# NOTICE

**All drawings located at the end of the document.**

# Final

# No Further Action Justification Document

## Rocky Flats Plant
## Low-Priority Sites
## (Operable Unit 16)

## U.S. Department of Energy
## Rocky Flats Plant
## Golden, Colorado

## Environmental Restoration Program

## October 1992

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**Environmental Restoration Program**

October 1992

Approved by:

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Manager, Remediation Programs RFI Project Manager

## TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

## LIST OF APPENDICES

Approved by:

____________________ __/__/__ ____________________ __/__/__

Manager, Remediation Programs RFI Project Manager

## EXECUTIVE SUMMARY

The No Further Action Justification document for Operable Unit 16 (OU16) - Low-Priority Sites at the Rocky Flats Plant (RFP) is part of the comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions currently in progress at RFP. These activities are pursuant to the Interagency Agreement (IAG) signed by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Colorado Department of Health (CDH).

OU16 contains seven Individual Hazardous Substance Sites (IHSSs) that were grouped together in the IAG because of the likelihood that previous response actions or natural environmental processes at these low-priority sites eliminated the need for further action. In accordance with EPA guidance (1989a), a no further action decision is appropriate at sites where a previous removal action or natural environmental processes mitigate risks to human health and the environment. The risks associated with each of the IHSSs in OU16 and the need for further action are assessed using a conceptual model to evaluate the exposure pathways by which human and biotic receptors may be exposed to contaminants.

The No Further Action Justification document for OU16 describes the site history, geology, hydrogeology, climatology, and current and future land use to characterize OU16 within the RFP site framework. Each IHSS, its spill history, potential contamination, and remedial action, if performed, are described. Also described is a site conceptual model for OU16 that includes contaminant sources, release mechanisms, transport pathways, exposure routes, and receptors. Each IHSS within OU16 is evaluated relative to the conceptual model to determine whether it poses a risk to human health or the environment.

The seven IHSSs comprising OU16 include: IHSS 185 - Solvent Spill; IHSS 192 - Antifreeze Discharge; IHSS 193 - Steam Condensate Leak - 400 Area; IHSS 194 - Steam Condensate Leak - 700 Area; IHSS 195 - Nickel Carbonyl Disposal; IHSS 196 - Water Treatment Plant Backwash Pond; and IHSS 197 - Scrap Metal Sites - 500 Area.

Potential risks to human health and the environment associated with historical releases and spills at IHSSs 185, 192, 193, 194, and 195 have been mitigated by past response actions and/or natural attenuation processes that eliminate the source or exposure pathways. Therefore, further action is not justified for these four IHSSs.

Because a previous removal action has not eliminated the source and natural environmental processes have not prevented release and migration of contaminants, the exposure pathways for IHSS 196 are complete. Therefore, there is potential risk to human health and the environment, and further action is warranted for this IHSS.

Further action for IHSS 196 is already scheduled. Investigatory action proposed for IHSS 115, OU5, in Attachment 2, Table 5 of the IAG (U.S. DOE, 1991a), represents appropriate further action for IHSS 196 because (1) the area of investigation for IHSS 115 includes IHSS 196, (2) the target analytes for the IHSS 115 investigation include contaminants associated with IHSS 196, and (3) contaminant concentrations associated with IHSS 115 are likely to be significantly greater than concentrations associated with IHSS 196. Thus, additional action specific to IHSS 196 is not warranted.

Further investigation of IHSS 197 is also warranted because of the uncertain extent of past removal actions. The investigation of IHSS 197 can be accomplished by including it with the investigation of IHSS 117.1, OU13. Investigatory action proposed for IHSS 117.1 represents appropriate further action for IHSS 197 because (1) the area of investigation for IHSS 117.1 includes IHSS 197 and (2) the target analytes for the IHSS 117.1 investigation include contaminants associated with IHSS 197. Additional action specific to IHSS 197 is not warranted.

Approved by:

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Manager, Remediation Programs RFI Project Manager

## 1.0 INTRODUCTION

This document presents historical information and available data pertaining to the types and extent of contamination/releases and remedial response actions at Operable Unit 16 (OU16) - Low-Priority Sites at the Rocky Flats Plant (RFP) in Jefferson County, Colorado. This information is used to determine the need for further action at the seven Individual Hazardous Substance Sites (IHSSs) comprising OU16, listed as follows:

| | |
|---|---|
| IHSS 185 | Solvent Spill |
| IHSS 192 | Antifreeze Discharge |
| IHSS 193 | Steam Condensate Leak - 400 Area |
| IHSS 194 | Steam Condensate Leak - 700 Area |
| IHSS 195 | Nickel Carbonyl Disposal |
| IHSS 196 | Water Treatment Plant Backwash Pond |
| IHSS 197 | Scrap Metal Sites - 500 Area |

Unlike other operable units at RFP where IHSSs were grouped together in the Interagency Agreement (IAG) on the basis of similar contaminants, release types, and/or location, the IHSSs comprising OU16 were grouped together because of the likelihood that previous remediation efforts and/or natural environmental processes at these low-priority sites eliminated the need for any further remedial response action. In accordance with Guidance on Preparing Superfund Decision Documents (U.S. EPA, 1989a), a no further action decision may be warranted at sites where a previous removal action and/or natural environmental processes mitigate threats to human health and the environment.

This document is part of a comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions currently in progress at RFP. These investigations are being conducted pursuant to the IAG signed by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH), dated January 22, 1991 (U.S. DOE, 1991a). The IAG program developed by DOE, EPA, and CDH addresses Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations applicable to remedial investigations at OU16.

## 1.1 ENVIRONMENTAL RESTORATION PROGRAM

The Environmental Restoration (ER) program, designed for investigation and cleanup of environmentally contaminated sites at DOE facilities, is being implemented in five phases. Phase 1 (Installation Assessment) includes preliminary assessments and site inspections to assess potential environmental concerns. Phase 2 (Remedial Investigations) includes planning and implementation of sampling programs to delineate the nature and extent of contamination at specific sites and evaluate potential contaminant migration pathways. Phase 3 (Feasibility Studies) includes evaluation of remedial alternatives and development of remedial action plans to mitigate environmental problems identified in Phase 2 as needing correction. Phase 4 (Remedial Design/Remedial Action) includes design and implementation of site-specific remedial actions selected on the basis of Phase 3 feasibility studies. Phase 5 (Compliance and Verification) includes monitoring and performance assessments of remedial actions as well as verification and documentation of the adequacy of remedial actions carried out under Phase 4.

## 1.2 DOCUMENT OVERVIEW

The available information is presented in this document to characterize site physical features, define sources of contamination, identify contaminants of concern, evaluate potential release pathways, document the remedial response cleanup activities, and determine the need, if any, for further action.

Section 2.0 (Site Characterization and Background) presents regional and plant site background information, a description of the physical/environmental setting of OU16, and relevant information pertaining to past operational histories or occurrences of contamination. Remedial response cleanup activities performed at the IHSSs are also described. Section 3.0 presents a conceptual model for the units based on the physical characteristics of the IHSSs, potential or known release pathways, and available information regarding the nature and extent of contamination known or potentially associated with each IHSS in OU16. The conceptual model identifies exposure pathways by which human and biotic receptors may be exposed to contaminants. Existing information is used to determine whether the exposure pathway is complete and, therefore, whether the IHSSs pose a risk to human health and/or the environment. Based on the evaluation of the exposure pathway for each of the OU16 IHSSs, the rationale for further action is presented.

Relevant information used in characterizing the OU16 IHSSs and associated remedial responses is presented in Appendices A through C.

Approved by:

_________________ __/__/__ _________________ __/__/__

Manager, Remediation Programs RFI Project Manager

## 2.0 SITE CHARACTERIZATION AND BACKGROUND

## 2.1 REGIONAL AND PLANT SITE BACKGROUND INFORMATION

### 2.1.1 Facility Background and Plant Operations

RFP is a government-owned, contractor-operated facility, which is part of the nationwide Nuclear Weapons Complex. The plant was operated for the U.S. Atomic Energy Commission (AEC) from its inception in 1951 until the AEC was dissolved in January 1975. At that time, responsibility for the plant was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977. Dow Chemical U.S.A., an operating unit of the Dow Chemical Company, was the prime operating contractor of the facility from 1951 until June 30, 1975. Rockwell International was the prime contractor responsible for operating RFP from July 1, 1975, until December 31, 1989. EG&G Rocky Flats, Inc. became the prime contractor at RFP on January 1, 1990.

Previous operations at RFP consisted of fabrication of nuclear weapons components from plutonium, uranium, and other nonradioactive metals (principally beryllium and stainless steel). Parts made at the plant were shipped elsewhere for assembly. Currently, the plant reprocesses components after they are removed from obsolete weapons for recovery of plutonium. Other activities at RFP include research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. Both radioactive and nonradioactive wastes were generated in the production process. Current waste handling practices involve onsite and offsite recycling of hazardous materials, onsite storage of hazardous and low-level radioactive mixed wastes, and offsite disposal of solid low-level radioactive materials at appropriate DOE facilities. However, RFP operating procedures have historically included both onsite storage and disposal of hazardous, low-level radioactive, and low-level radioactive mixed wastes.

### 2.1.2 Previous Investigations

Various studies have been conducted at RFP to characterize environmental media and to assess the extent of radiological and chemical contaminant releases to the environment. The investigations performed prior to 1986 were summarized by Rockwell International (1986a). Investigations characterized the regional geology and sitewide surface water and ground water hydrogeology. Ecological and public health studies were also conducted.

In 1986, two investigations were completed at the plant. The first was the DOE Comprehensive Environmental Assessment and Response Program (CEARP) Phase 1 Installation Assessment (U.S. DOE, 1986), which included analysis and identification of current operational activities, active and inactive waste sites, current and past waste management practices, and potential environmental pathways through which contaminants could be transported. A number of sites that could potentially have adverse impacts on the environment were identified. These sites were designated as Solid Waste Management Units (SWMUs) by Rockwell International (1987). In accordance with the IAG, SWMUs are now referred to as IHSSs.

The second investigation completed at the plant in 1986 involved a hydrogeologic and hydrochemical characterization of the plant site. Plans for this study were presented by Rockwell International (1986b and 1986c), and study results were reported by Rockwell International (1986d).

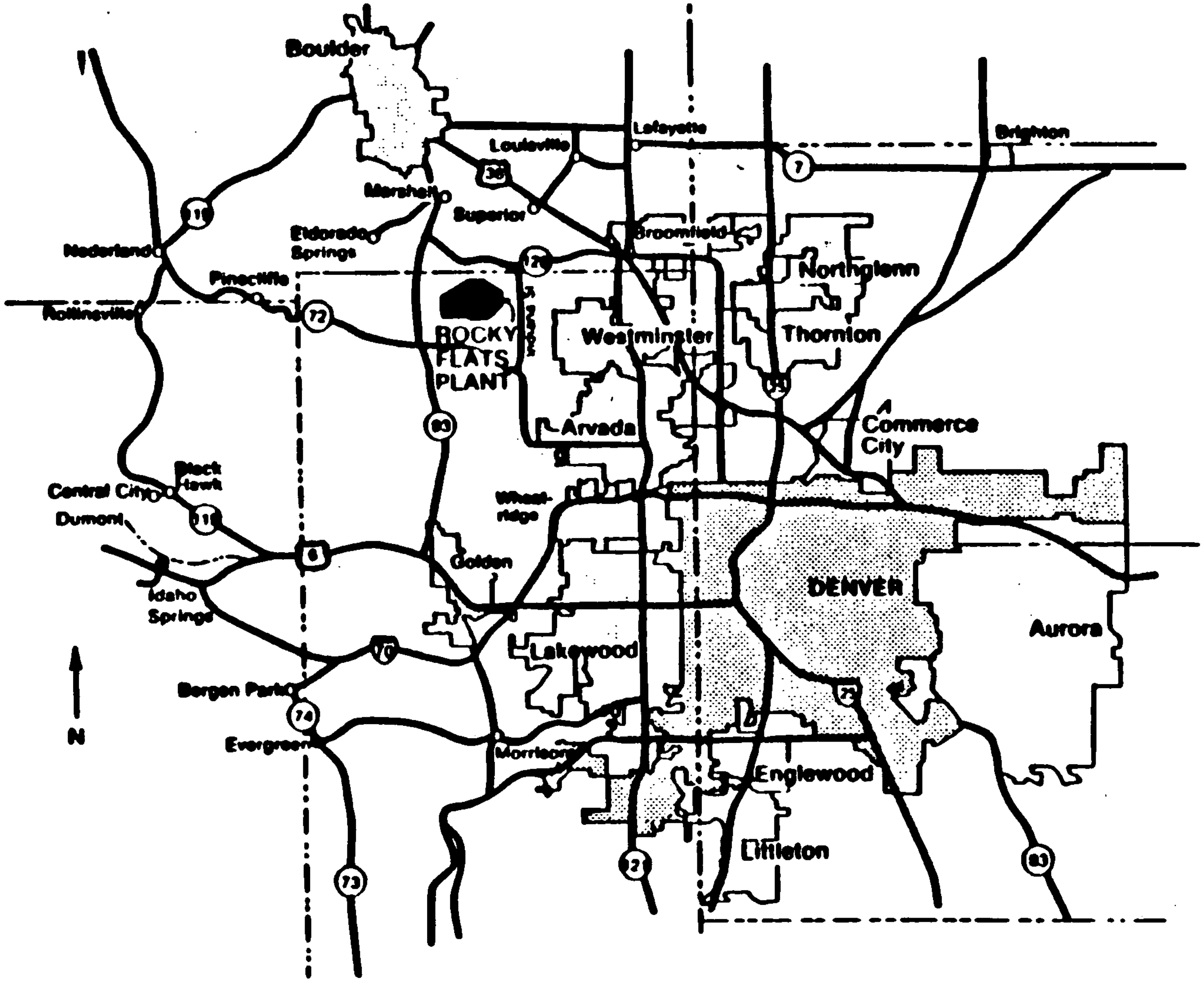
## 2.2 PHYSICAL SETTING

### 2.2.1 Location

RFP is located northwest of Denver in northern Jefferson County, Colorado (Figure 2-1). Other surrounding cities include Boulder, Broomfield, Westminster, and Arvada, all of which are located less than 10 miles to the northwest, northeast, east, and southeast, respectively. RFP occupies approximately 6,550 acres of federal land in Sections 1 through 4 and 9 through 15 of T2S, R70W, 6th Principal Meridian. Most plant structures are located within the primary RFP site, which occupies approximately 400 acres. RFP is surrounded by a buffer zone of approximately 6,150 acres (Figure 2-2).

RFP is bounded on the north by State Highway 128, on the east by Jefferson County Highway 17 (also known as Indiana Street), on the south by agricultural and industrial properties and Highway 72, and on the west by State Highway 93 (Figure 2-2).

The locations of the seven IHSSs comprising OU16 are shown on Figure 2-3. All of the IHSSs are located within the developed area of the RFP site, except for IHSS 195, the Nickel Carbonyl Disposal site, which is located north of the plant site.




**Area Map of Rocky Flats and Surrounding Communities**

Figure 2 -1

### 2.2.2 Topography

RFP is located along the eastern edge of the southern Rocky Mountain region, immediately east of the Colorado Front Range. The plant site is located on a broad, eastward-sloping pediment that is capped by alluvial deposits of Quaternary age (Rocky Flats Alluvium). The pediment surface has a fan-like form, with its apex and distal margins approximately 2 miles west of RFP. The tops of alluvial-covered pediments are nearly flat but slope eastward at 50 to 100 feet per mile (EG&G, 1992). At RFP, the pediment surface is dissected by a series of east-northeast trending stream-cut valleys. The bases of the valleys containing Rock Creek, North and South Walnut Creeks, and Woman Creek lie 50 to 200 feet below the elevation of the older pediment surface. These valleys are incised into the bedrock underlying alluvial deposits, but most bedrock is concealed beneath colluvial material accumulated along the gentle valley slopes.

Much of the ground surface in the controlled area of RFP has been disturbed by earthwork construction, thus obscuring original topographic undulations. Typical existing slopes in the controlled area are approximately 2 to 3 percent.

### 2.2.3 Climate

The area surrounding RFP has a semiarid climate characteristic of much of the central Rocky Mountain region. Based on precipitation averages recorded between 1953 and 1976, the mean annual precipitation at the plant is 15 inches. Approximately 40 percent of the precipitation falls during the spring season, much of it as wet snow. Thunderstorms (June through August) account for an additional 30 percent of the annual precipitation. Autumn and winter are drier seasons, accounting for 19 and 11 percent of the annual precipitation, respectively. Snowfall averages 85 inches per year, falling from October through May (U.S. DOE, 1980).

Winds at RFP, although variable, are predominantly from the west-northwest. Stronger winds occur during the winter, and the area occasionally experiences chinook winds with gusts up to 100 miles per hour (U.S. DOE, 1980).

The climate at RFP is strongly influenced by two flow patterns. During daytime hours, as the earth heats, air tends to flow toward the higher elevations (upslope). The general air flow pattern during upslope conditions for the Denver area is typically north to south, with flow moving up the South Platte River Valley that enters the canyons of the Front Range. After sunset, the air against the mountainside is cooled and begins to flow toward lower elevations (downslope). During downslope conditions, air flows down the canyons of the Front Range onto the plains (U.S. DOE, 1980).

Temperatures at RFP are moderate. Extremely warm or cold temperatures are usually of short duration. On average, daily summer temperatures range from 55 to 85 degrees Fahrenheit (°F), and winter temperatures range from 20 to 45°F. Temperature extremes recorded at the plant range from 102°F on July 12, 1971, to -26°F on January 12, 1963. The 24-year daily average maximum temperature for the period 1952 to 1976 is 76°F, the daily minimum is 22°F, and the average mean is 50°F. Average relative humidity is 46 percent (U.S. DOE, 1980).

### 2.2.4 Surface Water Hydrology

Three intermittent streams that flow generally from west to east drain RFP. These drainages are Rock Creek, Walnut Creek, and Woman Creek (Figure 2-2).

Rock Creek drains the northwestern corner of the buffer zone and flows northeastward through the buffer zone to its offsite confluence with Coal Creek. IHSS 195 is located in the Rock Creek drainage (Figure 2-3). North and South Walnut Creeks and Dry Creek drain the northern portion of the plant complex. These three forks of Walnut Creek join in the buffer zone and flow to Great Western Reservoir, approximately 1 mile east of the confluence. Flow is diverted around Great Western Reservoir into Big Dry Creek via the Broomfield Diversion Ditch. Rock Creek, North and South Walnut Creeks, and Dry Creek are intermittent streams. Flow occurs in these streams only after precipitation events and spring snowmelt. An east-west trending interfluve separates Walnut Creek from Woman Creek. Woman Creek, a perennial stream, drains the southern RFP buffer zone and flows eastward into Mower Reservoir. The South Interceptor Ditch, which collects runoff from the southern portion of the plant complex and diverts it to Pond C-2, is located between RFP and Woman Creek.

Retention ponds are located in each of the creeks downstream of the main plant site (Figures 2-2 and 2-3). The four ponds located along North Walnut Creek are designated (from west to east) as A-1, A-2, A-3, and A-4. Currently, Ponds A-1 and A-2 are used only for spill control, and North Walnut Creek stream flow is diverted around them through an underground pipe. Until 1980, Ponds A-1 and A-2 were used for storage and evaporation of plant laundry water. Pond A-3 receives North Walnut Creek stream flow and runoff from the northern portion of controlled area (and OU16). Pond A-4 is designed for surface water control and for additional storage capacity for overflow from Pond A-3.

The five retention ponds located along South Walnut Creek are designated (from west to east) as B-1, B-2, B-3, B-4, and B-5. Currently, Ponds B-1 and B-2 are reserved for spill control. Pond B-3 receives treated effluent from the sewage treatment plant. Ponds B-4 and B-5 receive surface runoff and occasionally collect discharge from Pond B-3. Pond B-5 receives runoff from the central portion of RFP (and OU16) and is used for surface water control in addition to collecting overflow from Pond B-4.

Ponds C-1 and C-2 (south and east of the plant, respectively) are located along Woman Creek. Pond C-1 receives stream flow from Woman Creek. This flow is diverted around Pond C-2 into the Woman Creek channel downstream. Pond C-2 receives surface runoff from the South Interceptor Ditch along the southern portion of RFP.

Surface water drainage in OU16 (except IHSS 195, located in the Rock Creek drainage basin) is controlled for the most part by water diversion structures such as ditches, pavements, gutters, drains, and culverts. Surface water drainage patterns in the controlled area are shown in Figures 2-2 and 2-3. The largest of the runoff control ditches in the controlled area is the Central Avenue Ditch, which runs eastward along Central Avenue and discharges to South Walnut Creek (Pond B-5). The other major runoff control ditch is the South Interceptor Ditch, which prevents runoff from the south side of main RFP complex from entering Woman Creek. This ditch discharges to Pond C-2.

Pond discharges are monitored in accordance with the RFP National Pollutant Discharge Elimination System (NPDES) permit conditions. In addition to NPDES monitoring requirements, offsite pond discharges are monitored for plutonium, americium, uranium, and tritium.

### 2.2.5 Ecology

The industrialized area at RFP is highly developed for plant operations, and only small fragments of highly disturbed or landscaped habitat currently exist. These fragments are too small to support viable ecosystem functions. Wildlife, particularly birds, use artificial structures within the industrial area only transiently and obtain food and water almost exclusively outside this area.

A variety of vegetation is found within the buffer zone surrounding RFP. Included are species of flora representative of tall-grass prairie, short-grass plains, lower montane, and foothill ravine regions. Riparian vegetation exists in the site's drainages and wetlands. These species of vegetation are not on the endangered species list (EG&G, 1991a). Since acquisition of RFP property, vegetative recovery has occurred, as evidenced by the presence of disturbance-sensitive grass species such as big bluestem (*Andropogon gerardii*) and side oats grama (*Bouteloua curtipendula*). One species, Ute Ladies'-tresses (*Spiranthes diluvialis*), has been identified as a threatened species on the Threatened and Endangered Species list. The plant's habitat has been identified as riparian areas of Colorado, specifically in riparian meadows in the City of Boulder, Boulder County, and along Clear Creek in Jefferson County. RFP is located on a flat that divides two drainages feeding into Boulder County and Clear Creek. The species has not been identified at RFP to date. Vegetative stresses attributable to hazardous waste contamination have not been confirmed (U.S. DOE, 1980).

The fauna inhabiting RFP and its buffer zone consists of species associated with western prairie regions. The most common large mammal is the mule deer (*Odocoileus hemionus*), with an estimated 100 to 125 permanent residents at RFP. A number of small carnivores, such as the coyote (*Canis latrans*), red fox (*Vulpes fulva*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*) are also found at RFP. Small herbivores can be found throughout the plant complex and buffer zone, including species such as the pocket gopher (*Thomomys talpoides*), white-tailed jackrabbit (*Lepus townsendii*), and meadow vole (*Microtus pennsylvanicus*) (U.S. DOE, 1980).

Commonly observed birds include western meadowlarks (*Sturnella neglecta*), horned larks (*Eremophila alpestris*), mourning doves (*Zenaidura macroura*), vesper sparrows (*Pooecetes gramineus*), western kingbirds (*Tyrannus vociferans*), black-billed magpies (*Pica pica*), American robins (*Turdus migratorius*), and yellow warblers (*Dendroica magnolia*). A variety of ducks, killdeer (*Charadrius vociferus*), and red-winged blackbirds (*Agelaius phoeniceus*) are seen in areas adjacent to ponds. Mallards (*Anas platyrhynochos*) and other ducks (*Anas sp.*) frequently nest and rear young on several of the ponds. Common birds of prey in the area include marsh hawks (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), ferruginous hawks (*Buteo regalis*), rough-legged hawks (*Buteo lagopus*), and great horned owls (*Bubo virginianus*) (U.S. DOE, 1980). Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aguila chrysaetos*) are seen at Rocky Flats as migrants and winter transients.

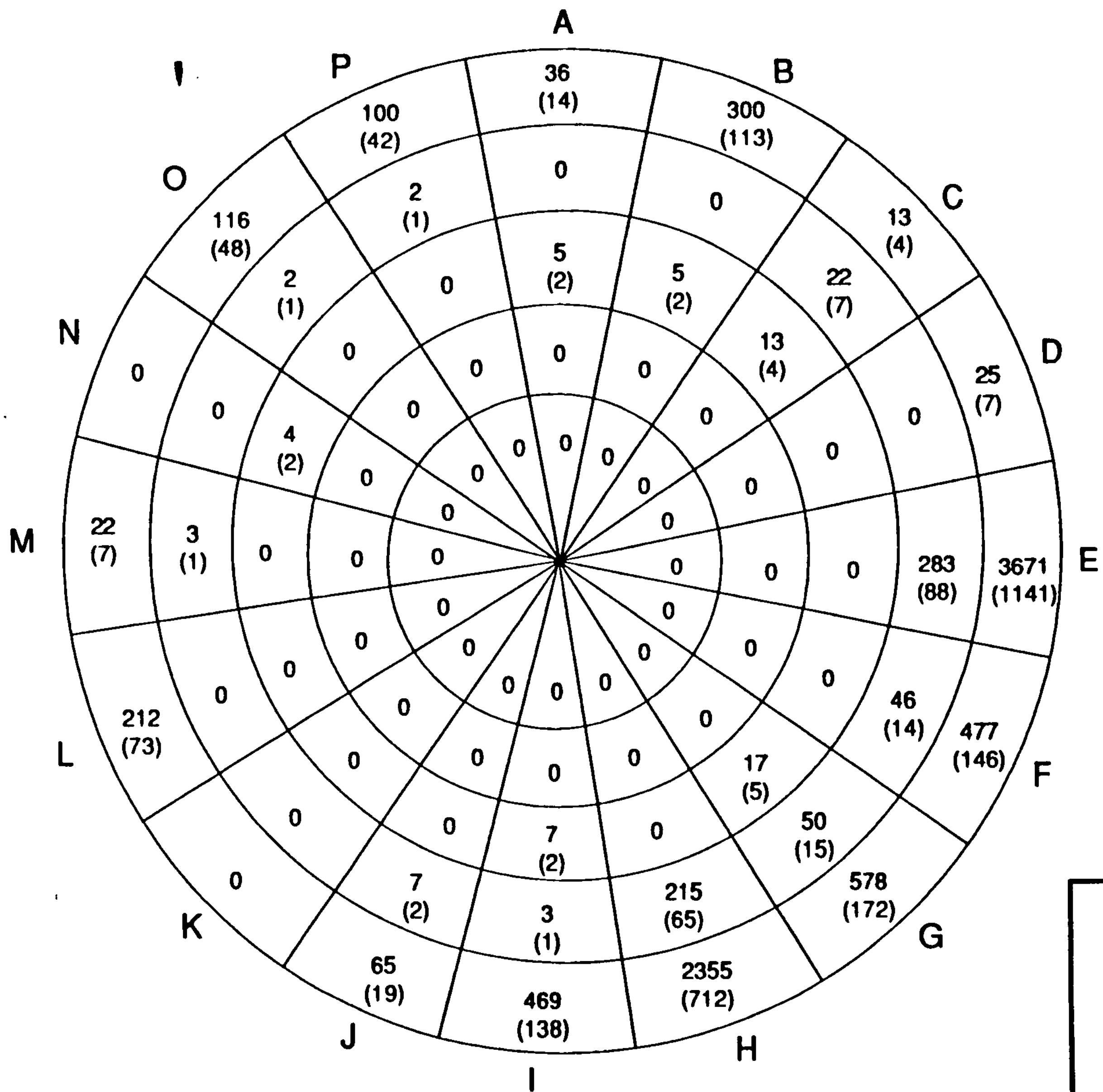
Bull snakes (*Pituophis melanoleucus*) and rattlesnakes (*Crotalus sp.*) are the most frequently observed reptiles. Eastern yellow-bellied racers (*Coluber constrictor flaviventris*) have also been noted. The eastern short-horned lizard (*Phrynosoma douglassi brevirostre*) has been reported on the site, but these and other lizards are not commonly observed. The western painted turtle (*Chrysemys picta*) and the western plains garter snake (*Thamnophis radix*) are found in and around many of the ponds (U.S. DOE, 1980).

