U
64-86	05/28/87	2	4 U	NR	NR	4 U	4 U	NR	4 U
64-86	07/16/87	3	4 U	NR	NR	4 U	4 U	NR	4 U
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
64-86	04/11/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
64-86	04/24/89	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
64-86	05/31/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
64-86	07/10/89		Data not yet received						
65-86	05/13/87	1	4 U	NR	NR	4 U	4 U	NR	4 U
65-86	05/28/87	2	4 U	NR	NR	4 U	4 U	NR	4 U
65-86	07/16/87	3	4 U	NR	NR	4 U	4 U	NR	4 U
65-86	09/09/87	3	5 U	NR	NR	5 U	5 U	NR	5 U
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
65-86	04/18/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
64-86	04/29/87	1	4 U	NR	NR	NR	NR	4 U	NR
64-86	05/28/87	2	4 U	NR	NR	NR	NR	4 U	NR
64-86	07/16/87	3	4 U	NR	NR	NR	NR	4 U	NR
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
64-86	04/11/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
64-86	04/24/89	2	5 U	10U R	5 U	5 U	5 U	5 U	5 U
64-86	05/31/89		5 U	10 U	5 U	5 U	5 U	5 U	5 U
64-86	07/10/89		Data not yet received						
65-86	05/13/87	1	4 U	NR	NR	NR	NR	4 U	NR
65-86	05/28/87	2	4 U	NR	NR	NR	NR	4 U	NR
65-86	07/16/87	3	4 U	NR	NR	NR	NR	4 U	NR
65-86	09/09/87	3	5 U	NR	NR	NR	NR	5 U	NR
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
65-86	04/18/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
64-86	04/29/87	1	4 U	NR	NR	NR	NR	NR	NR
64-86	05/28/87	2	4 U	NR	NR	NR	NR	NR	NR
64-86	07/16/87	3	4 U	NR	NR	NR	NR	NR	NR
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
64-86	04/11/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
64-86	04/24/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
64-86	05/31/89		5 U	5 U	5 U	NR	5 U	10 U	10 U
64-86	07/10/89		Data not yet received						
65-86	05/13/87	1	4 U	NR	NR	NR	NR	NR	NR
65-86	05/28/87	2	4 U	NR	NR	NR	NR	NR	NR
65-86	07/16/87	3	4 U	NR	NR	NR	NR	NR	NR
65-86	09/09/87	3	5 U	NR	NR	NR	NR	NR	NR
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
65-86	04/18/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
64-86	04/29/87	1	4 U	NR	NR	NR	NR	NR	NR
64-86	05/28/87	2	4 U	NR	NR	NR	NR	NR	NR
64-86	07/16/87	3	4 U	NR	NR	NR	NR	NR	NR
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
64-86	04/11/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
64-86	04/24/89	2	8 J	5 U	5 U	5 U	5 U	5 U	5 U
64-86	05/31/89		5 U	5 U	5 U	5 U	5 U	5 U	5 U
64-86	07/10/89		Data not yet received						
65-86	05/13/87	1	4 U	NR	NR	NR	NR	NR	NR
65-86	05/28/87	2	4 U	NR	NR	NR	NR	NR	NR
65-86	07/16/87	3	4 U	NR	NR	NR	NR	NR	NR
65-86	09/09/87	3	5 U	NR	NR	NR	NR	NR	NR
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
65-86	04/18/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U

NR = Analyte not reported
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U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
65-86	07/29/88	3	DRY						
65-86	10/21/88	4	DRY						
65-86	06/01/89		10 U	10 U	10 U	10 U	5 U	10 U	3 J
65-86	07/20/89		Data not yet received						
66-86	05/11/87	1	NR	NR	NR	NR	NR	NR	NR
66-86	05/28/87	2	NR	NR	NR	NR	NR	NR	NR
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	10 U	10 U	10 U	10 U	23	10 U	5 U
66-86	06/02/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
66-86	06/02/89		Data not yet received						
66-86	07/20/89		Date not yet received						
69-86	04/29/87	1	NR	NR	NR	NR	NR	NR	NR

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-Chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
65-86	07/19/88	3	DRY						
65-86	10/21/88	4	DRY						
65-86	06/01/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
65-86	07/20/89		Data not yet received						
66-86	05/11/87	1	4 U	NR	NR	4 U	4 U	NR	4 U
66-86	05/28/87	2	4 U	NR	NR	4 U	4 U	NR	4 U
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
66-86	06/02/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
66-86	06/02/89		Data not yet received						
66-86	07/20/89		Date not yet received						
69-86	04/29/87	1	4 U	NR	NR	4 U	4 U	NR	4 U

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E =Estimated value
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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
65-86	07/19/88	3	DRY						
65-86	10/21/88	4	DRY						
65-86	06/01/89		5 U	10 U	5 U	5 U	5 U	5 U	3 J
65-86	07/20/89		Data not yet received						
66-86	05/11/87	1	4 U	NR	NR	NR	NR	4 U	NR
66-86	05/28/87	2	4 U	NR	NR	NR	NR	4 U	NR
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
66-86	06/02/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
66-86	06/02/89		Data not yet received						
66-86	07/20/89		Date not yet received						
69-86	04/29/87	1	4 U	NR	NR	NR	NR	4 U	NR

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R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
65-86	07/19/88	3	DRY						
65-86	10/21/88	4	DRY						
65-86	06/01/89		5 U	5 U	5 U	NR	5 U	10 U	10 U
65-86	07/20/89		Data not yet received						
66-86	05/11/87	1	4 U	NR	NR	NR	NR	NR	NR
66-86	05/28/87	2	4 U	NR	NR	NR	NR	NR	NR
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	5 U	5 U	5 U	NR	5 U	10 U	10 U
66-86	06/02/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
66-89	06/02/89		Data not yet received						
66-89	07/20/89		Date not yet received						
69-86	04/29/87	1	4 U	NR	NR	NR	NR	NR	NR

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
65-86	07/19/88	3	DRY						
65-86	10/21/88	4	DRY						
65-86	06/01/89		5 U	5 U	5 U	5 U	5 U	5 U	5 U
65-86	07/20/89		Data not yet received						
66-86	05/11/87	1	4 U	NR	NR	NR	NR	NR	NR
66-86	05/28/87	2	4 U	NR	NR	NR	NR	NR	NR
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
66-86	06/02/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
66-86	06/02/89		Data not yet received						
66-86	07/20/89		Date not yet received						
69-86	04/29/87	1	4 U	NR	NR	NR	NR	NR	NR

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J = Present below detection limit
U = Analyzed but not detected
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* = Holding time not met
N = Batch spike not in 80-120% range
E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
69-86	05/26/87	2	NR	NR	NR	NR	NR	NR	NR
69-86	07/06/87	3	NR	NR	NR	NR	NR	NR	NR
69-86	10/07/87	4	NR	NR	NR	NR	NR	NR	NR
69-86	10/08/87		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
69-86	02/10/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U
69-86	04/11/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
69-86	07/18/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
69-86	10/20/88	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
69-86	01/12/89	1	10U R	10U R	10 U	10U R	5 U	10 U	5 U
69-86	04/17/89	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
69-89	05/26/89		10 U	10 U	10 U	10 U	5 U	10 U	5 U
69-86	8/11/89		Data not yet received						
02-87	05/29/87	2	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	06/24/87	2	10U	10U	10U	10U	35 B	65 B	5U
02-87	07/09/87	3	NR	NR	NR	NR	NR	NR	NR
02-87	10/07/87	4	NR	NR	NR	NR	NR	NR	NR
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	02/10/88	1	10 U	10 U	10 U	10 U	5 U	10 U	5 U

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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1-Di-chloro ethene ug/l	1,1-Di-chloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Di-chloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
69-86	05/26/87	2	4 U	NR	NR	4 U	4 U	NR	4 U
69-86	07/06/87	3	4 U	NR	NR	4 U	4 U	NR	4 U
69-86	10/07/87	4	5 U	NR	NR	5 U	5 U	NR	5 U
69-86	10/08/87		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
69-86	02/10/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
69-86	04/11/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
69-86	07/18/88	3	5 U	5 U	NR	5 U	5 U	10 U	5 U
69-86	10/20/88	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
69-86	01/12/89	1	5 U	5 U	NR	5 U	5 U	10U R	5 U
69-86	04/17/89	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
69-86	05/26/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
69-86	08/11/89		Data not yet received						
02-87	05/29/87	2	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	06/24/87	2	5U	5U	5U	5U	5U	10 U	5U
02-87	07/09/87	3	6	NR	NR	4 U	4 U	NR	4 U
02-87	10/07/87	4	5 U	NR	NR	5 U	5 U	NR	5 U
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	02/10/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U

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R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis-1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
69-86	05/26/87	2	4 U	NR	NR	NR	NR	4 U	NR
69-86	07/06/87	3	4 U	NR	NR	NR	NR	4 U	NR
69-86	10/07/87	4	5 U	NR	NR	NR	NR	5 U	NR
69-86	10/08/87		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
69-86	02/10/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
69-86	04/11/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U
69-86	07/18/88	3	5 U	10 U	5 U	5 U	5 U	5 U	5 U
69-86	10/20/88	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
69-86	01/12/89	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
69-86	04/17/89	2	5 U	10U R	5 U	5 U	5 U	5 U	5 U
69-86	05/26/89		5 U	10 U	5 U	5 U	5 U	5 U	5 U
69-86	08/11/89		Data not yet received						
02-87	05/29/87	2	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	06/24/87	2	5U	10U	5U	5U	5U	5U	5U
02-87	07/09/87	3	4 U	NR	NR	NR	NR	4 U	NR
02-87	10/07/87	4	5 U	NR	NR	NR	NR	5 U	NR
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	02/10/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U

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E =Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
69-86	05/26/87	2	4 U	NR	NR	NR	NR	NR	NR
69-86	07/06/87	3	4 U	NR	NR	NR	NR	NR	NR
69-86	10/07/87	4	5 U	NR	NR	NR	NR	NR	NR
69-86	10/08/87		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
69-86	02/10/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
69-86	04/11/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
69-86	07/18/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
69-86	10/20/88	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
69-86	01/12/89	1	5 U	5 U	5 U	NR	5 U	10 U	10 U
69-86	04/17/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
69-86	05/26/89		5 U	5 U	5 U	NR	5 U	10 U	10 U
69-86	08/11/89		Data not yet received						
02-87	05/29/87	2	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	06/24/87	2	5U	5U	5U	10U	5U	10U	10U
02-87	07/09/87	3	4 U	NR	NR	NR	NR	NR	NR
02-87	10/07/87	4	5 U	NR	NR	NR	NR	NR	NR
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	02/10/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U

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E = Estimated value
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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
69-86	05/26/87	2	4 U	NR	NR	NR	NR	NR	NR
69-86	07/06/87	3	4 U	NR	NR	NR	NR	NR	NR
69-86	10/07/87	4	5 U	NR	NR	NR	NR	NR	NR
69-86	10/08/87		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
69-86	02/10/88	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
69-86	04/11/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
69-86	07/18/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
69-86	10/20/88	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
69-86	01/12/89	1	5 U	5 U	5 U	NR	5 U	5 U	5 U
69-86	04/17/89	2	5 U	5 U	5 U	NR	5 U	5 U	5 U
69-86	05/26/89		5 U	5 U	5 U	NR	5 U	5 U	5 U
69-86	08/11/89		Data not yet received						
02-87	05/29/87	2	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	06/24/87	2	5U	5U	5U	5U	5U	5U	5U
02-87	07/09/87	3	4 U	NR	NR	NR	NR	NR	NR
02-87	10/07/87	4	5 U	NR	NR	NR	NR	NR	NR
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	02/10/88	1	5 U	5 U	5 U	5 U	5 U	10 U	10 U

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E = Estimated value
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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
02-87	04/07/88	2	10 U	10 U	10 U	10 U	23	10 U	5 U
02-87	07/13/88	3	10 U	10 U	10 U	10 U	5 U	10 U	5 U
02-87	10/20/88	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	11/14/88	4	10 U	10 U	10 U	10 U	4 JB	10 U	5 U
02-87	01/12/89	1	10U R	10U R	10U R	10U R	5 U	10 U	5 U
02-87	04/17/89	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
02-87	05/26/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	05/30/89		10 U	10 U	10 U	10 U	17 B	2 J	5 U
02-87	07/25/89		Data not yet received						
47-87	11/30/87	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
47-87	11/30/87	4	10 U	10 U	10 U	10 U	8 B	5 J	5 U
47-87	02/15/88	1	DRY						
47-87	04/13/88	2	DRY						
47-87	07/18/88	3	DRY						
47-87	10/21/88	4	DRY						
47-87	06/10/89		Data not yet received						

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,-Dichloro ethene ug/l	1,1-Dichloro ethane ug/l	Trans-1,2-Dichloro ethene ug/l	Chloroform ug/l	1,2-Dichloro ethane ug/l	2-Butanone ug/l	1,1,1-Tri chloro ethane ug/l
02-87	04/07/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
02-87	07/13/88	3	5 U	5 U	NR	5 U	5 U	10 U	5 U
02-87	10/20/88	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	11/14/88	4	5 U	5 U	NR	2 JB	5 U	10 U	5 U
02-87	01/12/89	1	5 U	5 U	NR	5 U	5 U	10 U R	5 U
02-87	04/17/89	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
02-87	05/26/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	05/30/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
02-87	07/25/89		Data not yet received						
47-87	11/30/87	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
47-87	11/30/87	4	5 U	5 U	5 U	1 J	5 U	10 U	5 U
47-87	02/15/88	1	DRY						
47-87	04/13/88	2	DRY						
47-87	07/18/88	3	DRY						
47-87	10/21/88	4	DRY						
47-87	06/10/89		Data not yet received						

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l		Bromo dichloro methane ug/l	1,2-Di-chloro propane ug/l	Cis,1,3-Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
02-87	04/07/88	2	5 U	10 U		5 U	5 U	5 U	5 U	5 U
02-87	07/13/88	3	5 U	10 U		5 U	5 U	5 U	5 U	5 U
02-87	10/20/88	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS							
02-87	11/14/88	4	5 U	10 U		5 U	5 U	5 U	5 U	5 U
02-87	01/12/89	1	5 U	10 U		5 U	5 U	5 U	2 J	5 U
02-87	04/17/89	2	5 U	10 U	R	5 U	5 U	5 U	5 U	5 U
02-87	05/26/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS							
02-87	05/30/89		5 U	10 U		5 U	5 U	5 U	5 U	5 U
02-87	07/25/89		Data not yet received							
47-87	11/30/87	4	5 U	10 U		5 U	5 U	5 U	5 U	5 U
47-87	11/30/87	4	5 U	10 U		5 U	5 U	5 U	5 U	5 U
47-87	02/15/88	1	DRY							
47-87	04/13/88	2	DRY							
47-87	07/18/88	3	DRY							
47-87	10/21/88	4	DRY							
47-87	06/10/89		Data not yet received							

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U = Analyzed but not detected
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N = Batch spike not in 80-120% range
E = Estimated value
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Groundwater Volatile Organic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Tri chloro ethane ug/l	Benzene ug/l	Trans-1,3-Dichloro propene ug/l	2-Chloro ethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-penta none ug/l	2-Hexanone ug/l
02-87	04/07/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
02-87	07/13/88	3	5 U	5 U	5 U	10 U	5 U	10 U	10 U
02-87	10/20/88	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	11/14/88	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
02-87	01/12/89	1	5 U	5 U	5 U	NR	5 U	10 U	10 U
02-87	04/17/89	2	5 U	5 U	5 U	NR	5 U	10 U	10 U
02-87	05/26/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	05/30/89		5 U	5 U	5 U	NR	5 U	10 U	10 U
02-87	07/25/89		Data not yet received						
47-87	11/30/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
47-87	11/30/87	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
47-87	02/15/88	1	DRY						
47-87	04/13/88	2	DRY						
47-87	07/18/88	3	DRY						
47-87	10/21/88	4	DRY						
47-87	06/10/89		Data not yet received						

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Groundwater Volatile Organic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
02-87	04/07/88	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
02-87	07/13/88	3	5 U	5 U	5 U	5 U	5 U	5 U	5 U
02-87	10/20/88	4	INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	11/14/88	4	5 U	5 U	3 JB	5 U	5 U	5 U	5 U
02-87	01/12/89	1	35 J	5 U	5 U	5 U	5 U	5 U	5 U
02-87	04/17/89	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
02-87	05/26/89		INSUFFICIENT SAMPLE FOR VOLATILE ORGANIC ANALYSIS						
02-87	05/30/89		5 U	5 U	5 U	5 U	5 U	5 U	5 U
02-87	07/25/89		Data not yet received						
47-87	11/30/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
47-87	11/30/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
47-87	02/15/88	1	DRY						
47-87	04/13/88	2	DRY						
47-87	07/18/88	3	DRY						
47-87	10/21/88	4	DRY						
47-87	06/10/89		Data not yet received						

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* = Holding time not met
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Groundwater Volatile Organic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Chloro methane ug/l	Bromo methane ug/l	Vinyl Chloride ug/l	Chloro ethane ug/l	Methylene Chloride ug/l	Acetone ug/l	Carbon Disulfide ug/l
48-87	11/18/87	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
48-87	11/18/87	4	10 U	10 U	10 U	10 U	2 JB	4 JB	5 U
48-87	02/15/88	1	10 U						
48-87	04/13/88	2	10 U	10 U	10 U	10 U	5 U	10 U	5 U
48-87	07/18/88	3	DRY	10 U	10 U	10 U	5 U	12	5 U
48-87	10/21/88	4	DRY						
48-87	06/09/89		Data not yet received						
48-87	07/25/89		Data not yet received						
55-87	11/30/87	4	10 U	10 U	10 U	10 U	5 U	10 U	5 U
55-87	11/30/87	4	10 U	10 U	10 U	10 U	8 B	10 U	5 U
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						
55-87	06/02/89		10 U	10 U	10 U	10 U	5 U	19	1 J
55-87	07/10/89		Data not yet received						

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J = Present below detection limit
U = Analyzed but not detected
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* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,-Dichloroethene ug/l	1,1-Di-chloroethane ug/l	Trans-1,2-Dichloroethene ug/l	Chloroform ug/l	1,2-Di-chloroethane ug/l	2-Butanone ug/l	1,1,1-Trichloroethane ug/l
48-87	11/18/87	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
48-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	10 U	5 U
48-87	02/15/88	1	5 U	10 U	5 U	5 U	5 U	5 U	5 U
48-87	04/13/88	2	5 U	5 U	NR	5 U	5 U	10 U	5 U
48-87	07/18/88	3	DRY						
48-87	10/21/88	4	DRY						
48-87	06/09/89		Data not yet received						
48-87	07/25/89		Data not yet received						
55-87	11/30/87	4	5 U	5 U	NR	5 U	5 U	10 U	5 U
55-87	11/30/87	4	5 U	5 U	5 U	5 U	5 U	10 U	5 U
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						
55-87	06/02/89		5 U	5 U	NR	5 U	5 U	10 U	5 U
55-87	07/10/89		Data not yet received						

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* = Holding time not met
N = Batch spike not in 80-120% range
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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Carbon Tetra chloride ug/l	Vinyl Acetate ug/l	Bromo dichloro methane ug/l	1,2-Di- chloro propane ug/l	Cis,1,3- Dichloro propene ug/l	Trichloro ethene ug/l	Dibromo chloro methane ug/l
48-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
48-87	11/18/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
48-87	02/15/88	1	5 U	5 U	NR	5 U	5 U	10 U	5 U
48-87	04/13/88	2	5 U	10 U	5 U	5 U	5 U	5 U	5 U
48-87	07/18/88	3	DRY						
48-87	10/21/88	4	DRY						
48-87	06/09/89		Data not yet received						
48-87	07/25/89		Data not yet received						
55-87	11/30/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
55-87	11/30/87	4	5 U	10 U	5 U	5 U	5 U	5 U	5 U
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						
55-87	06/02/89		5 U	10 U	5 U	5 U	5 U	5 U	5 U
55-87	07/10/89		Data not yet received						

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J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
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Groundwater Volatile Organic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	1,1,2-Trichloroethane ug/l	Benzene ug/l	Trans-1,3-Dichloropropene ug/l	2-Chloroethylvinyl ether ug/l	Bromoform ug/l	4-Methyl-2-pentanone ug/l	2-Hexanone ug/l
48-87	11/18/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
48-87	11/18/87	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
48-87	02/15/88	1	5 U	5 U	5 U	10 U	5 U	10 U	10 U
48-87	04/13/88	2	5 U	5 U	5 U	10 U	5 U	10 U	10 U
48-87	07/18/88	3	DRY						
48-87	10/21/88	4	DRY						
48-87	06/09/89		Data not yet received						
48-87	07/25/89		Data not yet received						
55-87	11/30/87	4	5 U	5 U	5 U	NR	5 U	10 U	10 U
55-87	11/30/87	4	5 U	5 U	5 U	10 U	5 U	10 U	10 U
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						
55-87	06/02/89		5 U	5 U	5U	NR	5 U	10 U	10 U
55-87	07/10/89		Data not yet received						

NR = analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Volatile Organic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Tetra chloro ethene ug/l	1,1,2,2-Tetrachloro ethane ug/l	Toluene ug/l	Chloro benzene ug/l	Ethyl benzene ug/l	Styrene ug/l	Total Xylenes ug/l
48-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
48-87	11/18/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
48-87	02/15/88	4	5 U	5 U	5 U	5 U	5 U	5 U	5U
48-87	04/13/88	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
48-87	07/18/88	1	DRY						
48-87	10/21/88	2	DRY						
48-87	06/09/89		Data not yet received						
48-87	07/25/89		Data not yet received						
55-87	11/30/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
55-87	11/30/87	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						
55-87	06/02/89		5 U	5 U	5 U	5 U	5 U	5 U	5 U
55-87	07/10/89		Data not yet received						

NR = analyte not reported
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B = Present in laboratory blank
* = Holding time not met
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E = Estimated value
R = Data rejected during validation.