Two procedures that pertain to identification and management of threatened and endangered species at RFP are currently being prepared by the EG&G National Environmental Policy Act (NEPA) group. These are the draft *Identification and Reporting of Threatened and Endangered and Special Concern Species*, Administrative Procedure NEPA.12, Rev. 0, and the draft *Protection of Threatened and Endangered and Special Concern Species*, Operations Procedure FO.21, Rev. 0.

### 2.2.6 Surrounding Land Use and Population Density

The population, economics, and land use of areas surrounding RFP are described in a 1989 Rocky Flats vicinity demographics report prepared by DOE (U.S. DOE, 1991b). This report divides general use of areas within 0 to 10 miles of RFP into residential, commercial, industrial, parks and open space, agricultural and vacant, and institutional classifications and considers current and future land use near the plant.

Most residential use within 5 miles of RFP is immediately northeast, east, and southeast of RFP. The 1989 population distribution within areas up to 5 miles from RFP is illustrated in Figure 2-4. Commercial development is concentrated near residential developments north and southwest of Standley Lake and around Jefferson County Airport, located approximately 3 miles northeast of RFP. Industrial land use within 5 miles of the plant is limited to quarrying and mining operations. Open-space lands are located northeast of RFP near the City of Broomfield and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada. The west, north, and east sides of Standley Lake are surrounded by Standley Lake Park open space. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located north and northeast of RFP near the cities of Broomfield, Lafayette, Louisville, and Boulder, and in scattered parcels adjacent to the eastern boundary of the plant. Several horse operations and small hay fields are located south of RFP. The demographic report characterizes much of the vacant land adjacent to RFP as rangeland (U.S. DOE, 1991b).




| Miles | Sector Name |
|---|---|
| 0-1 | Sector 1 |
| 1-2 | Sector 2 |
| 2-3 | Sector 3 |
| 3-4 | Sector 4 |
| 4-5 | Sector 5 |

**Figure 2-4**
**1989 POPULATIONS (AND HOUSEHOLDS), SECTORS 1-5**

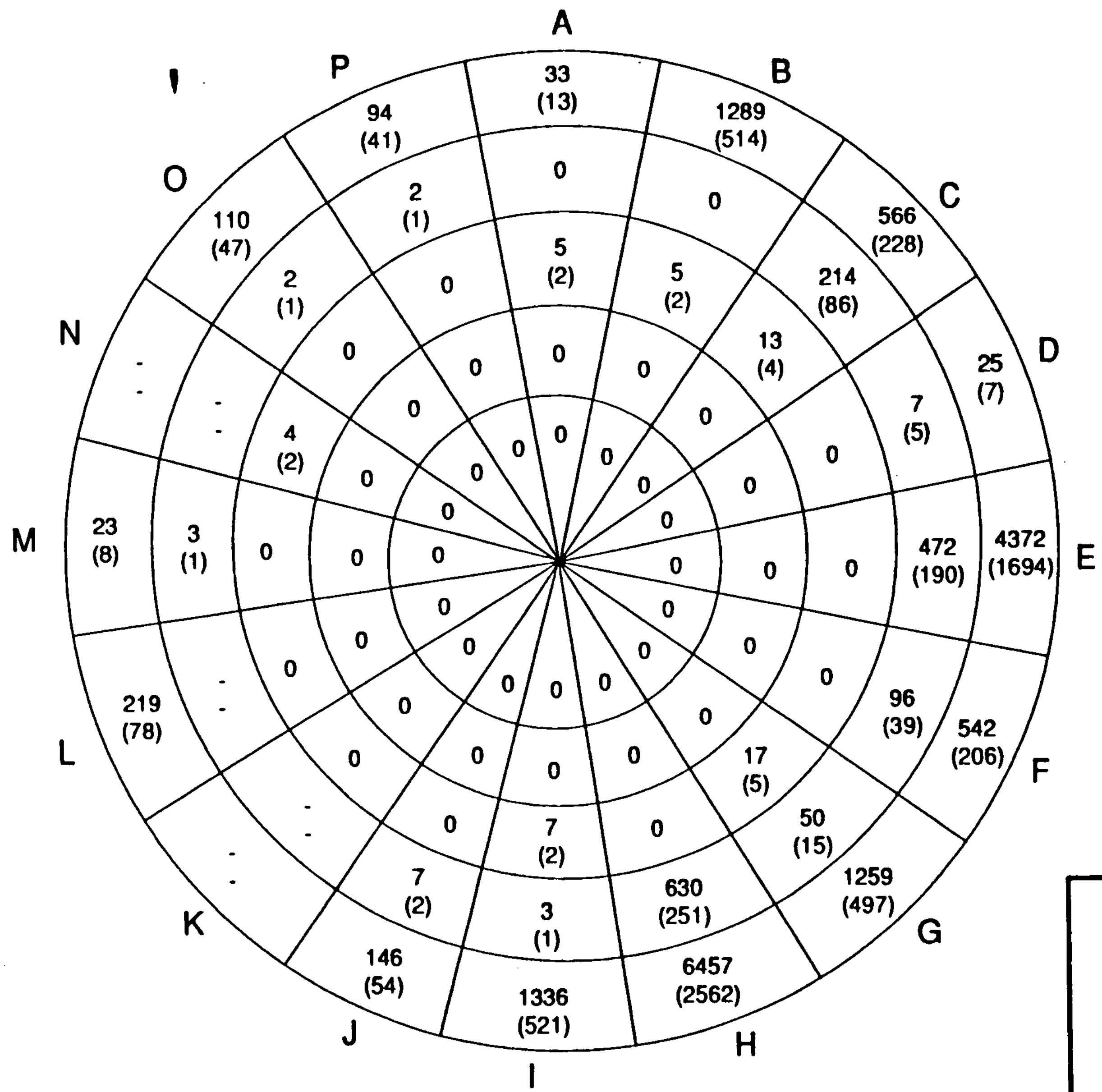
SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS)

Future land use in the vicinity of RFP most likely involves continued urban expansion, increasing the density of residential, commercial, and perhaps industrial land use in the area. The expected trend in population growth in the vicinity of RFP is also addressed in the DOE demographic study (U.S. DOE, 1991b). The report considers expected variations in population density by comparing the current (1989) setting to population projections for the years 2000 and 2010; thus a 21-year profile of projected population growth in the vicinity of RFP can be examined. DOE's projections are based primarily on long-term population projections developed by the Denver Regional Council of Governments (DRCOG). Expected population density and distribution around RFP for the years 2000 and 2010 are shown in Figures 2-5 and 2-6, respectively.

### 2.2.7 Regional Geology

RFP is located on a broad, eastward-sloping pediment surface along the western edge of the Denver Basin. The area is underlain by more than 10,000 feet of Pennsylvanian to Upper Cretaceous sedimentary rocks that have been folded and faulted. Along the foothills west of RFP, sedimentary strata are steeply east-dipping to overturned. On the western side of RFP, Upper Cretaceous strata dip steeply to the east along the western limb of an asymmetrical north-south trending syncline. Immediately west of the plant, steeply dipping sedimentary strata abruptly flatten to less than 2 degrees beneath and east of RFP (EG&G, 1991b). The sedimentary bedrock is unconformably overlain by Quaternary alluvial gravels that cap pediment surfaces of several distinct ages (Scott, 1965).

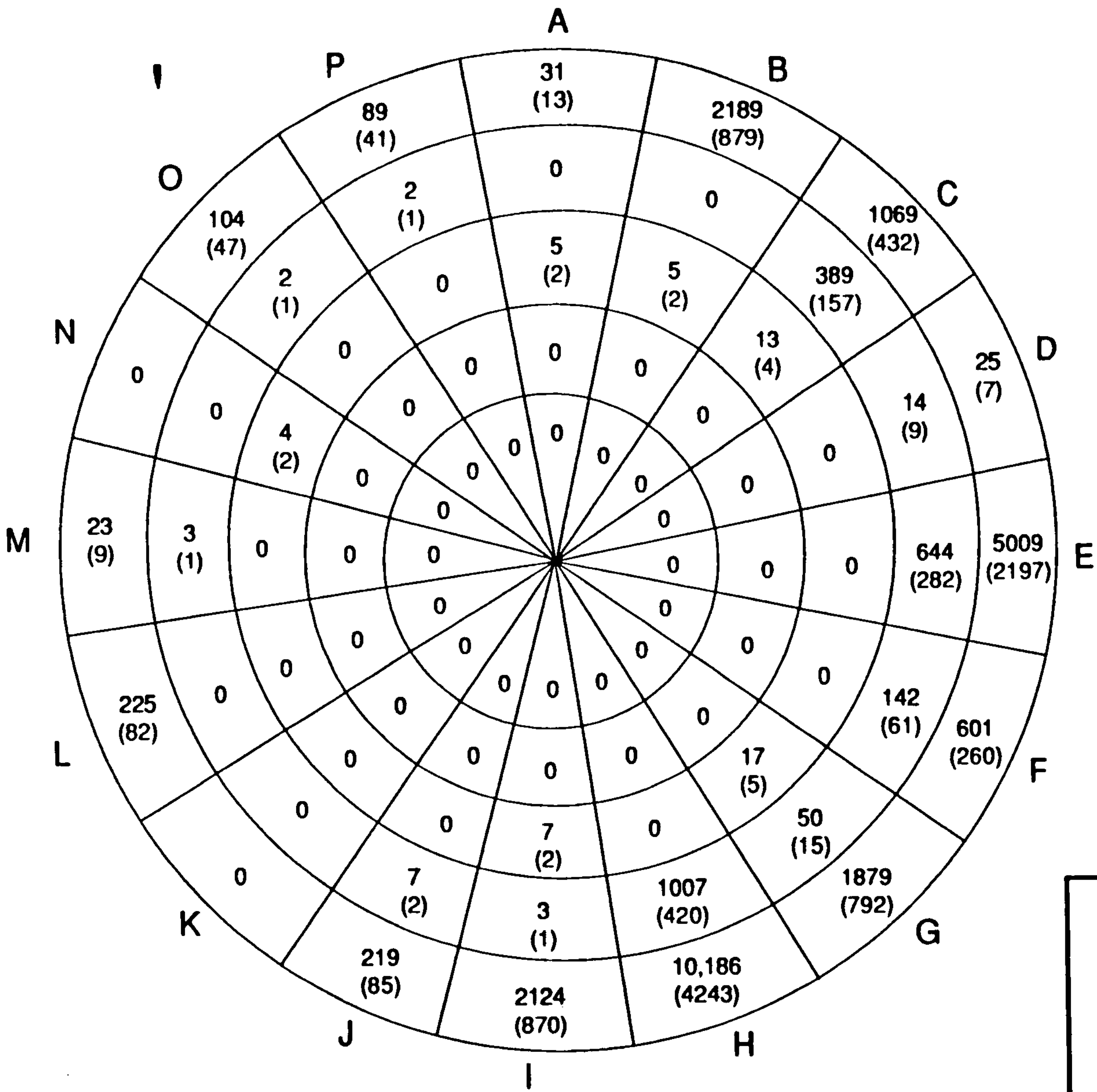
The local stratigraphic section for the RFP area is shown in Figure 2-7. Upper Cretaceous bedrock units directly underlying RFP and pertinent to plant site hydrogeology include, in descending stratigraphic order, the Arapahoe Formation, the Laramie Formation, the Fox




| Miles | Sector Name |
|---|---|
| 0-1 | Sector 1 |
| 1-2 | Sector 2 |
| 2-3 | Sector 3 |
| 3-4 | Sector 4 |
| 4-5 | Sector 5 |

**Figure 2-5**
**2000 POPULATIONS (AND HOUSEHOLDS), SECTORS 1-5**

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS)

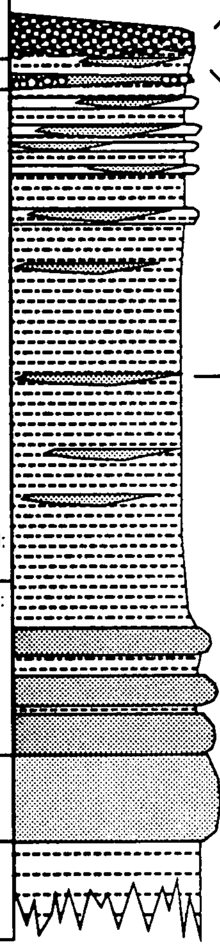



| Miles | Sector Name |
|---|---|
| 0-1 | Sector 1 |
| 1-2 | Sector 2 |
| 2-3 | Sector 3 |
| 3-4 | Sector 4 |
| 4-5 | Sector 5 |

**Figure 2-6**
**2010 POPULATIONS (AND HOUSEHOLDS), SECTORS 1-5**

SOURCE: DOE, "1989 POPULATION, ECONOMIC AND LAND USE DATA BASE FOR ROCKY FLATS PLANT", (IN PRESS)

| Age | Formation | Thickness (feet) |
|---|---|---|
| Quaternary | Rocky Flats Alluvium | 10-20 |
| Cretaceous | Arapahoe Fm. | 15-25 |
| Cretaceous | Laramie Formation | 600-800<br>upper interval: 300-500<br>lower interval: 300 |
| Cretaceous | Fox Hills Sandstone | 90-140 |
| Cretaceous | Pierre Shale and older units | |



**Clayey Sandy Gravels** - reddish brown to yellowish brown matrix, grayish-orange to dark gray, poorly sorted, angular to subrounded, cobbles, coarse gravels, coarse sands and gravelly clays: varying amounts of caliche

**Claystones, Silty Claystones, and Sandstone** - light to medium olive-gray with some dark olive-black claystone and silty claystone weathers yellowish orange to yellowish brown; a mappable, light to olive gray, medium- to coarse-grained, frosted sandstone to conglomeratic sandstone occurs locally at the base (Arapahoe marker bed)

**Claystones, Silty Claystones, Clayey Sandstones, and Sandstones** - kaolinitic, light to medium gray claystone and silty claystone and some dark gray to black carbonaceous claystone, thin (2') coal beds and thin discontinuous, very fine to medium-grained, moderately sorted sandstone intervals

**Claystones, Sandstones, and Coals** - light to medium gray, fine- to coarse-grained, poorly to moderately sorted, silty, immature quartzitic sandstone with numerous lenticular, subbituminous coal beds and seams that range from 2' to 8' thick

**Sandstones** - grayish orange to light gray, calcareous, fine-grained, subrounded, glauconitic, friable sandstone

U.S. Department of Energy
Rocky Flats Plant, Golden, Colorado

**Figure 2-7**

**Generalized Stratigraphic Section for the Central Portion of Rocky Flats Plant**

After EG&G, 1992 July 1992

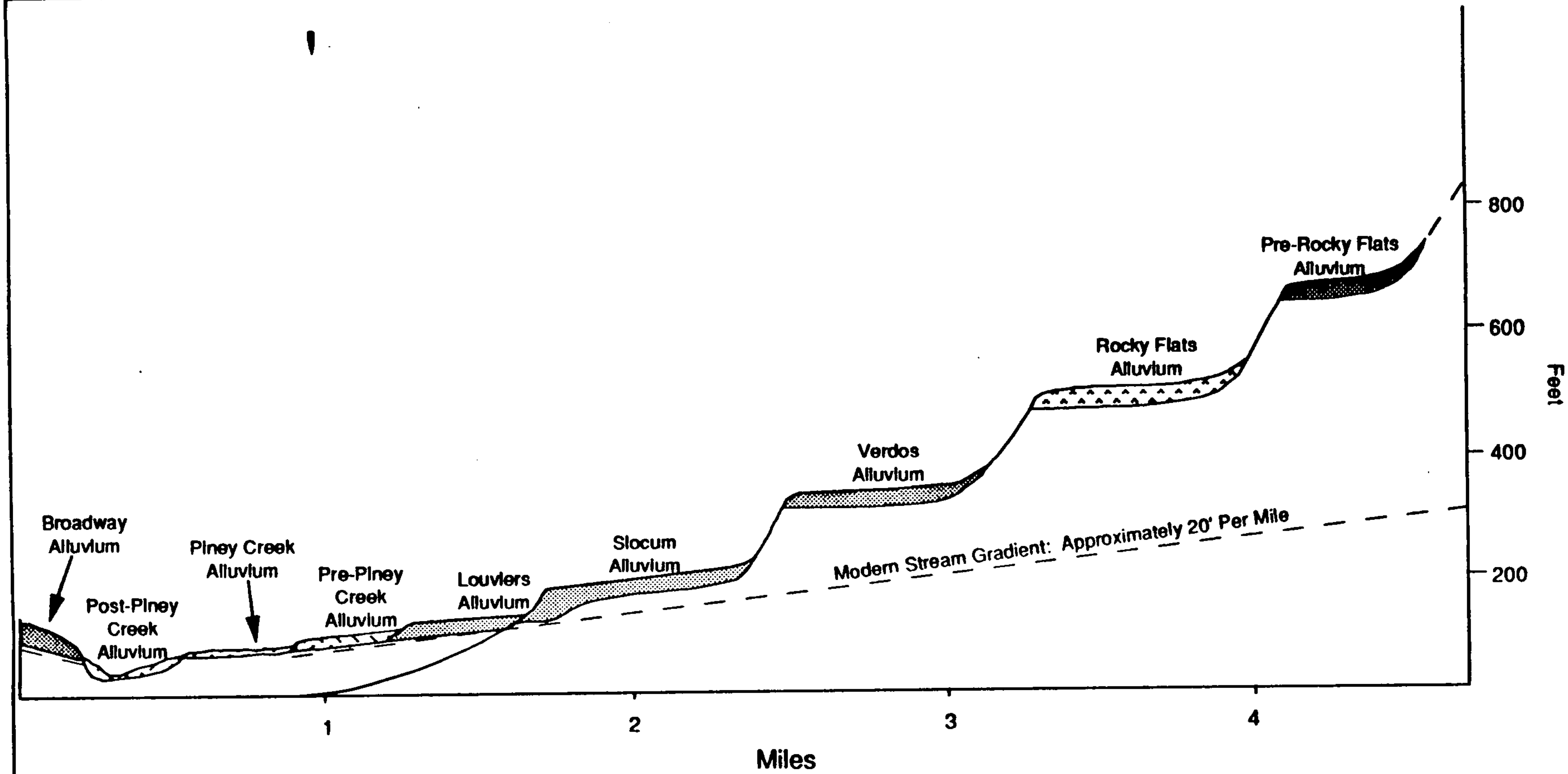
Hills Sandstone, and the Pierre Shale. Surficial deposits at RFP consist of Rocky Flats Alluvium, colluvium, valley-fill alluvium, disturbed ground, and artificial fill. The bedrock units and overlying surficial Quaternary units at RFP are described below.

### 2.2.7.1 Quaternary Deposits

The Quaternary deposits in the RFP area (Figure 2-8) have been categorized into pediment cover and valley fill. The Rocky Flats, Verdos, and Slocum Alluviums represent pediment covers. The valley-fill alluviums include the Louviers and the Broadway Alluviums. Additional recent alluvial valley-fill deposits include the Piney Creek and Post Piney Creek Alluviums (EG&G, 1991c).

The Rocky Flats Alluvium is the oldest alluvial deposit in the RFP area and consists of poorly sorted, angular to rounded, coarse gravels, sands, and gravelly clay. Caliche amounts vary from trace to abundant (EG&G, 1991c). Dominant lithologies include detritus from Precambrian quartzite, schist, and gneiss. Thickness at the type locality immediately south of RFP is 50 feet and ranges from 10 to 90 feet (Machette et al., 1976). The Verdos Alluvium consists of a sandy, cobbly to bouldery gravel deposited by Ralston Creek (Machette et al., 1976). Its thickness ranges from 15 to 35 feet. The Slocum Alluvium is composed of well-stratified, clayey, coarse gravel and coarse sand. Its thickness ranges from 10 to 90 feet (EG&G, 1991c).

The Louviers and Broadway Alluviums are composed of coarse sand and cobbly gravel. The thickness of these alluviums ranges from 10 to 25 feet. The Louviers Alluvium forms well-developed terraces above modern streams. The Broadway Alluvium occurs in channels cut into the Louviers Alluvium (EG&G, 1991c).




## LEGEND

| | |
|---|---|
| Qpr | Pre-Rocky Flats Alluvium |
| Qrf | Rocky Flats Alluvium |
| Qta | Undifferentiated Terrace Alluvium |
| Qa | Valley-Fill Alluvium |

EG&G Rocky Flats, Inc. March 1992

**Figure 2-8**

**Quaternary Stratigraphic Relationships in the Vicinity of the Rocky Flats Plant**

Reference: Scott (1963)

M51E\ES\KT FOLDER\QUAT STRAT.MDW\7/15

The Pre-Piney Creek, Piney Creek, and Post-Piney Creek Alluviums are the most recent identified deposits. The Pre-Piney Creek Alluvium consists of silt and sand with pebble lenses, and the Piney Creek Alluvium is composed of clay, silt, and sand with some pebble beds. The Post-Piney Creek Alluvium consists of poorly consolidated, humic, fine-grained to medium-grained sands interbedded with magnetite-rich sands (EG&G, 1991c).

#### 2.2.7.2 Other Surficial Deposits

Other surficial deposits within the Rocky Flats area consist of colluvium, slumps, and valley fill (EG&G, 1991b). Erosion has formed deposits of colluvium on the sides of steep slopes and in the stream valleys. The valley bottoms contain valley-fill deposits deposited by sedimentation from streams. Gentle stream-cut valley walls are often covered in part by shallow slumps. These features are recognized by a curved scarp at the top, a coherent mass of material downslope that may be rotated back toward the slip plane, and hummocky topography at the base. Surficial deposits are generally composed of variable amounts of gravel, sand, silt, and clay. These deposits are derived from Precambrian rocks, younger sedimentary bedrock, and older surficial deposits.

#### 2.2.7.3 Upper Cretaceous Sedimentary Rocks

The Arapahoe Formation is the uppermost bedrock unit underlying RFP and consists primarily of claystones and silty claystones in the RFP area. The Arapahoe Formation is approximately 15 to 20 feet thick in the center of RFP (EG&G, 1992). Arapahoe Formation sandstones are predominantly very fine grained to medium grained, with minor conglomeratic lenses. Weathered sandstones are pale orange, yellowish gray, and dark yellowish orange. Unweathered sandstones are light gray to olive gray. The sandstones typically are interlayered with clay lenses and are lenticular in geometry. The dominant claystones and silty claystones are light olive gray to medium olive gray and weather to dark yellowish orange. Iron-oxide staining of Arapahoe Formation sediments is common to depths of 20 feet (EG&G, 1991c).

The Laramie Formation, which is composed of an upper claystone interval and a lower sandstone and coal interval, is approximately 600 to 800 feet thick (EG&G, 1992). The upper Laramie Formation consists of silty claystones and siltstones and fine-grained, lenticular, fluvial sandstones. The silty claystones are light olive gray to olive black, massive, occasionally sandy, and contain carbonaceous material. The siltstones are also carbonaceous, with iron-oxide nodules and slickensides along fractures. The lower Laramie Formation consists of very fine-grained to medium-grained sandstones up to 50 feet thick and coal beds ranging from 2 to 8 feet thick (EG&G, 1991c).

The Fox Hills Formation averages 90 to 140 feet thick and consists of thick-bedded to massive, very-fine-grained to medium-grained feldspathic sandstone that is grayish orange to light gray in color. The sandstones are interlayered with thin beds of siltstone and claystone (EG&G, 1992). The Fox Hills Formation crops out within the RFP buffer zone west of the main plant site.

### 2.2.8 Hydrogeology

Ground water flows in surficial materials and in the Arapahoe and Laramie Formation sandstones and claystones. The uppermost aquifer at RFP consists of surficial materials (Rocky Flats Alluvium, colluvium, valley-fill alluvium, artificial fill, and disturbed ground), weathered bedrock units, and subcropping sandstones of the Arapahoe Formation.

The unconfined ground water flow system in the surficial materials exhibits relatively large potentiometric surface changes in response to precipitation events and stream and ditch flows (Hurr, 1976). There are also seasonal variations in the saturated thickness of the surficial materials. Relative fluctuations in the water-table surface vary approximately 2 to 25 feet at RFP (Hurr, 1976). Recharge is from precipitation, snowmelt, and infiltration from ditches, streams, and ponds. Discharge occurs at minor seeps in colluvial materials that cover the contact between the alluvium and bedrock along the edges of the valleys, by seepage into other geologic formations and streams, and through evapotranspiration. The Arapahoe Formation is recharged by ground water movement from overlying surficial deposits, by infiltration from streams, and by infiltration of precipitation into bedrock that crops out in the western portion of RFP. Recharge is greatest during the spring and early summer, when rainfall and stream flow are at a maximum and water levels in the Rocky Flats Alluvium are high. Recharge conditions in the main plant area may differ from those in undeveloped areas because of the greater amount of paved and covered surfaces.

The potentiometric map in Figure 2-9 indicates that ground water flow in the uppermost aquifer is generally toward the east for areas in OU16. The main plant area is situated on a ground water divide, which lies approximately west-east beneath Central Avenue. Generally, ground water flow along the lower contact of the surficial material with the underlying Arapahoe Formation claystones is downgradient.

In the western portion of RFP, where the alluvium is thickest, the potentiometric surface is 50 to 70 feet below ground surface. Although the depth to the potentiometric surface in the alluvium is variable, it becomes generally shallower from west to east as the thickness of the alluvium decreases. The direction of unconfined ground water flow is generally to the east along the gently sloping contact between the unconsolidated surficial materials and the underlying bedrock. Unconfined ground water also exists in subcropping Arapahoe and Laramie Formation sandstones. Regionally, ground water flow in the Arapahoe Formation is toward the South Platte River in the center of the Denver Basin (Robson et al., 1981). Ground water in some Arapahoe Formation sandstones exists under confined conditions.

Hydraulic conductivity data specific to the OU16 IHSSs do not exist. However, sitewide data are available. The uppermost aquifer is a heterogeneous deposit that exhibits a significant degree of lateral and vertical lithologic variability. Hydraulic conductivity for the Rocky Flats Alluvium ranges from $1 \times 10^{-2}$ centimeters per second (cm/s) (Hurr, 1976) to $4 \times 10^{-8}$ cm/s (U.S. DOE, 1988). The lower Arapahoe Formation sandstones have a hydraulic conductivity of approximately $1 \times 10^{-6}$ cm/s (EG&G, 1991c). The most recent hydrogeologic investigation indicated that the hydraulic conductivity of the uppermost aquifer is approximately $6 \times 10^{-5}$ cm/s (EG&G, 1991c).

## 2.3 IHSS DESCRIPTIONS AND HISTORIES OF OCCURRENCES/OPERATIONS

The initial step in development of this document was a review of existing information. Available historical and background data for each IHSS were collected through a review of the Rocky Flats Environmental Database Systems (RFEDS) and a literature search that included documents at the Rocky Flats Public Reading Room and various RFP libraries. The Historical Release Report (HRR) for the Rocky Flats Plant (U.S. DOE, 1992) was the primary source of background and environmental sampling information for the OU16 IHSSs. Therefore, the precise locations of OU16 IHSSs in this document may differ from the IAG locations as a result of new information obtained while preparing the HRR. References cited in the HRR relevant to OU16 IHSSs were reviewed and used for characterization of the OU16 IHSSs. The references are included in Appendix A.

Analytical results for routine environmental monitoring at RFP obtained from RFEDS were used where applicable to evaluate the nature and extent of contamination associated with the OU16 IHSSs. The RFEDS data for ground water and surface water samples for contaminants of interest are presented in Appendices B and C, respectively.

### 2.3.1 IHSS 185, Solvent Spill

Description of Occurrence

On November 10, 1986, at approximately 1:50 P.M., a forklift operator was transferring a pallet of 55-gallon drums from a truck to the southeast dock of Building 707. As the operator was lowering the pallet, a fork punctured a 55-gallon drum containing 1,1,1-trichloroethane (TCA), causing approximately 4 gallons of liquid to leak (Rockwell International, 1986e, 1986f, and 1988) onto the southeast dock and adjacent paved areas (U.S. EPA, 1988). The location of IHSS 185 is shown in Figure 2-3.

Response to Operation/Occurrence

The forklift operator immediately notified the shift superintendent, Environmental Science, and the Fire Department of the incident (Rockwell International, 1986e and 1986f). The Fire Department used four bags of Oil Dry, a commercial absorbent, to clean up the spill (Rockwell International, 1988). The absorbent was placed in drums. References state conflicting information regarding disposal of the absorbent, which was taken to either Hazardous Storage (Rockwell International, 1986e and 1986f) or an approved offsite facility (Rockwell International, 1988). The punctured drum was sealed, placed in an overpack drum, and sent to the Rocky Flats Hazardous Waste Group for disposal (Rockwell International, 1988).

### 2.3.2 IHSS 192, Antifreeze Discharge

Description of Operation/Occurrence

On the morning of December 2, 1980 (Rockwell International, 1980a and 1980b) or December 3, 1980 (Rockwell International, 1980c), RFP Utilities personnel drained approximately 155 gallons of antifreeze solution containing 25 percent ethylene glycol from the evaporator of Brine Chiller CH-1 into a floor drain in Building 708 (Rockwell International, 1980a, 1980b, and 1980c). The antifreeze was drained from the evaporator because it was leaking into the refrigerant portion of the Brine Chiller, which would have caused internal corrosion of the machine.

The floor drain discharged into a storm runoff collection system, which consists of a buried metal culvert south of the building. The buried culvert runs eastward from Building 708 under the Building 750 parking lot and terminates at an open metal culvert immediately east of Tenth Street. The storm runoff system discharges from the metal culvert at the east side of what is now the Protected Area (formerly the Perimeter Security Zone) into Walnut Creek (Rockwell International, 1980c).

Rockwell Environmental Analysis personnel observed the release in a ditch immediately east of the Building 750 parking lot at approximately 12:30 P.M. on the day of the spill (Rockwell International, 1980a). The location of IHSS 192 is shown in Figure 2-3.

Response to Operation/Occurrence

The flow was contained by diverting the stormwater discharge into retention Pond B-1. The Pond B-5 dam was closed, and there was no offsite discharge of the liquid. Following the release, 5,000 gallons of water were flushed through the drainage system into Pond B-1 (Rockwell International, 1980a).

Follow-up samples were collected from several locations between December 2 and December 5, 1980, and were reportedly analyzed (Rockwell International, 1980a); however, information regarding sampling locations, analytical suite, or laboratory results could not be located. Based on visual observations of color and flow direction, it is believed that the spill was contained in Pond B-1 (Rockwell International, 1980a). Pond B-1 (IHSS 142.5) is being investigated as part of OU6 - Walnut Creek.

### 2.3.3 IHSS 193, Steam Condensate Leak - 400 Area

Description of Operation/Occurrence

During the week ending November 30, 1979, an aboveground steam condensate line located between Building 443 and a valve pit north of a gasoline storage tank was found to be leaking (Rockwell International, 1979a). The steam condensate line is situated on a relatively flat part of the plant site (U.S. DOE, 1988), and aerial photographs (U.S. EPA, 1988) indicated that the area between Building 443 and the valve pit was paved at the time of the spill. The location of IHSS 193 is shown in Figure 2-3.

Response to Operation/Occurrence

The line was abandoned in place, and the condensate was rerouted through a different system by November 30, 1979 (Rockwell International, 1979a). Analysis indicated very low concentrations (0.135 ppm, mg/liter) of amines; however, the sampling locations were not identified (Rockwell International, 1979a).

2.3.4 IHSS 194, Steam Condensate Leak - 700 Area

Description of Operation/Occurrence

On September 26, 1979, an aboveground steam condensate line break occurred in the Building 707 area. Water from the line break flowed into the surface water drainage through Pond B-4 to Walnut Creek. The condensate line contained tritium at an activity of approximately 1,000 pCi/L (Rockwell International, 1979b and 1979c). The volume of condensate that had leaked was not determined, and it is unknown whether this area was paved at the time of the incident. The location of IHSS 194 is shown in Figure 2-3.

Response to Operation/Occurrence

The Rockwell Environmental Analysis group had been informed erroneously that the condensate was going to the sanitary sewer and then to Pond 207-B South. On the afternoon of September 27, 1979, diversion of water to Pond B-1 commenced. Also at that time, the valve at the new Pond B-5 dam was shut (Rockwell International, 1979b and 1979c).

Samples from Pond B-4 collected between September 26 and September 29, 1979, ranged in tritium activity from less than 524 pCi/L to approximately 926 pCi/L. A 24-hour composite sample collected from Walnut Creek at Indiana Street on September 26, 1979, contained 1,163 pCi/L tritium. A grab sample collected on September 27, 1979, from the same location contained approximately 700 pCi/L tritium (Rockwell International, 1979b and 1979c).

### 2.3.5 IHSS 195, Nickel Carbonyl Disposal

Description of Operation/Occurrence

Approximately 185 pounds of nickel carbonyl [$Ni(CO)_4$] contained in nine cylinders and one lecture bottle were stored in a toxic gas storage building for several years prior to 1972 (Rockwell International, 1972). From March through August 1972, the nickel carbonyl was disposed in a dry well located in the buffer zone, south of Lindsay Ranch.

The location of the well is unclear, as noted by the differing descriptions of the following sources. According to RFP employees involved with the operation, the location of the well was either to the east or west of the road leading north from the landfill. This road is no longer in existence and is not easily identified. The well was reportedly marked with a 6-foot-high fence post; however, the post could not be located during site visits conducted December 3 and December 9, 1991 (U.S. DOE, 1992). The IHSS 195 location described above differs from the location presented in the IAG, which placed the location along the firebreak road northeast of the intersection of road north of the landfill and the firebreak road. This location was based on a 1989 review of a map and aerial photograph by an employee involved in the operation. This location could not be verified (U.S. DOE, 1992). According to CEARP Phase I Interview Notes (Rea, 1986), the well was located approximately "100 feet before the drop in the first draw approaching the ranch from the south." This location has not been verified.

References state conflicting information as to well dimensions. The dry well was either 3 feet in diameter and 15 feet deep (Rockwell International, 1972), 4 feet in diameter and approximately 20 feet deep (Rea, 1986), or 2 feet in diameter and 15 feet deep (Dow Chemical Company, 1972). The cylinders were suspended in the dry well with ropes after the valves of the cylinders were opened to vent the nickel carbonyl. Further venting was accomplished with small arms fire. This method of disposal was selected because nickel carbonyl vapors are denser than air and decompose rapidly upon mixing with the atmosphere. Decomposition was so rapid that spontaneous combustion and/or explosion occurred (Rockwell International, 1972). Combustion products may have collected on the sides and bottom of the well (Dow Chemical Company, 1972). After 24 hours, the empty cylinders were retrieved and buried in the Present Landfill (IHSS 114). Two cylinders became wedged in the hole and were buried in place, presumably empty (Rea, 1986). Individuals wore supplied air packs, and a member of the RFP Fire Department supervised the proceedings (Rockwell International, 1972).

Response to Operation/Occurrence

A minimal amount of nickel carbonyl was probably released to the atmosphere during disposal. Samples (presumably of air) at the lip of the well collected after the initial disposal indicated nickel carbonyl concentrations of approximately 10 ppm (Rockwell International, 1972).

### 2.3.6 IHSS 196, Water Treatment Plant Backwash Pond

Description of Operation/Occurrence

The water treatment plant backwash pond, also known as Pond 6, is abandoned and was located south of the water treatment plant (Building 124) (U.S. DOE, 1992). Pond 6 was constructed by March 1955 to retain water for sampling purposes from the filter backwashing operations at the water treatment plant in Building 124. In 1953, effluent from the water treatment plant was intermittent and consisted of filter backwash, filter prewash, sludge blowdown, and other wastewater from raw water treatment. The characteristics of raw water were seasonally variable; therefore, the characteristics of the backwash effluent were also variable. Chemical analyses of Pond 6 water samples were performed from November 1952 until June 3, 1953 (Shephard, 1953).

A July 1955 aerial photograph shows a pond on the north slope of the Woman Creek drainage, approximately 800 feet south of Building 124 (U.S. EPA, 1988). The water treatment plant backwash discharge pipeline (U.S. DOE, 1992) is also apparent on this aerial photograph. Aerial photographs taken in 1962 (CAPS, 1962) show the remains of Pond 6 with no indication of retained water. Photographs taken between 1955 and 1962 have not been located. No records were found of the removal of sludge, sediment, or soil associated with this pond, and plant personnel interviewed by Doty and Associates (1992) were not aware of any such actions.

In approximately the summer of 1972, it is believed that a new pond was created in approximately the same location as Pond 6. The purpose of this new pond was to reduce the velocity of backwash effluent being discharged from the water treatment plant in order to allow sediments to settle out of the water before entering Woman Creek. No official designation was given to this new pond (Doty and Associates, 1992). The backwash settling pond was no longer used after the completion of the Building 124 Backwash Storage Tanks in 1975. As-built drawings dated June 18, 1975 indicate that the outfall pipe was abandoned (in place) and a concrete plug was installed at the inlet of the pipe at Building 124 (Rockwell International, 1975). An August 1, 1975, photograph indicates that water was present in the pond shortly after the time the pipe was believed to be plugged (RFP Photograph, 1975). The settling pond was no longer necessary after the pipeline was plugged, and the pond was allowed to deteriorate (Shirk, 1992).

The presence and function of this pond are confirmed by the Draft CEARP Phase I Installation Assessment of the RFP (U.S. DOE, 1986). It was stated that during the early

1970s, backwash from the water treatment plant was collected in a pond on the south side of Building 124. The water contained flocculants, residual chlorine, and suspended solids. The pond was reported to have dried up during construction of the South Interceptor Ditch (Doty and Associates, 1992) in the late 1970s. This pond was designated IHSS 196 in the RCRA 3004(u) report (Rockwell, 1987).

The area of the pond was significantly impacted during construction of the South Interceptor Ditch. At that time, the berm was destroyed and the pond no longer held water (Doty and Associates, 1992). The area where the pond had been located is now a level, grassy meadow.

Response to Operation/Occurrence

No remediation of or response to the water treatment plant backwash pond is known to have occurred (U.S. DOE, 1992).

### 2.3.7 IHSS 197, Scrap Metal Sites - 500 Area

Description of Operation/Occurrence

In approximately 1958 or possibly in the early 1960s, scrap metal components, primarily from the original plant construction program, were buried in trenches in the central portion of the plant site, west or southwest of Building 559 (Rockwell International, 1981a). The CEARP Phase I report (U.S. DOE, 1986) indicated that there was a second scrap metal burial site, located west of Building 559 and northwest of the first site, that contained building construction debris from early plant construction, most likely from the Austin Company. According to CEARP Phase I interview notes (U.S. DOE, 1986), early records do not document replacement of any transformers at RFP; therefore, there is a slight possibility that transformers containing polychlorinated biphenyls (PCBs) were disposed at the construction debris site. The location of IHSS 197 is shown in Figure 2-3.

Since completion of the Rocky Flats Plant Historical Release Report (U.S. DOE, 1992), additional information pertaining to IHSS 197 has been obtained through interviews with several former RFP employees. The scrap metal burial trenches appear to be associated with RFP Property Utilization and Disposal (PU&D) yards located east and northeast of the Warehouse (Building 551). The RFP PU&D group has been responsible since the late 1950s for the management and transfer of recyclable scrap metal and other reusable excess property. The PU&D yards near Building 551 have been used for storage of such materials from 1955 until the present time. RFP photographs from 1959 and 1960 show storage of aluminum turnings and other scrap metal in these yards (RFP Photographs, 1959; 1960). The transfer of property to PU&D was highly proceduralized to ensure that radioactively contaminated materials were not received. Scrap metal typically was stored at the PU&D yards until sufficient quantity had accumulated for sale to private sources (Doty and Associates, 1992).

Periodically during the history of the Building 551 PU&D yards, trenches were excavated at or near the yards to bury unusable scrap metal. It is believed that the metals excavated from trenches at IHSS 197 in 1981 (see following section) are at least in part, if not entirely, related to this practice. Former RFP employees identified an area north of Building 552 where aluminum and steel scrap were buried in a large hole (Doty and Associates, 1992).

<u>Response to Operation/Occurrence</u>

During the week ending September 4, 1981 (Rockwell International, 1981a), excavation in what is now the Protected Area (formerly the Perimeter Security Zone) unearthed an old scrap metal burial site immediately west of Building 559. A second scrap metal burial site, located west of Building 559 and northwest of the first site, was also unearthed (U.S. DOE, 1992). On September 9, 1981 (Rockwell International, 1981b), work began to remove buried material from the trenches, and excavation and disposal were completed by October 2, 1981. The material unearthed consisted of moist, but not oily, scrap metal consisting of machine turnings, rings, shapes, overlays, and other metal parts. Although some of the buried material was recovered from process areas and could have been radioactively contaminated, monitoring of the materials using a Field Instrument for Detection of Low-Energy Radiation (FIDLER) indicated no detectable radioactivity. In addition, total long-lived alpha concentrations from three portable air samplers at the Building 559 cleanup area showed zero count (Rockwell International, 1981b). Transformers or related material were not present in the material excavated from the scrap metal trenches. According to an internal letter, the material was disposed in the Present Landfill, IHSS 114 (Rockwell International, 1981c).

Approved by:

______________________ __/__/__ ______________________ __/__/__

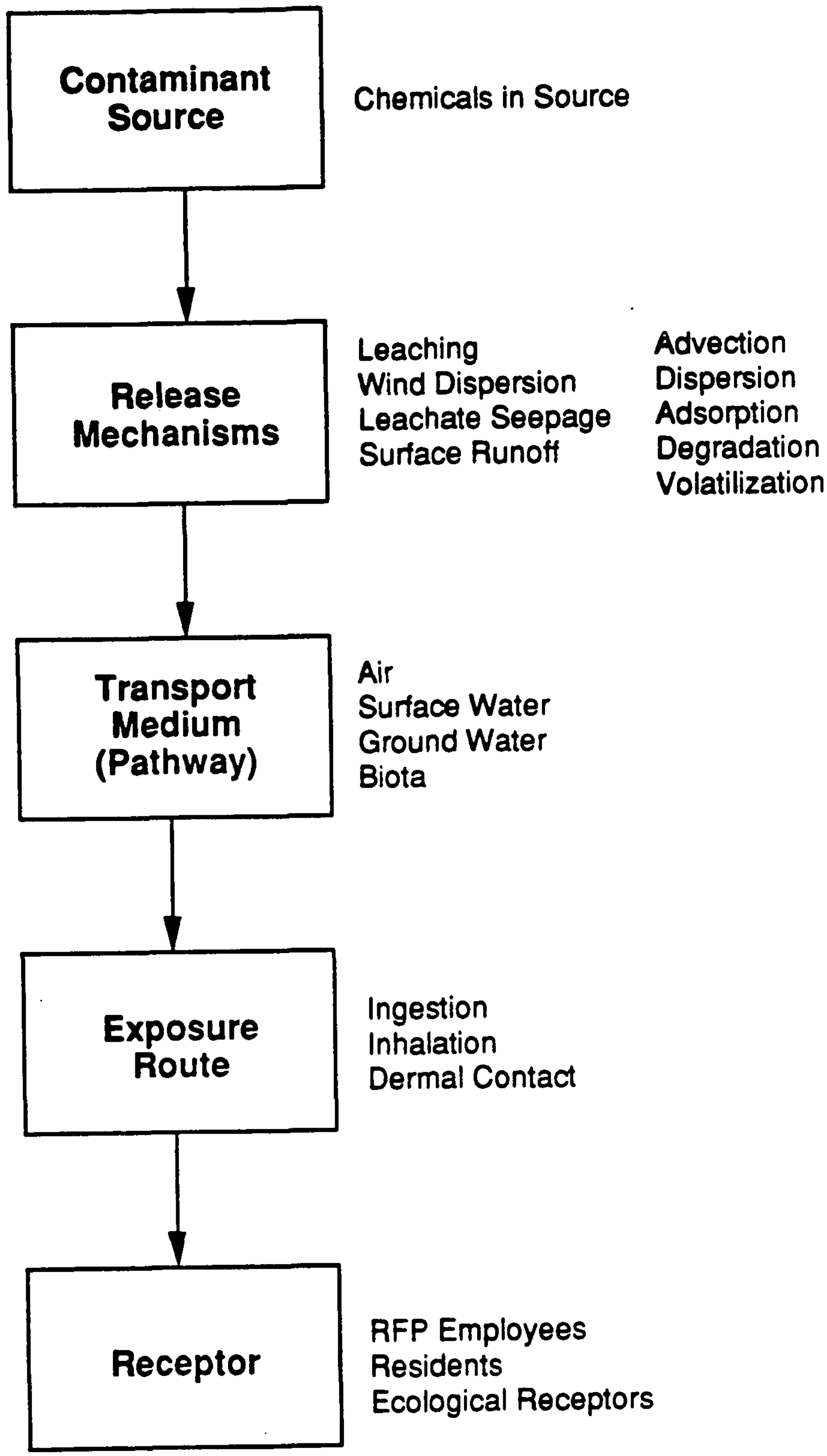
Manager, Remediation Programs RFI Project Manager

## 3.0 PROPOSED ACTIONS AND RATIONALE

### 3.1 APPROACH

In accordance with EPA guidance (U.S. EPA, 1989a), a no further action decision is appropriate at sites where a previous removal action or natural environmental processes (e.g., natural attenuation) mitigate risks to human health and the environment. The risks associated with the OU16 IHSSs and the need for further action were assessed using a conceptual model to evaluate the exposure pathways by which humans and biotic receptors may be exposed to contaminants. The conceptual model describes known and suspected sources of contamination, types of contamination, affected media, contaminant migration pathways, and environmental receptors.

EPA defines an exposure pathway as "a unique mechanism by which a population may be exposed to chemicals at or originating from the site" (U.S. EPA, 1989b). As shown in Figure 3-1, an exposure pathway must include a contaminant source, a release mechanism, a transport medium (pathway), an exposure route, and a receptor. An exposure pathway is not complete without each of these five components. If an exposure pathway is not complete, no risk is posed to human health and the environment and no further action is warranted.




**Generic Site Conceptual Model**

**Figure 3-1**

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The individual components of an exposure pathway are defined as follows:

- Contaminant Source: Includes contaminants and/or contaminated environmental media associated with historical operations/occurrences at each OU16 IHSS.

- Release Mechanisms: Physical and chemical processes by which contaminants are released from the source. The conceptual model identifies primary release mechanisms, which release contaminants directly from the IHSSs, and secondary release mechanisms, which release contaminants from environmental media.

- Transport Medium (Pathway): A medium into which contaminants are released from the source and from which contaminants are in turn released to a receptor (or to another transport medium by a secondary release mechanism). Primary transport media include air, surface water, ground water, and biota.

- Exposure Route: An avenue through which contaminants are physiologically incorporated by a receptor. Exposure routes for receptors at OU16 are inhalation, ingestion, and dermal contact.

- Receptor: A population affected by contamination released from a site. Human receptors for OU16 primarily include RFP workers and visitors. Environmental receptors include biota (both flora and fauna) indigenous to the OU16 environs.

The conceptual model for the OU16 is based on the physical setting, descriptions and histories of occurrences/operations, and nature of contamination at the IHSSs discussed in Section 2.3. The conceptual model provides an overview of all potential exposure pathways that may result from releases from and into each transport medium. Some of these pathways have a higher potential for occurrence than others, based on an evaluation of the source characterization information, including consideration of the remedial response actions and an evaluation of the fate and mobility of the contaminant in each potential source and transport medium.

## 3.2 IHSS-SPECIFIC RATIONALE

The evaluation of the exposure pathway specific to each IHSS in OU16 is presented below. Based on this evaluation, recommendations for further action are proposed.

### 3.2.1 IHSS 185, Solvent Spill

On November 10, 1986, approximately 4 gallons of TCA leaked from a 55-gallon drum onto the southeast loading dock of Building 707 and a paved area adjacent to the loading dock (Section 2.3.1). Documentation indicates that a commercial absorbent was used to clean up the spill (Rockwell International, 1986e and 1986f). This response action minimized or potentially eliminated the source of TCA contamination. Because the spill occurred on a paved area, the wind dispersion transport pathway is not applicable and the infiltration/leaching transport pathway was minimized or eliminated, depending on the condition of the pavement.

Ground water quality data from monitoring well P218089, located approximately 50 feet from IHSS 185 (Figure 2-9) and screened in the upper hydrostratigraphic unit, indicated that

TCA contamination of ground water has not occurred in the upper hydrostratigraphic unit at this location. TCA was not detected in any of the eight samples collected between November 1989 (the date of installation) and April 1992 (Appendix B). The vapor pressure of TCA at 20°C is 13.2 kPa (99 mm Hg; Mackay and Shiu, 1981), and volatilization is rapid (U.S. EPA, 1979). Volatilization represents the primary transport pathway for TCA at IHSS 185. Because the cleanup response action was immediate, the infiltration negligible due to paving, and the high volatility of TCA coupled with subsequent volatilization/loss since the spill occurred, the presence of residual TCA related to the release is eliminated. Because the contaminant source was removed the exposure pathway for IHSS 185 is not complete, thus eliminating risk to human health and the environment. Therefore, no further action is warranted for IHSS 185.

### 3.2.2 IHSS 192, Antifreeze Discharge

As described in Section 2.3.2, a release of 155 gallons of antifreeze containing 25 percent ethylene glycol was diverted into Pond B-1. The drainage system was subsequently flushed with 5,000 gallons of water (Rockwell International, 1980a).

Infiltration of ethylene glycol into the surficial materials likely occurred at the time of the release. However, infiltration of water (5,000 gallons) flushed through the system immediately after release and infiltration of surface runoff and rainwater during the 12 years since the release occurred have diluted the ethylene glycol to concentrations below the detection limit. In addition, modeling of fate and transport characteristics for ethylene glycol, discussed below, indicate that ethylene glycol has completely degraded since the spill occurred.

Ethylene glycol is highly soluble in water (196.4 gm/L at 21°C; Stephen and Stephen, 1963) and has a low vapor pressure (<1.3 Pa or 0.05 mm Hg at 20°C) (Mackay and Shiu, 1981). Data on ethylene glycol volatilization from soils, however, are not available. Ethylene glycol is not strongly sorbed on soil. Although some volatilization may occur at the surface, the low vapor pressure and high solubility of ethylene glycol suggest that vapor concentrations in soil will be low whenever water is present and volatilization will be minimal. Thermo-oxidative degradation of ethylene glycol has been reported. Laboratory tests with river water indicate complete degradation in a few days at 20°C; at 8°C, 14 days were required (Sax, 1986).

The degradation of ethylene glycol (250,000 ppm in antifreeze) at surface conditions was simulated using a mass-balance model (Mackay, 1991). The model uses the observed degradation rates referenced above and shows that ethylene glycol will degrade to less than 7 ppm (Adult Lifetime Advisory for Drinking Water: EPA, 1990) in approximately 20 to 40 days (see Figure 3-2) when using a very conservative degradation half-life of 8 days.