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
66-86	05/11/87	1	7.6188	0.1277	0.0002 U	0.0220 U	0.0983	5.0 U	0.005 U
66-86	05/28/87	2	9.5567	0.1474	0.0002 U	0.0220 U	0.0370 U	5.0 U	0.005 U
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	6.7024	0.0167	0.0002 U	0.0220 U	0.0415	1.0	0.005 U
66-86	06/02/88	2	5.4617	0.0092	0.0002 U	0.0220 U	0.0370 U	1.7	0.005 U
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
69-86	04/29/87	1	41.1264	0.0274	0.0002 U	0.0220 U	0.0370 U	5.0 U	0.24
69-86	05/26/87	2	39.8560	0.0051 U	0.0002 U	0.0220 U	0.0370 U	5.0 U	0.20
69-86	07/06/87	3	34.4513	0.0051 U	0.0002 U	0.0220 U	0.0370 U	0.8	0.02
69-86	10/07/87	4	30.8814	0.0222	0.0005	0.0220 U	0.0370 U	1.1	0.1
69-86	10/08/87		INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
69-86	02/10/88	1	44.1781	0.0051 U	0.0002 U	0.0220 U	0.0370 U	0.7	0.082
69-86	04/11/88	2	41.2807	0.0051 U	0.0002 U	0.0220 U	0.0394	0.8	0.17
69-86	07/18/88	3	34.5960	0.0078	0.0002* U	0.0220 U	0.0370 U	0.8	0.180
69-86	10/20/88	4	36.8031	0.0074	0.0002 U	0.0220 U	0.0370 U	2.0	0.077

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Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
66-86	05/11/87	1	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0193	0.0050 U	NR
66-86	05/28/87	2	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0125	0.018	NR
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	0.020 U	0.0100 U	0.0220 U	0.0072	0.0336	0.005 U	0.1 U
66-86	06/02/88	2	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.1015	0.005 U	NR
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
69-86	04/29/87	1	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.0050 U	NR
69-86	05/26/87	2	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.008	NR
69-86	07/06/87	3	0.02 U	0.0100 U	0.0220 U	0.0103	0.0128	0.005 U	NR
69-86	10/07/87	4	0.02 U	0.0234	0.0220 U	0.0133	0.0809	0.005 U	0.04 J
69-86	10/08/87		INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
69-86	02/10/88	1	0.02 U	0.0110	0.0220 U	0.0063 U	0.0615	0.005 U	0.1 U
69-86	04/11/88	2	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.005 U	0.1 U
69-86	07/18/88	3	0.020 U	0.0100 U	0.0220 U	0.0063 U	0.0300	0.005 U	NR
69-86	10/20/88	4	0.02 U	0.0100 U	0.0220 U	0.0248	0.0483	0.005 U	NR

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J = Present below detection limit
U = Analyzed but not detected
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* = Holding time not met
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E = Estimated value
R = Data rejected during validation.

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
66-86	05/11/87	1	0.0411	0.06 U	0.0100 U	0.0726	0.005 U	0.0050 U	33.8505
66-86	05/28/87	2	0.0290 U	0.06 U	0.01 U	0.1065	0.005 U	0.005 U	49.7015
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/31/88	1	0.0305	0.0340 U	0.005 U	0.0473	0.0010 U	0.0050 U	29.8451
66-86	06/02/88	2	0.0533	0.0340 U	0.005 U	0.0792	0.0010 U	0.0050 U	24.1847
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
69-86	04/29/87	1	0.0290 U	0.06 U	0.0100 U	0.1023	0.005 U	0.0050 U	148.0271
69-86	05/26/87	2	0.0290 U	0.06 U	0.01 U	0.1056	0.005 U	0.005 U	154.8550
69-86	07/06/87	3	0.0359	0.02 U	0.005 U	0.1215	0.005 U	0.001 U	138.0943
69-86	10/07/87	4	0.0700	0.02 U	0.005 U	0.1132	0.005 U	0.0005 J	113.3098
69-86	10/08/87		INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
69-86	02/10/88	1	0.1216	0.0340 U	0.002 J	0.1318	0.001 J	0.0016	147.3161
69-86	04/11/88	2	0.0290 U	0.0340 U	0.005 U	0.1074	0.0010 U	0.0050 U	134.6656
69-86	07/18/88	3	0.0371	0.0618	0.005 U	0.1063	0.0018	0.0050 U	136.7702
69-86	10/20/88	4	0.0535	0.0602	0.005 U	0.1307	0.0010 U	0.0050 U	137.9526

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Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
64-86	04/29/87	1	0.0076 U	88.4763	NR	0.4237	0.0100 U	0.0240 U	0.02
64-86	05/28/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
64-86	07/16/87	3	0.0076 U	167.2014	NR	0.6982	0.01 U	0.0368 U	0.0218
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	0.0076 U	105.6913	NR	0.5420	0.01 U	0.0240 U	0.0200 U
64-86	04/11/88	2	0.0076 U	95.3058	NR	0.4397	0.01 U	0.0360 U	0.0200 U
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
65-86	05/13/87	1	0.0076 U	74.5395	NR	0.5659	0.0100 U	0.0240 U	0.02 U
65-86	05/28/87	2	0.0076 U	72.2864	NR	0.5725	0.01 U	0.0240 U	0.0271
65-86	07/16/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
65-86	09/09/87	3	0.0076 U	75.5453	NR	0.7864	0.01 U	0.0240 U	0.0990
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	0.0076 U	67.5564	NR	0.6006	0.01 U	0.0240 U	0.0373
65-86	04/18/88	2	0.0076 U	55.3275	NR	0.4262	0.01 U	0.0360 U	0.1039
65-86	07/19/88	3	DRY						
65-86	10/21/88	4	DRY						

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J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value
R = Data rejected during validation.

Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
64-86	04/29/87	1	16.1115	0.2782	0.0002 U	0.0220 U	0.4380	5.0 U	0.005 U
64-86	05/28/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
64-86	07/16/87	3	23.3312	0.1053	0.006	0.0220 U	0.0370 U	2.4	0.002 J
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	19.9044	0.0587	0.0002 U	0.0234	0.0492	1.6	0.004 J
64-86	04/11/88	2	16.6025	0.0331	0.0002 U	0.0271	0.0370 U	1.3	0.009
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
65-86	05/13/87	1	20.9975	0.0145	0.0002 U	0.0220 U	0.0370 U	5.0 U	0.005 U
65-86	05/28/87	2	20.0700	0.0092	0.0002 U	0.0220 U	0.0370 U	5.0 U	0.005 U
65-86	07/16/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
65-86	09/09/87	3	26.1863	0.1589	0.0002 U	0.0220 U	0.0534	2.7	0.005 U
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	21.9367	0.0060	0.0002 U	0.0220 U	0.0370 U	1.3	0.005 U
65-86	04/18/88	2	16.6175	0.0051 U	0.0002 U	0.0220 U	0.0370 U	1.0	0.005 U
65-86	07/19/88	3	DRY						
65-86	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/L	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
64-86	04/29/87	1	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0069 U	0.0050 U	NR
64-86	05/28/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
64-86	07/16/87	3	0.02 U	0.0100 U	0.0220 U	0.0341	0.0069 U	0.005 U	NR
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	0.02 U	0.0100 U	0.0220 U	0.0097	0.0069 U	0.005 U	0.05 J
64-86	04/11/88	2	0.02 U	0.0100 U	0.0220 U	0.0078	0.0274	0.005 U	0.1 U
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
65-86	05/13/87	1	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0154	0.0050 U	NR
65-86	05/28/87	2	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0086	0.024	NR
65-86	07/16/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
65-86	09/09/87	3	0.02 U	0.0100 U	0.0220 U	0.0202	0.4065	0.001 J	NR
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	0.02 U	0.0100 U	0.0220 U	0.0063 U	0.0387	0.005 U	0.1 U
65-86	04/18/88	2	0.02 U	0.0100 U	0.0220 U	0.0102 U	0.0491	0.005 U	0.1 U
65-86	0719/88	3	DRY						
65-86	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
64-86	04/29/87	1	0.0290 U	0.06 U	0.0100 U	0.1111	0.005 U	0.0050 U	52.1962
64-86	05/28/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
64-86	07/16/87	3	0.0430	0.02 U	0.005 U	0.0774	0.005 U	0.0003 J	76.4896
64-86	10/12/87	4	DRY						
64-86	02/17/88	1	0.0290 U	0.02 U	0.005 U	0.0487	0.005 U	0.001 U	57.5364
64-86	04/11/88	2	0.0315	0.0340 U	0.005 U	0.0411	0.0010 U	0.0050 U	50.7763
64-86	07/13/88	3	DRY						
64-86	10/21/88	4	DRY						
65-86	05/13/87	1	0.0290 U	0.06 U	0.0100 U	0.0922	0.005 U	0.0050 U	85.8800
65-86	05/28/87	2	0.0290 U	0.06 U	0.01 U	0.1085	0.005 U	0.005 U	92.4841
65-86	07/16/87	3	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
65-86	09/09/87	3	0.2410	0.02 U	0.005 U	0.2399	0.005 U	0.001	99.8950
65-86	10/19/87	4	DRY						
65-86	02/29/88	1	0.0503	0.02 U	0.005 U	0.1020	0.005 U	0.001 U	80.8845
65-86	04/18/88	2	0.0332	0.0340 U	0.005 U	0.0470	0.0010 U	0.0050 U	62.1582
65-86	0719/88	3	DRY						
65-86	10/21/88	4	DRY						

NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spike not in 80-120% range
E = Estimated value

ALLUVIAL DOWNGRADIENT OF THE 881 HILLSIDE

DISSOLVED METAL RESULTS

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
48-87	04/13/88	2	****			
48-87	07/18/88	3	DRY			
48-87	10/21/88	4	DRY			
55-87	11/30/87	4	***			
55-87	11/30/87	4	***			
55-87	02/15/88	1	DRY			
55-87	04/11/88	2	DRY			
55-87	07/13/88	3	DRY			
55-87	10/21/88	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 PCI/L	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
48-87	04/13/88	2	****							
48-87	07/18/88	3	DRY							
48-87	10/21/88	4	DRY							
55-87	11/30/87	4	***							
55-87	11/30/87	4	***							
55-87	02/15/88	1	DRY							
55-87	04/11/88	2	DRY							
55-87	07/13/88	3	DRY							
55-87	10/21/88	4	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha PCI/L	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
48-87	04/13/88	2	****							
48-87	07/18/88	3	DRY							
48-87	10/21/88	4	DRY							
55-87	11/30/87	4	***							
55-87	11/30/87	4	***							
55-87	02/15/88	1	DRY							
55-87	04/11/88	2	DRY							
55-87	07/13/88	3	DRY							
55-87	10/21/88	4	DRY							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
02-87	07/09/87	3	NR		<514	
02-87	10/07/87	4	NR		<500	
02-87	10/08/87	4	NR		NR	
02-87	02/10/88	1	NR		<220	
02-87	04/07/88	2	NR		<200	
02-87	07/13/88	3	NR		230 ± 90	
02-87	10/20/88	4	Data not yet received			
02-87	11/14/88	4	***			
47-87	11/30/87	4	***			
47-87	11/30/87	4	***			
47-87	02/15/88	1	DRY			
47-87	04/13/88	2	DRY			
47-87	07/18/88	3	DRY			
47-87	10/21/88	4	DRY			
48-87	11/18/87	4	***			
48-87	11/18/87	4	***			
48-87	02/15/88	1	NR		<210	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 PCI/L	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
02-87	07/09/87	3	3.7 ± 1.4		5.6		.42 ± .81	0.8	.04 ± .75	1.5
02-87	10/07/87	4	4.5 ± 0.5		NR		.04 ± .09		0.00 ± .20	
02-87	10/08/87	4	4.644 ± 0.634		NR		0.211 ± 0.074		0.032 ± 0.046	
02-87	02/10/88	1	3.5 ± 0.4		NR		0.13 ± 0.12		0.0 ± 3.3	
02-87	04/07/88	2	3.5 ± 0.3		NR		0.00 ± 0.04	0.16	0.00 ± 0.16	0.43
02-87	07/13/88	3	4.2 ± 0.5		NR		0.00 ± 0.04		0.00 ± 0.08	
02-87	10/20/88	4	Data not yet received							
02-87	11/14/88	4	***							
47-87	11/30/87	4	***							
47-87	11/30/87	4	***							
47-87	02/15/88	1	DRY							
47-87	04/13/88	2	DRY							
47-87	07/18/88	3	DRY							
47-87	10/21/88	4	DRY							
48-87	11/18/87	4	***							
48-87	11/18/87	4	***							
48-87	02/15/88	1	6.1 ± 1.2		NR		0.00 ± 0.18		0.00 ± 0.12	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha PCI/L	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
02-87	07/09/87	3	100 ± 70		254 ± 68		8.9 ± 2.4		0.3 ± 0.4	2.0
02-87	10/07/87	4	66 ± 42		96 ± 50		11.0 ± 1.0		.35 ± .11	
02-87	10/08/87	4	NR		NR		13.180 ± 1.750		NR	
02-87	02/10/88	1	19 ± 12		6 ± 23		7.4 ± 0.6		0.26 ± 0.09	
02-87	04/07/88	2	9 ± 17	31	5 ± 19	43	7.6 ± 0.6		0.08 ± 0.02	0.21
02-87	07/13/88	3	11 ± 3		6 ± 2		9.2 ± 0.9		0.13 ± 0.05	
02-87	10/20/88	4	Data not yet received							
02-87	11/14/88	4	***							
47-87	11/30/87	4	***							
47-87	11/30/87	4	***							
47-87	02/15/88	1	DRY							
47-87	04/13/88	2	DRY							
47-87	07/18/88	3	DRY							
47-87	10/21/88	4	DRY							
48-87	11/18/87	4	***				0			
48-87	11/18/87	4	***							
48-87	02/15/88	1	26 ± 8		12 ± 13		7.7 ± 1.5		0.16 ± 0.18	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 PCI/L	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
66-89	05/28/87	2	See total radiochemistry							
66-86	07/17/87	3	DRY							
66-86	10/19/87	4	DRY							
66-86	03/13/88	1	0.36 ± 0.13	0.37	NR		0.00 ± 0.16	0.57	0.00 ± 0.40	1.3
66-86	06/02/88	2	0.03 ± 0.23	0.83	NR		0.00 ± 0.04	0.11	0.00 ± 0.10	0.36
66-86	10/07/88		DRY							
66-86	12/23/88		DRY							
69-86	04/29/87	1	See total radiochemistry							
69-86	05/26/87	2	See total radiochemistry							
69-86	07/06/87	3	8.9 ± 1.6		3.8		-.02 ± .69	0.7	0.5 ± 2.5	3.7
69-86	10/07/88	4	6.5 ± 0.7		<1.0		0.00 ± .22	1.6	0.00 ± 0.5	.25
69-86	10/08/87		6.275 ± 0.761		NR		-0.042 ± 0.037		0.004 ± 0.040	
69-86	02/10/88	1	8.1 ± 2.2		NR		0.02 ± 0.21		0.00 ± 0.30	
69-86	04/11/88	2	8.0 ± 0.9		NR		NR		NR	
69-86	07/18/88	3	7.1 ± 0.7		NR		0.00 ± 0.06		0.00 ± 0.17	
69-86	10/20/88	4	Data not yet received							
02-87	05/29/87	2	See total radiochemistry							
02-87	06/24/87	2	***							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
66-89	05/28/87	2	See total radiochemistry			
66-86	07/17/87	3	DRY			
66-86	10/19/87	4	DRY			
66-86	03/13/88	1	NR		<210	
66-86	06/02/88	2	NR		<210	
66-86	10/07/88		DRY			
66-86	12/23/88		DRY			
69-86	04/29/87	1	See total radiochemistry			
69-86	05/26/87	2	See total radiochemistry			
69-86	07/06/87	3	NR		<493	
69-86	10/07/87	4	NR		510 ± 290	
69-86	10/08/87		NR		NR	
69-86	02/10/88	1	NR		<210	
69-86	04/11/88	2	NR		<200	200
69-86	07/18/88	3	NR		200	
69-86	10/20/88	4	Data not yet received			
02-87	05/29/87	2	See total radiochemistry			
02-87	06/24/87	2	***			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha PCI/L	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
66-86	05/28/87	2	See total radiochemistry							
66-86	07/17/87	3	DRY							
66-86	10/19/87	4	DRY							
66-86	03/13/88	1	12 ± 5		3 ± 11	25	0.20 ± 0.16	0.43	0.03 ± 0.07	0.39
66-86	06/02/88	2	1 ± 4	9	6 ± 8	18	0.12 ± 0.24	0.86	0.00 ± 0.03	0.10
66-86	10/07/88		DRY							
66-86	12/23/88		DRY							
69-86	04/29/87	1	See total radiochemistry							
69-86	05/26/87	2	See total radiochemistry							
69-86	07/06/87	3	59 ± 40		78 ± 42		9.1 ± 1.9		0.8 ± 0.5	
69-86	10/07/88	4	53 ± 10		48 ± 10		8.4 ± 0.9		.35 ± .12	
69-86	10/08/87		NR		NR		8.707 ± 1.107		NR	
69-86	02/10/88	1	16 ± 8		7 ± 15		9.4 ± 2.5		0.65 ± 0.46	
69-86	04/11/88	2	14 ± 8		4 ± 11	25	11 ± 1		0.38 ± 0.07	
69-86	07/18/88	3	8 ± 3		9 ± 3		10 ± 1		0.19 ± 0.06	
69-86	10/20/88	4	Data not yet received							
02-87	05/29/87	2	See total radiochemistry							
02-87	06/24/87	2	***							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 PCI/L	(MDA)	Tritium PCI/L	(MDA)
64-86	04/29/87	1	See total radiochemistry			
64-86	05/28/87	2	***			
64-86	07/16/87	3	***			
64-86	10/12/87	4	DRY			
64-86	02/17/88	1	NR		<220	
64-86	04/11/88	2	NR		<220	220
64-86	07/13/88	3	DRY			
64-86	10/21/88	4	DRY			
65-86	05/13/87	1	See total radiochemistry			
65-86	05/28/87	2	See total radiochemistry			
65-86	07/16/87	3	***			
65-86	09/09/87	3	NR		<509	
65-86	10/19/87	4	DRY			
65-86	02/29/88	1	NR		<210	
65-86	04/18/88	2	NR		<200	
65-86	07/19/88	3	DRY			
65-86	10/21/88	4	DRY			
66-86	05/11/87	1	See total radiochemistry			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 PCI/L	(MDA)	Strontium 89, 90 PCI/L	(MDA)	Plutonium 239, 240 PCI/L	(MDA)	Americium 241 PCI/L	(MDA)
64-86	04/29/87	1	See total radiochemistry							
64-86	05/28/87	2	***							
64-86	07/16/87	3	***							
64-86	10/12/87	4	DRY							
64-86	02/17/88	1	1.2 ± 0.3		NR		0.00 ± 0.22		0.00 ± 0.13	
64-86	04/11/88	2	2.5 ± 0.4		NR		0.00 ± 0.05	0.19	NR	
64-86	07/13/88	3	DRY							
64-86	10/21/88	4	DRY							
65-86	05/13/87	1	See total radiochemistry							
65-86	05/28/87	2	See total radiochemistry							
65-86	07/16/87	3	***							
65-86	09/09/87	3	1.6 ± 1.5	1.9	2.0		-.03 ± 16	2.9	.02 ± .32	0.4
65-86	10/19/87	4	DRY							
65-86	02/29/88	1	4.0 ± 0.4		NR		0.00 ± 0.25		0.00 ± 0.20	
65-86	04/18/88	2	2.3 ± 0.4		NR		0.02 ± 0.06	0.15	0.00 ± 0.16	0.84
65-86	07/19/88	3	DRY							
65-86	10/21/88	4	DRY							
66-86	05/11/87	1	See total radiochemistry							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