Degradation of ethylene glycol in multi-media environments (air, soil, aqueous leachate) was modeled using the fugacity approach of Mackay (1991). For the purpose of modeling the spill, the following simplifying assumptions were made: (1) all of the ethylene glycol released, 155 gallons of antifreeze, was retained within the storm-runoff system drainage, (2) the 155 gallons of antifreeze were diluted with 5,000 gallons of water within the drainage system, and (3) infiltration of the mixture (antifreeze plus water) to the top 20 centimeters of soil lining the drainage occurred as a single, instantaneous step. Calculations were made using half-life decays of 1.5, 4, and 8 days for ethylene glycol. The results given by the model using a very conservative 8-day half-life show the distribution of ethylene glycol in the air, near-surface soil, and resulting leachate through time (Figure 3-3). These results

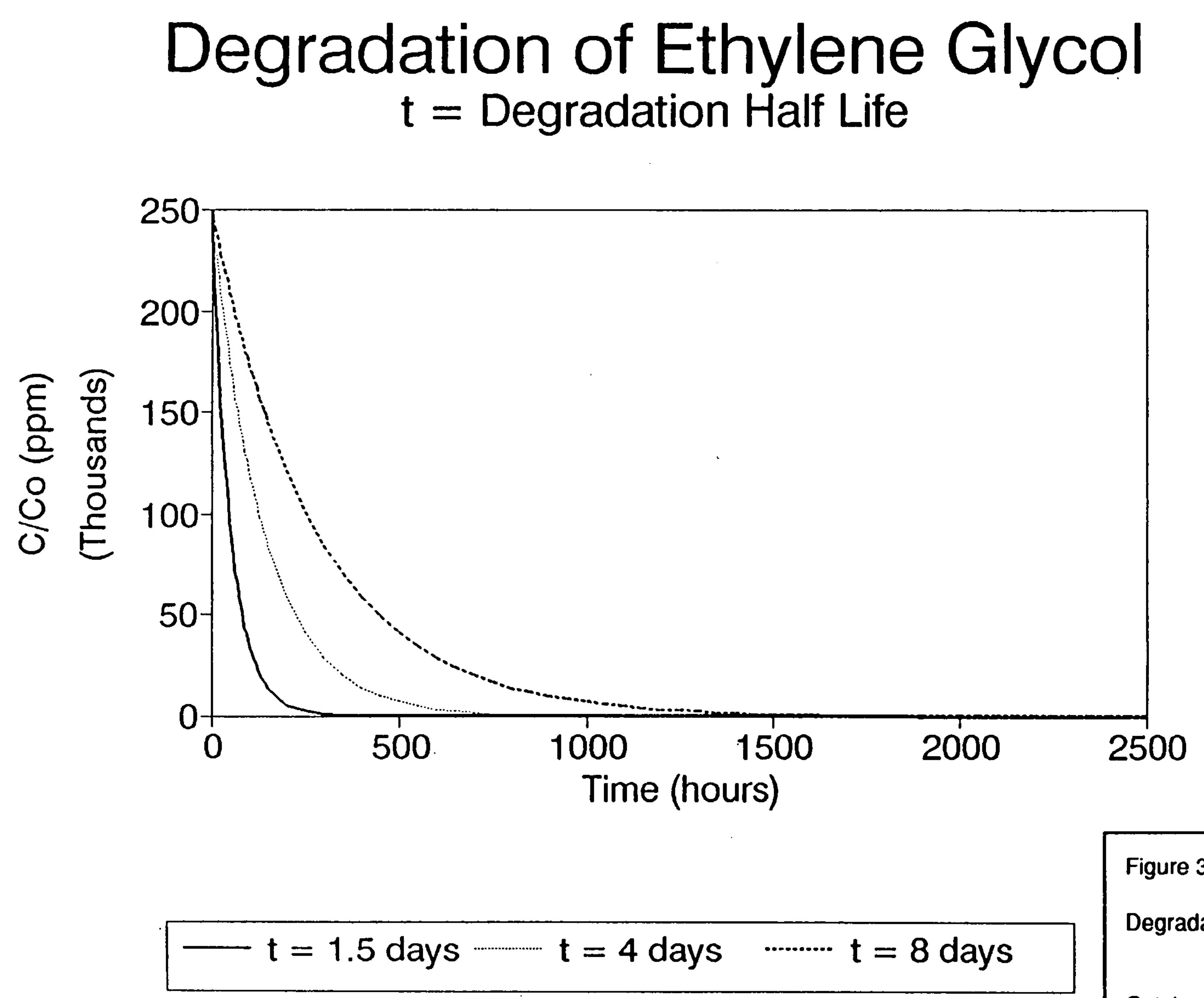



Figure 3-2

Degradation of Ethylene Glycol

October 1992

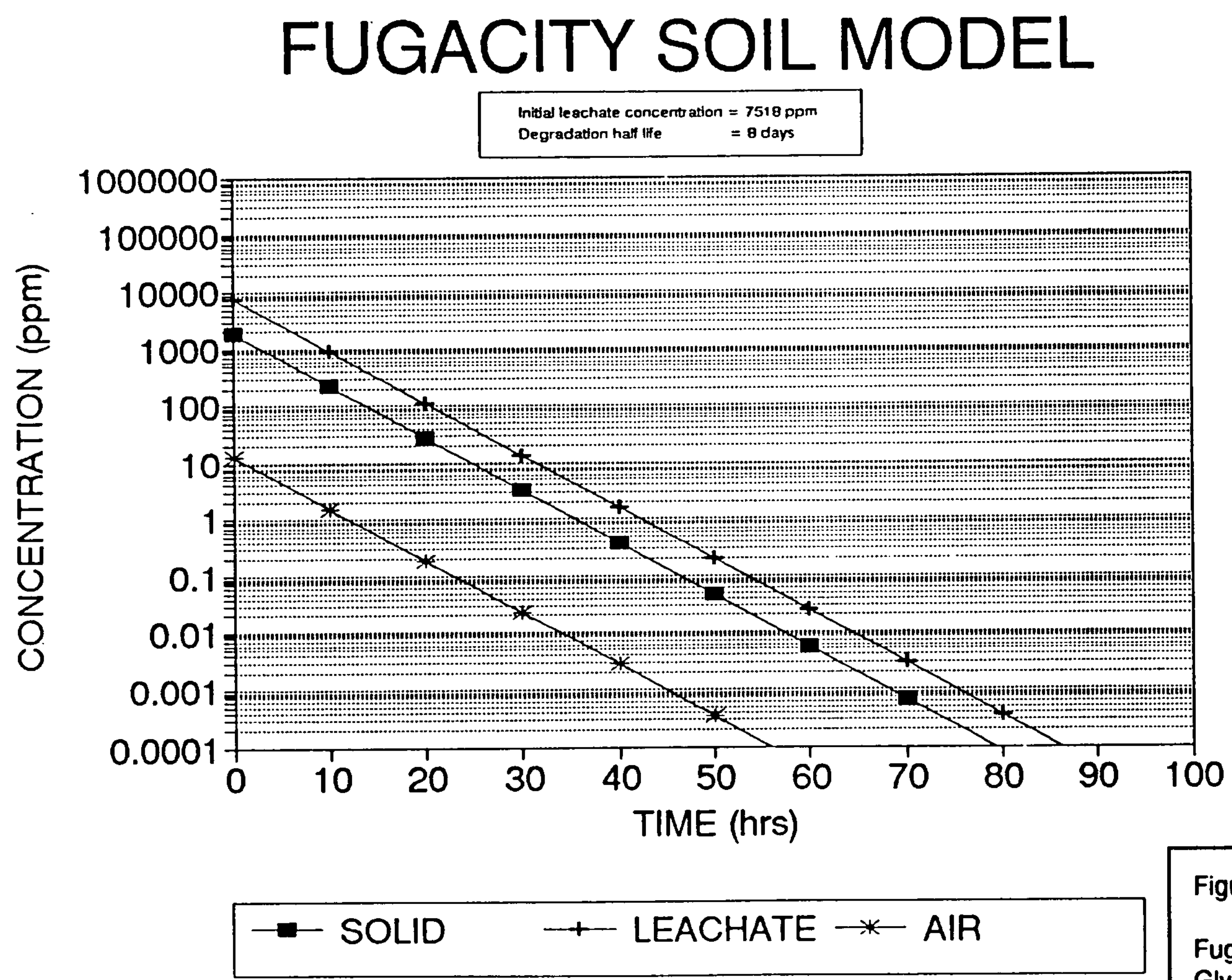



Figure 3-3

Fugacity Soil Model for Ethylene Glycol

October 1992

demonstrate that the concentration of ethylene glycol in the infiltrating solution (leachate, Figure 3-3) decreases to less than 1 ppb in 4 days.

The degradation model described above predicts that no ethylene glycol could be detected in leachate or soils in less than one week following the spill. Detection of ethylene glycol in these media 12 years later would clearly be impossible. Because ethylene glycol related to the 1979 spill is completely degraded at this time, there is no source and the exposure pathway is not complete. As a result, the ethylene glycol spill presents no risk to human health and the environment, and no further action is necessary for IHSS 192.

### 3.2.3 IHSS 193, Steam Condensate Leak - 400 Area

During the week ending November 30, 1979, a steam condensate line containing water (condensate) with 0.135 milligrams per liter (mg/L) amines was found to be leaking (Section 2.3.3). Aerial photographs (U.S. EPA, 1988) indicated that the area where the leak occurred was paved. The paved surface minimized or eliminated the infiltration pathway, depending on the condition of the pavement. The wind dispersion pathway was also eliminated because of the paved surface.

Amines are a large group of organic compounds containing trivalent nitrogen atoms bonded to one or more carbon atoms. The specific compound or compounds detected in the 1979 water analysis was either not determined or not recorded. The duration and volume of the leak and its exact location also remain unknown, and the specific sampling location was not recorded. Communication with plant personnel (Daryl Hornbacher, August 1992) revealed that an amine compound was used at RFP to inhibit corrosion of steam condensate lines. The condensate corrosion inhibitor used was diethylaminoethanol, a highly soluble, alcohol-based compound that is readily transported in solution by water. Skin contact is the primary route of exposure, and the amine has a permissible exposure limit (PEL) of 10 ppm or 10 mg/L in solution (Betz, MSDS, 1988). The concentration of amines in the steam condensate (0.135 mg/L) was approximately two orders of magnitude less than the PEL of 10 mg/L.

In addition, the initial concentration of amines has been diluted many times by rainfall and runoff during the 12 years since the spill occurred. Therefore, diethyaminoethanol could not be detected and no source of contamination is present.

Because the initial concentration of amines was significantly lower than the PEL and because no contaminant source is present, the steam condensate release presents no risk to human health and the environment. Therefore, no further action is necessary for IHSS 193.

3.2.4 IHSS 194, Steam Condensate Leak - 700 Area

On September 26, 1979, a break in a steam condensate line containing low levels of tritium occurred inside what is now the Protected Area (formerly the Perimeter Security Zone) in the Building 707 area (Section 2.3.4). The condensate had an approximate tritium activity of 1,000 pCi/L (Rockwell International, 1979b and 1979c). As discussed in Section 2.3.4, condensate flowed through Pond B-4 to Walnut Creek until the afternoon of September 27, 1979, when flow was diverted into retention Pond B-1. Tritium activity in water samples collected from Pond B-4 between September 26 and September 29, 1979, ranged from 524 pCi/L to 926 pCi/L (Rockwell International, 1979b and 1979c). Samples collected from Walnut Creek at Indiana Street on September 26, 1979, contained slightly elevated tritium activity (1,136 pCi/L) for a 24-hour composite. By the time the water was diverted to Pond B-1 on September 27, 1979, a grab sample collected at the same spot on Walnut Creek contained a lower tritium activity (700 pCi/L).

Tritium is both a naturally occurring and man-made isotope of hydrogen and behaves identically to hydrogen when combining with oxygen to form water molecules. As a result, tritium is readily transported as a component of surface water and groundwater and is highly mobile within the hydrosphere. Tritium decays rapidly and has a half-life of 12.26 years (IAEA, 1968). The EPA has set a public drinking water standard of 20,000 pCi/L as a maximum contaminant level. The very low levels of tritium released to the environment at IHSS 194 preclude drinking water exposures at this level.

The Background Geochemical Characterization Report (EG&G, 1990) states that the maximum background activity for tritium measured in RFP surface water during 1989 was 980 pCi/L (Table 5-56). There is no information on background levels of tritium at RFP at the time the condensate leak occurred. The concentration of tritium released in the condensate leak does not differ statistically from the reported range of background values measured in 1989. Because the released tritium has undergone one half-life decay during the 12 years since the release occurred, the present-day maximum tritium activity associated with this IHSS would be less than approximately 500 pCi/L. This value is also within the range of background activities reported for tritium in surface waters at RFP (EG&G, 1990). For this reason, contributions of tritium to surface water from the 1979 tritium release are now indistinguishable from the natural background levels of tritium at RFP.

Tritium activity in samples collected from Pond B-4 from May through September 1991 were within background activity levels for surface waters (Appendix C). In 1989, samples from Pond B-1 were analyzed for tritium (EG&G, 1991d); analytical results indicated an activity level of 360 pCi/L ± 220 pCi/L. RFP alluvial monitoring well P218089 is located within 50 feet of the IHSS (Figure 2-9). Groundwater samples collected in May 1990, June 1991, and August 1991 were analyzed for tritium (Appendix B). Tritium acitivity ranged from 110 to 383 pCi/L, within the range of background activities (390 pCi/L maximum) reported for alluvial groundwater at RFP (EG&G, 1990).

At present, the available data indicate that tritium values associated with the steam condensate leak do not exceed background values because (1) tritium concentrations in the initial release were not statistically distinct from the current range of background values, (2) the half-life decay of tritium has reduced the initial activity by half since 1979, (3) a portion of the release was contained in the B-series ponds, and (4) current analyses of Ponds B-1 and B-4 water and groundwater from a well adjacent to the IHSS have indicated background-level tritium activities. Therefore, tritium associated with this IHSS does not represent an existing source of contamination. IHSS 194 does not pose a risk to human health or the environment, and no further action is warranted.

### 3.2.5 IHSS 195, Nickel Carbonyl Disposal

From March through August 1972, cylinders of nickel carbonyl were opened, lowered into a dry well located in the buffer zone, and vented with small arms fire to allow decomposition in air. Two of the cylinders became wedged and were buried in place (Section 2.3.5).

Samples, probably of air, from the lip of the well indicated nickel carbonyl concentrations of approximately 10 ppm being released during the disposal. These samples, collected and analyzed 20 years ago at the time of disposal, would not represent modern-day conditions because of the fate and transport characteristics of nickel carbonyl. Nickel carbonyl is highly volatile (oxidation is so rapid that combustion and/or explosion occur in air) and readily decomposes in the presence of oxygen. Immediately upon decomposition of nickel carbonyl, residual nickel would combine with oxygen in the atmosphere to form very fine-grained nickel oxide (Brady and Humiston, 1982), which would be driven from the dry well by air currents resulting from explosion and the heat of combustion. Wind dispersion probably caused widespread dissemination of nickel oxide particles, which would not be detected at concentrations exceeding background. Nickel oxide may have collected on the sides and bottom of the well. Buried nickel oxide present at IHSS 195 is not released to air or surface water.

Nickel oxide buried within the well has extremely low potential for release. Nickel can be released from buried nickel oxide to groundwater and soils by (1) dissolution of nickel oxide in water and (2) cation exchange between groundwater and the host soil or sediments. The rate of cation exchange is dependent on the cation exchange capacity of the surrounding soils or sediments and the availability of nickel in groundwaters. Nickel oxide, however, is essentially insoluble. The equilibrium constant (K) for pure nickel oxide dissolution in water can be calculated from thermodynamic data (see Appendix D). The calculated K for the reaction $NiO_{(s)} \rightarrow Ni^{2+}{}_{(aq)} + 0.5O_{2(aq)}$ is $10^{-30.5}$, and the activity (effective concentration) of nickel in aqueous solution resulting from nickel oxide dissolution will not be measurable by existing methods. For every gram (0.002 pound) of nickel oxide in contact with typical groundwater, approximately $10^{-26}$ microgram ($\mu$g) of nickel per liter of water is transfered to solution. EPA's reference dose for nickel in drinking waters is 100 $\mu$g/L (U.S. EPA, 1990).

Based on the above information, residual nickel oxide associated with IHSS 195 does not represent a potential source of groundwater contamination. IHSS 195 does not pose a risk to human health and the environment because there are no viable transport pathways. No further action is warranted.

### 3.2.6 IHSS 196, Water Treatment Plant Backwash Pond

The CEARP Phase I document (U.S. DOE, 1986) suggested that IHSS 196 was excavated in the 1970s when the RFP surface water diversion system was constructed. However, this information cannot be verified because of the anonymity of the interviewees.

New information presented in the HRR (U.S. DOE, 1992) indicated that the correct location of IHSS 196 is approximately 800 feet south of Building 124 on the north slope of the Woman Creek drainage. This location is approximately 100 feet hydraulically downgradient of IHSS 115, the Original Landfill. Doty and Associates (1992) confirmed this location for IHSS 196. The backwash pond that makes up IHSS 196 was also known as Pond 6, or the Landfill Pond. None of the persons interviewed by Doty and Associates (1992) had any recollection of any materials ever being removed from Pond 6.

Because previous removal has not eliminated the source, and natural environmental processes have not prevented release and migration of contaminants, the exposure pathway for IHSS 196 is complete. Therefore, there is potential risk to human health and the environment, and further action is warranted. However, investigative action proposed for IHSS 115 (Original Landfill) in Table 5 of the IAG (U.S. DOE, 1991a) represents further action appropriate to IHSS 196. The present scope of the IHSS 115 investigation is appropriate to IHSS 196 for the following reasons: (1) the area of investigation for IHSS 115 includes IHSS 196 (Figure 3-4), (2) the target analytes for the IHSS 115 investigation include contaminants associated with IHSS 196, and (3) contaminant concentrations associated with IHSS 115 are likely to be significantly greater than concentrations associated with IHSS 196. Relevant portions of the Field Sampling Plan from the OU5 (Woman Creek) Phase I RFI/RI Work Plan (EG&G, 1992a) are included in Appendix E. Additional action specific to IHSS 196 is not warranted.

### 3.2.7 IHSS 197, Scrap Metal Sites - 500 Area

As discussed in Section 2.2.7, scrap metal components from the original plant construction program were buried in trenches in the central portion of the plant site in the vicinity of Builing 559 during the late 1950s to early 1960s. In 1981, the buried material was excavated for construction of what is now the Protected Area (formerly the Perimeter Security Zone). Documentation of the excavation activities indicated that the material unearthed was not oily and did not contain electrical transformers and/or related material (Rea, 1986). Health and safety monitoring performed during removal activities did not detect any radioactive contamination.

New information in the HRR (U.S. DOE, 1992) and Doty and Associates (1992) indicates that IHSS 197 is closely related to IHSS 117.1 (North Site Chemical Storage) OU13, and the area defined for IHSS 117.1 includes most of IHSS 197. Both of these sites are associated with the original Property Utilization and Disposal (PU&D) yard located immediately north of Building 551. This yard was used for temporary storage of reusable equipment, recyclable scrap metals, and some drummed wastes. Section 2.3.7 summarizes this new information.

Given the uncertain characterization of the remaining waste materials, their volumes, and the extent of their removal during PA perimeter construction, further investigation of IHSS 197 is warranted. The investigation of IHSS 197 can be accomplished by including it with the investigation of IHSS 117.1. This will require extension of the area to be sampled in the

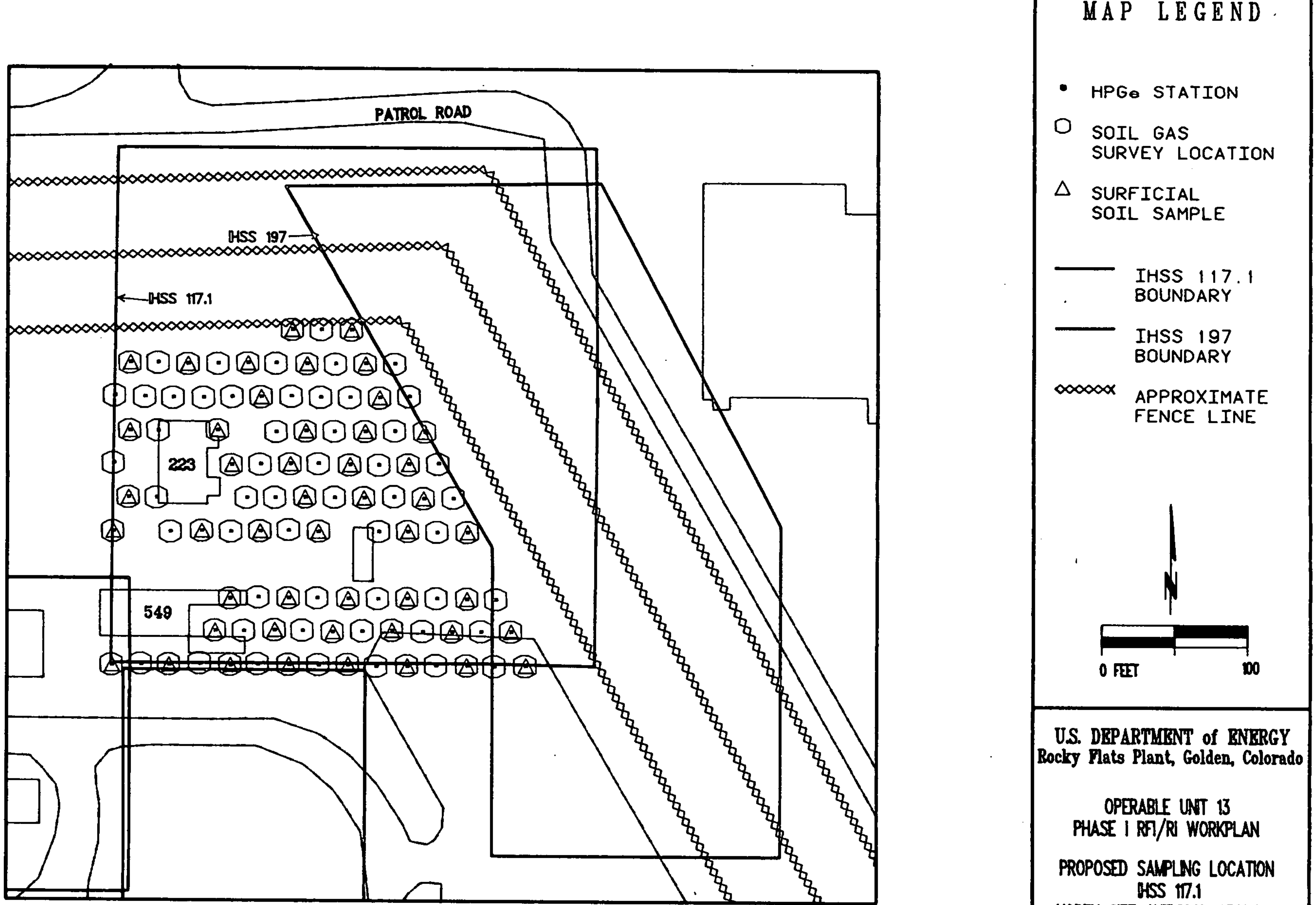
IHSS 117.1 investigation to include all of IHSS 197 (see Figure 3-5). The OU13 Phase I RFI/RI Work Plan (EG&G, 1992b) is currently being prepared. Relevant portions of the Field Sampling Plan are included in Appendix F. Additional action specific to IHSS 197 is not warranted.

## 3.3 SUMMARY

Sources and potential migration pathways for each IHSS in OU16 are summarized in Table 3-1. Potential risks to human health and the environment associated with historical releases and spills at IHSSs 185, 192, 193, 194, and 195 have been mitigated by past response actions and/or natural attenuation processes that eliminate the source or exposure pathways. Therefore, further action is not justified for these four IHSSs.

Because a previous removal action has not eliminated the source, and natural environmental processes have not prevented release and migration of contaminants, the exposure pathways for IHSS 196 are complete. Therefore, there is potential risk to human health and the environment, and further action is warranted for this IHSS. Investigative action proposed for IHSS 115 in Attachment 2, Table 5, of the IAG (U.S. DOE, 1991a) represents appropriate further action for IHSS 196, and separate action specific to IHSS 196 is not warranted.

Further investigation of IHSS 197 is also warranted because of the uncertain extent of past removal actions. The investigation of IHSS 197 can be accomplished by including it with the investigation of IHSS 117.1. Investigatory action proposed for IHSS 117.1 represents appropriate further action for IHSS 197 because (1) the area of investigation for IHSS 117.1 can be expanded to include all of IHSS 197 and (2) the target analytes for the IHSS 117.1




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

OPERABLE UNIT 13
PHASE I RFI/RI WORKPLAN

PROPOSED SAMPLING LOCATION
IHSS 117.1
NORTH SITE CHEMICAL STORAGE
OU15 OCTOBER 1992

FIGURE 3-5

## Table 3-1 OU16 Low-Priority Sites Sources and Pathways

| | Source | Air Pathway | Surface Water Pathway | Groundwater Pathway | Analytical Results |
|---|---|---|---|---|---|
| **IHSS 185** | | | | | |
| Solvent Spill | Eliminated by response action | Eliminated by wind dispersion, paved surface | Eliminated by volatilization and dilution | Eliminated by paved surface | Below detection limits |
| **IHSS 192** | | | | | |
| Antifreeze Discharge | Eliminated by degradation and dilution | Not applicable | Contained by diversion, eliminated by degradation | Eliminated by degradation | N/A* |
| **IHSS 193** | | | | | |
| Steam Condensate Leak - 400 Area | Source possible | Eliminated by wind dispersion, paved surface | Eliminated by volatilization, degradation, dilution | Eliminated by paved surface | N/A* |
| **IHSS 194** | | | | | |
| Steam Condensate Leak - 700 Area | Eliminated by half-life decay, dilution, diversion | Not applicable | Eliminated by half-life decay, dilution, diversion | Eliminated by half-life decay, dilution, diversion | Below background values |
| **IHSS 195** | | | | | |
| Nickel Carbonyl Disposal | Eliminated by wind dispersion | Eliminated by wind dispersion and subsurface disposal | Eliminated by degradation and subsurface burial | Eliminated by insolubility of nickel oxide | N/A* |
| **IHSS 196** | | | | | |
| Water Treatment Plant Backwash Pond | Source present | Air pathway exists | Surface water pathway exists | Groundwater pathway exists | N/A* |
| **IHSS 197** | | | | | |
| Scrap Metal Sites - 500 Area | Buried source possible | Not applicable | Not applicable | Groundwater pathway exists | Below detection limits |

* N/A = analytical results not available

investigation include contaminants potentially associated with IHSS 197. Additional action specific to IHSS 197 is not warranted.

Approved by:

_______________ __/__/__ _______________ __/__/__

Manager, Remediation Programs RFI Project Manager

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# APPENDIX A

# OU 16 REFERENCES FROM THE HISTORICAL RELEASE REPORT

# APPENDIX A

1500856

IHSS # 185

**Internal Letter**

**Rockwell International**

Date December 15, 1986

No.

TO (Name, Organization, Internal Address)

Those Listed

FROM (Name, Organization, Internal Address, Phone)

D. O. Kissel
I&SSE
Building T452C
2991

SUBJECT: FINAL SIR #86-11-707.1 - TRICHLOROETHANE INCIDENT

Per HSE 3.01, "Notification, Investigation, and Reporting of Occurrences," a copy of the SIR investigation is forwarded to you.

A master copy will be retained in the Industrial & Systems Safety Engineering office.

D. O. Kissel
Industrial Safety Coordinator
Industrial & Systems
Safety Engineering

Enc.

| Distribution | Directors | HS&E Area Reps. | Bldg. Supers. |
| --- | --- | --- | --- |
| F. T. Antonich | G. W. Campbell | S. A. Buckie | R. J. Nau |
| C. P. Bader | J. E. Kinzer | E. A. DiCarlo | J. H. Quella |
| C. W. Ellis | W. A. Kirby | C. R. Lagerquist | D. E. Sturgeon |
| M. F. Hickey | G. R. Langheim | J. M. Ortiz | |
| C. T. Illsley | D. J. Sanchini | J. A. Ray | |
| G. J. Steppen | W. M. Shannon | D. R. Sweet | |
| | C. W. Weidner | | |
| | W. F. Weston | | |
| | G. L. Wilson | | |
| | B. D. Wozniak | | |
| | E. R. Young | | |

1. S. I. R. 86-11-707.1
2. Status Initial:
And Interim:
Final: November 19, 1986

3. Division or Project
Rockwell International

4. Facility, System or Equipment
Rocky Flats Plant, Building 707 Dock Southeast.

5. Date of Occurrence
November 10, 1986

6. Time of Occurrence
1:50 P.M.

7. Subject of Occurrence
55 gallon drum of 1,1,1-Trichloroethane

8. Apparent Cause

Design _____ Material _____ Personnel __X__ Procedure _____
Other____

9. Description of Occurrence
The fork lift operator was lifting a pallet of drums from a truck to the southeast dock of Bldg. 707. As he was lowering the pallet of drums to the dock, he was in close proximity to drums already stationed on the dock. A fork punctured one of the drums containing trichloroethane, causing approximately 4 gallons of material to leak to the ground. Four bags of absorbent was used to clean up the spill.