Groundwater Dissolved Radiochemistry Results

for Regulated Units at Rocky Flats Plants

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha PCI/L	(MDA)	Gross Beta PCI/L	(MDA)	Uranium 233, 234 PCI/L	(MDA)	Uranium 235 PCI/L	(MDA)
64-86	04/29/87	1	See total radiochemistry							
64-86	05/28/87	2	***							
64-86	07/16/87	3	***							
64-86	10/12/87	4	DRY							
64-86	02/17/88	1	10 ± 8		-2 ± 12		1.7 ± 0.4		0.17 ± 0.11	
64-86	04/11/88	2	6 ± 8	17	5 ± 16	38	3.0 ± 0.4		0.07 ± 0.04	0.09
64-86	07/13/88	3	DRY							
64-86	10/21/88	4	DRY							
65-86	05/13/87	1	See total radiochemistry							
65-86	05/28/87	2	See total radiochemistry							
65-86	07/16/87	3	***							
65-86	09/09/87	3	1.5 ± 19	29	23 ± 27	66	4.2 ± 1.9		0.4 ± 0.5	
65-86	10/19/87	4	DRY							
65-86	02/29/88	1	4 ± 9		-4 ± 17		5.5 ± 0.5		0.14 ± 0.08	
65-86	04/18/88	2	10 ± 6		7 ± 10	22	2.8 ± 0.4		0.07 ± 0.04	0.14
65-86	07/19/88	3	DRY							
65-86	10/21/88	4	DRY							
66-86	05/11/87	1	See total radiochemistry							

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analytes

DISSOLVED RADIOCHEMISTRY RESULTS SUMMARY
FOR GROUND WATER AT Rockwell (Rocky Flats)

Analyte	Maximum Value	Minimum Value	Number of Samples: Above Detection	Below Detection	Not Reported	Mean Value*
ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE						
Gross Alpha (pci/L))	100 ± 70	1 ± 4	18	0	2	24
Gross Beta (pci/L)	254 ± 68	-.4 ± 17	18	0	2	31
Uranium 233,234 (pci/L)	13.180 ± 1.750	0.12 ± 0.24	20	0	0	6.955
Uranium 235 (pci/L)	0.8 ± 0.5	0.00 ± 0.03	18	0	2	0.252
Uranium 238 (pci/L)	8.9 ± 1.6	0.03 ± 0.23	20	0	0	4.350
Strontium 89, 90 (pci/L)	5.6 ±	<1.0 ±	4	0	16	2.850
Plutonium 239, 240 (pci/L)	.42 ± .81	-0.042 ± 0.037	19	0	1	0.039
Americium 241 (pci/L)	0.5 ± 2.5	-.04 ± .75	18	0	2	0.029
Cesium 137 ( )			0	0	20	
Tritium (pci/L)	510 ± 290	<220 ±	18	0	2	52

* - For activities above detection only

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

DISSOLVED RADIOCHEMISTRY RESULTS

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
48-87	04/13/88	2	***	
48-87	07/18/88	3	DRY	
48-87	10/21/88	4	DRY	
55-87	11/30/87	4	***	
55-87	11/30/87	4	***	
55-87	02/15/88	1	DRY	
55-87	04/11/88	2	DRY	
55-87	07/13/88	3	DRY	
55-87	10/21/88	4	DRY	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89.90 Pci/l	Plutonium 239 pCi/l	Americium 241 pCi/l
48-87	04/13/88	2	***			
48-87	07/18/88	3	DRY			
48-87	10/21/88	4	DRY			
55-87	11/30/87	4	***			
55-87	11/30/87	4	***			
55-87	02/15/88	1	DRY			
55-87	04/11/88	2	DRY			
55-87	07/13/88	3	DRY			
55-87	10/21/88	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 234 pCi/l	Uranium 235 pCi/l
48-87	04/13/88	2	***			
48-87	07/18/88	3	DRY			
48-87	10/21/88	4	DRY			
55-87	11/30/87	4	***			
55-87	11/30/87	4	***			
55-87	02/15/88	1	DRY			
55-87	04/11/88	2	DRY			
55-87	07/13/88	3	DRY			
55-87	10/21/88	4	DRY			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
02-87	07/09/87	3	See dissolved radiochemistry.	
02-87	10/07/87	4	See dissolved radiochemistry.	
02-87	10/08/87	4	See dissolved radiochemistry.	
02-87	02/10/88	1	See dissolved radiochemistry.	
02-87	04/07/88	2	See dissolved radiochemistry.	
02-87	07/13/88	3	See dissolved radiochemistry.	
02-87	10/20/88	4	See dissolved radiochemistry.	
02-87	11/14/88	4	***	
47-87	11/30/87	4	***	
47-87	11/30/87	4	***	
47-87	02/15/88	1	DRY	
47-87	04/13/88	2	DRY	
47-87	07/18/88	3	DRY	
47-87	10/21/88	4	DRY	
48-87	11/18/87	4	***	
48-87	11/18/87	4	***	
48-87	02/15/88	1	See dissolved radiochemistry.	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89,90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
02-87	07/09/87	3	See dissolved radiochemistry.			
02-87	10/07/87	4	See dissolved radiochemistry.			
02-87	10/08/87	4	See dissolved radiochemistry.			
02-87	02/10/88	1	See dissolved radiochemistry			
02-87	04/07/88	2	See dissolved radiochemistry.			
02-87	07/13/88	3	See dissolved radiochemistry.			
02-87	10/20/88	4	See dissolved radiochemistry.			
02-87	11/14/88	4	***			
47-87	11/30/87	4	***			
47-87	11/30/87	4	***			
47-87	02/15/88	1	DRY			
47-87	04/13/88	2	DRY			
47-87	07/18/88	3	DRY			
47-87	10/21/88	4	DRY			
48-87	11/18/87	4	***			
48-87	11/18/87	4	***			
48-87	02/15/88	1	See dissolved radiochemistry.			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233,234 pCi/l	Uranium 235 pCi/l
02-87	07/09/87	3	See dissolved radiochemistry.			
02-87	10/07/87	4	See dissolved radiochemistry.			
02-87	10/08/87	4	See dissolved radiochemistry.			
02-87	02/10/88	1	See dissolved radiochemistry.			
02-87	04/07/88	2	See dissolved radiochemistry.			
02-87	07/13/88	3	See dissolved radiochemistry.			
02-87	10/20/88	4	See dissolved radiochemistry.			
02-87	11/14/88	4	***			
47-87	11/30/87	4	***			
47-87	11/30/87	4	***			
47-87	02/15/88	1	DRY			
47-87	04/13/88	2	DRY			
47-87	07/18/88	3	DRY			
47-87	10/21/88	4	DRY			
48-87	11/18/87	4	***			
48-87	11/18/87	4	***			
48-87	02/15/88	1	See dissolved radiochemistry.			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
66-86	05-28/87	2	NR	<110
66-86	07/17/87	3	DRY	
66-86	10/19/87	4	DRY	
66-86	03/31/88	1	See dissolved radiochemistry.	
66-86	06/02/88	2	See dissolved radiochemistry.	
66-86	10/07/88		DRY	
66-86	12/23/88		DRY	
69-86	04/29/87	1	NR	300
69-86	05/26/87	2	NR	<110
69-86	07/06/87	3	See dissolved radiochemistry.	
69-86	10/07/87	4	See dissolved radiochemistry.	
69-86	10/08/87		See dissolved radiochemistry.	
69-86	02/10/88	1	See dissolved radiochemistry.	
69-86	04/11/88	2	See dissolved radiochemistry.	
69-86	07/18/88	3	See dissolved radiochemistry.	
69-86	10/20/88	4	See dissolved radiochemistry.	
02-87	05/29/87	2	1.4	120
02-87	06/24/87	2	***	

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Stronium 89,90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
66-86	05/28/87	2	0.94 ± 0.6	3.3	0.0 ± 0.63	0.0 ± 1.3
66-86	07/17/87	3	DRY			
66-86	10/19/87	4	DRY			
66-86	03/31/88	1	See dissolved radiochemistry.			
66-86	06/02/88	2	See dissolved radiochemistry.			
66-86	10/07/88		DRY			
66-86	12/23/88		DRY			
69-86	04/29/87	1	33 ± 5	.83	0.0 ± 2.1	0.0 ± 1.3
69-86	05/26/87	2	7.2 ± 1.3	<1.0	0.0 ± 0.6	0.0 ± 1.8
69-86	07/06/87	3	See dissolved radiochemistry.			
69-86	10/07/87	4	See dissolved radiochemistry.			
69-86	10/08/87		See dissolved radiochemistry.			
69-86	02/10/88	1	See dissolved radiochemistry.			
69-86	04/11/88	2	See dissolved radiochemistry.			
69-86	07/18/88	3	See dissolved radiochemistry.			
69-86	10/20/88	4	See dissolved radiochemistry.			
02-87	05/29/87	2	6.3 ± 1.9	0.74	0.9 ± 1.1	0.0 ± 6.0
02-87	06/24/87	2	***			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233,234 pCi/l	Uranium 235 pCi/l
66-86	05-28/87	2	21 ± 8	55 ± 6	0.4 ± 0.71	0.07 ± 0.39
66-86	07/17/87	3	DRY			
66-86	10/19/87	4	DRY			
66-86	03/31/88	1	See dissolved radiochemistry.			
66-86	06/02/88	2	See dissolved radiochemistry.			
66-86	10/07/88		DRY			
66-86	12/23/88		DRY			
69-86	04/2/87	1	40 ± 7	49 ±75	12 ± 3	.66 ± .62
69-86	05/26/87	2	41 ± 13	75 ± 2	10 ± 2	0.3 ± 0.51
69-86	07/06/87	3	See dissolved radiochemistry.			
69-86	10/07/87	4	See dissolved radiochemistry.			
69-86	10/08/87		See dissolved radiochemistry.			
69-86	02/10/88	1	See dissolved radiochemistry.			
69-86	04/11/88	2	See dissolved radiochemistry.			
69-86	07/18/88	3	See dissolved radiochemistry.			
69-86	10/20/88	4	See dissolved radiochemistry.			
02-87	05/26/87	2	130 ± 17	100 ± 12	9.6 ± 2.6	.70 ± .76
02-87	06/24/87	2	***			

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium 137 pCi/l	Tritium pCi/l
64-86	04/29/87	1	NR	<110
64-86	05/28/87	2	***	
64-86	07/16/87	3	***	
64-86	10/12/87	4	DRY	
64-86	02/17/88	1	See dissolved radiochemistry.	
64-86	04/11/88	2	See dissolved radiochemistry.	
64-86	07/13/88	3	DRY	
64-86	10/21/88	4	DRY	
65-86	05/13/87	1	NR	<110
65-86	05/28/87	2	NR	<110
65-86	07/16/87	3	***	
65-86	09/09/87	3	See dissolved radiochemistry.	
65-86	10/19/87	4	DRY	
65-86	02/29/88	1	See dissolved radiochemistry.	
65-86	04/18/88	2	See dissolved radiochemistry.	
65-86	07/19/88	3	DRY	
65-86	10/21/88	4	DRY	
66-86	05/11/87	1	NR	<110

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Uranium 238 pCi/l	Strontium 89,90 pCi/l	Plutonium 239 pCi/l	Americium 241 pCi/l
64-86	04/29/87	1	2.1 ± 1.0	NR	0.2 ± 1.1	0.0 ± 1.4
64-86	05/28/87	2	***			
64-86	07/16/87	3	***			
64-86	10/21/87	4	DRY			
64-86	02/17/88	1	See dissolved radiochemistry.			
64-86	04/11/88	2	See dissolved radiochemistry.			
64-86	07/13/88	3	DRY			
64-86	10/21/88	4	DRY			
65-86	05/13/87	1	1.9 ± 0.7	1.74	0.0 ± .65	0.0 ± 1.3
65-86	05/28/87	2	3.3 ± 1.0	<1.0	0.16 ± 0.78	0.0 ± 1.2
65-86	07/16/87	3	***			
65-86	09/09/87	3	See dissolved radiochemistry.			
65-86	10/19/87	4	DRY			
65-86	02/29/88	1	See dissolved radiochemistry.			
65-86	04/18/88	2	See dissolved radiochemistry.			
65-86	07/19/88	3	DRY			
65-86	10/21/88	4	DRY			
66-86	05/11/87	1	1.1 ± 0.7	4.01	0.0 ± .55	0.0 ± 1.2

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

Groundwater Total Radiochemistry Results
for Wells at Rocky Flats Plant

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Gross Alpha pCi/l	Gross Beta pCi/l	Uranium 233, 324 pCi/l	Uranium 235 pCi/l
64-86	04/29/87	1	5 ± 14	-8 ± 2	1.7 ± 1.0	.13 ± .40
64-86	05/28/87	2	***			
64-86	07/16/87	3	***			
64-86	10/21/87	4	DRY			
64-86	02/17/88	1	See dissolved radiochemistry.			
64-86	04/11/88	2	See dissolved radiochemistry.			
64-86	07/13/88	3	DRY			
64-86	10/21/88	4	DRY			
65-86	05/13/87	1	31 ± 4	4 ± 10	3.6 ± 1.1	.04 ± .32
65-86	05/28/87	2	16 ± 0	42 ± 31	4.0 ± 1.1	0.22 ± 0.37
65-86	07/16/87	3	***			
65-86	09/09/87	3	See dissolved radiochemistry.			
65-86	10/19/87	4	DRY			
65-86	02/29/88	1	See dissolved radiochemistry.			
65-86	04/18/88	2	See dissolved radiochemistry.			
65-86	07/19/88	3	DRY			
65-86	10/21/88	4	DRY			
66-86	05/11/87	1	23 ± 13	28 ± 27	0.0 ± .54	.15 ± .46

Notes: NR = Analyte not reported
*** = Insufficient Sample for Radiochemistry Analyses

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE
TOTAL RADIOCHEMISTRY RESULTS

TOTAL RADIOCHEMISTRY RESULTS SUMMARY
FOR GROUND WATER AT Rockwell (Rocky Flats)

Analyte	Maximum Value	Minium Value	Number of Samples: Above Detection	Below Detection	Not Reported	Mean Value*
ALLUVIAL WELLS DOWNRADIENT OF THE 881 HILLSIDE						
Gross Alpha (pci/l)	130 ± 17	5 ± 14	8	0	0	38
Gross Beta (pci/l)	100 ± 12	-8 ± 2	8	0	0	43
Uranium 233, 234 (pci/l)	12 ± 3	0.0 ± .54	8	0	0	5.162
Uranium 235 (pci/l)	.70 ± .76	.04 ± .32	8	0	0	0.284
Uranium 238 (pci/l)	33 ± 5	0.94 ± 0.6	8	0	0	6.980
Strontium 89, 90 (pci/l)	4.01 ±	<1.0 ±	7	0	1	1.517
Plutonium 239, 240 (pci/l)	0.9 ± 1.1	0.0 ± .65	8	0	0	0.158
Americium 241 (pci/l)	0.0 ± 6.0	0.0 ± 1.4	8	0	0	0.000
Cesium 137 (pci/l)	1.4 ±	1.4 ±	1	0	7	1.400
Tritium (pci/l)	300 ±	<110 ±	8	0	0	53

* - For activities above detection only.