10. Operating Certification of Facility at Time of Occurrence:
Does not apply

11. Immediate Evaluation:
The cause of the occurrence was the fork lift operator could not judge the distance between the drum on the dock, and the drums that he was setting on the dock.

12. Immediate Action Taken and Results:
The fork lift operator notified the Shift Superintendent, Environmental Science and the Fire Department by Emergency phone (2911) of the incident. The material was cleaned up by the Fire Department and placed into a drum. The drum was removed from the area and taken to Hazardous Storage.

13. Is Further Evaluation Required?
Yes___ No X___

14. Final Evaluation and Lesson Learned:
Fork lift operators have been informed when unloading drums, to be certain of the distance they have to work with when setting them on the docks.

15. Corrective Action:
The fork lift operators have been instructed when unloading drums o r pallets to the dock area, to be sure that they are totally aware of their surroundings and the distances involved. In the future spotters will be used in areas of restricted vision.

16. Programmatic Impact:
None

17. Impact Upon Codes and Standards:
None

18. Similar Unusual Occurrence Report Numbers:
None

19. Signatures:

C. W. Ellis, Plant Services

F. T. Antonich, Industrial Safety Representative

G. J. Steppens, HS&E Area Representative

C. T. Ilsley, Environmental Specialist

IHSS # 185

/SC/OS3



1. S. I. R. 86-11-707.1
2. Status Initial:
And Interim:
Final: November 19, 1986

3. Division or Project
Rockwell International

4. Facility, System or Equipment
Rocky Flats Plant, Building 707 Dock Southeast.

5. Date of Occurrence
November 10, 1986

6. Time of Occurrence
1:50 P.M.

7. Subject of Occurrence
55 gallon drum of 1,1,1-Trichloroethane

8. Apparent Cause

Design ____ Material ____ Personnel X Procedure ____
Other____

9. Description of Occurrence
The fork lift operator was lifting a pallet of drums from a truck to the southeast dock of Bldg. 707. As he was lowering the pallet of drums to the dock, he was in close proximity to drums already stationed on the dock. A fork punctured one of the drums containing trichloroethane, causing approximately 4 gallons of material to leak to the ground. Four bags of absorbent was used to clean up the spill.

10. Operating Certification of Facility at Time of Occurrence:
Does not apply

11. Immediate Evaluation:
The cause of the occurrence was the fork lift operator could not judge the distance between the drum on the dock, and the drums that he was setting on the dock.

12. Immediate Action Taken and Results:
The fork lift operator notified the Shift Superintendent, Environmental Science and the Fire Department by Emergency phone (2911) of the incident. The material was cleaned up by the Fire Department and placed into a drum. The drum was removed from the area and taken to Hazardous Storage.

13. Is Further Evaluation Required?
Yes___ No X___

14. Final Evaluation and Lesson Learned:
Fork lift operators have been informed when unloading drums, to be certain of the distance they have to work with when setting them on the docks.

15. Corrective Action:
The fork lift operators have been instructed when unloading drums o r pallets to the dock area, to be sure that they are totally aware of their surroundings and the distances involved. In the future spotters will be used in areas of restricted vision.

16. Programmatic Impact:
None

17. Impact Upon Codes and Standards:
None

18. Similar Unusual Occurrence Report Numbers:
None

19. Signatures:

C. W. Ellis, Plant Services

F. T. Antonich, Industrial Safety Representative

G. J. Steppens, HS&E Area Representative

C. T. Ilsley, Environmental Specialist

IHSS# 192

**Internal Letter**

**Rockwell International**

Date: December 5, 1980

To: D. D. Hornbacher
Address: Building 123

From: R. F. Rogers
Bldg. 707 Utilities

2363

Subject: RELEASE OF ANTIFREEZE SOLUTION INTO STORM DRAIN - BUILDING 708

During the morning of Wednesday, December 3, 1980, two Utilities operators and a Maintenance pipefitter drained about 150 gallons of antifreeze solution from the evaporator of Brine Chiller CH-1 into the floor drains near the chiller. The antifreeze solution contained 25% ethylene glycol in water. The floor drains in the building discharge into a buried culvert south of the building. The culvert runs eastward from Building 708 under the Building 750 parking lot and terminates just east of Tenth Street. The appearance of the antifreeze was noted in the ditch by Environmental personnel.

The antifreeze had to be removed from the chiller without undue delay since it was discovered it was leaking into the refrigerant portion of the equipment. A freon-water mixture can corrode the machine internally if not removed promptly. The Environmental group was not advised of the evaporator draining operation.

After draining the evaporator it was decided by Utilities to remove the antifreeze contaminated refrigerant from the chiller. The Environmental group was notified of this phase of the operation in advance of pumping out the freon into drums. Waste Processing personnel were also contacted to determine proper disposal procedures for the freon.

Obviously the Environmental group should have been contacted during the initial phase of the operation. To ensure that everyone in the Building 707 Utilities group is made aware of the importance of environmental concerns, this subject will be the main topic of the December safety meetings. In addition, arrangements will be made with Environmental personnel to conduct a tour for all operators to show how the water courses and holding ponds downstream from the plant are used to control effluent from the plant.

R. F. Rogers

R. F. Rogers
707 Utilities

cc:
R. W. Woodard

16

Rockwell, 1980a

IHSS# 192 **Internal Letter** **Rockwell International** 15/200

Date December 5, 1980 No.

TO T. R. Crites FROM D. D. Hornbacher
Address Address

Phone

Subject ENVIRONMENTAL ANALYSIS WEEKLY HIGHLIGHTS
WEEK ENDING DECEMBER 5, 1980

PROBLEMS

Anti-Freeze Discharge Into Walnut Creek-RLH, RWH
On December 2, 1980 approximately 155 gallons of 25 percent ethelyene glycol (anti-freeze) solution was discharged into North Walnut Creek. The anti-freeze was released from a chiller unit into a floor drain in the Utilities Bldg. 708. This drain discharges into a storm runoff collection system in the Bldg. 700 complex. At about 12:30 p.m., it was initially observed by Environmental Analysis personnel at a point just east of the Bldg. 750 parking lot. The flow was contained by diversion into Pond B-1. Follow-up samples were collected from several locations and are being analyzed. Based on visual observations of color and flow, it is believed that all of the spill was contained in Pond B-1. The Pond B-5 dam was closed and there was no offsite discharge of the liquid.

Follow-up activities include: (1) flushing 5000 gallons of water through the system into Pond B-1; (2) Utilities will prepare a report of the incident that includes corrective actions.

Ambient Air Sampler Down Time-RWH
Due to a transformer failure, ambient air sampler No. S-36 was out of service for about one week. Repairs have been ordered to correct the problem.

Buffer Zone Access -CTI
Unauthorized personnel have been gaining access to the buffer zone by merely signing the log book. Plant Protection has been reminded that approval for access must come from the Environmental Analysis Land Use Coordinator.

Hydrologic Test Hole Laboratory Support-NDK
Four hydrologic test hole samples are split with the Colorado Department of Health. The alpha and beta concentrations for four samples collected in September were reported by CDH at the November exchange meeting. The Rocky Flats samples have not been analyzed by the Bldg. 881 Laboratory. Faster turn around time is needed on any sample that is split with an outside agency. The Laboratory has been contacted concerning this problem.

Rockwell, 1980b

ACCOMPLISHMENTS

Computer Support-JLZ
The first portion of a computer program designed to keep track of the HS&E budget and manpower allocation has been completed. The program has been demonstrated to R. E. Yoder and W. L. Jacobs. Overall, the program was found to be satisfactory and some additions were suggested. Graphics will be added after our plotting software package arrives.

Annual Report-CJB, IMM
A "mock-up" of a new version for annual report formatting was prepared and distributed for review. A meeting will be held in January to firm up format changes before drafting of the 1980 report begins.

Plant Clean Plan-RWH
Milestone No. 1 of a long-range HS&E goal to conduct cleanup activities was completed on schedule. This milestone was to prioritize all future cleanup activities. The priority list is for the period 1981 through 1995.

INFORMATION

Reviews-CJB, RWH, IMM, RLH
A total of five Federal Registers and four Engineering Authorizations were reviewed. One of the authorizations is for modifications to the Bldg. 995 Sanitary Treatment Plant.

Wind Energy Sewage Treatment Facility-RWH
The proposed septic tank/leach field system for the new Wind Energy Building has been disapproved by Jefferson County.

Lawsuit Support-CTI
The 16 air filters originally sent to EML for analysis have been forwarded to LASL and that laboratory is in the process of analyzing the samples. This work is in support of the lawsuit.

Geologic/Seismologic Project-CTI
The final trenches near Golden have been excavated and geologic examination will be complete this weekend. A final discussion of data and conclusions will be held with the U.S. Geological Survey and the Colorado Geological Survey on December 10. Project completion is projected at this time for January 30, 1981.

NPDES Permit Presentation-NDK, RLH
Information Services is preparing slides for the December 10, 1980 NPDES Permit Public Hearing. Also, backup data on the hydrologic test holes is being prepared for use if needed. A final review of the presentation will be held on Monday, December 8, at 1:30 p.m. in the Bldg. 111 Conference Room A.

D. D. Hornbacher

~~COMPANY CONFIDENTIAL~~

IHSS# 192

# Internal Letter

Rockwell International

Date December 8, 1980

No.

TO F. G. Owen

FROM R. E. Yoder

Phone 2206

Subject HEALTH, SAFETY AND ENVIRONMENT HIGHLIGHTS

## PROBLEMS

On December 2, 1980 approximately 155 gallons of 25 percent ethelyene glycol (anti-freeze) solution was discharged into North Walnut Creek. The anti-freeze was released from a chiller unit into a floor drain in the Utilities Building 708. This drain discharges into a storm runoff collection system in the Building 700 complex. At about 12:30 p.m., it was initially observed by Environmental Analysis personnel at a point just east of the Building 750 parking lot. The flow was contained by diversion into Pond B-1. Follow-up samples were collected from several locations and are being analyzed. Based on visual observations of color and flow, it is believed that all of the spill was contained in Pond B-1. The Pond B-5 dam was closed and there was no offsite discharge of the liquid. Follow-up activites include: (1) flushing 5000 gallons of water through the system into Pond B-1; (2) Utilities will prepare a report of the incident that includes corrective actions.

Four hydrologic test hole samples are split with the Colorado Department of Health. The alpha and beta concentrations for four samples collected in September were reported by CDH at the November exchange meeting. The Rocky Flats samples have not been analyzed by the Building 881 Laboratory. Faster turn around time is needed on any sample that is split with an outside agency. The Laboratory has been contacted concerning this problem.

Problems have caused our backlog of samples to be alpha counted to increase to 230. Removing this backlog prior to the holiday break may require some weekend sample changing, particularly if there is much more of a delay in getting the 32 detectors back on line.

## ACCOMPLISHMENTS

A paper titled "Dose Limitation Practices in Recovery Operations Involving Prior Environmental Releases of Plutonium" by D. D. Hornbacher, C. J. Barker, and T. R. Crites has been approved by DOE for submittal to the IAEA symposium on "The Application of the Dose Limitation System in Radiation Practices" to be held in Madrid, Spain, October 1981.

DOES NOT CONTAIN
OFFICIAL USE ONLY INFORMATION
Name/Org J A Nesheim EMCBC Closure Date 10-28-08

~~COMPANY CONFIDENTIAL~~

Rockwell, 1980c

COMPANY CONFIDENTIAL

F. G. Owen
Page 2
December 8, 1980

Dr. Bistline called on several hospitals in the Denver area to discuss obtaining the records of our former employees who died of brain tumors in their hospitals. The hospitals said they must have current and acceptable authorizations--St. Anthony's Central said this must be dated within 90 days of the request and Beth Israel said within 30 days. St. Anthony's said they will consider releasing the records for this special project, but only three out of the 22 cases of interest would be involved. They will be contacting us on this. The other hospitals were very emphatic about their requirements.

Ten nuclear materials safety limits were written; four Engineering, OSA and Work Order reviews were completed; twelve nuclear safety audits were performed; and two criticality indoctrinations were given.

Three self-testing neutron criticality detectors (which constantly compare the count rate of the internal detector, having an alpha source near its active surface, to the output of a local oscillator have been installed in Building 707 criticality alarm system since December 1.

Total laboratory analyses for the week - 7,480

INFORMATION

There were four OSAs acted upon during the past week.

At 1:56 p.m. on December 3, a fire sprinkler head was opened in Room 32 of Building 447 by radiant heat from the "chip roaster" located in that area. The roaster is located in the southwest portion of the room and extends into Room 502 above and on previous occasions has opened sprinklers in this manner at both levels. Approval to remove and plug one head at each floor level where this problem occurs, was obtained from Bob Morris which should eliminate further occurrences.

Michelle Reyes of the LASL Epidemiology Group is coming to Rocky Flats December 10 and 11 to work with us on the brain tumor cases and controls.

Oak Ridge has expressed interest in having an experiment performed at the RFP Critical Mass Laboratory. From brief discussions, the experiment would involve uranyl nitrate, and anticipated funds to RFP would be ~$15,000.

[redacted]

F. G. Owen
Page 3
December 8, 1980

A meeting was held at DOE/ALO on December 1, 1980 to discuss SAR requirements for the Small Wind Energy Conversion Systems (SWECS) program. It was decided that W. Sayer, ALO/OSD, would write a letter to DOE Headquarters requesting that the OSAs, RF Test Program Data, and Environmental Assessments suffice for fulfilling the intent of the SARs. No further action is required of RFP at this time.

Troublesome alarming of large numbers of Selective Alpha Air Monitors throughout Building 771 continues to occur. Previous efforts to confirm and correct ground and neutral input voltage paths seems to be only a partial answer. Multiple alarming, occurring over the Thanksgiving weekend at times during the day shift when no welding or building electrical modifications are occurring, is complicating the troubleshooting approach. Different experiments on power line isolation are being conducted but with no definite conclusion.

We are still finding high bacteria counts in bottled water. Various alternatives are being considered: Finding another vendor (there are indications the water is coming in this way), using tap water in the bottles, or stopping the use of bottled water altogether (our preferred way).

We have no official word from DOE on DOP usage. George Carroll of ALO reports by phone they are working on it and we should probably continue as we are (using DOP for filter and respirator checks, and proceed with efforts to use corn oil for quantitative fitting) until DOE can investigate all alternatives.

Robert E. Yoder
Robert E. Yoder, Director
Health, Safety and Environment

cc:
D. H. Dunbar
R. O. Williams, Jr.

[redacted]

I?C

IHSS #193

# Internal Letter

Rockwell International

Date November 30,1979

No.

TO T. R. Crites

Address

FROM D. D. Hornbacher

Address

Phone

Subject ENVIRONMENTAL ANALYSIS WEEKLY HIGHLIGHTS
WEEK ENDING NOVEMBER 30, 1979

PROBLEMS

Radiometric Survey-RWH
Due to snow and cold weather, no work was conducted on the radiometric survey.

Plant Security Zone-RWH, DFH
A meeting was held with Rockwell Engineering and the consulting engineers for the new plant security zone. Problems were identified concerning footing drains at Buildings 371, 374, 771 and 991 which will have to be modified.

→ Steam Condensate Line Leakage-DFH
A steam condensate line located between Bldg. 443 and a valve pit north of a gasoline storage tank was found to be leaking. Water analysis indicated very low concentration (0.135 ppm) of amines. The line has been abandoned and the condensate rerouted.

Buffer Zone Control-CTI
On November 19, Gate P21 in the buffer zone was found to be partially rewired. An unknown person entered Sector X and drove to Pond D-1. This incident was reported to the Security Department.

Stack Effluent Data-RMN
Plutonium, uranium and beryllium stack data were not available in time for the monthly exchange meeting. Also, the uranium data for Bldg. 881 are higher than normal and require followup actions to determine if the data are valid and if valid, the cause for increases.

Soil Sampling Program-CTI
Due to multiple snow falls, the new soil sampling program to study vertical and horizontal migration of radionuclides in soils in the east sector of the buffer zone has been delayed. Unless we have some nice weather, there may not be any soil data for the annual environmental monitoring report for CY 79.

ACCOMPLISHMENTS

Information Exchange Meeting-CJB
The monthly information exchange meeting for October data was held on November 28. Rocky Flats did not have stack emission data. All other data reported by Rocky Flats and The colorado Department of Health were normal.

Rockwell, 1979c

EPA Discharge Permit Application-RLH
The permit application forms for Dams A-4, B-5 and C-2 have been completed and are ready for transmittal to RFAO.

INFORMATION

Talks-DDH
One new employee indoctrination on environmental monitoring was given this week.

Reviews-CJB, RWH
A total of six Federal Registers, five EJO's, and two OSA's were reviewed for environmental concerns.

EIS Activities-CTI
Preparation of Appendix J for the Final Impact Statement has been initiated. This appendix will list the names and qualifications of major contributors to Volume I has been initiated and is to be completed by December 14.

Draft Soil Sampling Reports-CTI
Two draft reports that evaluate some past soil data have been prepared, reviewed and are ready for final typing and distribution.

Travel-RLH
R. L. Henry traveled to San Francisco to participate in a training course on Water Quality Engineering for Industry. The course was offered by the American Society for Chemical Engineers.

Daryl

D. D. Hornbacher

COMPANY CONFIDENTIAL

1501006-00004328-214

1501006

IHSS #194

Internal Letter

Rockwell International

September 28, 1979

TO R. E. Yoder

T. R. Crites

ENVIRONMENTAL SCIENCES WEEKLY HIGHLIGHTS
WEEK ENDING SEPTEMBER 28, 1979

PROBLEMS

A steam condensate line break in the Bldg. 707 area occurred on September 26. Environmental Analysis was informed by Utilities that the water was going to the sanitary system and then to Pond 207-B-South. This was not the case, the water was actually going into surface water drainage through Pond B-4 to Walnut Creek. On the afternoon of September 27, we began diverting water to Pond B-1 and also shut the valve at the new B-5 dam. Fortunately, the condensate contained tritium at only about 1000 pCi/l. Samples from Pond B-4 ranged from $\leq$ 524 to approximately 926 pCi/l. Samples from Walnut Creek at Indiana showed 1163 pCi/l for a 24 hour composite covering 9-26-79 and about 700 pCi/l in a grab sample for 9-27-79. We are meeting with Utilities to discuss the problem of misinformation and the potential consequences of offsite release of steam condensate.

On Friday, September 21, the contractor for the Surface Water Control Project was found scraping top soil in an area that had not been scarified near the C-2 dam. The operation was stopped immediately. Air sampler results did not show any airborne TLL$\alpha$ activity. On Monday, the area was covered with new top soil.

We have experienced difficulty with Site Survey monitors meeting their support requirements. Special and routine air sampler filter pickup schedules were missed several times this week.

The flux tower anemometer is still awaiting calibration in the University of Colorado wind tunnel as the Wind Test Site has not paid their bill from previous work there.

ACCOMPLISHMENTS

The information exchange meeting to exchange August data with the Colorado Department of Health was held on September 25. All data reported by Rockwell and CDH were within normal ranges. There were no violations of the NPDES permit. Personnel from the USEPA presented a program on the proposed standard for uranium in drinking water. The Safe Drinking Water Act of 1974 was discussed at length.

A total of 30,000 square feet was radiometrically surveyed this week. No hot spots were found.

[redacted]

Rockwell, 1979a

The tandem filter project on an ambient air sampler, installed near sampler S-7, is underway. A location for the stack sampler phase of the project, in the 771 main stack, has been selected and the samplers are being installed. Three samplers will be run in parallel.

Litter samples (15) from the southeast and northeast terrestrial study plots were collected this week for transuranic analysis.

INFORMATION

The posting to replace S. M. Elgawhary has been made.

Track analysis has been completed on the S-7 vicinity impactor sampler data (obtained in July prior to application of coherex on the interior security fence road). This implies a specific activity of the fines of about ten times that as on the course cyclone material.

A total of seven Federal Registers and five construction projects were reviewed this week for environmental concerns.

A paper by Tom Crites, "The Effect of Plowing on $^{241}$Am Contamination in Sandy Soil," has been accepted for publication in Health Physics.

T. R. Crites, Manager
Environmental Sciences

[redacted]

Internal Letter

IHSS #194

Rockwell International

150225

Date September 28, 1979

No.

TO T. R. Crites

Address

FROM D. D. Hornbacher

Address

Phone

Subject ENVIRONMENTAL ANALYSIS WEEKLY HIGHLIGHTS
WEEK ENDING SEPTEMBER 28, 1979

PROBLEMS

Air Sampler Filter Pickup Support-CJB, RWH
Site Survey monitors are not doing their job. Special and routine air sampler filter pickup schedules were missed several times this week.

Surface Water Control Project-RWH
On Friday, September 21, the contractor for the Surface Water Control Project was found scraping top soil in an area that had not been scarified near the C-2 dam. The operation was stopped immediately. Air sampler results did not show any airborne TLLα activity. On Monday, the area was covered with new top soil.

Steam Condensate-RLH, DFH
A steam condensate line break in the Bldg. 707 area occurred on September 26. Environmental Analysis was informed by Utilities that the water was going to the sanitary system and then to Pond 207-B-South. This was not the case, the water was actually going into surface water drainage through Pond B-4 to Walnut Creek. On the afternoon of September 27, we began diverting water to Pond B-1 and also shut the valve at the new B-5 dam. Fortunately. the condensate contained tritium at only about 1000 pCi/l. Samples from Pond B-4 ranged from $\leq$ 524 to approximately 926 pCi/l. Samples from Walnut Creek at Indiana showed 1163 pCi/l for a 24 hour composite covering 9-26-79 and about 700 pCi/l in a grap sample for 9-27-79. We are meeting with Utilities to discuss the problem of misinformation and the potential consequences of off site release of steam condensate.

ACCOMPLISHMENTS

Information Exchange Meeting-CJB
The information exchange meeting to exchange August data with the Colorado Department of Health was held on September 25. All data reported by Rockwell and CDH were within normal ranges. There were no violations of the NPDES permit. Personnel from the USEPA presented a program on the proposed standard for uranium in drinking water. The Safe Drinking Water Act of 1974 was discussed at length.

Plant Wide Radiometric Survey-RWH
A total of 30,000 square feet was radiometrically surveyed this week. No hot spots were found.

Rockwell, 1979b

INFORMATION

Reviews-CJB, RWH
A total of seven Federal Registers and five construction projects were reviewed this week for environmental concerns.

Sewage Sludge Removal Procedure-CJB
In the past, airborne dust has been a perpetual problem during sludge removal. Therefore, at the request of the Environmental Analysis Group, Solid Waste Management has prepared a draft procedure for sewage sludge removal. We have reviewed this procedure and provided changes which will ensure appropriate environmental controls for this operation.

EPA Conference on PCB's-DFH
On September 25, Don Haumann attended an EPA conference on PCB's.

Quality Plan-CAK
The Environmental Analysis Group Quality Plan has been final proofed and typed and submitted for director and plant manager approval.

D. D. Hornbacher

IHSS #195

1500914

File

# PRODUCT AND HEALTH PHYSICS RESEARCH SERVICE REPORT

Report No: 317-72-174

Title: Nickel Carbonyl Disposal

Work Requested by: G. J. Werkema

Date Requested: March 1972

Work Performed by: S. H. Pitts, F. D. Hobbs

Manhours: 200

Date Work Started: March 1972

Date Work Completed: August 1972

Date This Report: September 1972

Report Written by: F. D. Hobbs

Distribution:

S. H. Pitts
J. E. Hill
G. J. Werkema
Attn: S. E. Hammond
M. A. Thompson
IRF (Record)

KWIC Index:

Nickel Carbonyl
Chemicals ~~Disposal~~
Disposal
Hazardous materials
Employee safety
report 317-72-174

## Introduction

Approximately 185 pounds of nickel carbonyl ($Ni(CO)_4$) contained in seven 25-pound cylinders, two 5-pound cylinders and one lecture bottle had been stored in the toxic gas storage building over the past several years. Because of the inherent hazards associated with nickel carbonyl, it was desired to dispose of the chemical in an expeditious manner. Several disposal methods were considered with primary emphasis on safety and minimum environmental effects. The hazards associated with the chemical and ultimate disposal method are described in this report.

## Conclusions

The nickel carbonyl previously stored in the toxic gas storage building has been safely destroyed. The chemical was drained into a deep "dry well" and allowed to decompose. Decomposition occurred with a minimum of hazard to individuals involved in the disposal and the environment.

## Properties of Nickel Carbonyl

Nickel carbonyl is a colorless liquid with a boiling point of approximately 43°C. The vapors are extremely toxic with suggested limits of 0.001 parts per million average concentration in processing plants. Concentrations of only a few parts per million in air can be very dangerous and appreciable adsorption through the skin has been claimed.[1] The toxic symptoms created by inhalation are believed to be caused by liberation of both nickel and carbon monoxide in the lungs.[2]

In addition to the toxicity, nickel carbonyl has a fire hazard and moderate explosion hazard. Ignition can be spontaneous.[2]

Disposal Procedure

In light of the extreme hazards associated with nickel carbonyl a great deal of consideration was given to any method for its disposal. First of all, it was obvious that disposal had to be performed as far from the populated areas of the plant site as practicable. Secondly, the safety of individuals involved directly with the disposal was a paramount consideration. Thirdly, the maximum allowable concentration of nickel carbonyl in ambient air is only 0.07 ppb.[3]

After numerous proposed disposal methods were rejected for various reasons a rather simple and effective method was devised. A hole approximately fifteen feet deep and three feet in diameter was drilled in a remote area of the plant site. The cylinders containing the chemical were opened and suspended in this "dry well" until they were drained. The chemical and its much heavier than air vapors collected and decomposed in the bottom of the well.

Of course, the procedure was not quite as simple as it sounds. Individuals involved wore supplied air packs and a member of the

Rocky Flats Fire Department supervised the proceedings. The chemical proved to be completely unpredictable. On occasion it ignited immediately after release into the well. At other times the well would remain mysteriously silent for long periods before a muffled ignition occurred.

A minimum of the chemical was released to the air during the disposal procedure. Samples at the lip of the well indicated nickel carbonyl concentrations of approximately 10 parts per million being released during disposal. Rapid dilution with ambient air and the fact that the chemical decomposes in air[4] both reduced any environmental upset.

(1) F. A. Patty, Industrial Hygiene and Toxicology, Volume II, Toxicology, Interscience Publishers, New York, 1962, Second Edition.

(2) N. I. Sax, Dangerous Properties of Industrial Materials, Reinhold Book Corporation, New York, 1968, Third Edition.