Groundwater Inorganic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L		Sulfate MG/L	HC03- MG/L
66-86	05/28/87	2	249	19.8	0.20	U	33.0	150
66-86	07/17/87	3	DRY					
66-86	10/19/87	4	DRY					
66-86	03/31/88	1	209	42.6	0.09		27.0	73.9
66-86	06/02/88	2	163	20.1	0.02	U	24.8	83.9
66-86	10/07/88		DRY					
66-86	12/23/88		DRY					
69-86	04/29/87	1	1017	114	2.30		270	385
69-86	05/26/87	2	929	85.5	1.80		53.0	379
69-86	07/06/87	3	892	85	1.72		167	362
69-86	10/07/87	4	841	91.1	1.10		173	375
69-86	10/08/87		INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
69-86	02/10/88	1	997	113	1.66		260	401
69-86	04/11/88	2	960	102	3.90		233	387
69-86	07/18/88	3	915	104	4.29		256	382
69-86	10/20/88	4	894	18.2	1.92		253	337
02-87	05/29/87	2	547	66.0	0.20	U	99.0	275

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank

Groundwater Inorganic Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L	Sulfate MG/L	HC03- MG/L
48-87	02/15/88	1	2081	838	0.32	218	198
48-87	04/13/88	2	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
48-87	07/18/88	3	DRY				
48-87	10/21/88	4	DRY				
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS				
55-87	02/15/88	1	DRY				
55-87	04/11/88	2	DRY				
55-87	07/13/88	3	DRY				
55-87	10/21/88	4	DRY				

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank

Groundwater Inorganic Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L		Sulfate MG/L	HC03- MG/L
02-87	06/24/87	2	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
02-87	07/09/87	3	549	66	0.54		81.0	283
02-87	10/07/87	4	525	73.3	0.20	U	71	309
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
02-87	02/10/88	1	558	73.0	0.02	U	81.0	387
02-87	04/07/88	2	620	71.4	0.02	U	83.0	371
02-87	07/13/88	3	595	94.2	0.02	U	102	381
02-87	10/20/88	4	623	91.6	2.54		96.3	383
02-87	11/14/88	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
47-87	02/15/88	1	DRY					
47-87	04/13/88	2	DRY					
47-87	07/18/88	3	DRY					
47-87	10/21/88	4	DRY					
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank

Groundwater Inorganic Results
For Wells at Rockwell (Rocky Flats)
ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Total Dissolved Solids MG/L	Chloride MG/L	Nitrate+ Nitrite-Nitrogen MG/L		Sulfate MG/L	HC03- MG/L
64-86	04/29/87	1	438	38.0	1.28		168	162
64-86	05/28/87	2	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
64-86	07/16/87	3	742	44.0	0.99		133	306
64-86	10/12/87	4	DRY					
64-86	02/17/88	1	616	54.1	0.18		168	235
64-86	04/11/88	2	593	49.7	0.56		180	213
64-86	07/13/88	3	DRY					
64-86	10/21/88	4	DRY					
65-86	05/13/87	1	444	43.7	0.20	U	89.0	234
65-86	05/28/87	2	498	46.2	0.20	U	103	269
65-86	07/16/87	3	INSUFFICIENT SAMPLE FOR INORGANIC ANALYSIS					
65-86	09/09/87	3	655	64.0	0.20	U	190	306
65-86	10/19/87	4	DRY					
65-86	02/29/88	1	529	62.0	0.08		116	134
65-86	04/18/88	2	427	47.9	0.06		148	185
65-86	07/19/87	3	DRY					
65-86	10/21/87	4	DRY					
66-86	05/11/87	1	193	17.0	0.20	U	26.5	100

Notes: NR = Analyte not reported
J = Present below detection limit
U = Analyzed but not detected
B = Present in laboratory blank

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE
INORGANIC COMPOUND RESULTS

Groundwater Dissolved Metals Results

For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	02/15/88	1	0.0076 U	211.3462	NR	2.9066	0.01 U	0.0240 U	2.4559
48-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	07/18/88	3							
48-87	10/21/88	4	DRY						
			DRY						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						

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U = Analyzed but not detected
B = Present in laboratory blank
* = Holding time not met
N = Batch spoke not in 8–120% range
E = Estimated value

Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	02/15/88	1	95.5074	0.4340	0.0002 U	0.0495	1.1827	7.0	0.033
48-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	07/18/88	3	DRY						
48-87	10/21/88	4	DRY						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						

NR = Analyte not reported
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Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	02/15/88	1	0.02 U	0.0100 U	0.0220 U	0.3270	0.0069 U	0.005 U	0.1 U
48-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	07/18/88	3	DRY						
48-87	10/21/88	4	DRY						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						

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E = Estimated value

Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	02/15/88	1	0.0290 U	0.02 U	0.003 J	0.3110	0.005 U	0.001 U	299.3337
48-87	04/13/88	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
48-87	07/18/88	3	DRY						
48-87	10/21/88	4	DRY						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
55-87	02/15/88	1	DRY						
55-87	04/11/88	2	DRY						
55-87	07/13/88	3	DRY						
55-87	10/21/88	4	DRY						

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Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
02-87	05/29/87	2	NR	NR	NR	NR	0.01 U	NR	0.02 U
02-87	06/24/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	07/09/87	3	0.0076 U	147.4389	NR	0.4626	0.01 U	0.0240 U	0.0200 U
02-87	10/07/87	4	0.0076 U	144.1006	NR	0.4715	0.01 U	0.0240 U	0.0201
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	02/10/88	1	0.0076 U	123.2256	NR	0.6156	0.01 U	0.0360 U	0.0261
02-87	04/07/88	2	0.0076 U	119.4989	NR	0.8552	0.01 U	0.0360 U	0.0200 U
02-87	07/13/88	3	0.0076 U	120.5121	NR	1.2313	0.010 U	0.0360 U	0.0748
02-87	10/20/88	4	0.0076N U	111.2068	NR	1.4080	0.01 U	0.0360 U	0.0488
02-87	11/14/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	02/15/88	1	DRY						
47-87	04/11/88	2	DRY						
47-87	07/13/88	3	DRY						
47-87	10/21/88	4	DRY						
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

NR = Analyte not reported
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Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Magnesium (Mg), diss. mg/l	Manganese (Mn), diss. mg/l	Mercury (Hg), diss. mg/l	Molybdenum (Mo), diss. mg/l	Nickel (Ni), diss. mg/l	Potassium (K), diss. mg/l	Selenium (Se), diss. mg/l
02-87	05/29/87	2	NR	NR	0.0003	NR	NR	5.0 U	0.005 U
02-87	06/24/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	07/09/87	3	12.2454	0.2178	0.0001 J	0.0533	0.0370	3.2	0.005 U
02-87	10/07/87	4	12.6281	0.4433	0.0004	0.0344	0.0370 U	6.2	0.005 U
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	02/10/88	1	17.0658	0.3739	0.0002 U	0.0220 U	0.0370 U	2.3	0.005 U
02-87	04/07/88	2	22.9480	0.3665	0.0002 U	0.0220 U	0.0370 U	1.9	0.005 U
02-87	07/13/88	3	26.5500	0.4379	0.0002 U	0.0220 U	0.0370 U	2.5	0.005 U
02-87	10/20/88	4	31.3471	0.5431	0.0002 U	0.0220 U	0.0370 U	1.9	0.005 U
02-87	11/14/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	02/15/88	1	DRY						
47-87	04/11/88	2	DRY						
47-87	07/13/88	3	DRY						
47-87	10/21/88	4	DRY						
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

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ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Cesium (Cs), diss. mg/l	Chromium (Cr), diss. mg/l	Cobalt (Co), diss. mg/l	Copper (Cu), diss. mg/l	Iron (Fe), diss. mg/l	Lead (Pb), diss. mg/l	Lithium (Li), diss. mg/l
02-87	05/29/87	2	0.2 U	NR	NR	NR	NR	0.005 U	0.02
02-87	06/24/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	07/09/87	3	0.2 U	0.0100 U	0.0220 U	0.0148	0.0069 U	0.005 U	NR
02-87	10/07/87	4	0.2 U	0.0100 U	0.0220 U	0.0101	0.1869	0.005 U	0.04
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	02/10/88	1	0.2 U	0.0100 U	0.0220 U	0.0064	0.0470	0.005 U	0.01 U
02-87	04/07/88	2	0.2 U	0.0100 U	0.0220 U	0.0063 U	0.0076	0.005 U	0.01 U
02-87	07/13/88	3	0.020 U	0.0100 U	0.0220 U	0.0083	0.1808	0.005 U	NR
02-87	10/20/88	4	0.2 U	0.0100 U	0.0220 U	0.0275	0.0472	0.005 U	NR
02-87	11/14/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	02/15/88	1	DRY						
47-87	04/11/88	2	DRY						
47-87	07/13/88	3	DRY						
47-87	10/21/88	4	DRY						
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

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Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Aluminum (Al), diss. mg/l	Antimony (Sb), diss. mg/l	Arsenic (As), diss. mg/l	Barium (Ba), diss. mg/l	Beryllium (Be), diss. mg/l	Cadmium (Cd), diss. mg/l	Calcium (Ca), diss. mg/l
02-87	05/29/87	2	NR	0.06 U	0.01 U	NR	NR	0.005 U	NR
02-87	06/24/87	2	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	07/09/87	3	0.0290 U	0.02 U	0.005 U	0.0622	0.005 U	0.001 U	46.8264
02-87	10/07/87	4	0.2600	0.02 U	0.005 U	0.1160	0.005 U	0.001 U	43.6185
02-87	10/08/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
02-87	02/10/88	1	0.0847	0.0340 U	0.005 U	0.0953	0.005 U	0.001 U	54.1928
02-87	04/07/88	2	0.0313	0.0340 U	0.005 U	0.0778	0.0010 U	0.0050 U	70.0849
02-87	07/13/88	3	0.0290 U	0.0563	0.005 U	0.1315	0.0017	0.0050 U	91.3990
02-87	10/20/88	4	0.0357	0.0392	0.005 U	0.1507	0.0010 U	0.0050 U	106.5044
02-87	11/14/88	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	11/30/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
47-87	02/15/88	1	DRY						
47-87	04/11/88	2	DRY						
47-87	07/13/88	3	DRY						
47-87	10/21/88	4	DRY						
48-87	11/18/87	4	INSUFFICIENT SAMPLE FOR METALS ANALYSIS						

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Groundwater Dissolved Metals Results
For Wells at Rockwell (Rocky Flats)

ALLUVIAL WELLS DOWNGRADIENT OF THE 881 HILLSIDE

Well Number	Date Sampled	Qtr.	Silver (Ag), diss. mg/l	Sodium (Na), diss. mg/l	Tin (Sn), diss. mg/l	Strontium (Sr), diss. mg/l	Thallium (Tl), diss. mg/l	Vanadium (V), diss. mg/l	Zinc (Zn), diss. mg/l
66-86	05/11/87	1	0.0076 U	23.3693	NR	0.2074	0.0100 U	0.0240 U	0.02 U
66-86	05/28/87	2	0.0076 U	28.6255	NR	0.2748	0.01 U	0.0240 U	0.0200 U
66-86	07/17/87	3	DRY						
66-86	10/19/87	4	DRY						
66-86	03/13/88	1	0.0076 U	29.4104	NR	0.1921	0.010 U	0.0360 U	0.0466
66-86	06/02/88	2	0.0076 U	21.1230	NR	0.1450	0.01 U	0.0360 U	0.0281
66-86	10/07/88		DRY						
66-86	12/23/88		DRY						
69-86	04/29/87	1	0.0076 U	142.8058	NR	1.1452	0.01 U	0.0240 U	0.02 U
69-86	05/26/87	2	0.0076 U	134.4014	NR	1.0142	0.01 U	0.0240 U	0.0209
69-86	07/06/87	3	0.0076 U	139.0061	NR	1.0493	0.01 U	0.0240 U	0.0200 U
69-86	10/07/87	4	0.0076 U	129.8482	NR	0.8966	0.01 U	0.0240 U	0.0425
69-86	10/08/87		INSUFFICIENT SAMPLE FOR METALS ANALYSIS						
69-86	02/10/88	1	0.0076 U	134.3162	NR	1.1063	0.01 U	0.0360 U	0.0238
69-86	04/11/88	2	0.0076 U	121.7074	NR	1.0063	0.01 U	0.0360 U	0.0381
69-86	07/18/88	3	0.0076 U	133.4556	NR	1.0698	0.010 U	0.0360 U	0.0757
69-86	10/20/88	4	0.0076N U	141.3305	NR	1.1370	0.01 U	0.0360 U	0.0614

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E = Estimated value

PROPOSED
INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN AND DECISION DOCUMENT
881 HILLSIDE AREA
(OPERABLE UNIT No. 1)

RESPONSIVENESS SUMMARY

U.S. Department of Energy

Rocky Flats Plant

Golden, Colorado

January 1990

A. OVERVIEW

The Department of Energy (DOE) is pursuing an Interim Measure/Interim Remedial Action (IM/IRA) at the 881 Hillside Area (Operable Unit No. 1) at the Rocky Flats Plant (RFP). This interim action is to be conducted to minimize the release of hazardous substances from this Area that pose a potential long-term threat to the public health and environment. The plan involves the collection of contaminated ground water, treatment by UV/hydrogen peroxide oxidation and ion exchange, and surface discharge of treated water that meets or exceed applicable water quality standards for parameters known to be present in the ground water. Complete information is presented in the document entitled "Final Interim Measures/Interim Remedial Action Plan and Decision Document, 881 Hillside Area, Operable Unit No. 1", dated January, 1990 Information concerning the proposed Interim Remedial Action was presented during a public meeting held from 6 to 10 p.m., Thursday, November 9, 1989, at the Front Range Community College in Westminster, Colorado.

This Responsiveness Summary presents all comments received at the public meeting, and DOE's response to those comments. Many of the comments were peripheral to the interim action plan; however, there were a number of technical comments on the plan that DOE f eels have been addressed herein. Two major issues that arose were the potential release of plutonium contaminated dust during construction of the interim action, and the routing of Woman Creek flow around Standley Lake, the drinking water supply for Westminster, Thornton, and Northglenn (Woman Creek is the proposed drainage where the effluent is to be discharged). The potential release of plutonium contaminated dust is addressed in the response to comment 6. The discharge to Woman Creek is discussed in the response to comment 1. There is mixed public opinion on routing of the flow around Standley Lake, and in many respects the issue is not germane to the proposed interim action (see our response to comment 1). Relative to the comments received at the public meeting, the public is generally in favor of the proposed interim action plan.

As with the issues mentioned above, there are at times several comments referring to the same issue. To facilitate cross referencing, issues where there were multiple comments are presented below with the associated comment numbers.

ISSUE	COMMENTS REFERRING TO ISSUE
Generation of plutonium contaminated dust	8, 12, 13, 15, 22, 26, 27, 28, 30, 40, 61, 66,72
Rerouting of Woman Creek flow	1, 21, 77, 78
Lack of upgradient/background data	14, 20, 23
Quality assurance problems	5, 9, 17
UV/Peroxide performance	25, 69
Misrepresenation of surrounding land use	11, 35, 62
Poor report organization	33, 46, 47
Potential for plutonium in ground water	43, 53, 60, 63
Closure of interim action facilities	30, 64
Water storage/treatment	52, 56, 65

These sections of the Responsiveness Summary follow:

- Background on Community Involvement
- Summary of Comments Received during the Public Meeting
- Remaining Concerns
- Attachment: Community Relations Work Plan

B. BACKGROUND ON COMMUNITY INVOLVEMENT

The Communications Department at Rocky Flats is developing a Community Relations Plan to actively involve the public in the decision-making process as it relates to environmental restoration activities. A work plan has been completed and forwarded to the Environmental Protection Agency (EPA), the Colorado Department of Health (CDH), and the public for review. The work plan specifies timeliness and activities planned to complete the Community Relations Plan, including plans for community interviews. Public questionnaires related to development of the plan have been distributed during public meetings for additional input.

In the meantime, efforts have been made to keep the public informed, and solicit public opinion, on current environmental restoration efforts, including the 881 Hillside Area. Notices were published in area newspapers announcing the availability of the public comment period on the Proposed Interim Measures/Interim Remedial Action Plan and Decision Document for the 881 Hillside Area. The public comment period was extended to provide adequate opportunity for public comment. A public presentation on the plan was made during the October meeting of the Rocky Flats Environmental Monitoring Council, while a second meeting to hear public comment on the Proposed Interim Remedial Action Plan was conducted November 9, 1989, at the Front Range Community College. Copies of appropriate documents are available for public review at the Rocky Flats Public Reading Room, U.S. EPA, and CDH.

The Communications Department also is continuing other public information efforts to ensure the public is kept informed of environmental restoration activities and other issues which relate to plant operations. A Speakers Bureau program sends speakers to civic groups and educational organizations, while a public tour program allows the public to visit Rocky Flats. Road tours of areas such as the 881 Hillside are common during public tours, as well as other tours arranged for public officials. An Outreach Program also is in place where plant officials will visit elected officials, the news media, and business and civic organizations to further discuss issues related to Rocky Flats and environmental restoration activities. The Communications Department also receives numerous public inquiries which are answered during telephone conversations, or by sending written informational materials to the requestor.

Efforts also are under way to expand the Public Reading Room to an offsite location more easily accessible to the public, further ensuring public access to information about the plant. The reading room will house all pertinent public documents about the plant and ongoing environmental restoration activities.

C. RESPONSES TO COMMENTS RECEIVED DURING PUBLIC COMMENT PERIOD

On November 9, 1999, DOE held a public meeting to receive comments on the 881 Hillside Area IM/IRA. These comments are presented here in the order they were received at the public meeting. If written comments were also provided, they are presented here in lieu of the transcription of the verbal comments made at the meeting. However, if verbal comments requiring a DOE response were presented at the meeting that are not reflected in the written comments, they have also been included here. Written comments were also provided by the City of Thornton and EPA that were not verbally presented at the public meeting. Their respective comments are at the end of this section. The comments have been subdivided at points where the issue or subject changes, and the DOE response directly follows. All comments have been numbered sequentially to allow cross-referencing of responses.

COMMENTOR: George Hovorka, Mayor, City of Westminster

Comment 1

I'm appearing on behalf of the City to comment on the Proposed Interim Measures / Interim Remedial Action Plan and Decision Document for the 881 Hillside Area.

The City of Westminster supports the concept and plan to take immediate action to intercept and treat contaminated ground water at the 881 Hillside area. Failure to take such action could lead to the adverse impacts to the City's water supply, Standley Lake, which is located downstream of the 881 Hillside. Standley Lake supplies water to over 180,000 people in Westminster, Thornton and Northglenn. as well as irrigation water for shareholders in the Farmers Reservoir and Irrigation Company. Therefore, it is imperative that this work begin as soon as possible to protect the downstream water users. Westminster submits the following comments on the proposed plan:

The proposed plan calls for the water to be discharged to the south interceptor trench after it has been treated. The water then flows into Pond C-2. which is periodically discharged to Woman Creek, which flows into Standley lake. The City of Westminster strongly opposes this aspect of the plan in the absence of an interceptor canal around Standley Lake. Effluent generated at Rocky Flats should not be allowed to enter Standley Lake in order to protect public health. DOE's actions to oppose the permanent adoption of a water supply classification and associated standards for Woman Creek would further weaken the protection of Standley Lake, increasing the City's resistance to this proposed discharge.

DOE's opposition to the standards goes against DOE's "good neighbor" policy which they have publicly stated. Westminster, Thornton and Northglenn have been working with DOE on developing plans for the interceptor canal. However, no definite solution has been developed. Such an interceptor canal would not only protect Standley Lake during controlled discharges, but also during accidents and unknown releases.

Routing all water from Rocky Flats around Standley Lake effectively solves DOE's credibility problem with the general public, as the water can no longer impact the water supply. Without the interceptor canal, however, the City must seek the most stringent protection available to maintain its high quality water supply. Therefore, Westminster must oppose discharge to the south interceptor trench. Once an interceptor canal around Standley Lake is in place, the discharge as proposed would be acceptable.

Response to Comment 1

DOE recognizes and completely understands the concern of users of Standley Lake that potentially contaminated water could be released from the Rocky Flats Plant and enter this body of water used for drinking, agricultural, and recreational purposes. The issue goes beyond whether the effluent from the interim action treatment system is discharged into Woman Creek via Pond C-2. DOE is studying the issue and has met and will continue to meet with the representatives of the neighboring cities, EPA and CDH to discuss the matter. We do note that there is public opposition to such a diversion canal (See comment 21). In the mean time, the water in Pond C-2 will continue to be chemically analyzed before it is released to assure that the concentrations of all chemical constituents are below the applicable Colorado Department of Health water quality standards set for the protection of public health and the environment. This monitoring is required by the Plant's National Pollutant Discharge Elimination System (NPDES) permit.