(3) "Global Pollution Control Guidelines, The Dow Chemical Company, Fourth Draft, November 12, 1971.

(4) "Liquid Nickel Carbonyl is Dangerous" Product Bulletin Published by The Matheson Company.

IHSS #195

**THE DOW CHEMICAL COMPANY**

ROCKY FLATS DIVISION
P. O. BOX 888
GOLDEN, COLORADO 80401

March 29, 1972

15886

J. R. Seed

STATUS REPORT - MARCH 1972
INDUSTRIAL HYGIENE & HEALTH PHYSICS RESEARCH

## SECTION G. ECOLOGY

### G.1. Health Physics

#### Personnel Exposures - C. R. Lagerquist

The name of one employee was added to the "Internal Exposure Index" during March. This was an inhalation case resulting from the explosion of an aerosol spray can in the 771 Building incinerator. Other personnel data for the month of March are tabulated below.

| Time Period | Wounds Measured | Wounds Positive After Treatment | Internal Exposure Index |
|---|---|---|---|
| March 1972 | 94 | 5 | 1 |
| FY 1972 | 881 | 35 | 5 |

#### Dose Calculations - R. L. Murri

An estimate of the potential radiation hazard resulting from exposure to radioactive noble gases released during a maximum credible accident was calculated. It was assumed that all noble gas fission products plus their respective daughter products escaped the building following an incident which produced $10^{19}$ fissions. The calculated hypothetical dose to an individual at the exclusion fence (1600 meters) due to the passage of the cloud of fission products is of the order of 2 rad. This is within AEC guidelines.

## G.2. Industrial Hygiene

### Effluent Monitoring - J. E. Hill

Adjustments to the 883 effluent scrubber have resulted in substantially reduced concentrations of nitric acid vapors in the effluent stream. Nitric acid concentrations downstream of the new scrubber averaged 8 parts per million (14 parts per million maximum) during March. It appears that adequate control has been achieved, and subsequent reports will be by exception.

### Air Quality Standards - F. D. Hobbs

A review and compilation of air quality standards set forth by the Environmental Protection Agency, the United States Atomic Energy Commission, the State of Colorado, Jefferson County, and Dow Chemical U.S.A. has been completed. Part I of the compilation describes the standards for various air pollutants as set forth by each of the controlling agencies. Part II contains the directives and required sampling techniques.

## G.3. Sanitation and Chemical Disposal

### Nickel Carbonyl Disposal - F. D. Hobbs and S. H. Pitts

Various methods for safe disposal of nickel carbonyl have been tested. One method consisted of burning the liquid in a tray while collecting the resulting dense combustion products on a filter. This was judged to be slow and potentially hazardous. Disposal in a dry well (2 feet in diameter, 15 feet deep) has been highly successful. Vapors of the compound, being denser than air, reside at the bottom of the well and either decompose on the walls of the well or mix slowly with air with consequent burning. The rate of burning can be controlled by moving a cover plate over the well. Combustion products collect on the sides and bottom of the well.

The behavior of nickel carbonyl is unpredictable. It can burn spontaneously, although ignition is not always immediate. Operators handling the material outside of a sealed gas transfer system should wear supplied air masks and should be prepared for spontaneous ignition of spills.

Control of Food Serving Areas - A. H. Voight

Considerable traffic behind the steam table and serving area in Building 771 resulted in radioactive contamination of the floor up to 700 d/m ft$^2$. The building superintendent was notified by letter that corrections were needed. Shortly thereafter, footprints were found on the preparation table. Although there was no radioactive contamination, conditions in the Building 771 cafeteen are clearly unacceptable. These conditions appear to result from problems in industrial relations or industrial psychology rather than from any abstracted sanitation consideration.

G.4. Environmental Assay

Particle Size Analysis - J. A. Hayden

Alpha Track Method

The sizes of several radioactive particles collected on an outdoor air filter were calculated using Leary's autoradiographic technique. Values for particles of $PuO_2$ were found to be 0.13 - 0.19 microns (u) in agreement with values reported by Trapelo/West (0.13 - 0.15$\mu$ median range). Outdoor air filters may also collect particles of carnotite ($K_2O \cdot U_2O_3 \cdot V_2O_5 \cdot 3H_2O$), a naturally occurring mineral found in this area. These particles also produce alpha tracks in film, and could cause uncertainty in the interpretation of autoradiograms. To resolve the uncertainty, an autoradiogram of a particle of pure $U_3O_8$ was prepared. A readily apparent difference between uranium and plutonium oxide particle autoradiograms was found.

Fission Track Method

a. Fission tracks were obtained by exposing mica to aquaeous solutions containing varying concentrations of plutonium. A semi logarithmic plot of concentration vs number of tracks per unit area yields a straight line between values of 0.09 and 0.35 d/min cm$^3$. The technique could develop into a valuable analytical tool for analysis of pond and reservoir water.

b. Fission tracks were produced in Lexan® polycarbonate by exposure to a gelled aqueous medium containing known $PuO_2$ particles. Comparison of this radiogram with those produced by exposure to aqueous plutonium solutions shows clearly that a particle in suspension can be readily differentiated from ions in solution in the same medium. This is an important achievement, for it provides the first means to establish the physical nature (particle or ion) of plutonium in the aquatic environment.

## Operation Prairie Dog - D. E. Michels

Twelve animals were captured and relocated at Rocky Flats on March 9 and 10. Positive identification of ten of the relocated animals was made in the vicinity of the original emplacement on March 16. An increase in the local predator population has been noted, with sightings of coyotes, badgers, and hawks. No evidence of successful predation has been observed, however, "Operation Prairie Dog" was conducted with the participation of students from Alameda High School. Future activities of this kind should include similar participation whenever possible.

## G.5. Building 774 Release

Due to an inadvertent release of liquid waste from Bldg. 774, Ponds 2 through 5 (B-1 through B-4) and Walnut Creek at Indiana were sampled twice daily from March 9, 1972 to March 23, 1972 and once daily through March 28, 1972. Fifty-ml. samples were analyzed by liquid scintellation spectrometry. This analysis provides rapid answers (less than 24 hours) but does not afford the precision of the routine method on 7-liter samples. Summary of results:

| | Low | High |
|---|---|---|
| Pond 2 | 9. pCi/l | 140. pCi/l |
| Pond 3 | 22. " | 75. " |
| Pond 4 | 17. " | 95. " |
| Pond 5 | Bkgd " | 45. " |
| Walnut Creek at Indiana | Bkgd " | 68. " |

G.6. Laboratory Productivity

A summary of analyses reported during the previous 6-month period is attached.

Publications

| | |
|---|---|
| Journal Articles | 0 |
| RFP Reports | 0 |
| Internal Reports | 0 |
| Service Reports | 3 |
| Speeches | 1 |

Service Reports

J. A. Hayden, "Analysis of Particles Collected Near the Incinerator During a Contamination Incident," Service Report No. 317-72-126, March 14, 1972.

F. D. Hobbs, "Lithium Hydride and Lithium Deuteride Disposal," Service Report No. 317-72-123, March 1, 1972.

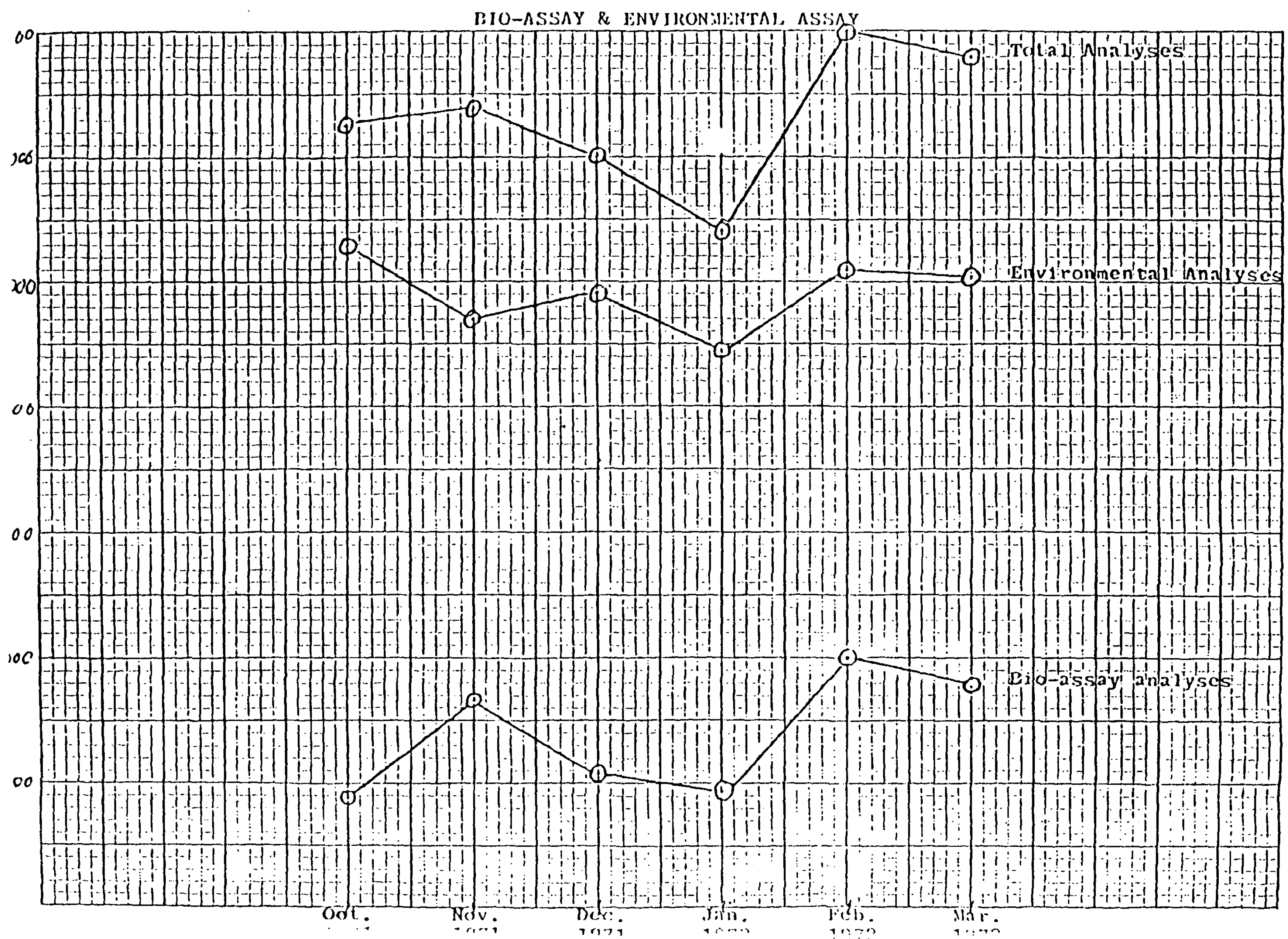
D. E. Michels, "Investigation of Contamination in 776 Alley," Service Report No. 317-72-128, March 16, 1972.

G. J. Werkema, "Between the Risk of Radiation and the Prospect of Peace," Arvada Morning Optimists Club, March 29, 1972.

S. E. Hammond
Industrial Hygiene Mgr.

SEH:gc

cc:
~~G.~~ W. Piltingsrud


BIO-ASSAY & ENVIRONMENTAL ASSAY
Total Analyses
Environmental Analyses
Bio-assay analyses
Oct.
Nov.
Dec.
Jan.
Feb.
1972
Mar.

IHSS #195, 196, 197

RF-0255

# CEARP Phase I Interview Notes

## Rocky Flats Plant

REVISED WITH RF COMMENTS ON APRIL 16, 1985

ALL EARLIER VERSIONS CONTAIN SIGNIFICANT ERRORS

by

Kenneth Rea, Roger Ferenbaugh, and Lew Walker

Bldg. 881 – Solvent out drain – on plumbing ...

Bldg. 991 – Outside shed area

oil is placed into storage for shipment to an approved PCB disposal facility.

Earlier operations - From the beginning of plant operations, all large transformers at Rocky Flats have been diked, and no major leaks have occurred. No early records exist on replacement of small transformers or capacitors nor on what types of oil these transformers or capacitors may have contained. These items may have been placed into the scrap metal site west of Building 559. (DOUBTFUL SINCE NONE WERE FOUND DURING THE EXCAVATION IN 1981.)

PCB disposal. - There are no known incidents of fires with PCB at Rocky Flats. In earlier years, small quantities of PCB oil could have possibly been destroyed at the Oil Burn Pits; however, no documentation exists.

PCB spill. - In 1983, there was a small (2 to 3 gallon) (NOT SO, MAY BE A HALF PINT) spill of PCB oil in the visitor's parking lot located next to the east guard gate. The incident occurred when a transformer tipped over in the bed of a truck belonging to an outside contractor coming into the plant. The spill was cleaned up by removing and replacing the PCB contaminated pavement.

EPA/PCB - In the late 1970s, Rocky Flats was asked by the EPA to assist with the removal of 17 drums of PCB from a farm in Lafayette. The material was located during the investigation of a reported PCB contamination incident involving a nursing infant.

Building 122. - The sump in this building may contain low level radioactive contamination. This sump collects the rinse water from decontamination. (RF COMMENT - NO. WASTE WENT OUTSIDE INTO AN ABOVE GROUND STORAGE TANK)

C. 123 Building - Health Physics

Building 123. - There may be low level radioactive contamination from both plutonium and uranium under and around Building 123. The building previously drained into a sump (tank outside building?) and the liquid is then pumped into a different waste line. There is the potential for leakage from this system. Picric acid is used in Building 123. (RF COMMENT - STILL?)

Around Building 123. - There have been several small spills of nitrate wastes around the outside of this building. (RF COMMENT - WHAT WAS SPILLED? URINE?)

D. 124 Building - Water Treatment Plant

124 Building. - Backwash went to a pond on the south side of Building 124 and may have drained into Woman Creek.

Under Building 559 - There was a break in a pyrex waste line under the slab-on-grade. A new waste line was installed above grade; however, some contamination may exist under the slab. The broken waste line would have contained plutonium, uranium, and nitrates. An incident report should exist in the Environmental Master File.

Building 559 and Building 774 - Both Building 559 and Building 774 are suspect for radioactive contamination in their footing drains.

West of Building 559 - During the excavation for the Personnel Security Zone, a non-radioactive waste disposal site was uncovered at this location. This site contained some classified metal shapes (RF COMMENT - DOUBT THIS). The material unearthed consisted of machine turnings, rings, shapes, overlays, and other metal parts; the material was moist but not oily. The burial probably occurred in the early 1960s. The recovered material is now located in a small pile next to Valve Vault 11, west of Building 559, and east of the Nitrogen Plant. (RF COMMENT - NO, ITS IN THE LANDFILL)

Near Building 559 - There was a scrap metal disposal site at this location, west of Building 559 and northwest of the other site uncovered during the construction of the PSZ, that contained building construction debris from early plant construction. This site was probably used by the Austin Company (contractors). There

Trench surface cover - At the time the trenches were closed, each trench was covered with 2 to 3 feet of soil. There are eleven identified trenches in this general location near the east guard gate. [John Epp may be a good source for information about the trenches].

Trenches in general. - Many trenches were used in the early days of Plant operation and could contain a variety of materials.

D. Lindsay Ranch Road

Lindsay Ranch Road; nickel carbonyl - Several bottles of nickel carbonyl were destroyed in a hole drilled beside the Lindsay Ranch Road. (RF COMMENT - SOUTH OF THE LINDSAY RANCH). (The hole was located about 100 feet before the drop into the first draw approaching the ranchsite from the south.) The hole was 4 feet in diameter and about 20 feet deep. The valves were cracked open on the cylinders and the cylinders were lowered into the hole with ropes. After 24 hours, the cylinders were removed from the hole, vented by small arms fire, and buried in the landfill. Two cylinders got stuck in the hole and were buried in place.

IHSS #197

# Internal Letter

Rockwell International

Date September 4, 1981

No. 1700483

TO T. R. Crites
Address

FROM D. D. Hornbacher
Address

Phone

Subject ENVIRONMENTAL ANALYSIS WEEKLY HIGHLIGHTS
WEEK ENDING SEPTEMBER 4, 1981

PROBLEMS

→ PSZ Construction-CTI, RWH
Excavation for the PSZ unearthed an old burial site immediately west of Building 559. This site was previously identified as a scrap metal disposal area in 1958. The material will be removed, monitored for radioactivity and disposed either in the sanitary landfill or in radioactive waste containers.

Buffer Zone Control-RWH
HS&E Laboratory technicians have been observed driving off road in the buffer zone while collecting water samples. They have been advised to stay on approved roads.

Sediment in Pond B-5 Discharge-RLH
During a routine discharge of Pond B-5, high sediment content was observed. This indicates that sediment may have accumulated above the sediment control standpipe. After the discharge is completed, it will be determined if dredging is necessary.

Ambient Air Samplers-CJB
Air sampler S-21 has been out of service for approximately a week due to damage done to electrical service by construction contractor personnel. Because of new asphalt, Maintenance cannot get into the area to restore service. Air samplers S-4, S-5 and S-22 should provide adequate sampling in the interim period.

Ureabor Application-CTI
Application of ureabor sterilant to ground areas along Central Avenue was accidentally extended to the areas surrounding decorative spruce trees. After the accident was recognized, attempts were made to remove the ureabor. The success of this action will be visible if the trees remain green.

MAAM Van-RJC
Startup of the MAAM van continues to be a problem. One of the air conditioners is not operating properly, the ozone analyzer gain controls are peaking out during upscale voltage checks, and the calibration system cannot be used until parts that have been ordered are received.

Rockwell, 1981a

ACCOMPLISHMENTS

Total Suspended Particulate Sampling-RJC
The calibration orifice for field calibration of a total suspended particulate (TSP) air sampler has been calibrated by the EPA. The TSP program should begin within about two weeks.

Reports and Procedures-CJB
Procedure EA-ERP-3 (formerly EA-ERP-1) ARAC Capability, was revised and distributed. Status of EA Section reports since the new review system was initiated is as follows: 3 distributed, one ready for distribution, 2 awaiting peer review, 3 awaiting management review.

INFORMATION

MAAM Van Quality Plan-RJC
Work is continuing to prepare operational manuals that include quality assurance procedures for each instrument in the MAAM van.

Hydrologic Test Hole Data-NDH
Peer review of a historical hydrologic test hole data report has been completed and appropriate comments are being included in the report. Also, a computer file has been created for the test hole data.

Rocky Flats Blue Ribbon Committee Activities-CTI
C. T. Illsley attended the Rocky Flats Blue Ribbon Committee Public Meeting that was held in Broomfield this week. He responded to questions in regard to the Geologic/Seismologic report.

Ambient Air Concentrations-CJB
Air sampler S-8 has shown a dramatic drop in plutonium concentration from 135 d/m per sample for the time period 7/13 to 7/27 to 11 d/m per sample for the time period 7/27 - 8/10. The first application of Coherex was done on July 17.

Maintenance Activities in Plenum FU-2B, Bldg. 771-JMW
Major maintenance and repair work on the filter frames in Plenum FU-2B, Building 771 are required because of corrosion from acid fumes. Environmental Analysis has been involved in the initial planning phase for the maintenance and repair work and will continue to monitor the work for environmental concerns.

Daryl

D. D. Hornbacher

IHSS #197

# Internal Letter

Rockwell International

Date September 11, 1981

No. 1700482

TO T. R. Crites
Address

FROM D. D. Hornbacher
Address

Phone

Subject ENVIRONMENTAL ANALYSIS WEEKLY HIGHLIGHTS
WEEK ENDING SEPTEMBER 11, 1981

PROBLEMS

ARAC System-JLZ
The ARAC system is partially functional since receipt of a new software tape from LLL. Tower data are being received and transmitted to LLL and communications can be established. The video screen is still not functional. One-half of the necessary power transistors on order have been received the remainder are still on back order.

Weather Tower Upgrade-JMW
Strong interference signals from the temperature probe aspirator motors are causing problems with the temperature measurement signals. Conduit may have to be installed on the tower to isolate the aspirator motor lines from the rest of the cables.

Nitrate Irrigation Water-CTI
Samples of nitrate irrigation water were collected in July to obtain baseline analytical data. Two of four samples have yielded unacceptable radionuclide data. Another sample has been collected to resolve discrepancies.

ACCOMPLISHMENTS

Inventory of Records-CJB
The FY 1981 records inventory and cleanout was performed for the EA Section and the summary report was submitted on time.

Total Suspended Particulate Sampling Program-RJC
The final draft of Total Suspended Particulates (TSP) standard operating procedures and Quality Assurance manual has been developed and will be submitted for typing next week. All TSP data collected at the Rocky Flats monitoring network will be corrected to the standard reference conditions and the methodology will be consistent with procedures developed by EPA Region VIII. The target date to begin sampling is September 28, 1981. Sampling will follow the national 6-day sampling schedule after this date.

MX Missile Program-CTI
A response was prepared for Rockwell Facility Design on the question of additional NEPA documentation required for equipment installation in support of the MX Missile Program. A letter has been sent to Facility Design that states that the existing Rocky Flats FEIS should be adequate according to DOE regulations.

Rockwell, 1981b

Computer Support-JLZ

1. Industrial Safety is planning to purchase a Compustar computer terminal. In support of this activity, an ADP requirements and check list has been completed for submission to Management Systems for approval.
2. Text editing (word processing) software has been received and installed on the Environmental Sciences terminals. This software enables the user to compose and store reports, letters and other text on floppy disks for later retrieval, editing and printing.

INFORMATION

Weather Data Summarization Software-JMW

A software package to summarize weather data will be needed upon completion of the data acquisition system. A meeting was conducted with Analytical Systems to determine feasibility and to define the scope of the prospect. The current plan is for Analytical Systems to provide the software on the RFP central computer beginning in CY 1982.

Status of Reports and Procedures-CJB

One procedure, EA-ERP-3, ARAC Capability, was issued, four reports and one procedure awaiting EA management review, one report under peer review and one report receiving author revision.

PSZ Trench Removal-CJB, RWH

On September 9, work began to remove the buried material from a trench located in the PSZ near Building 559. No contaminated materials have been found thus far and all the material is being hauled to the landfill. Total long lived alpha concentrations from three portable air samplers run at the 559 cleanup area on September 4 showed zero count.

Ground Water Monitoring-CTI, NDH

A request was received from DOE to prepare before November 16 documents describing the Rocky Flats groundwater monitoring program. These documents are required by the RCRA program administered by EPA. Both the evaporating ponds and process waste ponds are considered surface impoundments of hazardous wastes and require monitoring wells and testing programs.

$NO_3$ Measurements in Westminster Water Supply-RLH, CTI

The erratic nitrate concentrations in Westminster raw water persists with an increase to 4.4 mg/l on September 3. Daily samples collected this week all contained low concentrations (less than 0.5 mg/l). The source of the erratic data is still being pursued. A meeting was held with the Westminster Chief Chemist to discuss possible sources for nitrates.

D. D. Hornbacher

1500905-00002850-214

IHSS #197 Internal Letter

Rockwell International

8805

| | | | |
|---|---|---|---|
| Date | October 2, 1981 | No. | |
| TO | R. E. Yoder | FROM | T. R. Crites |
| Address | Bldg. 111 | Address | Bldg. 123 |
| | | Phone | X4098 |

Subject FOURTH QUARTER, FY 81, ACCOMPLISHMENTS

The following accomplishments were noted during the quarter ending September 30, 1981:

1. ARAC was switched over to new LLNL software and the meteorological tower was refurbished with new instruments and tied into the building via light pipe connections.

2. The long-range site clean-up priorities were evaluated and reviewed with RFAO for concurrence.

3. An old scrap metal burial area west of building 559 was cleaned out and properly disposed of.

4. The exhaust HEPA filter loading study made significant progress: measurement methods were tested out on FU-2B second stage filters and samples obtained from building 771 main final stage filters.

5. Food stuffs were collected and agreements established for analysis to meet CDH request.

6. A summer student project to determine air flow rates as a function of time in our ambient air samples was completed.

7. The EML samplers were upgraded and EML #1 shut down for some indefinite time period.

8. A spill prevention and control committee was established, charter drafted, and procedures initiated in compliance with the NPDES permit.

9. CSU completed a wind tunnel study of the Sierra impactor collection efficiency.

Keyword
Crites, T.
accomplishments

Rockwell, 1981c

10. The EG&G plant site photos were obtained.

11. Considerable progress was made in establishing EPA acceptable calibrations to MAAM van instrumentation.

T. R. Crites

TRC/ja
Distribution:
D. D. Hornbacher
D. C. Hunt

1500887-00002757-214

IHSS #197

# Internal Letter

Rockwell International

Date December 19, 1978

No. 1500887

TO M. V. Werkema

Address

FROM C. T. Illsley

Address

Phone

Subject BRIEFING ON BURIAL TRENCHES

On Friday, December 15, 1978, I attended a meeting in the DOE Conference Room with the following people in attendance:

| | |
|---|---|
| Robert D. Smith | NRC |
| Ray Miller | DOE, ALO |
| Tom Bosworth | DOE, ALO |
| Gary Echert | DOE, RFAO |

At the request of DOE, I gave a brief overview of the location and contents of the burial trenches on-site at Rocky Flats. The material was read from the attached discussion originally written by E. A. Putzier in 1970. A copy of this report and an earlier report should be in the EMF. A map showing trench locations previously prepared for the Lawsuit Tour was handed out at the meeting. No copies of my written briefing was given to attendees.

The same information is presented in the Rocky Flats Radioactive Waste Management Plan, 1978. A copy was reportedly sent to NRC by DOE.