Comment 2

Westminster fully supports the remainder of the plan and urges DOE to pursue implementation of the plan aggressively. Questions did arise, however, during the review of the plan. Many stem from a lack of detail in the plan. For instance, there is no mention of how wide the French drain will be or what will be done with any ground water encountered during the construction operation. There was also not enough information available to determine if the French drain was located far enough downstream to capture all of the possible contaminated ground water. It would be helpful if Westminster could review further plans as they become available.

Response to Comment 2

We inadvertently omitted the width of the french drain. It will be two feet wide and is located hydraulically downgradient of confirmed organically contaminated alluvial ground water. The chemical data are shown in Table 2-2 (upgradient of the french drain) and Table 2-3 (downgradient of the french drain) of the plan (also see discussion on page 2-29). The treatment facility will be on-line to treat ground water collected during construction of the french drain (see the schedule on page 3-2 of the plan). Detailed design plans can be provided to the City of Westminster.

COMMENTOR: **Joe Tempel, President, Rocky Flats Cleanup Commission**

Comment 3

First of all, the public should be aware that this document describes the cleanup of only 12 of the 166 polluted sites at Rocky Flats. These sites contain cancer-causing volatile organic compounds and uranium tainted soils that have leached into the groundwater. These sites have been given priority for cleanup because the volatile organic compounds have percolated down to the groundwater which enters Woman's Creek which drains into Standley Reservoir, the drinking water supply for the northern suburbs. To put this cleanup proposal in another perspective; it will cost approximately $6 million to construct and operate compared to an estimate of $1 billion to cleanup the entire plant site. Therefore, while the RFCC is very excited that cleanup is finally progressing, this action is only the tip of the iceberg: or should we say the tip of the trash pile.

Response to Comment 3

We are aggressively pursuing the investigation and cleanup of the Rocky Flats Plant. Investigations have been conducted at the 881 Hillside Area, the, 903 Pad, Mound and East Trenches Areas, and at various units being cleaned up under the Resource Conservation and Recovery Act. We are spending approximately $ 65 million in fiscal year 1990 on environmental restoration activities. Construction of the final remedy for the 881 Hillside Area is scheduled to begin in 1994.

Comment 4

The public should also be aware that cleanup will take a very long time at the rate DOE is progressing. The purpose of the IRA is to begin cleanup on a temporary basis until a permanent solution can be agreed upon. Unfortunately, the temporary solution will not be operational until the Spring of 1991, about a year and a half away from now. This is not acceptable. Cleanup should be accelerated at the plant.

Response to Comment 4

We understand how the time frame for design, procurement and construction appears lengthy. However, given the size of the project, the 1-1/2 year time frame is not unreasonable. These activities occur in sequence, and several months is required for the procurement of some equipment once it is ordered from the vendor. However, we would like to point out that treatment of contaminated ground water will begin by December 19, 1990. These dates are reflected in the schedule on page 3-2 of the plan.

Comment 5

It is unclear when the permanent solution for these 12 sites will be in place because no schedule has been produced by DOE. This schedule is to be outlined in an Intergovernmental Agreement (IAG) which was due in October. In fact the permanent solution has been under study since 1987 when work began on the Remedial Investigation/Feasibility Study 881 Hillside. These reports have still not been completed because of the inadequacies in the draft reports. The following inadequacies were identified by the DOE Special Assignment Environmental Team in their Report entitled "Assessment of the Environmental Conditions at the Rocky Flats Plant", dated August 1989:

> *There is inadequate background characterization for metals and radionuclides primarily because there was only one background well drilled upgradient of the site to determine what contamination is being generated on-site versus off-site.*
>
> *There is a poorly defined extent of contamination because of the few number of test wells (33).*

There is inadequate quality control of testing so the data may not be valid.

Therefore, DOE admits that their past studies have been flawed and that a permanent solution cannot be defined until one completely understands the problem. The RFCC requests that these inadequacies be corrected as soon as possible so that a final cleanup solution can be implemented.

<u>Response to Comment 5</u>

The permanent remedy for the 881 Hillside Area is scheduled to begin in 1995. The Phase II remedial investigation (RI) did not resolve all outstanding issues regarding soil and ground water contamination at the 881 Hillside Area. The deficiencies cited above were largely a result of unrealistic schedules for the performance of RIs and feasibility studies (FSs), which was also noted by the Special Assignment Environmental Team. Comprehensive plans for completing the RI/FS will be submitted to EPA in February 1990 in accordance with the draft Inter-agency Agreement (IAG). The draft IAG schedule calls for the final remedial investigation /feasibility study to be completed in 1992.

<u>Comment 6</u>

While the IRA proposes to construct a french drain to collect the pollutants which are leaching into the groundwater, nothing is being proposed to cleanup the contaminated soils. The RFCC is concerned that the citizens and workers downwind of the construction of the drain may be contaminated by the radioactive dust disturbed on the surface of the ground. The RFCC wants to review a Health and Safety Plan which describes how the workers and community will be protected during construction. The RFCC does not want the cleanup to create additional health risks to the workers and the community like that which was experienced at the Rocky Mountain Arsenal. The RFCC also wants adequate monitoring to be in place during construction so that environmental standards are not exceeded.

<u>Response to Comment 6</u>

The nature, magnitude, and extent of contaminated soils is still under investigation; however, it is recognized that plutonium is above background in surface soils at the 881 Hillside Area. Surface soils samples have yielded plutonium concentrations no greater than 5 pCi/gm, with the average level being 1.63 pCi/gm. Higher levels of plutonium are not expected to be encountered because samples did not show measurable concentrations of plutonium below the ground surface. Also, elevated levels of uranium have been identified in surface soils in four small discrete locations (< 10 sq. ft. each) with measured levels as high as 3,072 pCi/gm (draft Environmental Assessment for 881 Hillside (High Priority Sites) Interim Remedial Action, November 30, 1989).

A Rockwell Job Safety Analysis (JSA) will be prepared before construction that will specify dust control measures to limit dust inhalation exposures. (The JSA is a process developed from the Rocky Flats Health and Safety policy. The JSA addresses health and safety protection of outside contractors). These measures include the premoistening of the excavation area with a sprinkler system for three days prior to start-up, and the continued moistening of the site throughout the excavation. Ambient air high volume air samplers will be used to measure radiation and wind velocity. These will be installed bef ore commencement of construction. Operations will be suspended by requirements in the Occupational Safety Analysis (OSA) if wind velocity exceeds 15 mph or alpha radiation exceeds 0.03 pCi/m^3 as measured by a high volume sampler located immediately downgradient of the construction activities. (The OSA addresses health and safety concerns originating from routine site operations, and is similar to the JSA.) A Health and Safety Plan will also be prepared for construction activities that will supplement the JSA.

Notwithstanding health and safety controls, an analysis has been made of the potential public exposure from inhalation of dust contaminated with plutonium and uranium, and the committed effective dose equivalent (CEDE) from such intake. Conservatively assuming the amount of dust resuspended remains less than 10 mg/m^3 (the OSHA regulatory limit on nuisance dust in the work environment), the wind velocity is 3 m/sec, and exposure occurs at the closest property boundary, the CEDE calculated for uranium is 5×10^{-5} Rem, and for plutonium is 8×10^{-8} Rem. These totals may be compared to the DOE radiation protection standard for the public of 1×10^{-1} Rem per year. As can be seen, the public exposure to plutonium and uranium is insignificant relative to the DOE radiation protection standard for the public (Environmental Assessment for 881 Hillside, November 30, 1989).

Even though the health risk from inhalation of plutonium contaminated dust is low at the 881 Hillside, DOE respects the concerns of the public and intends to investigate several options for control of plutonium contaminated dust for use at other more contaminated sites. These options include a vacuum extraction system for removing the uppermost layer of loose soil before construction commences, addition of cement type additives to bind the surface soils and minimize the release of plutonium contaminated dust, and a mobile enclosure with a ventilation/filtering system to remove plutonium dust before it is released to the atmosphere. At all sites where plutonium contaminated soils exist, including the 881 Hillside Area, construction traffic will be carefully routed to further minimize release of any plutonium contaminated dust.

Comment 7

Finally, the RFCC wants to see a Community Involvement Plan which outlines how the community will be informed of the progress of the cleanup and given assurance that environmental standards are being met.

Response to Comment 7

The attachment to this Responsiveness Summary is the Community Relations Work Plan. Implementation of the Community Relations Plan (CRP) will provide the public with accurate, timely, and understandable information, and steps the public can take to participate in decisions regarding cleanup activities at the 881 Hillside Area and the entire Rocky Flats Plant Site. The community relations program will allow the public the opportunity to learn about the Site, the Superfund program, and to provide input on technical decisions during the investigations and studies prior to remediation. The program will also keep the public continuously informed of on-going cleanup activities, including the interim action at the 881 Hillside Area. The Work Plan (see Attachment) provides a schedule for the activities and public involvement that lead to finalizing a Community Relations Plan.

Comment 8

Although plutonium deposition on the area surrounding the RFP as a result of the 1957 and 1969 fires and other events is not well understood, the fact remains the National Institute of Standards and Technology (formerly the National Bureau of Standards) chose the soil from the RFP, in July, 1978, to make a plutonium in soil standard. (Development of some natural matrix standards - progress report. Environment International, Vol. 3, pp 395-398, Pergamon Press 1980. Published in Great Britain.) Specifically, the standard, SRM 4353, was made from a 13 cm deep sample taken along the east perimeter fence just north of the southeast corner of the RFP. To make this standard, 600 kg of this soil was "diluted" with 300 kg of soil taken from near the western fence to get the plutonium concentration down to a level of about ten (10) times average, world-wide "background" levels. (From a conversation with Robin Hutchinson, NIST, Gaithersburg, MD. on 12 July, 1989.) This standard reference material is now being used by the scientific community around the world to calibrate their instruments.

Given this fact, how can the surface of 881 Hillside where the french drain is proposed, which is 2.9 kms west of the place from where the soil standard was taken, be free of surface plutonium contamination?

Response to Comment 8

As stated in response to comment 6, it is recognized that plutonium concentrations in surface soils at the 881 Hillside Area are above background and appropriate measures will be taken to minimize any release of plutonium contaminated dust during construction. The Rocky Flats Plant Annual Environmental Report, a public document which provides a summary of the environmental monitoring conducted at the Plant, indicates elevated plutonium levels exist in the surface soils to the east within the Plant boundaries. The data show that the soils may contain up to 10 -100 times background levels of plutonium. However, these levels are typical of those observed at the 881 Hillside Area where the exposure due to dust inhalation has been shown to be minor (see our response to comment 6 for estimated exposures).

Comment 9

After an in-depth discussion with Mr. Tom Greengard of the methods used to determine what, where, and why to drill the monitoring wells that are used to assess the 881 Hillside it seems that no industry accepted protocol was followed. What is the statistical validity of the methods used? If the methods used are invalid and hence a wrong assessment made, was this a cover-up to conceal more important and dangerous conditions elsewhere?

Response to Comment 9

It seems there may have been a misunderstanding concerning the discussion with Mr. Greengard. EPA accepted protocols were followed to locate the monitoring wells at the 881 Hillside Area and include interpretation of existing ground water chemistry data, soil gas measurements, geophysics, and most importantly, mapping of disposal sites based on historical aerial photographs. Statistical methods were not needed to locate monitoring wells because of the information gained fromuse of these methods was more than adequate. There was and is no cover-up to conceal more dangerous conditions elsewhere.

COMMENTOR: Kim R. Grice, Rocky Flats Cleanup Commission

Comment 10

DOE and its contractors at Rocky Flats have not been very nice neighbors! They have polluted the groundwater and soil at their facility to the extent that remedial action is necessary to protect the public from added health risks. The public deserves to be informed that this is not a cleanup operation of hazardous waste; it is only an interim solution to keep the contamination at these sites from spreading.

Response to Comment 10

The proposed action at the 881 Hillside Area is both an initial cleanup of hazardous waste from past disposal practices and an interim solution to mitigate contamination migration. The interim action will be consistent with the final remedial action for the 881 Hillside Area. It is anticipated this interim action will be a major component of the final remedial action.

Comment 11

The IRA mentioned that RFP is located in a rural area where there was no schools, no hospitals. and no parks within 5 miles of the RFP site. This comment is grossly in error! The facts are that there exists 20 schools, a hospital called "Avista" in Louisville, 11 child care centers, and over 14 parks and public open space areas within 5 miles from the boundary of Rocky Flats. The map shown in figure 2-1 is not an updated map. It also blocks out major development areas east of RFP, and Broomfield is omitted completely. It is recommended that a detailed map showing current development, schools, hospitals, parks, etc., within a 10 mile radius of the RFP boundary be incorporated into this IRA. The population census in this report uses outdated 1980 data, when with a little effort current population figures could easily be obtained from county and city records.

Response to Comment 11

This section of the IRA has been updated to reflect more current information. The final interim remedial action plan that reflects these changes is now available for review in the Rocky Flats Public Reading Room. There was no intent to misrepresent land use in the general vicinity. The oversight was a result of the considerable attention given to the selection of the appropriate interim action given the chemical conditions at the 881 Hillside Area.

Comment 12

There is very little mention in this IRA regarding soil characterization. There is much concern that this remediation project will disturb soils contaminated with varying levels of plutonium and other radionuclides (see HUD's RF Advisory Notice attached). The resuspension of respirable size dust containing radioactive elements could have direct health impacts on citizens residing and working downwind when these particulates are inhaled or ingested. As noted in attached chart, there has been an escalation of airborne contamination during past soil excavations at RFP. The excavation requires 2100 feet of French Drain and 1320 feet of Slurry Walls that are 4-20 feet deep. Excavation also includes over 2500 feet of effluent piping trenches and the excavation and encapsulating 86,000 square feet of contaminated soil. We are not informed of the total amount of soil (cubic yards) that will be excavated at these sites. Much of the proposed remedial area contains large quantities of plutonium contamination of the soil (see attached Krey and Hardy map). A complete chemical and radionuclide soil characterization for specific construction sites has not been performed and included in this IRA, why? Will the proposed sites be tested for total amount of respirable size particulates to determine the amount of airborne dust that could be resuspended during construction? How many cubic yards of soil will be removed from the borrowed site south of Woman Creek; and what will be its characterization? What safety precautions are planned for the workers? What will be the health risks to the public during the *remedial actions? It is recommended that a closed environmental chamber be used to conduct any excavation within, in order to limit and filter resuspended contaminates before release to the outside environment.*

Response to Comment 12

There appears to be some misunderstanding of activities associated with the proposed interim remedial action, and activities associated with the other alternatives that were evaluated. The slurry walls and borrow site south of Woman Creek refer or to the second alternative, which is not the preferred and proposed interim remedial action.

DOE very much appreciates your concern for generation of respirable size particulates during construction that may be contaminated with plutonium. However, in order to allay your concern, we note that the plutonium contamination is at the surface and therefore the total volume of material excavated should not matter to the generation of respirable size particulates possibly contaminated with plutonium. The french drain and piping are located such that encountering soils contaminated with organics is unlikely. Chemical testing will be conducted on these soils prior to excavation to assess whether organic contaminants or radionuclides are present, so that the appropriate health and safety measures, as well as storage and final disposition of excavated soils can be determined. Our response to comment 6 addresses the potential public exposure to plutonium contaminated dust, and the health and safety measures that will be taken to further minimize these risk. The use of a closed environmental chamber cannot be justified at this time, however, it is being carefully studied as an option to minimize generation of plutonium contaminated dust at more contaminated sites.

Comment 13

The IRA needs to include a comprehensive site specific ambient air monitoring plan. Meteorological data pertinent to these sites is needed to determine direction and distance, etc., that this respirable dust might travel. According to a 1987 Meteorological Tracer Study published in September 1988 by Rockwell, the distribution of emission plumes can be dynamic. The report mentions that during the 12 day study, tracer elements traveled west to the Continental Divide and as far east as 45 miles from the release site located near the 903 Pad. It was interesting to note that during the tests, the plume was in contact with the ground. Sector #2 which is southeast of the RFP, according to the Colorado Department of Health, continually reports the highest levels for plutonium in soils (see CDH map and chart attached).

Response to Comment 13

You are quite correct that meteorological data is necessary for these sites in order to design and implement a sound air monitoring program. DOE fully intends to conduct a comprehensive air monitoring program as part of the health and safety monitoring during construction. All pertinent meteorological data will be incorporated into the plan for this air monitoring program. Please see response to comment 6 for more details.

Comment 14

Deficiency in characterizing extent of soil and groundwater contamination:

- *Vertical / horizontal profile (3 dimensional) of extent of the groundwater plume should be characterized and included.*
- *There are no wells north of the SWMUs.*
- *Existing soil data does not characterize adequately the current status of the contaminated area.*

Response to Comment 14

The response to comment 5 discusses the shortcomings of the previous remedial investigation and the plans for correcting past deficiencies. Wells will be installed north of the Area to assess any impacts to ground water arising from other upgradient SWMUs on the plant site. These wells, and other wells and soil borings are being proposed in the Phase III Remedial Investigation / Feasibility Study Plan to be submitted to the regulatory agencies in February 1990. The data discussed in the interim remedial action plan is of adequate quality (data have been validated and found to be valid or acceptable with qualifications), and provides sufficient detail of the ground-water contamination in surficial materials to justify and define the scope of the proposed interim remedial action.

Comment 15

Radioactive ambient air monitoring program is deficient.

- *Ambient air monitoring should analyze for uranium and americium as well as plutonium.*

- *Design and install new samplers to limit particulate losses within the samplers.*

- *Incorporate flow control systems that will maintain a constant air flow rate over sampling period.*

- *Expedite an air dispersion study to verify and design new ambient air monitoring sampling network.*

Response to Comment 15

An extensive air monitoring network known as the Radioactive Ambient Air Monitoring Program (RAAMP) is maintained at the Plant in order to monitor particulate emissions from Plant facilities and soils. The RAAMP has found ambient air samples for plutonium to be well within the DOE guidelines of 20.0×10^{-15} FCi / ml established for the protection of human health. Americium and uranium are not presently measured because air emissions are expected to be less, and their maximumallowable concentration in air in an unrestricted area is 10 and 100 times greater than plutonium, respectively (Standards for Protection Against Radiation, 10 CFR 20, Appendix B, Table 2).

To further assess emissions of radionuclides and other toxic compounds from the facility, DOE has agreed to improve air quality monitoring at the Rocky Flats Plant (Agreement in Principle with CDH). Air quality monitoring provisions of this Agreement include:

- The DOE will submit a comprehensive air emissions inventory for CDH review.

- The DOE will provide a comprehensive materials balance of VOCs for CDH review.

- The DOE will identify all toxic and radioactive emissions coming from the facility (stacks, vents, ponds, etc.) and will support CDH in the use of an accepted emissions model to predict any areas of off-site impact.

- DOE will conduct promptly the stack testing necessary to verify the amount and type of emissions.

- The DOE will install continuous emission monitors in all appropriate sources to ensure continuous compliance with air pollution requirements.

- CDH will prepare a comprehensive review, in cooperation with EPA and local governments, of the air monitoring system and will implement needed improvements to the air quality monitoring network.

- CDH will deploy VOC ambient monitors off -site, as necessary.

Comment 16

Groundwater data and sampling.

- *Analytic data produced for the 881 site should be organized in a manner for easy reference and rapid evaluation by way of database systems that permit selection and sorting of several parameters.*

- *Sampling procedures to fully document chain of custody.*

- *Sampling team should be provided formal training in the use of methods, etc.*

Response to Comment 16

A computerized environmental data base is maintained in a database format and is called the Analytical Data Management System. With respect to the sampling procedures and training, the ER Program Standard Operating Procedures (SOPs) and Quality Assurance / Quality Control (QA / QC) Plan have been revised and provided to the field personnel. Both classroom and on-the-job training is provided for field personnel. Data validation and audit programs have also been put into place. CDH and EPA have reviewed many of these procedures and will continue to review future plans during cleanup.

Comment 17

Quality assurance

- *A comprehensive quality assurance control program is recommended to adequately document the validity and analytical data for 881 Hillside remedial actions and assessments.*

Response to Comment 17

Quality assurance has suffered in the past with respect to environmental restoration activities. This has been largely due to the aggressive schedules for completing RCRA and CERCLA activities which precluded a thorough quality assurance review of data and deliverables. In effect, a quality assurance program commensurate with the volume of work being performed was missing. A comprehensive QA / QC Program is now currently in place. QA procedures adhere to the Environmental Restoration QA Program Plan and the QA / QC project plans. Chemical analyses are performed in accordance with the EPA Contract Laboratory Program and the QA / QC Plan, and data validation is performed by a qualified independent subcontractor.

Comment 18

Community relations

- *There is a lack of a finalized and implemented community relations plan for the 881 Hillside Remedial Corrective Action Program.*

Response to Comment 18

True, but preparation of a Community Relations Plan including community surveys is in progress. Please see Section B and the attachment to this Responsiveness Summary which contain a summary of community relations activities and the Community Relations Work Plan, respectively.

Comment 19

According to the 1987 Annual Environmental Monitoring Report, VOCs are detected in the bedrock ground water below the 903 Pad in Wells 1287, 1187 and 1487.

- *What effects will they have on the remediation at 881?*

Response to Comment 19

The interim action addresses shallow (alluvial) ground water contamination. Therefore possible bedrock ground water contamination will not influence the interim action. Future investigations at both the 881 Hillside Area and 903 Pad, Mound, and East Trenches Areas will characterize the nature and extent of bedrock ground-water contamination. If contaminated bedrock ground water in wells 12-87, 11-78, and 14-87 is determined to arise from the 881 Hillside Area, then remediation of this bedrock ground water will become a part of the final remedy for that Area.

Comment 20

Why was Well 5586 chosen as a background well?

Response to Comment 20

Well 55-86 was the only alluvial well upgradient of all historical waste disposal sites that was in existence at the time of the remedial investigation of the 881 Hillside Area. DOE recognizes this is far from adequate to characterize background ground water, and therefore a comprehensive background hydrogeochemical characterization program has now been implemented at the Rocky Flats Plant. Fifty wells have been installed and sampled, and over 100 soil samples collected to characterize background ground water and soils in 1989. Background stream sediments and surface water have also been characterized. A draft report was issued on December 15, 1989 (Background Geochemical Characterization Report). The background characterization program is on-going.

Comment 21

They Mayor of Westminster said he would accept said diversion canal to channel effluent from Pond C-2 around Standley Lake. I would like to inform everyone as a citizen of Westminster that said Rocky Flats effluents then would no longer be diverted by Standley Lake, but would flow near many residential areas down Big Dry Creek. This is not an acceptable solution to me.

Response to Comment 21

DOE recognizes your concern on this very controversial issue. Please refer to our response to comment 1.

Comment 22

While it makes sense to attempt to confine the spread of groundwater contamination in order to reduce added health risks imposed on the public, we should also be concerned about the daily emissions of radiotoxic waste from over 50 vents at this facility, and the subsequent inhalation / ingestion of these carcinogens by our family and friends.

Response to Comment 22

DOE appreciates your concern about these emissions. As discussed in our response to comment 15, the RAAMP is implemented in order to monitor plutonium emissions f rom the f acility, and additional more comprehensive monitoring will be undertaken pursuant to the Agreement in Principle.

COMMENTOR: Paula Elofson-Gardine, Director, Concerned Health Technicians for a Cleaner Colorado, Secretary, Rocky Flats Cleanup Commission

Comment 23

The lack of upgradient wells indicates deficiency regarding "background" levels of contaminants versus those found in alluvial measurements and groundwater wells in the area known as the 881 Hillside.

Response to Comment 23

Your are quite correct in pointing out this deficiency. As discussed in our response to comment 14, an upgradient well will be installed in order to define upgradient chemical conditions and allow determination of ground-water contamination originating only from the 881 Hillside Area. Furthermore, a comprehensive background hydrogeochemical background characterization program is now in place as discussed in our response to comment 20. Regardless of background concentrations, the ground-water treatment system proposed as part of the IM/IRA will remove organic and inorganic chemical constituents to levels that are below the applicable CDH water quality standards for the protection of public health and the environment.

Comment 24

There is serious deficiency regarding lack of chemical and radionuclide direct soil analysis both on and off-site for the determination of spread of contaminants originating from the Rocky Flats Plant.

Response to Comment 24

Considerable data exist today regarding on-site and off-site contamination. This data has been collected as part of remedial investigations, and Rockwell's Health, Safety, and Environment Department's environmental monitoring. This latter data is published in the Annual Environmental Monitoring Report. As you may be aware, DOE has recently signed a draft Interagency Agreement with the EPA and the CDH for investigation and cleanup of the Rocky Flats Plant. To supplement the existing data, a number of plans will be prepared in 1990 pursuant to that agreement that will serve to guide the investigations of the nature and extent of contamination at the Rocky Flats Plant. The draft Agreement has been released for public review and comment.

Comment 25

Sources of contaminants are not identified, so that an eventual permanent solution could be initiated. As an interim measure, the peroxide/UV application for destruction of VOCs is controversial, and has not been "proven" for remediations of this size. The benefit of this technology is questionable in terms of the volume it is capable of handling.

Response to Comment 25

You are correct to point out that sources of contaminants have not been adequately identified. Further source characterization is a specific objective of the upcoming Phase III Remedial Investigation of the 881 Hillside Area. With regard to UV/Peroxide, DOE is confident that the system will perform to the expectations inherent in the interim action plan. As described on pages 4-13 through 4-17, it is clear that UV/peroxide is a proven technology at the design flow rate. Also, UV/Peroxide systems are now in use at the DOE Lawrence Livermore facility in California, and locally, at the Boulder Syntex facility and Rocky Mountain Arsenal. Furthermore, the vendor of the equipment has guaranteed it's performance in meeting the effluent standards given the expected influent characteristics. If during startup of the UV/Peroxide system the unit does not perform to specification, a carbon system may be installed as a final "polishing" unit to assure compliance with effluent standards. A carbon system can be installed readily and would remain in operation as long as needed.

Comment 26

In comparing the site diagrams of the Proposed Interim Measures / IRA Plan and Decision Document for the 881 Hillside area, the 903 Pad, Mound, and East Trenches Remedial Investigation, and the Rocky Flats Plant, site map in the Assessment of Environmental Conditions at the Rocky Flats Plant report, it appears that the area blocked outfor 881 remediation encroaches in part on the 903 Pad area. If this is so, how will the public be protected during the remediation process from the radionuclides liberated from this process? Resuspension is a problem.

Response to Comment 26

The 881 Hillside Area and 903 Pad Area due indeed overlap. Your review of this information has been thorough. However, the plutonium concentration data for surficial soils in this area of overlap do not pose a threat to the public from dust resuspension during construction. Please refer to our response to comment 6 regarding potential public exposure to plutonium contaminated dust, and techniques for minimization of such dust during construction of the 881 Hillside Area interim remedial action.

Comment 27

Migration from the 903 area to the 881 area is not addressed as a possible source of contaminants. The 885 building is adjacent to the 881 area as well. Where do the discharges from this building drain to? A chart detailing groundwater migration and the plant piping system and drains would assist in determining sources and potential toxicity.

Response to Comment 27

The only contamination arising from the 903 Pad that would influence contamination at the 881 Hillside is resuspension of plutonium contaminated soils. This will be referenced in the final IM/IRA Plan. Potential public exposure to plutonium contaminated dust and health and safety measures to be used during construction that minimize this exposure are discussed in our response to comment 6. Building 885 is a RCRA storage facility from which there are no discharges. The building and surrounding soils will be investigated and closed in accordance with the State of Colorado hazardous waste regulations. Ground water flow in surficial materials is to the south/southeast at the 881 Hillside Area. The proposed french drain has been located to the south / southeast downstream of all known organically contaminated ground water in surficial materials, and is designed to intercept this ground water to prevent it from entering into the ground water of the valley fill alluvium in the Woman Creek drainage.

Comment 28

No mention is made regarding protection of the community during remediation activities. Historically, monitoring of this are has shown elevated readings of radionuclide activity during these types of activities (eg: barrel removal). Please see report # RFP-3914, Dust Transport-Wind and Mechanical Resuspension. We would suggest a containment structure such as temporary buildings and / or domes be used to contain contaminants that are disturbed during cleanup phases of note such as drilling, earthmoving and the like.

Response to Comment 28

Please see our response to comment 6 which we are hopeful will alleviate your concern on this matter.

Comment 29

There is a lack of dispersion modeling for migration of plumes of contamination that would also assist in the identification of source points of many of the contaminants in question.

Response to Comment 29

There is insufficient data to use a dispersion model to determine the sources of contaminant plumes at the 881 Hillside. The hydrogeology at the 881 Hillside Area is relatively complex and not adequately defined for use of a ground water model. Furthermore, it is unlikely a ground water model will provide information that cannot be ascertained through interpretation of ground water surface elevation maps together with contaminant contour maps.

Comment 30

I have a couple of comments submitted to me by Neils Schoenbeck that I would like to submit with mine. They have a question as to existing data about the integrity of the impermeable membrane in the french drain for the period of 20 years. What is the known lifetime of that membrane? What plans exist for the disposal of the material of the french drain itself when the cleanup is completed? I think there is a great deal of concern about the proximity of the 903 Pad in light of the resuspension and windblown resuspension reports from the repository, that the problems with the resuspension in this area are not being addressed that already exist in that area, sands remediation.

Response to Comment 30

Synthetic membranes have been in use at waste disposal sites for over 20 years, many of which have not shown leakage. EPA guidance suggest the expected life of a synthetic membrane is no longer than 30 years. If repairs are required to the french drain during the course of the interim action, they will be undertaken immediately. This will be outlined in the Operation and Maintenance manual. If necessary, the french drain will be completely rebuilt, if liner leakage is frequent. When remediation is complete, the french drain will be removed and disposed in accordance with all regulatory requirements. The treatment facility may be used for other ground water treatment purposes, or decommissioned in accordance with RCRA closure regulations and DOE Orders when it has no further utility. Please see our response to comment 6 addresses resuspension of plutonium contaminated dust.

COMMENTOR: W.A. Kemper, Rocky Flats Cleanup Commission

Comment 31

This plan is, as its title states, only an interim remedial action, not a cleanup. But is a first step and accordingly, I believe it should be supported unless seriously flawed. I found it somewhat difficult to read and possibly containing some small technical errors easily correctable, but nothing that would cause it to be rejected.

Response to Comment 31

The interim action is a cleanup because contaminated ground water will be removed from the Area and treated. We recognize there are some small technical errors in the plan, and do appreciate your support of this action. This interim action is a significant step in the remediation of the 881 Hillside Area. The technical errors in the report will be corrected, and a final plan will be available for your review.

Comment 32

There is some question whether 881 Hillside should have been chosen for the initial remedial action. Perhaps it is the area of greatest immediate concern, but it does appear that the danger from 881 Hillside is principally from volatile organic compounds (VOCs) whereas the public's greatest concern is with radionuclides. But the public should be aware the VOCs are also toxic and can cause problems such as attributed to Martin Marietta. The cost of implementing this interim remedial action will be about $4.6 million. It will affect the removal of about 80 lb VOCs, 5 lb selenium, and 0.1 x 10^{-3} *curie of radionuclides and other substances of lesser concern per year. More important, it should assure that seepage and drainage from 881 Hillside will present, absolutely no risk to the drinking water supply.*

Response to Comment 32

The 881 Hillside Area was chosen for initial investigation and cleanup because of the high concentrations of organic contaminants in the ground water, many of which are carcinogenic, and the proximity of the contamination to a major drainage that leads to Standley Lake. DOE is aware that the public's general perception is that highly radioactive contaminated sites and off-site areas are of higher interest and concern. However, in dealing with the 881 Hillside first, DOE is implementing a policy of contaminant source control in an area where there is the greatest potential future risk to the public.

Comment 33

The report would be easier to read had it been organized differently and a table of acronyms been included. For example, it is to readily clear "alternatives" whether measures being discussed are for water treatment or for containment and collection. nor which measures are recommended of those being considered. The final proposed system is shown in Figure 6-1.

Response to Comment 33

The organization of the document generally follows EPA guidance for the preparation of an Engineering Evaluation/Cost Analysis (EE/CA) as defined in the proposed National Contingency Plan. We agree, the organization could be improved but it was mutually agreed with EPA that the EE/CA guidance would be followed. The revised plan will contain a table of acronyms. Consideration will be given for a different organization in future reports.

Comment 34

The site numbers, p. 2-3, do not correspond to the numbers on Figure 2-2.

Response to Comment 34

We have reviewed the site numbers and the numbers on the figure and have noted that SWMU 177 is not located on the map. SWMU 177 was not shown on the map because it will be closed under the State of Colorado hazardous waste regulations and therefore is not included in this interim action. Please excuse this confusion. The final plan will note the location of SWMU 177.

Comment 35

The "description of surrounding land use and population density" minimizes the area at risk. Are there not schools and hospitals closer than 6 and 10 miles from the plant and ranches closer than 10 miles? I'd say they are right adjacent. (Ranch and farm areas) Several new housing subdivisions are within a few miles of the buffer zone. See Figure 2-3. A 5 mile radius takes in all of Broomfield, most of Westminster and part of Arvada.

Response to Comment 35

Please see our response to comment 11 which addresses your concern. This section of the plan will be updated in the final interim remedial action plan.

Comment 36

It may be noted that all the VOCs above tolerated concentrations (AAAR) are chlorinated hydrocarbons. Are there no other appreciable amounts of non-volatile organic compounds; dioxins, PCBs or other? Of the metals, only selenium seems to be of appreciable concern, except of course the radionuclides. More needs be known about these. How much is natural uranium? How much is background? And, how much cesium and other fission products exist, if any? If any fission products are detected, I would not expect that they were from world wide fallout.

Response to Comment 36

No other Hazardous Substance List or Target Compound List non-volatile organic compounds are present in appreciable amounts. Selenium is of greatest concern, although manganese and to a lesser extent nickel are also of concern. Uranium is the only radionuclide of concern at the 881 Hillside Area ground water. Depleted uranium which is used at Rocky Flats has a U^{234}/U^{238} activity ratio less than one whereas natural uranium has a ratio greater than one. The activity ratio for uraniumin ground water at the 881 Hillside Area is always greater than 1 which suggest the uranium is natural, however, the concentrations are observed to be over 10 times background in some locations. Cesium 137 and strontium 89, 90 are radionuclides present in the environment due to fallout. There is insufficient data to determine if these radionuclides are above background in ground water at the 881 Hillside Area. The Phase III RI and background hydrogeochemical characterization will allow determination of whether these radionuclides are contaminants of the ground water. However, we note that an Independent Criticality Safety Assessment Team concluded in a report released in 1989, that there has not been a criticality at the Rocky Flats Plant. Their conclusion was based on review of radioactive cesium and strontium in soil and water, records of past operations, criticality procedural infractions, plant renovations, fires and radioactive exposures.

Comment 37

In tables 2-1, 2-2, and 2-3, 400 pCi/l is stated as background for tritium. How can there be a *background value for tritium since all is man made? The measured values for average tritium activity exceeds the average "gross" Beta activity by an order of magnitude. How can this be when all the tritium activity is Beta?*

Response to Comment 37

We understand your confusion on this subject. The background value for tritium is simply the Minimum Detectable Activity for the analytical method, i.e., background concentrations of tritium are less than what can be measured. However, we do note that tritium is a naturally occurring isotope of hydrogen present in water and in the atmosphere. The gross beta value does not include tritium, i.e., tritium is associated with the water which is driven off prior to the analysis for gross beta.

Comment 38

If U (natural) content of the water to be treated is 15 pCi/l (p. 2-23, 2-27, and p. 4-26) and has an activity of 7×10^{-7} Ci/g. (See RFP response, p 12, to EPA 2/24/89) and most of this Uranium is absorbed on the strong base resin, this amounts to 285 g/yr. Will 28 cubic feet of the resin contain this for 30 years as stated? Quite reasonable to believe it should. 285 g/yr is only 0.6 lb/yr.

Response to Comment 38

Our calculations indicate 30 years to be a reasonable life of the resin.

Comment 39

Will French trench contain surface runoff in heavy rain?

Response to Comment 39

The french drain is not designed to intercept surface runoff at any time, i.e., it is covered. It is only designed to intercept ground water.

Comment 40

p. 4-49 Worker (and surrounding populace) protection requires that no radionuclides are released from the soil into the air and drift away.

Response to Comment 40

Please see our response to comment 6 that discusses your concern.

Comment 41

14,000 gallons of wastewater are generated per 100,000 gallons of water treated. What happens to this wastewater? See p. 4-28.

Response to Comment 41

As stated at the top of the paragraph. the Building 374 Process Waste Treatment System (a precipitation/flash evaporation process) will treat the regeneration waste. Waste regenerant will be transported to Building 374 by tanker truck.

Comment 42

P. 4-27. Does IR120 or IRA 94/402 remove Se? If not, and only the activated alumina absorbs the Selenium, a 50/50 split will not reduce the selenium to an ARAR level.

Response to Comment 42

IRA 94/402 removes selenium. It is the activated alumina that does not remove TDS. However, only one-third of the flow need be demineralized through the strong cation and anion system to achieve the TDS standard.

Comment 43

Will the Rohm & Haas IRA-402 resin remove any plutonium that might be present?

Response to Comment 43

Any plutonium that is present will be particulate in nature because of its very low solubility. Particulates will be removed by the influent filters, and the filters will be disposed off-site as a radioactive mixed waste. Plutonium would not be a problem in the effluent because of its very low solubility.

Comment 44

I am curious why old fuel oil tanks were filled with concrete rather than disposed of as scrap. Did they contain something more toxic than oil? See p. 2-3, site 4, 5.

Response to Comment 44

Filling tanks with concrete is a common practice for abandonment. It guarantees nothing else will be disposed in the tanks. We are not aware that the tanks contained anything else than oil.

Comment 45

Par. 2 of p. 2-1 states that the mission of the plant is fabrication of warhead components. I am left to wonder what else goes on in the plant that kilograms of plutonium, as reported in the press, were in the ducts.

Response to Comment 45

We recognize yours' and the public's concern regarding plutonium handling at the facility. However, the subject of plutonium operations is outside the scope of this interim remedial action plan.

COMMENTOR: Joseph Goldfield, P.E., Vice President, Rocky Flats Cleanup Commission

Comment 46

The problem is not stated until page 2-31. It should be up front.