C. T. Illsley

C. T. Illsley
Environmental Analysis and Control

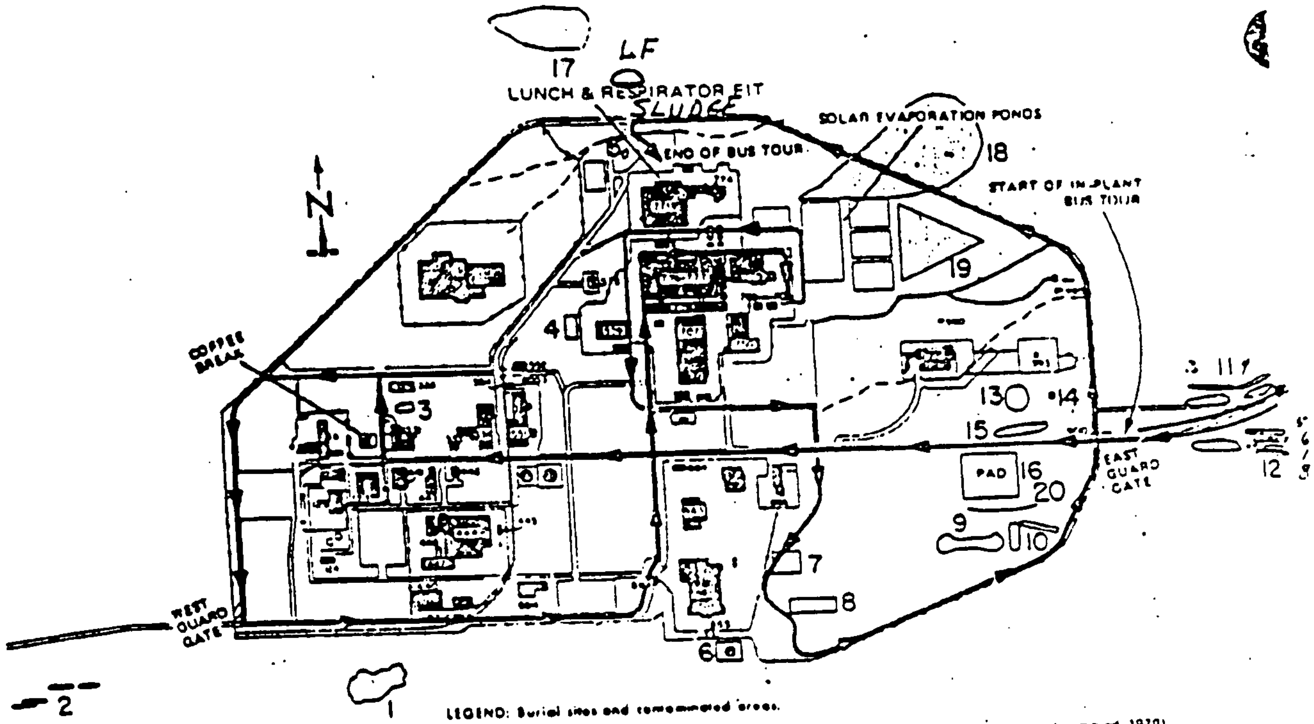
CTI:mmk

cc:
D. D. Hornbacher
R. E. Yoder

See 60-13370-RR-001

91HRR23 B 00014599

# Rocky Flats Plant ON SITE EXTERIOR TOUR




LEGEND: Burial sites and contaminated areas.

1. Original sanitary landfill (1953-1967).
2. Incinerator ash pits.
3. Lithium destruction area.
4. Scrap metal disposal (~1958).
5. 771 outfall.
6. Oil-sludge disposal (1968).
7. Contaminated soil burial.
8. Contaminated asphalt disposal (1969).
9. Sanitary sewage sludge disposal trenches.
10. Lithium destruction area.
11. Sanitary sewage sludge disposal trenches (1954-1968).
12. Sanitary sewage sludge disposal trenches (1954-1968).
13. Oil burning pit.
14. Mound area (all material removed 1970).
15. Depleted uranium chip disposal (1954-1962).
16. Oil barrel storage area (1958-1967).
17. Current sanitary landfill (1968 to present).
18. Nitrate fields.
19. Cargo container storage area.
20. "LID" area

Map ~~11~~ 2? AEC-approved Burial Sites

Locations and quantities known to have been buried are detailed on Map ~~12~~ 10. Further research has revealed that the soil and asphalt disposal areas (east of 881) are actually in the same location. The soil was deposited on top of the asphalt - the location is about halfway between the two as shown on Map ~~11~~ 20

Oil Burning Pit No. 1. Ten drums of oil containing depleted uranium were burned in August 1956 and the residue covered with backfill.

Oil Burning Pit No. 2. (1957, 1961-1965) Total 1082 drums of oil containing uranium burned. The residues (and some flattened drums) were covered with backfill.

Mound Area. (1954-1958) Total 1405 drums oil and solid waste. Mostly depleted uranium with some enriched uranium and possibly extremely low-level plutonium. Complete retrieval (for offsite disposal) achieved May 1970. Samples were taken in the vicinity of this burial site to determine levels in the location of a proposed holding pond. Results, as indicated on Map ~~8~~ 9, are thought to be more due to infiltration from the 903 Area rather than to an influence from the burial sites or oil disposal pit (No. 2).

Oil Drum Storage Field. (1958-1967) 3572 drums of oil from plutonium process areas and 1254 drums of oil from uranium process areas stored in this location until removal completed in June 1968. Leakage from drums deposited multi-Curie amounts of plutonium and uranium in soil. A 98,000 square foot area covered with an asphalt cap (completed November 1969) to contain the material until a safe disposal method can be developed and the AEC has determined an appropriate disposal site. (See Section I.)

Trench T-1. (1954-1962) Approximately 25,000 kg of depleted uranium chips in drums were deposited in this trench and covered with about 2 feet of fill dirt.

Trenches T-2 through T-8. (1954-1968) Disposal site for approximately 100,000 kg sanitary sewage sludge. Earlier pits involve mostly uranium with an increasing plutonium fraction in later pits. Activity ranges from 800 to 8000 dpm/gram. T-4 also contains some uranium plutonium infiltrated asphalt planking from the 207 ponds. Estimated total alpha radioactivity is between 100 and 150 mCi.

Asphalt Disposal Area. (1969) Approximately 320 tons of plutonium-infiltrated asphalt and soil (from the 776 fire, May 1969) buried under 1 to 2 feet fill dirt. Less than 1 mCi plutonium is estimated to be dispersed in approximately 250 cubic yards of material, with an estimated alpha activity about 7 dpm/gram.

Soil Burial. (1972) Approximately 60 cubic yards of plutonium-infiltrated soil from the 774 waste storage-tank area, now covered with about 3 feet of fill dirt. Estimated activity less than 250 dpm/gram (total long-lived alpha).

Incinerator Ash Pits (I-1 through I-4). (1952-1968) Estimated 100 grams depleted uranium burned with general combustible waste over 16-year period. Ashes buried in trenches.

Original Sanitary Landfill. (1952-1968) Former sanitary landfill area. Estimated 20 kg depleted uranium ash (60 kg inadvertently burned, approximately 40 kg recovered) buried along with normal plant waste, including small quantities of various surplus chemicals.

Oil Disposal Pit. (1958) Approximately 30 to 50 drums of oil sludge from a storage tank cleanout were emptied into a pit, which was then backfilled. No radioactivity involved.

Sanitary Landfill. (Started in 1968) From August 1968 to February 1970, approximately 1000 kg sanitary sewage sludge (800 to 8000 dpm/gram) were buried in landfill. (Estimated total of 1 to 1.5 mCi alpha radioactivity buried with sludge.) Estimated annual (Dow/Contractor) waste is 9,000,000 pounds. Materials with less-than-minimum-detectable (smear or direct count) radioactivity levels (500 dpm/60 square centimeters direct, or 50 dpm/square foot smear) are accepted for burial. Recent surveys have also disclosed other radicisotopes (e.g., tritium) in small quantities.

Lithium Destruction Areas. (1956-1970) Approximately 400 to 500 pounds of metallic lithium were destroyed and the residues (primarily nontoxic lithium carbonate) buried. Smaller quantities of other reactive metals - sodium, calcium, magnesium - and some solvent -type chemical compounds were also destroyed in this location.

Scrap Metal Disposal. (Approximately 1958) Scrap metal components, mostly from original construction. Although no detectable radioactive or chemical materials were observed, some pieces were recovered from process areas. Hence, minute radioactivity of a small percentage is possible.

Cooling Tower Blowdown Retention Ponds. (Small ponds used to contain cooling tower waters.) Hexavalent chromium (used to inhibit corrosion) is present. Some small quantity of lithium was also destroyed in the two eastern-most ponds. These ponds were covered with fill.

IHSS #197

OFFICIAL USE ONLY

160105

# environmental inventory

## A HISTORICAL SUMMATION OF ENVIRONMENTAL INCIDENTS AFFECTING SOILS AT OR NEAR THE U.S.AEC ROCKY FLATS PLANT.

Jan 29, 1974


J. B. OWEN

DRAFT

L. M. STEWARD


PP 66-72

Keywords
Owen, J B
Soils
Storage Tanks
Maps
Burial Sites
Plutonium
Americium
Uranium
Sanitary Waste
Disposal
Asphalt Pad
Plastics
Beryllium
Oil
Trenches
Sanitary landfill
Pits
Leaks
Contamination Incidents
Steward, L.M.

DOES NOT CONTAIN
OFFICIAL USE ONLY INFORMATION
Name/Org: EMCBC Classn Date 10-28-08

OFFICIAL USE ONLY

DOW

ROCKY FLATS DIVISION
DOW CHEMICAL U.S.A.

91HRR33 ITEM 2 B 00021698

DRAFT

Scrap Metal Disposal (Approximately 1958)

Scrap metal components, mostly from original construction, were buried in this area. Although no detectable radioactive or chemical materials were observed, some pieces were recovered from process areas and low level radioactivity of a small percentage of the scrap is possible.

Cooling Tower Blowdown Retention Ponds

These are small ponds which were used to contain water from cooling towers. Hexavalent chromium is present. Some small quantity of lithium was also destroyed in the two eastern-most ponds. These ponds were covered with fill.

Map 15 (Other Areas)

In addition to the noted areas, some potential for minor chemical infiltration exists in the vicinity of various storage and holding tanks (Map 15). This potential is, in most cases, extremely slight, particularly in those locations where tanks are diked. In the past, before diking was installed, minor spills have occurred and have been discussed in conjunction with the sectional maps.

Map 15A shows the approximate location where empty bottles of nickel carbonyl were buried after the nickel carbonyl was destroyed. The (89) gas was destroyed by burning (during the 1957 fire in Building 771 or when ready for discard). Explosive charges were used to destructively (90) vent the cylinders and ignite any residual gas. No known infiltration or affective residues were generated during these operations or as a result of the burials.

Station Number 218089

Page #: 00001 Date: 06/16/92

| LOCATI | ID | PROJ_SAM_NO | CHEMICAL | RESULT | UNIT | ERR | QUAL. | D.LIMIT | VA | GROUP | SAM_DA | QC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P218089 | TRG | GW01410IT | 1,1,1-TRICHLOROETHANE | 5 | UG/L | | U | 5 | | VOCCLPT | 12-JUN-91 | REAL |
| P218089 | TRG | OP03890406 | 1,1,1-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | GW02716IT | 1,1,1-TRICHLOROETHANE | 5 | UG/L | | U | 5 | | VOCCLPT | 21-APR-92 | REAL |
| P218089 | TRG | GW02518IT | 1,1,1-TRICHLOROETHANE | 5 | UG/L | | U | 5 | | VOCCLPT | 27-FEB-92 | REAL |
| P218089 | TRG | OP03890204 | 1,1,1-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890002 | 1,1,1-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890608 | 1,1,1-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890810 | 1,1,1-TRICHLOROETHANE | 6 | UG/G | | U | 6 | | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | GW02716IT | 1,1,2,2-TETRACHLOROETH | 5 | UG/L | | U | 5 | | VOCCLPT | 21-APR-92 | REAL |
| P218089 | TRG | GW01410IT | 1,1,2,2-TETRACHLOROETH | 5 | UG/L | | U | 5 | | VOCCLPT | 12-JUN-91 | REAL |
| P218089 | TRG | OP03890204 | 1,1,2,2-TETRACHLOROETH | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890608 | 1,1,2,2-TETRACHLOROETH | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890002 | 1,1,2,2-TETRACHLOROETH | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890406 | 1,1,2,2-TETRACHLOROETH | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890810 | 1,1,2,2-TETRACHLOROETH | 6 | UG/G | | U | 6 | | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | GW02716IT | 1,1,2-TRICHLOROETHANE | 5 | UG/L | | U | 5 | | VOCCLPT | 21-APR-92 | REAL |
| P218089 | TRG | GW02518IT | 1,1,2-TRICHLOROETHANE | 5 | UG/L | | U | 5 | | VOCCLPT | 27-FEB-92 | REAL |
| P218089 | TRG | GW01410IT | 1,1,2-TRICHLOROETHANE | 5 | UG/L | | U | 5 | | VOCCLPT | 12-JUN-91 | REAL |
| P218089 | TRG | OP03890002 | 1,1,2-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890608 | 1,1,2-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890810 | 1,1,2-TRICHLOROETHANE | 6 | UG/G | | U | 6 | | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890406 | 1,1,2-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | OP03890204 | 1,1,2-TRICHLOROETHANE | 6 | UG/KG | | U | 6 | A | RFVO | 01-NOV-8 | REAL |
| P218089 | TRG | GW02716IT | TRICHLOROETHENE | 5 | UG/L | | U | 5 | | VOCCLPT | 21-APR-92 | REAL |
| P218089 | TRG | GW02518IT | TRICHLOROETHENE | 5 | UG/L | | U | 5 | | VOCCLPT | 27-FEB-92 | REAL |
| P218089 | TRG | GW02716IT | TRICHLOROETHENE | 5 | UG/L | | U | 5 | | VOCCLPT | 21-APR-92 | REAL |
| P218089 | | OP-0389-0529-02-1300 | TRITIUM | 110 | PCI/L | 190 | | 400 | | TRADS | 31-MAY-90 | |
| P218089 | TRG | GW01410IT | TRITIUM | 369.6 | PCI/L | 197 | J | 400 | | DRADS | 12-JUN-91 | REAL |
| P218089 | TRG | GW01714IT | TRITIUM | 383.3 | PCI/L | 210 | J | 400 | | DRADS | 26-AUG-9 | REAL |
| P218089 | | OP-0389-0529-02-1300 | TRITIUM | 110 | PCI/L | 190 | | 400 | | TRADS | 31-MAY-90 | |
| P218089 | TRG | GW01410IT | TRITIUM | 369.6 | PCI/L | 197 | J | 400 | | DRADS | 12-JUN-91 | REAL |
| P218089 | TRG | GW01714IT | TRITIUM | 383.3 | PCI/L | 210 | J | 400 | | DRADS | 26-AUG-9 | REAL |
| P218089 | | OP-0389-0529-02-1300 | TRITIUM | 110 | PCI/L | 190 | | 400 | | TRADS | 31-MAY-90 | |
| P218089 | TRG | GW01410IT | TRITIUM | 369.6 | PCI/L | 197 | J | 400 | | DRADS | 12-JUN-91 | REAL |
| P218089 | TRG | GW01714IT | TRITIUM | 383.3 | PCI/L | 210 | J | 400 | | DRADS | 26-AUG-9 | REAL |

# APPENDIX C

# SURFACE WATER QUALITY DATA

## Station Number B4

Page #: 00001 Date: 06/15/92

| LOCATI | PROJ | SAM | CHEMICAL | RESULT | UNIT | ERR | QUAL | D.LIMIT | VA | GROUPS | SAM DAT | QC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B4 | T | NP50390WC | TRITIUM | 180.4 | PCI/L | 194 | J | 400 | | DRADS | 12-JUN-91 | REAL |
| B4 | T | NP50460WC | TRITIUM | 29 | PCI/L | 250 | U | 410 | | TRADS | 11-SEP-91 | REAL |
| B4 | T | NP50352WC | TRITIUM | 93.69 | PCI/L | 197 | J | 400 | V | DRADS | 14-MAY-91 | REAL |
| B4 | T | NP50417WC | TRITIUM | 172.9 | PCI/L | 202 | J | 400 | | DRADS | 15-JUL-91 | REAL |
| B4 | T | NP50441WC | TRITIUM | -100 | PCI/L | 140 | U | 240 | | TRADS | 19-AUG-91 | REAL |

Station Number B4

| LOCATI | ST | QCTYPE | SAM NO | DATE | DR | RES TY | TO CODE | CHEMICAL NAME | RESULT | UNIT | ERR | QAUL | D LIMIT | VAL | 1 | 2 | 3 | 4 | VRESUL | VUNIT | VQUAL | VDET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B4 | SW | REAL | NP50417WC | 15-JUL-91 | N | TRG | DRADS | TRITIUM | 172.9 | PCI/L | 202 | J | 380 | V | 99 | 52 | 78 | | | | | |
| B4 | SW | REAL | NP50352WC | 14-MAY-9 | N | TRG | DRADS | TRITIUM | 93.69 | PCI/L | 197 | J | 400 | V | 78 | 99 | | | | | | |

# APPENDIX D

## CALCULATED EQUIILIBRIUM CONSTANT

### for Nickel Oxide Dissolution

$$NiO_{(s)} \rightarrow Ni^{2+}_{(aq)} + \frac{1}{2} O_{2(aq)} \tag{1}$$

$$\Delta G^o_R = -RT \ln K = -2.303\ RT \log K \tag{2}$$

(at equilibrium)

$$\Delta G^o_R = \sum \Delta G_f\ (products) - \sum \Delta G_f\ (reactants) \tag{3}$$

| | $\Delta\ G_f\ (kJ/mole)$[1] |
|---|---|
| $Ni^{2+}_{(aq)}$ | -45.6 |
| $NiO_{(s)}$ | -211.6 |
| $O_2(aq)$ | 16.32 |

$\Delta\ G^o_R$ = 348.32 kJ/mole for $NiO_{(s)}$ dissolution (in pure water) using equation (3)

$\log K = -30.52$ using equation (2)

$$K = \frac{a_{Ni^{2+}} * a_{O_2}^{\frac{1}{2}}}{a_{NiO}} \tag{4}$$

$$K_{sp} = (a^{2+}_{Ni})(a_{O_2})^{\frac{1}{2}} = 10^{-30.52} \tag{5}$$

[1] Thermodynamic data from Robie, R.A., Hemingway, B.S., Fischer, J.R., 1978, Thermodynamic properties of minerals and related substances at 298.15K and 1 Bar pressure and at higher temperatures, U.S.G.S. Bulletin No. 1452.

$$NiO_{(s)} \rightarrow Ni^{2+}_{(aq)} + \frac{1}{2} O_{2(aq)} \qquad (1)$$

$$\Delta G^o_R = -RT \ln K = -2.303\ RT \log K \qquad (2)$$
*(at equilibrium)*

$$\Delta G^o_R = \sum \Delta G_f\ (products) - \sum \Delta G_f\ (reactants) \qquad (3)$$

| | $\Delta G_f$ (kJ/mole)[1] |
|---|---|
| $Ni^{2+}_{(aq)}$ | -45.6 |
| $NiO_{(s)}$ | -211.6 |
| $O_2(aq)$ | 16.32 |

$\Delta G^o_R$ = 348.32 *kJ/mole for* $NiO_{(s)}$ *dissolution (in pure water) using equation* (3)

log $K$ = -30.52 *using equation* (2)

$$K = \frac{a_{Ni^{2+}} * a_{O_2}^{\frac{1}{2}}}{a_{NiO}} \qquad (4)$$

$$K_{sp} = (a^{2+}_{Ni})(a_{o_2})^{\frac{1}{2}} = 10^{-30.52} \qquad (5)$$

[1] Thermodynamic data from Robie, R.A., Hemingway, B.S., Fischer, J.R., 1978, Thermodynamic properties of minerals and related substances at 298.15K and 1 Bar pressure and at higher temperatures, U.S.G.S. Bulletin No. 1452.

# APPENDIX E

# OU 5 FIELD SAMPLING PLAN

# from Phase I RFI/RI Work Plan

# February 1992

two additional surface disturbances; these are the surface disturbance west of IHSS 209 and the surface disturbances south of the Ash Pits. The area south of OU5 to the property boundary will be investigated, if warranted. For reference, the Phase I investigation programs for each IHSS are summarized below. A number of SOPs will be used during the investigation. The SOPs are cited in this section and discussed further in Section 11.0 of this Phase I work plan.

### 7.2.1 IHSS 115 - Original Landfill

Stage 1 - Review Aerial Photographs and Gamma Radiation Survey Results

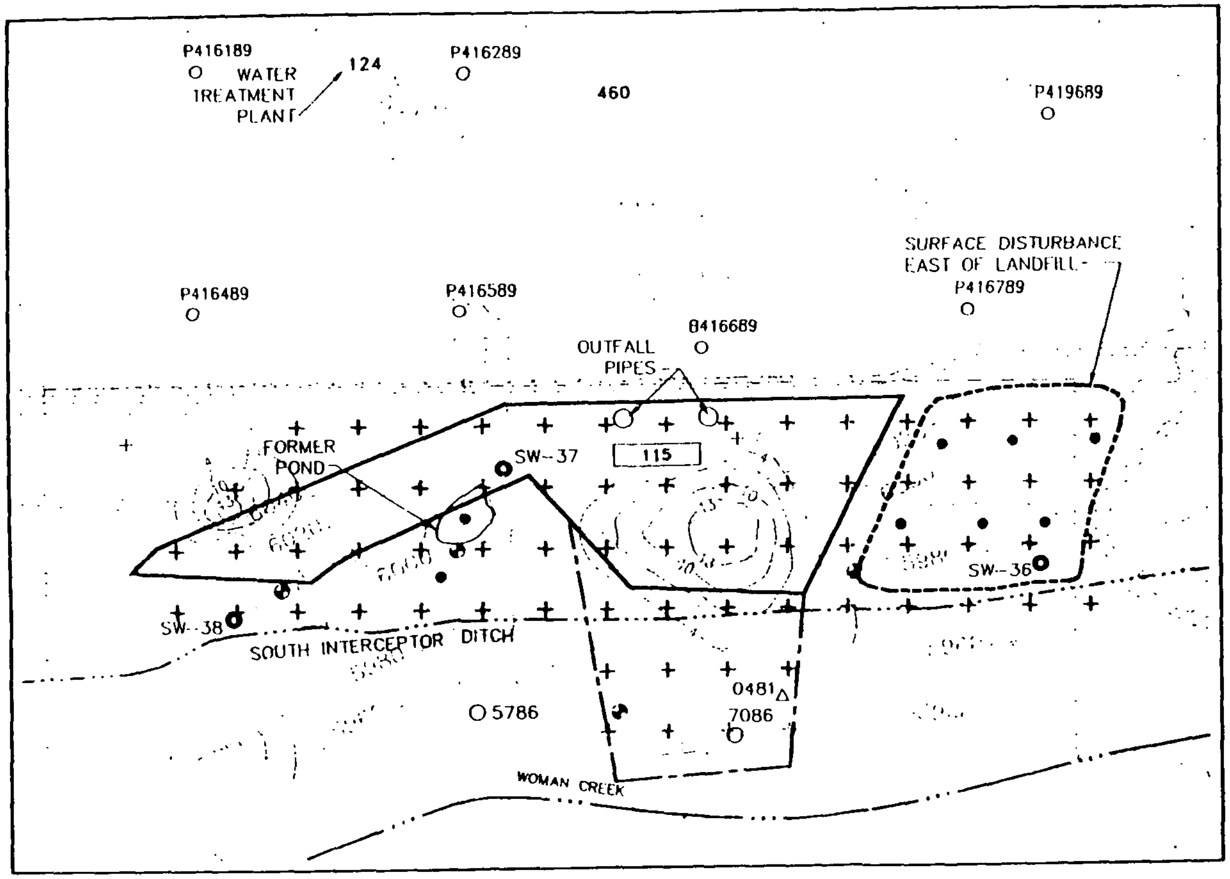
Aerial photographs taken during operation of the Original Landfill will be reviewed to identify the extent of the Original Landfill and the disturbed area located to the east of the Original Landfill. The areas to be studied during later steps of this investigation, including the location of former ponds, will be delineated from the aerial photographs and surveyed in on the ground as needed to define their locations for the Phase I field work. Additional studies conducted at the Landfill after preparation of this Phase I work plan will be evaluated during Stage 1 (see Table 7-1). Also as part of this stage, the gamma radiation survey conducted at the Original Landfill in Fall 1990, using a germanium detector (Appendix B) will be further reviewed, and the elevated radiation readings shown on Figure 7-1 will be surveyed on the ground to define their locations.

Stage 2 - Magnetometer, EM, and Soil Gas Surveys

A magnetometer survey will be performed over and downgradient of the Old Landfill and the disturbed area to the east (Figure 7-1). This survey will be conducted on a 25-foot grid in the area outlined for the radiation survey in Figure 7-1. The survey will be completed according to the magnetic locator procedure in SOP GT.10. Resulting anomalies will be mapped and contoured.

An EM geophysical survey will be performed over the Old Landfill on the same 25-foot grid established for the magnetometer survey and will cover the same area. The survey will be completed according to the EM geophysical procedures in SOP GT.18. Details of both the magnetometer and EM geophysical survey will be supplied to the Agencies for review in a TM. The TM will include the type of geophysical surveys to be performed, procedures, and grid spacing.

A real-time soil gas survey will be conducted over the Original Landfill and the disturbed area located to the east of the Landfill (Figure 7-1) to identify areas of volatile organic contamination. As specified in the IAG, the soil gas samples will be taken on a 100-foot grid according to the procedures described in SOP GT.9. To further improve the sampling coverage, the grid will be reduced to 25-foot spacing at the downgradient perimeter of the landfill, over areas of suspected buried metallic materials based on the magnetometer and EM survey, and over areas where volatiles are found during the 100-foot grid soil gas survey. The perimeter of the landfill will be defined by the aerial photograph interpretation, radiation,




N

0 100 200

SCALE: 1" = 200'

## EXPLANATION

- 115 — INDIVIDUAL HAZARDOUS SUBSTANCE SITE
- SW-1 — EXISTING SURFACE WATER SAMPLING LOCATION
- 5786 — EXISTING ALLUVIAL GROUNDWATER MONITORING WELL
- 0481 — PRE-1986 MONITORING WELL
- INTERMITTENT STREAM
- DIRT ROAD
- 124 — ROCKY FLATS BLDG. NO.
- PRELIMINARY EXTENSION OF THE LANDFILL BASED ON A SITE RECONNAISSANCE
- PROPOSED WELL LOCATION*
- PROPOSED SOIL BORING LOCATION*
- PROPOSED SOIL GAS SAMPLES*
- $^{238}U$ (pCi/G) ISOCONCENTRATION CONTOURS
- 1990 GERMANIUM SURVEY BOUNDARY AROUND OLD LANDFILL

*ALL PROPOSED LOCATIONS ARE APPROXIMATE

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OPERABLE UNIT 5
PHASE I RFI/RI WORK PLAN

PROPOSED SAMPLING AND WELL LOCATIONS
IHSS 115
ORIGINAL LANDFILL

REV. FEB. 1992
MARCH 1991

FIGURE 7-1

magnetometer, and EM survey review, and by field reconnaissance. The 25-foot soil gas grid spacing around the downgradient perimeter will cover at least the area between the last 100-foot grid location within the landfill area and the first 100-foot grid location outside the landfill area (see Figure 7-1). The 25-foot soil gas grid located over metallic materials or volatile plumes will continue for at least 50 feet beyond the edge of the anomaly. This approach should better characterize the area of likely contamination. A probe will be driven approximately 5 feet into the soil to collect the soil gas. The soil gas samples will be analyzed for 1,1,1-trichloroethane (TCA), dichloromethane, benzene, carbon tetrachloride, tetrachloroethene (PCE), and trichloroethene (TCE) using a portable gas chromatograph (GC). Analytical peaks of compounds for which the GC is not calibrated will be noted. It will not be possible to analyze for solvent breakdown products like 1,2-dichloroethane and vinyl chloride with a GC because they co-elute with other compounds. Vinyl chloride co-elutes with freon compounds, and 1,2-dichloroethane co-elutes with methyl ethyl ketone and dibromomethane. The analytical program for the soil gas survey is discussed in Subsection 7.3.2. Details of the proposed soil gas surveying grid will be presented to the Agencies for review in a TM.