Response to Comment 46

Please see our response to comment 33.

Comment 47

The plan should start with a summary and conclusions.

Response to Comment 47

We agree with you, but as stated in our response to comment 33, the EPA EE/CA guidance was agreed with EPA to be followed.

Comment 48

A section that defines the acronyms and initials designating agencies, laws, and many other items must be included.

Response to Comment 48

The regulatory climate pertaining to hazardous waste management and cleanup has created a preponderance of acronyms that are used routinely. We understand your frustration, and a table of acronyms will be provided in the final plan.

Comment 49

Table 3-1.2 - The ARAR for antimony is exceeded--0.0798>0.06.

Response to Comment 49

You are quite correct. This is a typographical error and will be corrected in the final plan.

Comment 50

Beryllium is extremely poisonous. In Table 3-22 why not set ARAR=005? In air maximum allowable concentrations for exposures to cadmium and selenium are 200 times greater than that for beryllium. Why is the concentration allowable in water set 10 times greater for beryllium than for either cadmium or selenium?

Response to Comment 50

The maximum allowable concentration for beryllium in air is 200 times lower than for cadmium and selenium because of the relatively more severe effects beryllium has on lung tissue. Therefore, the analogy is inappropriate for determining the allowable concentration in water.

Comment 51

In Tables 3-1.1 to 3-1.4. 29 ARARs are exceeded. When reducing them to acceptable limits, each one is considered as if there are no other dangerous materials present. In setting standards for the removal of air contaminants the presence of all contaminants are taken into account. The concentration of each one, after cleanup is divided by the maximum allowable concentration for that contaminant. The total of all the fractions cannot exceed one. Thus, even if each contaminant is brought down to an acceptable level, compliance is not achieved until all of the dangerous contaminant fractions with respect to the allowable maximum total less than one. Unless a similar method is used with water contaminants, synergistic effect are not accounted for.

Response to Comment 51

We are familiar with this methodology to account for additive effects. It is used routinely in risk assessments. However, the chemical specific ARARs identified for the 881 Hillside Area IM/IRA are largely CDH ground water standards or surface water standards for Woman Creek. There is no provision in the respective regulations for downward adjustment of these standards based on additive effects, i.e., compliance is achieved by meeting the chemical specific standards.

Comment 52

Table 4-1 gives the contaminant concentrations that are used as a basis for design of the removal systems. These values are lower than the maximum concentrations given in Tables 3-1.1 to 3-1.4. Why aren't the higher values used for system design? If average values are being used for design, that is dead wrong. It means that for about half of the time, type system is underdesigned.

Response to Comment 52

Flow is the most critical design parameter for sizing a treatment system. We believe the flow estimates for the IM/IRA to be conservative and thus the treatment system is adequately sized. The use of maximum concentrations versus average concentrations for contaminants having the greatest impact on the treatment operation, i.e., organics and total dissolved solids (majorions), would not change the design because these contaminants do not display high variability. The treatment system can handle the maximum expected loading of contaminants.

Comment 53

Page 4-10 says that carbon beds that must be discarded become a candidate for discharge at the Nevada test site. What radionuclides are being collected that pose such danger that the carbon must be shipped to Nevada? The report does not make this clear.

Response to Comment 53

On page 4-41, first paragraph, it is stated that uranium, either naturally occurring or from past waste disposal, will likely adsorb to the activated carbon. Uranium is the only radionuclide in the alluvial ground water at the 881 Hillside Area that is above estimated background concentrations. Thus, there is a concern over the radioactivity of the carbon increasing over time with the continued use of the carbon.

Comment 54

(See page 4-17)-A preheater will not "dehumidify" the air stripper emissions. If dehumidification is required a different process than preheating is needed. Heating the air will reduce the relative humidity.

Response to Comment 54

Dehumidify may be a poor choice of words. It is only necessary to reduce the relative humidity to prevent water from condensing on the carbon. The wording of this statement will be changed in the final interim remedial action plan.

Comment 55

Selenium has an ARAR of 0.01 mg/l but its concentration is 3.2 mg/l in the water stream that must be treated (320 times as much). Similarly total dissolved solids are 2374 mg/l but the ARAR is 400 mg/l - less than 20% of the amount to be treated. If only half the water flow is treated for each of the aforementioned constituents how can the required concentrations be attained?

Response to Comment 55

The expected influent concentration of total dissolved solids is 718 mg/l, not 2374 mg/l which is the maximum observed total dissolved solids concentration in the ground water. The influent concentration is significantly less than the maximumbecause the influent represents a blend of low total dissolved solids ground water from the footing drain with collected ground water from the french drain. Because both the activated alumina and two stage demineralizer remove selenium but the activated alumina does not remove total dissolved solids, it is only necessary to treat approximately half the flow with the two stage demineralizer to achieve the ARAR for total dissolved solids.

Comment 56

The treatment system is designed to treat 30 gpm for 8 hours per day. 30 gpm x 60 min/hr x 8 hrs/day x 350 days per year = 5,000,000 gals/yr. The wall to stop contaminated water flow is 2100 feet long. If an area 300 feet wide is drained and the precipitation is 14 inches per year, the gallons per year that will drain are 300 feet x 2100 feet x 14/12 feet x 7.5 gals/cu ft = 5,500,000 gals/year. The capacity of the system is almost exactly equal to the water draining from the area 300 feet above the retaining wall. If a greater area must be drained or if the wall must be extended the system may have inadequate capacity.

Response to Comment 56

Your calculation of the expected flow at the french drain is a good theoretical method. However, you should note that of the 14" of precipitation falling on the 881 Hillside Area, much of this will runoff or be evaporated. Nevertheless, if additional capacity is required, it will be necessary to operate the system beyond 8 hours per day. The actual capacity of the system is 2 to 3 times what is estimated to be required.

Comment 57

The key problem with the proposed interim plan is that is must be regarded as temporary. Until the sources of the contamination in the burial ground surrounding building 881 are completely removed, the people drinking water downstream of the ground water flow (drawing water from Woman's Creek) are in danger of getting contaminated drinking water.

Response to Comment 57

The IM/IRA specifically protects downstream users of alluvial ground water or surface water of Woman Creek. The collection of the footing drain flow and the interception of the contaminated alluvial ground water by the french drain will provide positive cutoff of contaminant migration in these media. The IM/IRA will operate until ARARs are achieved for ground water and/or a final remedy is implemented.

Comment 58

On p. 2-25 dioctyl phthalate (DOP) is described as the most prominent volatile organic contaminant of the 881 Hillside. DOP is principally used to test HEPA filters. Does the presence of DOP annunciate the presence of spent HEPA filters grossly contaminated with plutonium? If it does, then the validity of the "Interim Remedial Action Plan" is called into question.

Response to Comment 58

The validity of the IM/IRA is based on our understanding of ground water chemistry and flow, and the effectiveness of the proposed treatment system. Bis(2-ethyl hexyl)phthalate is cited in the text as being prevalent in the soil. This is not the same as di-n-octyl phthalate which was rarely present in the soils at the 881 Hillside Area. Bis(2-ethyl hexyl)phthalate is a common plasticizer that is likely to be found wherever plastics have been used. We believe, although we have not proven this hypothesis, that bis(2-ethyl hexyl)phthalate is present in the soil samples because of handling the samples with plastic gloves. We have no reason to believe, based on historical information, that HEPA filters were disposed at the 881 Hillside Area. Also, the remedial investigation information does not indicate the presence of buried HEPA filters.

Comment 59

As near as I can tell, the plan estimates the expenditure of about $3 million in capitol funds in the next 1-1/2 year - about $2 million per year. We have heard estimates of about $1 billion to clean up the contamination at the Rocky Flats Plant. At the rate we are moving, 500 years is a good estimate of how long it will take.

Response to Comment 59

The 881 Hillside IM/IRA is only one of many parallel on-going activities that are pertinent to cleanup of the Rocky Flats Plant and that are included in the $1 billion figure. In fiscal year 1990, approximately $65 million dollars is budgeted for environmental restoration activities at the Rocky Flats Plant.

Comment 60

In the cleaning of the ground water, the various methods described do not include the possibility of plutonium emissions since the drilling has not detected significant quantities of this metal. However, this metal may not migrate with the ground water if it attaches itself to soil particulates. This could also account for the small amounts detected in the sampled water. When remedial activities start, the amount, pressure and chemical composition of the liquid passing through the soil as part of the in-situ cleaning process could capture the plutonium, bring it to the surface, and produce measurable quantities in the processed water. A design for accommodating this possibility needs to be included in the program. Otherwise the plutonium could be released into the atmosphere (perhaps undetected) since no provisions were made for its presence.

Response to Comment 60

Please see our response to comment 43.

Comment 61

The possibility exists that a source of air borne plutonium from the area is due to refloatation from the soil. It could be that some of this plutonium is from the 903 pad, however, the highest measurements are east and southeast of 881. Disruption of the ground for mitigation could release the plutonium contaminated soil into the air. There is no mention in the plan for mitigation of this possibility. A very thorough dust control plan needs to be established -even to the degree of enclosing the earth moving activities. Many techniques have been established for asbestos control to the environment; surely this plutonium remedial action could adopt some of these techniques.

Response to Comment 61

Please see our response to comment 6.

COMMENTOR: Bini Abbott

Comment 62

I have three main comments and first is on your inaccurate measuring of distances from Rocky Flats to the neighboring communities. In the first place, on page 2-5, you're talking about surround land use and you state that the nearest educational facility is the Sierra Elementary School, which is six miles southeast of Rocky Flats Plant. If you look at the map, Sierra School is the red dot way over here. That is not the nearest school. Sierra was built about 18 years ago. However, nine years ago Witt Elementary was built, which is about four miles, three and a half miles from the boundary of Rocky Flats. Standley Lake High School is closer. Lucas Elementary was just built. Moore Junior High was built in 1980 and is also closer to Rocky Flats.

I also feel that you should not measure from the center of the Rocky Flats Plant any more than you would measure from the center of a beehive that is a half-mile by a half-mile, and then say the only danger is coming from the very center of the beehive. You need to, I think, measure from the Rocky Flats boundary when you're stating what is close. We live way closer than any of your maps show.

On that same page, page 2-5, you talk about some of the plants that are near Rocky Flats and you have omitted floral products. which has had two fires and produced a lot of problems, also. Then your bottom paragraph is ridiculous in my estimation. You're talking about agricultural statistics in 1976. Why would we care how many pigs and so on there were in the 1976 area? You could get updated information.

You also have a map, which is Figure 2-3, but not a page number, and it's talking about land use in the vicinity of Rocky Flats Plant. It was taken after a Rockwell International map done in 1986. Who knows what they took their map from, maybe something done prior to then. It is absolutely inaccurate on where there's industry, where there are housing area, and it should be updated.

How can we have faith in your credibility when you can't even put the background information down accurately? I'm aware that the chemists and so on who are doing the other reports did not do this part, but this is sloppy and should not be left that way.

Response to Comment 62

Thank you for your comments. We have updated this information as indicated in our response to comment 11.

COMMENTOR: Barb Moore

Comment 63

I have just a few objections to the remedial action plan. I have a problem with that there is no provision for extracting plutonium from the water. I understand that now that has not shown up, but what is going to happen if it does show up? Do we have a plan for that? I think it is -- should be planned for. I think it is likely that plutonium could show up with the amounts of plutonium that have been released on Hillside 881. I think that should be planned for.

Response to Comment 63

Please see our response to comment 43.

Comment 64

I'd like to know how the cleanup of the cleanup operations are going to be handled. Are the French Drains and all this piping going to be left in place afterwards, or is it going to be cleaned up? And if it's going to be cleaned up, how is that going to happen?

Response to Comment 64

Please see our response to comment 30.

Comment 65

And what if the water does not prove to be safe that you are extracting? Do we have facilities to store this water? If so, where is that going to be stored? I understand that we are going to reach our capacity in the springtime. This cleanup operation isn't happening for another year. Where are we going to store this extracted waste and the water should it become necessary?

Response to Comment 65

We do not understand your reference to reaching storage capacity in the springtime but believe you may be confusing this with other Rocky Flats Plant waste storage issues not connected with this action. The design of the IM/IRA calls for two effluent tanks each with one week of storage capacity. Furthermore, the capacity of the treatment system is 2 -3 times the expected influent flow. In consideration of this treatment and storage capacity, we feel it is reasonable that any operational difficulties encountered with the treatment plant can be corrected in sufficient time such that discharge of contaminated water is avoided. In addition, a carbon "polishing" system may be installed if there are any operational difficulties with the UV/Peroxide system. Ground water will not be collected from the french drain and Building 881 footing drain until after startup testing operations are performed and the treatment system is shown to be operating according to specification. In the meantime, we note that organic contaminants are migrating very slowly in the ground water, and the footing drain discharge may contain very low concentrations of organics (recent results show PCE at only 8 ppb). Organic contaminants have never been detected in Pond C-2 where the footing drain discharge ultimately flows. Furthermore, Pond C-2 is monitored before discharge to assure the water quality is acceptable as dictated by the plants NPDES permit. In light of this, you should not be concerned about contamination being released off the Rooky Flats Plant property before the interim action construction is completed.

Comment 66

I understand there's, you know, from what I've been able to figure, over 50,000 square feet of contaminated land area on Hillside 881. I have a real problem with heavy machinery driving over this area and resuspending the particles into the air. During past cleanup operations air monitoring levels, plutonium levels have reached the state standards and, at times, have exceeded the state standards. What air monitoring is going to happen during the cleanup and at what point will cleanup stop should we exceed those air monitoring standards?

Response to Comment 66

Please see our response to comment 6.

Comment 67

I am confused that this plan has come about, in my eyes, fairly rapidly. In last February, 1989, Troy Wade, in testimony before a Senate hearing, was telling us that Rocky Flats could never be - may never be cleaned up. When Senator Tim Wirth asked him about the ground water contamination, Wade acknowledged that the technology does not exist for cleaning up the ground water or stopping the contamination. I want to know, you know, what drastic measures have occurred since February, 1989, to make this now a safe and feasible plan?

Response to Comment 67

We do not know what information Mr. Wade was basing his comments on. However, we are certain that the proposed IM/IRA will be effective in significantly reducing contaminant migration in the alluvial ground water system at the 881 Hillside Area, and in removing the contaminants from the extracted ground water. DOE also recognizes that the public must be reasonably convinced of the feasibility and legitimacy of this action.

Comment 68

At the last meeting here at Front Range Community College, I may have misinterpreted the comments, but the way I interpret it is that because of strong public objection, may delay the cleanup of the ground water on Hillside 881. would be the fault of the people who drafted the plan. We need to have a plan that is acceptable to the public and that will not endanger our health. I think our priorities should lie with the people and the public safety, and not with how many dollars this is going to cost us to clean this up.

Response to Comment 68

Strong public opposition to the plan would delay the IM/IRA. However, DOE is committed to expediting the IM/IRA according to a plan that is first and foremost protective of the public health and environment. We feel that the plan that has been reviewed by the public and this responsiveness summary demonstrates that commitment.

COMMENTOR: Mel Wright

Comment 69

First, comments against Rockwell--not against Rockwell. I appreciate you trying to clean it up. Leaving that stuff there is nothing but a time bomb and it's going to get us. Any attempt to do something is better than sitting on our hands. However, after going to the hazardous waste seminar Monday and Tuesday, the manufacturer of this ozone peroxide cleanup says they're having a lot of problems it won't touch, carbon tetrachloride, and it won't touch some of the unsaturated chlorides. It works extremely well on trichloroethylene and the some chlorinated solvents, but at least it's an attempt. At least it's something that's going to remove the great majority of the contaminants as I see from the list. Just realize it will not work on carbon tet at all, and probably will not work on the tetrachloroethylene, so you're probably going to have to do some air-stripping or carbon filtration, something along that line as an after- though. In other words, you don't want to saturate your carbon filters, so you basically will need an in-series type thing.

Response to Comment 69

The UV/Peroxide equipment specification calls for the reduction of the expected influent concentrations of both carbon tetrachloride and tetrachloroethylene to achieve the effluent standards, i.e., the vendor of the equipment must guarantee the equipment will meet these performance criteria. Furthermore, one vendor, Peroxidation Systems, notes that there is a substantial body of evidence that indicates saturated compounds can be treated with the UV/peroxidation process. The evidence indicates that longer residence times are required to treat saturated organics relative to unsaturated organics. Data presented in 1987 (Hager, Loven, and Giggy, Chemical Oxidation Destruction of Organic Contaminants in Groundwater HMCRI National Conference and Exhibition, November, 1987), indicates that 1,200 mg/l of carbon tetrachloride was reduced to 0.3 mg/l with a reaction time of 30 minutes. The Hager paper also noted that 705 Fg/l of tetrachloroethylene was reduced to non-detectable limits in just 2.5 minutes. The longer residence time required for treating saturated compounds translates into higher operating costs but no reduction in protection of human health and safety.

Comment 70

One other thing, I really didn't get to see your total diagram, but at one point your treated water was going to come out. You were going to test it. If it failed the test you are going to pump it back in, in line, and in some ways it almost sounds like dilution. I'd rather see you set up another second set of either the ozone treatment or some more carbon filters. Possibility put some secondary backup systems; in other words, if you have breakthrough, don't resend it back through kind of as a dilution scheme, but go on down the line.

Response to Comment 70

Indeed the influent would be diluted by recycling the effluent through the treatment system. However, it is impossible for this effluent to dilute the influent to meet ARARs without further treatment. Nevertheless, your comment is well taken. In order to minimize any operational difficulties, a carbon "polishing" system may be installed downstream of the ion exchange system. This redundancy would further facilitate smooth operation of the facility.

Comment 71

I'm just going to keep it at that for your comments, and some comments to my concerned citizens. First, even though this is an interim cleanup. hopefully you're going to follow the OSHA rules. 1910.20, it very well defines exactly what these guys have to do, how they monitor, what kind of equipment the people have to wear, what kind of dust they can stir up, and all you have to do is you can call up OSHA and ask for 1910.20. It'll tell you everything you want to know about what these *guys have to do. Hopefully, You will follow it.*

Okay. Even though it's an interim cleanup, by law, a lot of times if you're doing interim, EPA allows you to bypass or not follow a lot of the rules that a Super Fund site would, or a normal cleanup facility would. Hopefully you're going to follow 1910.20, and I highly suggest everybody in the audience call up OSHA and ask for that paper, and it will answer--there was about three people who had questions about that. It will answer all your questions. All you've got to do is ask these guys are they going to follow that.

Let's see, the second thing, I'm concerned that it seems like the major concern of the audience is, "Let's don't do anything. We'll just leave it there." My complaint is, we've put it there. It's there in concentrated form. Let's get rid of it. You guys are worrying about stirring up a little dust. What do you think wind storms do? What do you think--where does the rainwater go? It washes off the property. You guys are probably more contaminated by what the wind blows up, what the rainwater washes off than these guys will ever stir up. Hopefully they will reduce it, you know, put up--hopefully, you'll take this one guy's comments, maybe put a dome over it, a simple, cheap dome. You'll water it down, do everything possible to reduce it, but you know and I know as an environmental chemist these guys are more at risk from what the environment is throwing out to them than you guys will stir up in the cleanup.

We've got to start trying to remove something. If you leave it there, it's a time bomb and it will get you. So my comment is, first, I appreciate that we're going to try something, work it out, realizing it is an experiment, but hopefully intelligence allows some thought to go into it. You work at it you improve it but at least do something.

Again, send away for the information and let's try and work together. I want to protect my life and my environment and the way to do it is to help people solve the problem and understand it. So send away for, the literature and go from there. Remember the ozone thing doesn't work on the carbon tet, and that's it. Thank you very much.

Response to Comment 71

We fully intend to comply with OSHA regulations. We appreciate your support on this project.

COMMENTOR: **Mr. Reynolds**

Comment 72

My concern is--one is resuspension and on-site and off-site Hill 881, as well as some of the areas that I've been told about that have a fairly high radioactivity just east of Indiana. Is there any particular reason why we couldn't be using some of the adhesive sprayed currently in some of the core sample sites or some of the core sites to keep the resuspension down in this area, which is only about, what, a mile and a half, two miles from a major high school that was just fairly recently built and a very large population in that area. Is there any particular reason why we couldn't be putting something down to keep that down? I understand that they're taking measures to, I've been told, plow under as well as re-vegetate, but some of this adhesive material that I've read about that they've been spraying in these areas for the core sampling have been used, and why not use it there?

Response to Comment 72

The plowing and revegetating activities refer to the soil remediation being conducted just east of Indiana Street. We appreciate your concern, however, that project is not part of this interim action and is therefore outside the scope of the plan and this response to comments. With regard to the 881 Hillside Area, please see our response to comment 6.

Comment 73

Also, in the--this may not--I may be out of order in asking this questions, but with the recent accident yesterday of the aircraft accident and previous to that, the air show which we had a large number of aircraft, is there--especially now with the--all these boxcars out there and the high potential of--or high exposure I'd suggest that we've had probably prior to the--and I think you call it the EPA's evaluation of accidents. I don't know if that was considered at that time; that is, all the boxcars we have out there now. But is there any consideration in the remedial time of looking at redirecting traffic or--and I don't know how you do that with a major airport right next to it, but on the other hand, is that being considered? And if it's not, I'd sure appreciate it if it would be.

Response to Comment 73

We appreciate your concern regarding the potential for these accidents but we note that the air space above the Rocky Flats Plant is already restricted.

WRITTEN COMMENTS: Annette Barnard, Manager of Water Quality, City of Thornton

Comment 74

The City of Thornton would like to thank the Colorado Department of Health and the Department of Energy (DOE) for the opportunity to submit comments on the Proposed Interim Measures/Interim Remedial Action Plan and Decision Document for the 881 Hillside Area. The City believes that the option selected by Rockwell International, the UV/peroxide and ion exchange treatment system, is the appropriate solution because it accomplishes complete destruction of the contaminants without formation of additional hazardous wastes or other byproducts. In addition, we feel that the French Drain collection system is an excellent choice for collection of the groundwater.

Response to Comment 74

We appreciate your Support.

Comment 75

The French Drain should be extended on the east end to include coverage of Solid Waste Management Unit (SWMU) 119.2 which was used for barrel storage.

Response to Comment 75

As discussed on page 6-1, second paragraph, if the bedrock lithology verification program indicates the presence of saturated colluvial material downgradient of SWMU 119.2, the french drain will be extended to collect ground water in this area.

Comment 76

A detailed operating procedure should be developed to establish an appropriate water quality monitoring system and to define treatment criteria and standards.

Response to Comment 76

Treatment criteria and standards are defined in the plan. An Operation and Maintenance manual will be prepared for the facility which will outline the monitoring requirements. This manual will be available for public review before the treatment system is operational.

Comment 77

In the interest of public relations and public safety a study should be funded to determine an appropriate collection system to take Pond C-2 water and runoff from the site to prevent contamination of the drinking water supply for the Cities of Thornton, Northglenn and Westminster.

Response to Comment 77

DOE is investigating alternatives to discharge of Plant runoff via Pond C-2 to the Woman Creek drainage. However, we would like to point out that all discharges from Pond C-2 will be monitored in accordance with the Plant's National Pollutant Discharge Elimination System Permit. Water that does not meet the surface water standards for Woman Creek will not be discharged. Please see our response to comment 1.

COMMENT 78

A permanent system should be developed to intercept flow from Woman Creek and divert it around Standley Lake to protect public health from contamination which may not be known or apparent at this time.

Response to Comment 78

Please see our responses to comments 1 and 77.

Comment 79

Section 2.1.6.2. In light of the data validation study performed by Argonne National Laboratory, conservative analyses of the soils data must be summarized for inclusion within this report. Specifically, until further field work is conducted at the 881 Hillside to verify or refute the presence of both volatile and semi-volatile constituents, the previous soils evaluation must be presented. More than 3 of the 23 boreholes were contaminated and the soils were contaminated with more than PCE, TCE and 1,1,1-TCA.

Response to Comment 79

The text will be revised in the final plan to simply summarize the data and discuss it's limitations. References to risk will be deleted.

Comment 80

Section 2.1.6.3. It should be stated that recent valid sampling of the ponds within Woman Creek indicate that there are no VOCs present.

Response to Comment 80

This addition will be made in the final plan.

Comment 81

Section 3.2. The schedule presented must reflect the extension of the public comment period. The procurement dates for the Ion Exchange System seem to be in error.

Response to Comment 81

This is a typographical error that will be corrected in the final plan. Also, the extension of the public comment period, and the response to public comments and finalization of the plan will be reflected in the new schedule. This will alter the overall schedule for construction and startup of the IM/IRA. The revised schedule is provided in Section 3 of the final plan.

Comment 82

Section 3.3. The chemical specific ARAR for gross beta is 4 mrem/yr (a National Interim Primary Drinking Water Regulation) or 50 pCi/l (a SDWA MCL), whichever is more stringent.

Response to Comment 82

Actually, 50 pCi/l is simply a criterion above which it is necessary to analyze specific man-made beta emitting isotopes to assess if the 4 mrem/yr standard is exceeded. The change will be made in the final plan.

Comment 83

Section 3.3.1. The Chemical Specific ARAR for antimony is exceeded. It appears that the Chemical Specific ARAR for nitrate is exceeded. The RCRA Subpart F standard for 1.2 Dichloroethane is 5 ppb. This is a final MCL.

Response to Comment 83

Antimony and nitrate do exceed ARAR. These were typographical errors that will be corrected in the final plan. As noted in Table 3-2.1, 5 ppb is the RCRA Subpart F, CDH ground water, CDH surface water, and MCL standard.

Comment 84

Section 4.3. Table 4-1 presents the basis for design of the 881 Hillside treatment technology as based on a flow weighted average of the footing drain and alluvial groundwater collected by the french drain. Is the source well included in the design basis for the treatment technology?

Response to Comment 84

The source well has not been included because it would represent double accounting of contamination. Well 9-74 and 43-87 are included in the computation of the expected ground water chemistry of alluvial ground water collected by the french drain. Also, the source well will be pumped and the discharge treated prior to the french drain being placed into service. By the time the french drain is in service, it is expected that the source well will have lower contaminant concentrations and produce a low steady flow (estimated below 1 gpm). This should not significantly affect the influent chemical characteristics, at least relative to the computed influent characteristics.

Comment 85

Section 4.5.1.1. Figure 4-9 shows the 6" perforated pipe placed above the drain sump. The top of the sump shall be located approximately two feet below the interface of the 10^{-6} cm/s hydraulic conductivity bedrock and bedrock or alluvial soils having greater than 10^{-6} cm/sec hydraulic conductivity. The perforated pipe should be placed so that liquid cannot accumulate above the level of the lined sump, i.e. the top of the pipe should be placed below the top of the sump.

Response to Comment 85

We agree, and the changes will be made in the final plan.

Comment 86

Section 4.5.3.2. The last paragraph states this action is a removal. This action is an IRA. Delete this statement.

Response to Comment 86

This is a typographical error resulting from the original draft plan referring to the IM/IRA as a removal action. The terminology will be deleted.

Comment 87

Section 6.0. As the soil boring program is scheduled for mid-October through mid-January, the driest time of the year, placement and frequent monitoring of permanent piezometers downgradient of SWMU 119.2 is recommended to evaluate the saturated or unsaturated conditions downgradient of the site.

Response to Comment 87

The schedule for the soil boring program has been moved back for technical and administrative reasons. It will now be conducted in the late winter/early spring.

Comment 88

It should be noted that the 15 feet into bedrock calculation for interception of dipping sandstones is dependent on the relative elevation of the top of bedrock. If the adjacent western borehole bedrock elevation is lower than the elevation of bedrock in the borehole being drilled, 15 foot penetration into bedrock may not intercept a dipping sandstone identified in the adjacent borehole.

Response to Comment 88

Given the 15 foot depth was estimated based on a dip of 7°, and the current estimate of dip is 1° to 2°, intercepting potentially subcropping sandstones with a penetration depth of 15 feet is almost certain regardless of differences in the top of bedrock elevations.

Comment 89

It might be prudent to maintain and archive the bedrock cores for potential future submittal for laboratory permeability testing. This contingency could be used if the in-situ permeability testing proposed does not generate acceptable information.

Response to Comment 89

The suggestion is a good one and will be considered.

D. REMAINING CONCERNS

All issues pertaining to the proposed interim action have been resolved by this Responsiveness Summary or the final interim action plan. The only issue that remains unresolved is the mixed public opinion regarding routing Woman Creek flow around Standley Lake. The issue, however, is not pertinent to the 881 Hillside Area interim action.

ATTACHMENT

COMMUNITY RELATIONS WORK PLAN

COMMUNITY RELATIONS

WORK PLAN

SUBMITTED TO EPA, REGION VIII

by

The Department of Energy, Rocky Flats Office

October 28, 1989

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requires that a Community Relations Plan be developed if a facility is placed on the Environmental Protection Agency's (EPA) National Priorities List (NPL - Superfund). In September of 1989, The Rocky Flats Plant, owned by the Department of Energy, was placed on the NPL by the EPA. Once a site is added to the NPL, a Community Relations Plan must be prepared for removals (cleanup sites) lasting longer than 45 calendar days. The following is the proposed work plan for the Rocky Flats Community Relations Plan and is divided accordingly:

1. <u>Content:</u>

- # Purpose of the Community Relations Plan
- # Historical Geographical and Technical Site History
- # Community Background
- # Key Community Concerns (derived from Interviews)
- # History of Community Involvement (derived from media clips)
- # Community Relations Strategies (required and suggested by EPA's <u>Community Relations in Superfund: A Handbook)</u>
- # Schedule of Community Relations Activities
- # Procedure for Administrative Record and Locations
- # Repository Information (content and locations)
- # Remodel Investigations/Feasibility Studies (RI/FS) Process and General Remediation Information and Procedures
- # Required Public Comment Procedures and Time Periods
- # Mailing List of Key Contacts and Interested Parties
- # Information on Determining Location of Public Meetings, News Conferences, Presentations and Workshops

2. <u>Goals and Objectives:</u>

- # Community Relations Plan (CRP) will provide in document form accurate, timely, and understandable information, and steps the public can take to participate in decisions regarding cleanup activities at the Rocky Flats Plant. The CRP win allow the public the opportunity to learn about the Site, the Superfund program and to provide input on technical decisions during the RI/FS process prior to remedial field work.

- # The CRP will continuously inform the public of planned and/or ongoing remedial cleanup activities at the Plant. Throughout all of the cleanup processes it will serve as a blueprint outlining the timing of those activities and the public's role.

- # The CRP will establish a positive working relationship among the public, the Department of Energy (DOE), the EPA, the Colorado Department of Health (CDH), and Plant personnel. This communication will focus on and resolve any past conflict and avoid any future miscommunications.

3. The Design of the CRP:

- # The design of the CRP will follow the guidance and regulations provided in EPA's Community Relations in Superfund: A Handbook, the DOE, and CDH regulations.

- # The design of the CRP will include input by the public through surveys and extensive community Interviews conducted by the CRP Coordinator and staff, Plant public information staff, and Plant technical staff (when appropriate).

- # The proposed final draft of the CRP will be developed by the CRP Coordinator and reviewed by the operating contractor, DOE, EPA, and CDH personnel. After review of the document by these agencies the CRP will be subject to the required public comment period.

- # Following guidelines established by applicable regulatory agencies for community relations activities related to cleanup and remedial investigations, the CRP will also be subject to continuous revisions for specific sites undergoing remedial action at the Plant Under these guidelines, the CRP will be perceived as a "living document" and tho public will be provided the opportunity for input throughout the process.

4. Community Concerns:

- # Prior to the writing of the proposed CRP, extensive interviews will be conducted. Citizens will have the opportunity to participate through public meetings, face-to-face interviews, informal group meetings and workshops. Groups to be targeted for interviews are discussed in Section 6. Based on existing historical information, initial concerns to be explored, but not limited to, are: real or perceived health threats from the production at the plant; environmental concerns; levels of public technical knowledge; economic issues such as property values, income tax bases and revenues; and the credibility of involved government agencies.

- # The goal of community involvement In the CRP will be to include and Inform the public through accurate information and communication regarding cleanup activities, and to develop trust and respect between the surrounding communities, the operating contractor, and the appropriate agencies.

- # The strategy to be used for gathering information on current community concerns through the interviewing process will include:

< Development of an interviewing team(s) who win be knowledgeable, empathetic, non-threatening and know site background and community history.

< Prior to interviewing, the town will determine a cross-section of the public to interview. These groups and persons will be derived from mailing lists and correspondence files provided by the DOE, EPA, CDH, and the Plant. it is anticipated that once the interviewing process begins, interviewees will suggest other groups or persons who may wish to provide input.

< The interviewing teams(s) will divide the list of interviewees and, based on the team's expertise, determine who will target certain groups and/or areas.

< Times and locations for interviews will be arranged at least seven to tan days prior to the interview. Confirmation telephone calls will be made.

< Prior to going into the field, the interview team(s) will outline the purpose of the CRP, organize, questions, and practice diplomatic responses to difficult questions.

The media will be contacted and briefed on the development of the CRP by personnel selected by the operating contractor. This brifing will continue throughout the CRP process, maintaining consistency and clarity at all times.

The media will serve as a successful tool for the CRP as the interviewing team(s) and appropriate agency personnel will concentrate on building good media relations through open communication, updated information, and easy accessibility.

5. <u>Activities:</u>

Activities included in the CRP will be determined by the EPA guidelines as set forth in the <u>Community Relations in Superfund: A Handbook</u> it is anticipated that additional activities will result from community interviews; however, history shows that the following activities will occur:

Maintaining open lines of communication with interested parties. The CRP Coordinator and appropriate agency personnel will continue to make themselves available to talk to interested persons about environmental issues and concerns. This policy of open communication will continue during the entire CRP process and will include follow-up. The CRP Coordinator and agency pesonnel will also participate in meetings to keep the public informed about technical and community relations activities.

Fact sheets, informational updates, and technical summaries will be prepared, kept current, and made available to the public through the Plant Public Information Department and repositories on a regular basis. A thorough mailing and contact list will be established and maintained. These lists will be kept current and expanded as remedial projects progress to provide information to all interested parties.

- News releases will be prepared for the local media. Because the local media are the source of information for many of the people queried, news releases will be provided to newspapers, television, and radio stations to announce significant findings and/or milestones and to notify the community of public meetings.

- Administrative records will be kept on site and project information and will be maintained at information repositories. The CRP Coordinator or his/her designee will ensure accuracy by keeping the information up to date at the repositories. The information in the administrative record will focus an remodel cleanup activities at the Plant and will be available for public review and comment. Although at least four exist additional repositories may be established.

- Informal and formal public meetings with interested groups and area residents will be hold with required advanced notice followed by a required comment period. These meetings will provide information on specific projects at the Plant, and appropriate agency personnel will respond to concerns, including those of a technical nature. Public meetings will be scheduled in relation to each remedial cleanup project. Some of these meetings may take the farm of an “open house” featuring experts In a variety of fields.

- The opportunity for public comment will be welcomed. Interested groups and citizens will be encouraged to comment verbally or in written form an remedial investigations, feasibility studies, and other major reports as they relate to specific cleanup projects. Sufficient time is required for advanced notice of the comment periods to allow adequate time for comment. A minimum of 60 days will be allowed for public comment on preferred alternatives for remedial action at the Plant.

- As the CRP will address CERCLA and Resource Conservation and Recovery Act (RCRA) issues, the CRP Coordinator and Plant personnel will work closely and cooperatively with DOE, EPA and CDH.

- Responsiveness summaries will be prepared which will summarize significant public comments and concerns raised before and during the public comment period on draft feasibility studies. The Responsiveness Summary is required as part of the Record of Decision (ROD) and Corrective Action Decision (CAD) for each remedial cleanup site. It will document how citizen comments were considered throughout the decision-making process.

- Newspaper notices will be published to inform the public that the ROD prepared, kept current, and made available to the public through the Plant Public Information Department and repositories on a regular basis. A thorough mailing and contact list will be established and maintained. These lists will be kept current and expanded as remedial projects progress to provide information to all interested parties.

News releases will be prepared for the local media. Because the local media are the source of information for many of the people queried, new releases will be provided to newspapers, television, and radio stations to announce significant findings and/or milestones and to notify the community of public meetings.

Administrative records will be kept on site and project information and will be maintained at information repositories. The CRP Coordinator or designee will ensure accuracy by keeping the information up to date at the repositories.

The information in the administrative record will focus on remedial cleanup activities at the Plant and will be available for pubic review and comment Although at least four exist additional repositories may be established.

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or CAD is signed and of the availability of the final remedial action plan selected. These notices will be placed in major local newspapers of general circulation after the remedy has been selected and the ROD or CAD is signed, but before commencement of any remedial activities.

In summary, open communication with concerned citizens and groups, regular public meetings and open houses, informal group meetings, and public comment periods an major reports are the primary activities of the CRP for the Plant.

6. Groups Identified to Interview for Comments to be included in the CRP:

- Elected and/or appointed officials:
  - Governor's Office
  - Congressional delegation
  - Mayors, City Managers, select Council members and Legislators of the surrounding area
- Educators
- Rocky Flats Environmental Monitoring Council
- Chambers of Commerce in surrounding area
- Civic groups in surrounding Plant area
- Environmental groups
- Rocky Flats Cleanup Commission
- Church groups
- Industrial groups
- Area reporters
- Union employees
- Local landowners
- Directors of area homeowners' associations
- Area agricultural associations
- Area editorial boards

It is anticipated that this list of groups will be expanded once the interviewing process begins.

7. Project Schedule:

A CRP will be prepared according to the following schedules:

Early Start	Early Finish	Activity
11/1/89	11/14/89	Community Survey Plan (CSP) scoping with EPA and CDH
11/15/89	12/15/89	Draft Community Survey Plan (CSP)
12/18/89	1/23/90	RFP review draft CSP. Resolve and finalize (CSP)
1/24/90	2/21/90	EPA and CDH review CSP
2/22/90	3/22/90	Finalize CSP
3/23/90	5/21/90	Implement CSP (Perform survey/interviews CSP)
5/22/90	7/19/90	Review survey findings and prepare CRP draft
7/20/90	8/17/90	RFP review draft CRP
8/20/90	9/18/90	Resolve comment and finalize draft (CRP)
9/19/90	10/17/90	EPA/CDH review (CRP)
10/18/90	12/18/90	Resolve Issues and finalize CRP
12/19/90	2/6/91	Public comment period - CRP
2/7/91	4/5/91	Public comment response (Responsiveness Summary)
4/8/91	5/6/91	EPA/CDH final review Response Summary (CRP)