Stage 3 - Surface Soil, Soil Core, Soil Boring, Sediment, and Surface Water Samples

Randomly located surficial soil samples will be collected to characterize the landfill cover material and exposed fill material using the Rocky Flats method. Depending upon the results of the radiation screening, additional surface soil samples may be required at identified areas with above background radiation. These samples will help establish whether the landfill is leaking via fugitive dust entrained in air for risk assessment purposes. In addition, based on the review of the gamma radiation survey, additional surficial soil samples will be collected within the areas that have above background radiation. At least two samples will be collected at small or point sources of radiation and at least three will be collected over disturbed areas. A TM will be submitted to the Agencies for review prior to implementation that will specify the exact number of samples necessary for the risk assessment, and identify the sampling locations and sampling method protocol.

Soil cores will be collected on a random basis to verify the soil gas survey and other screening methods (e.g., false negative). One soil core (grab sample) will be collected for every 15 to 20 soil gas samples at the same depth as the soil gas samples. Based on the number of original grid soil gas sampling locations, it is estimated that four soil cores will be collected.

Three soil borings will be placed at up to three areas where plumes have been identified by the soil gas survey. This will result in a maximum of nine soil borings being drilled at the three plume areas. At each plume area, one soil boring will be placed at the point of the highest soil gas reading, and two borings will be located downslope of that point within the plume identified by the soil gas survey.

Soil borings will also be drilled for subsurface characterization purposes. One soil boring will be drilled in the location of each of the two former ponds. Six soil borings will be drilled in the disturbed area east of the landfill. Each soil boring will be drilled at least 6 feet below the base of the alluvial material according to the procedures described in SOP GT.2. Samples will be taken continuously in these borings. Discrete samples will be collected from every 2-foot increment and analyzed for the TCL volatile organic compounds (VOCs). Samples will be composited from every 6-foot interval and analyzed for the TCL semivolatile organic compounds, the TAL metals, and radionuclides. As specified in the SOP, samples will not be collected for chemical analysis from the saturated alluvium. The analytical program for those samples is presented in Subsection 7.3.

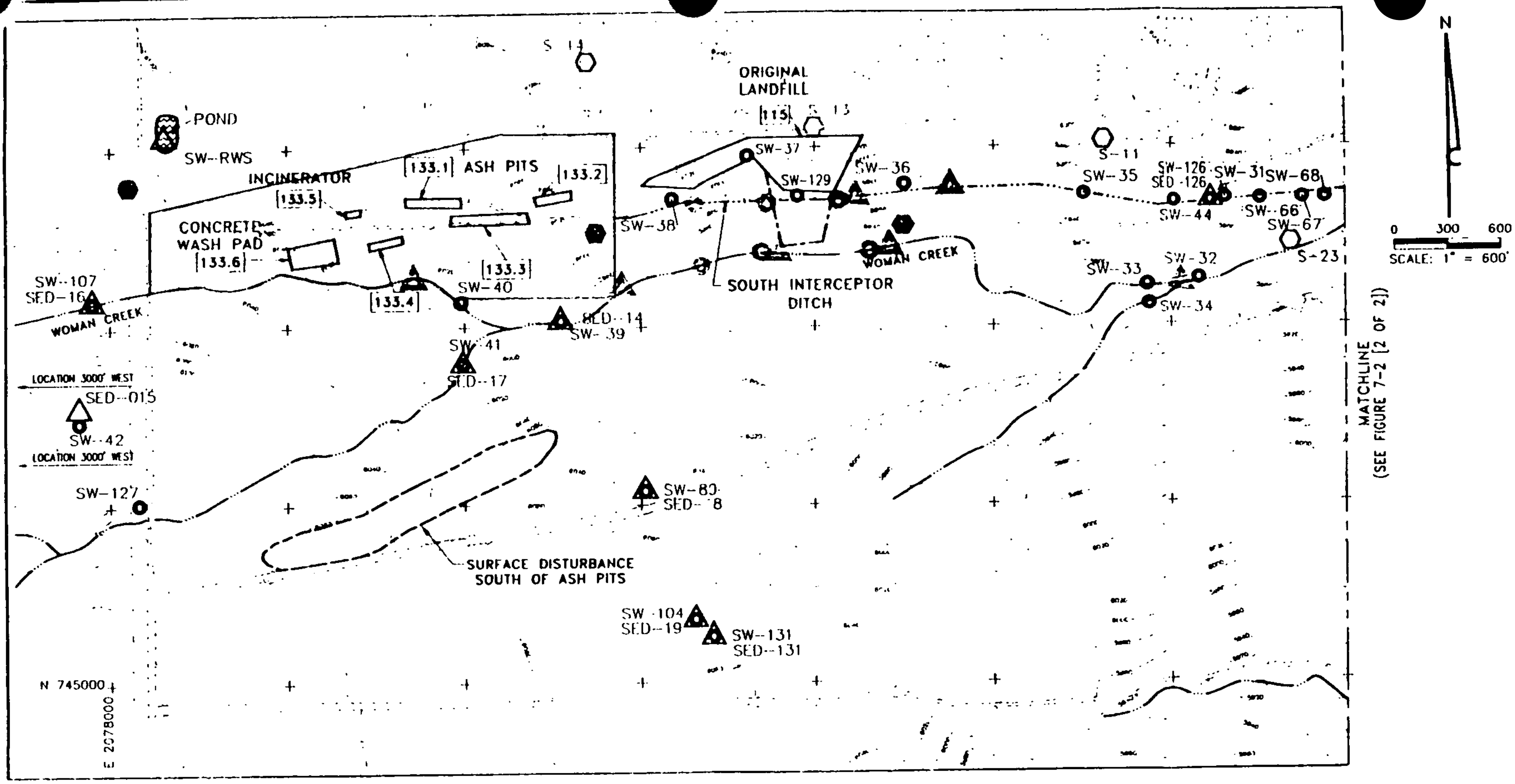
During sampling a soil classification survey will be completed at the Original Landfill for use in the Environmental Evaluation. Several samples may also be collected from 0 to 2 feet for grain size analysis.

The sediments and surface water of the SID and Woman Creek will be sampled immediately downgradient of the Original Landfill. These locations are shown in Figure 7-2, which is a map of all the proposed surface water and sediment sampling locations for OU5. Surface water samples will be collected at three locations along the SID and three locations on Woman Creek (total of six samples) according to the procedures specified in SOPs SW.2 and SW.3 for surface water. Sediment samples will be collected at two locations along the SID and two locations on Woman Creek (total of four samples) according to procedures specified in SOP SW.6 (see Subsection 7.2.3). The sediment samples will be collected in areas of the creek or ditch that are conducive to sediment accumulation. The analyses to be performed on these samples are listed in Subsection 7.3.

Stage 4 - Cone Penetrometer, BAT Sampler (or equivalent), Monitoring Well Installation and Groundwater Sampling

A cone penetrometer will be used to establish subsurface conditions and lithologies downgradient from the landfill. One subsurface condition that is essential to characterize is soil moisture and/or saturation. A cone penetrometer with this capability will be used. Two lines of cone penetrometer surveys will be taken with a maximum of 100-foot spacing between penetrometers; one line will be between the Landfill and the SID, and one line between the SID and Woman Creek (see Figure 7-1). In the appropriate cone penetrometer survey locations (locations where significant soil moisture is present), BAT sampling, or an equivalent, will be used to sample any encountered groundwater or interstitial fluid. These samples are necessary to help establish whether contaminated plumes are presently leaking from the landfill. To calibrate the cone penetrometer, one of the soil borings discussed above will be "twinned" so that the cone penetrometer will penetrate known lithologies and saturations. A TM will be submitted to the Agencies for review outlining the details of the cone penetrometer use, type of sampler, spacing and analyte list.

Based on information from the magnometer, EM, and soil gas surveys, and cone penetrometer data, the location for alluvial monitoring wells will be determined. Final locations for the monitor wells will be submitted to the Agencies for review in a TM. It is possible due to the limited saturated thickness of the alluvium, that there may be locations where there is no water or times of the year when the saturated




## EXPLANATION

- [115] INDIVIDUAL HAZARDOUS SUBSTANCE SITE
- SW-1 EXISTING SURFACE WATER LOCATION
- SED-1 EXISTING SEDIMENT SAMPLING LOCATION
- INTERMITTENT STREAM
- DIRT ROAD
- PRELIMINARY EXTENSION OF THE SURFACE DISTURBANCE BASED ON A RECONNAISSANCE
- S-23 EXISTING RADIOACTIVE AMBIENT AIR MONITORING PROGRAM LOCATION
- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED RADIOACTIVE AMBIENT AIR MONITORING PROGRAM LOCATION
- PROPOSED SURFACE WATER LOCATION
- PROPOSED GERMANIUM SURVEY FOR ASH PIT AREA

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PHASE I RFI/RI WORK PLAN

### SEDIMENT & SURFACE WATER SAMPLING SITES & AIR MONITORING STATIONS ALONG WOMAN CREEK AND THE SOUTH INTERCEPTOR DITCH

REV. FEB. 1992
MARCH 1991

FIGURE 7-2 (1 OF 2)

R33MO81:MBC2`592/80C

thickness is zero. If this is the case, it may be necessary to relocate the wells or possibly install a vadose zone sampling device such as the BAT sampler (or an equivalent) capable of characterizing the contaminant plumes in zones of limited water. It may also be necessary to install bedrock wells beneath zones of contaminated alluvial groundwater or if a subcropping sandstone is encountered. The need for bedrock wells will be evaluated after lithologic and preliminary chemistry data has been gathered and interpreted. At this time it is proposed that a maximum of three monitoring wells will be installed in these borings. As specified in the IAG, all of these wells will be installed in the alluvium just above the bedrock according to SOP GT.6.

In addition to the above wells, four alluvial monitoring wells and/or vadose zone samplers will be installed in the alluvium downgradient of the Original Landfill. The location, type, and number of monitoring devices will be dependent upon the results of all other data gathered in this Phase I investigation. At this time, it appears at least three wells should be installed between the Landfill and the SID, and one well installed between the SID and Woman Creek: locations shown on Figure 7-1 are tentative. The first well will be placed approximately between the western leg of the Landfill and the SID. The second well will be placed in the alluvium in the surface drainage north of Well 5786 between the Landfill and the SID within the area of the old embankment. The third well will be placed in the alluvium between the southeastern corner of the boundary of IHSS 115 and the SID, downgradient of the outfall identified on the east side of the Landfill. The fourth well will be placed between existing wells 5786 and 7086. These locations may be modified slightly depending upon the results of the screening surveys. If a water-bearing sandstone unit is found to be the first bedrock unit underlying the alluvium in a boring, then an additional well will be completed in the sandstone at that location. The use and location of the proper type of monitoring device should be able to ascertain both present and future contaminant levels and help establish any future or present contaminant migration problems. The locations for the monitoring devices should allow for monitoring the principal groundwater and downgradient migration pathways of the Old Landfill.

All groundwater monitoring wells will be drilled according to SOP GT.2 and installed according to SOP GT.6. All wells will be developed according to SOP GW.2. Following development, wells will be sampled according to SOPs GW.5 and GW.6. The analyses to be performed on these samples are listed in Subsection 7.3. The results of the first round of sampling will be reported in the Phase I RI Report. The four monitoring wells downgradient of the Landfill will be sampled quarterly for a minimum 1 year.

Stage 5 -- Outfall Pipe Location, Source, and Sampling

The two corrugated metal pipes protruding from the Landfill (Figure 7-1) will also be investigated in this FSP. Plant plans will be reviewed and a sewer snake survey will be conducted to attempt to identify the open length of the pipes and the sources of water. This survey may use a traceable electronic or magnetic source attached to the snake such that surface instruments can be used to follow the path of the pipe. Other methods for locating pipes may also be used if the sewer snake survey is inconclusive. If water is found to be flowing through either of the corrugated pipes during this Phase I investigation, the effluent will be sampled according to SOP SW.3. Results of the sampling will be reported in the Phase I RI Report.

### 7.2.2 IHSS 133 - Ash Pits 1-4, Incinerator, and Concrete Wash Pad

Stage 1 - Review Aerial Photographs

Aerial photographs from 1953, 1955, 1964, 1969, and 1978 through 1988 will be reviewed to identify the extent of the disposal areas for these sites including an area north of the west access road and possible waste disposal areas beyond the boundaries of Ash Pit 1 and the Concrete Wash Pad (see Section 2.0). The dimensions of each pit, determined from the aerial photographs, will be land surveyed in and used to assist in planning the Phase I drilling program and for defining the area of the radiation survey (see Figure 7-2 and Table 7-2).

Stage 2 - Radiation, Magnetometer and EM Geophysical Surveys

A ground based radiation survey employing a high purity germanium gamma-ray sensor will be performed over the four Ash Pits, the Concrete Wash Pad, and the Incinerator. The area to be surveyed for IHSS 133 is shown on Figure 7-2 and extends from the western boundary of the previously surveyed area over the Original Landfill (Appendix B) to approximately 600 feet west of the Concrete Wash Pad. The sodium iodide sensors employed for this survey will be spaced such that there is overlapping coverage between stations to guarantee that there is 100% coverage. The gamma emitting radionuclides that are detected will be analyzed to identify the isotopes that may be present. An SOP is currently being developed for performing this survey. If areas of anomalous radiation readings are detected, they will be surveyed and staked sufficiently to define their lateral extent. The results will be plotted and contoured on a map and will also be presented in tabular form.

Using the Observational Approach, a magnetometer and an EM geophysical survey may be performed over the Ash Pits in the same area as outlined for the radiation survey on Figure 7-2 to help locate the boundaries of each IHSS. These surveys will be performed if the results of the previous activities fail to outline the locations of the Ash Pits 1-4, Incinerator, and Concrete Wash Pad. These surveys would be conducted on a 25-foot grid according to the magnetic locator procedure described in SOP GT.10 and according to the EM geophysical procedure described in SOP GT.18. Resulting anomalies would be mapped and contoured. Prior to implementation, the need for, and as appropriate, the details of the magnetometer and EM surveys will be presented to the Agencies for review in a TM. Type of instrumentation, grid spacing, operating procedures, and justification for use or non-use will be included.

# APPENDIX F

# OU 13 FIELD SAMPLING PLAN

**from Phase I RFI/RI Work Plan**

**Draft-final (September, 1992)**

resulting data will subsequently identify the radionuclides that are present and their indicated concentrations for each station. A 20-ft grid spacing will also be used for HPGe surveys of soils beneath paved areas. As ~~demonstrated~~ described in Section 5.1.2.4, this grid spacing results in an acceptable probability of not finding an elliptical contaminated area approximately 16 ft by 32 ft in size.

As discussed above, minimal numbers of surficial soil and depth profile samples will be collected to confirm the results of the HPGe survey. At the time surficial soil samples are collected for analysis of nonradioactive parameters, approximately 10 percent of the samples collected will be split and submitted for analysis of radionuclides. At those IHSSs where surficial soil sampling programs for nonradioactive parameters are not planned, surficial soil samples will be collected for analysis of radionuclides at approximately 10 percent of the HPGe stations. After the completion of the HPGe surveys, the resultant data will be examined and discussed with CDH and EPA and the location of vertical profile samples will be determined.

The soil gas and surficial soil sampling for nonradioactive parameter programs will be established on 20-ft or 40-ft triangular grids (see Section 5.1.2.4), with additional points added in suspect locations (i.e., areas where stained soils exist or where activities are associated with likely spills). The basis for the grid spacing selected for soil gas and surficial soil sampling programs for each IHSS is discussed in the following sections.

6.3.1.1 North Chemical Storage Site (IHSS 117.1)

Stage 1 sampling efforts for IHSS 117.1 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-3 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The analytical data available for borehole samples from well P214689, located within this IHSS, indicate that soils in the area contain above background concentrations of several radionuclides necessitating the performance of the surface radiological survey. Because the size of possible releases within this IHSS are not known, the 20-foot grid spacing for soil gas surveys will provide a conservative approach to locating contamination. Due to access and security restrictions, these investigations will not be performed within that section of the IHSS which is believed to extend into the Protected Area. That portion of the IHSS will be addressed as part of D&D The portion of this IHSS that is paved will require access holes to be cut through the pavement prior to initiating these investigations. The available information regarding releases at this IHSS indicates that these releases occurred prior to the area being paved. Thus, these investigations will focus on the potential contamination of soils beneath the pavement. As discussed in Section 6.3.1.11, the HPGe and soil gas surveys for this IHSS will also provide information regarding releases associated with IHSS 186.

The surface radiological survey will be performed with a tripod-mounted HPGe instrument over unpaved areas and with the HPGe instrument placed directly over access holes in the pavement in paved areas. Subsequent to the HPGe survey, surficial soil samples will be collected from alternate HPGe stations for analysis of TAL metals. At 10 percent of these sampling sites, surficial soil samples will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. Two of these samples will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds detected but which were not calibrated for:

<u>IAG Required</u>

| | | | |
|---|---|---|---|
| 1,1,1-trichloroethane | perchloroethene | benzene | carbon tetrachloride |
| dichloromethane | trichloroethene | | |

Indicated by Available Data

total xylenes    carbon disulfide    acetone    ethylbenzene

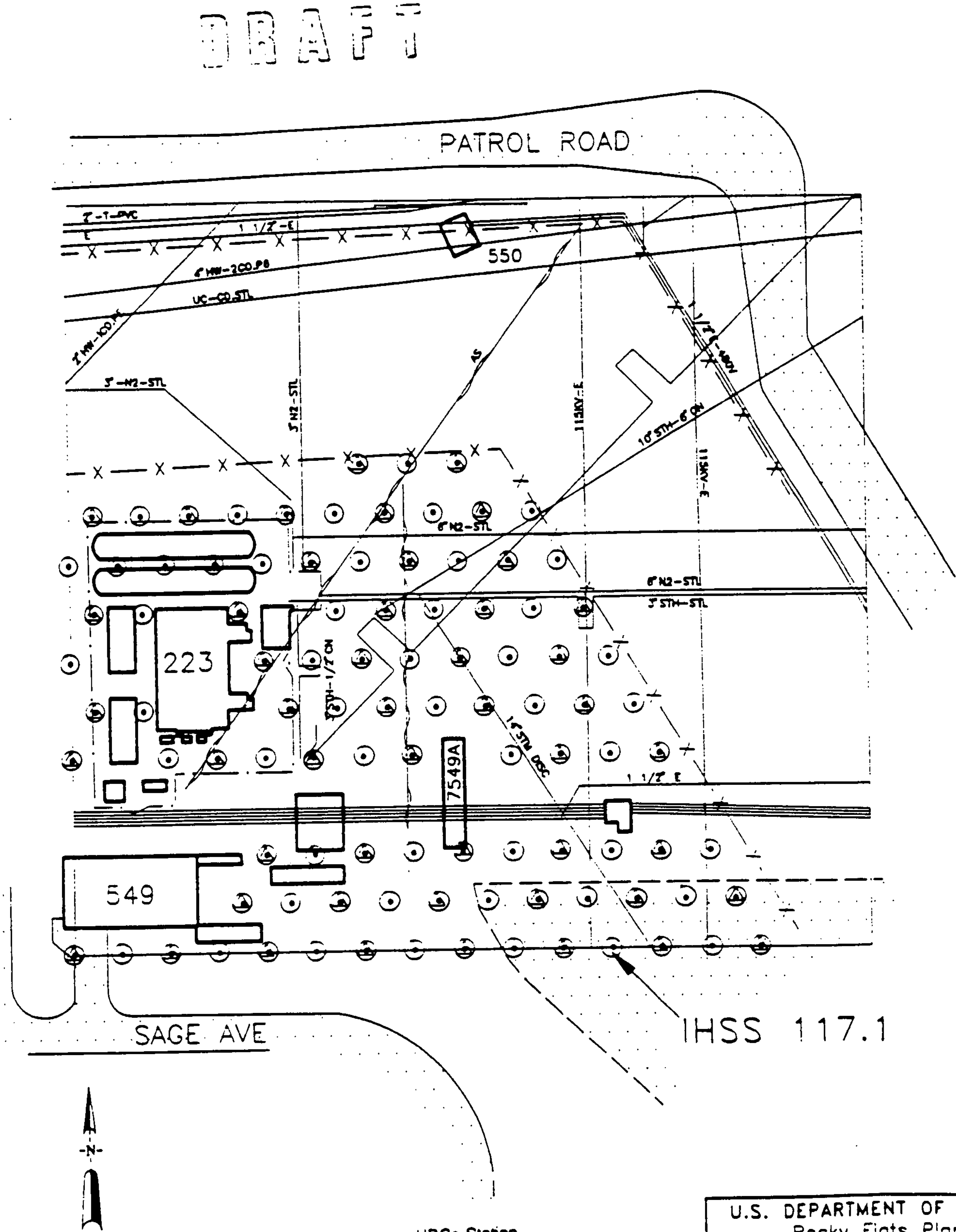
toluene

Analyses of groundwater samples from existing piezometers P214689 and P115589 will provide data which may be useful in assessing potential contamination associated with IHSS 117.1 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.2 Middle Chemical Storage Site (IHSS 117.2)

Stage 1 sampling efforts for IHSS 117.2 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-4 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. Because the size of possible releases with this IHSS are not known, the 20-foot grid spacing for the soil gas survey will provide a conservative approach to locating contamination. The available information regarding releases at this IHSS indicates that these releases occurred both before and after the IHSS was paved. Thus, the investigation of this IHSS will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The entire area of IHSS 117.2 is paved, requiring access holes be cut through the pavement and base material removed prior to performing investigations of potential contamination in the soils beneath the pavement. The presence of a numerous items that are stored in this IHSS and of a large storage tent will not allow for the performance of these activities over the entire area of the IHSS (Figure 6-4).

The surface radiological survey will initially be performed with the HPGe instrument mounted on a tripod to measure concentrations of radionuclides on the pavement surface. After the results of this survey have been evaluated, samples of asphalt will be collected at a maximum of 5 anomalous areas detected by this survey. These samples will be analyzed with a laboratory




- HPGe Station
- Soil Gas Survey Location
- Surficial Soil Sample

0 30 60

SCALE: 1" = 60'
SCALE APPROXIMATE

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe survey results.

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Rocky Flats Plant
Golden Colorado

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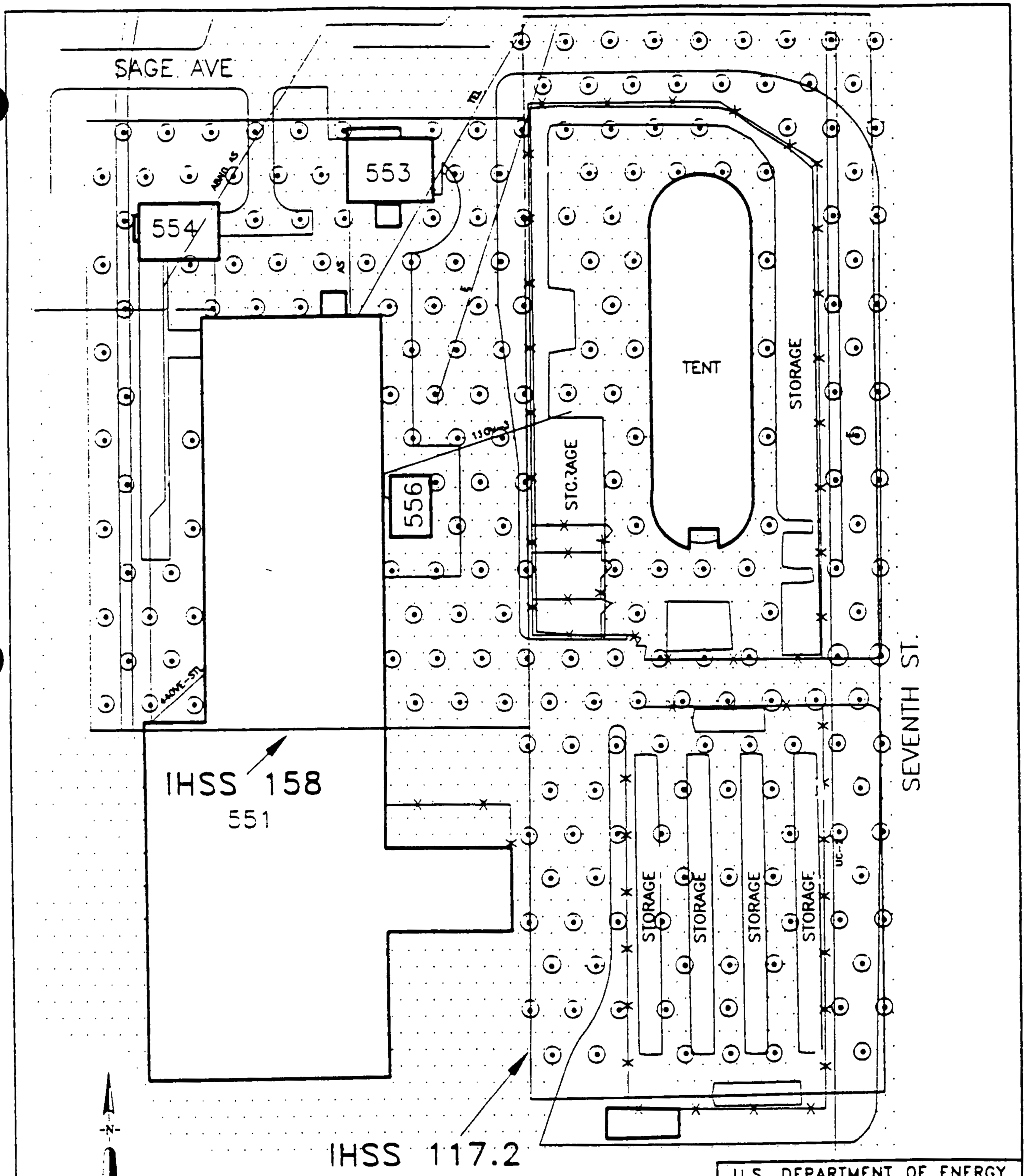
**FIGURE 6-3**

**IHSS LOCATION & UTILITIES MAP WITH PROPOSED SAMPLING LOC'S**
**…S 117.1**




• HPGe Station

◯ Soil Gas Survey Location

NOTE: Surficial Soil Sample at Each HPGe Station

0 30 60

SCALE: 1" = 60'

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe survey results.

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Rocky Flats Plant
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OPERABLE UNIT NO. 13
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**FIGURE 6-4**

**IHSS LOCATION & UTILITIES MAP WITH PROPOSED SAMPLING LOC'S IHSS 158 & 117.2**

HPGe. Subsequently the area will be surveyed by placing the instrument directly over access holes in the pavement. Subsequent to this survey, surficial soil samples will be collected from each HPGe station for analysis of TAL metals. At 10 percent of these sampling sites, surficial soil samples will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. Two of these samples will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds detected but which were not calibrated for:

IAG Required

| | | | |
|---|---|---|---|
| 1,1,1-trichloroethane | perchloroethene | benzene | carbon tetrachloride |
| dichloromethane | trichloroethene | | |

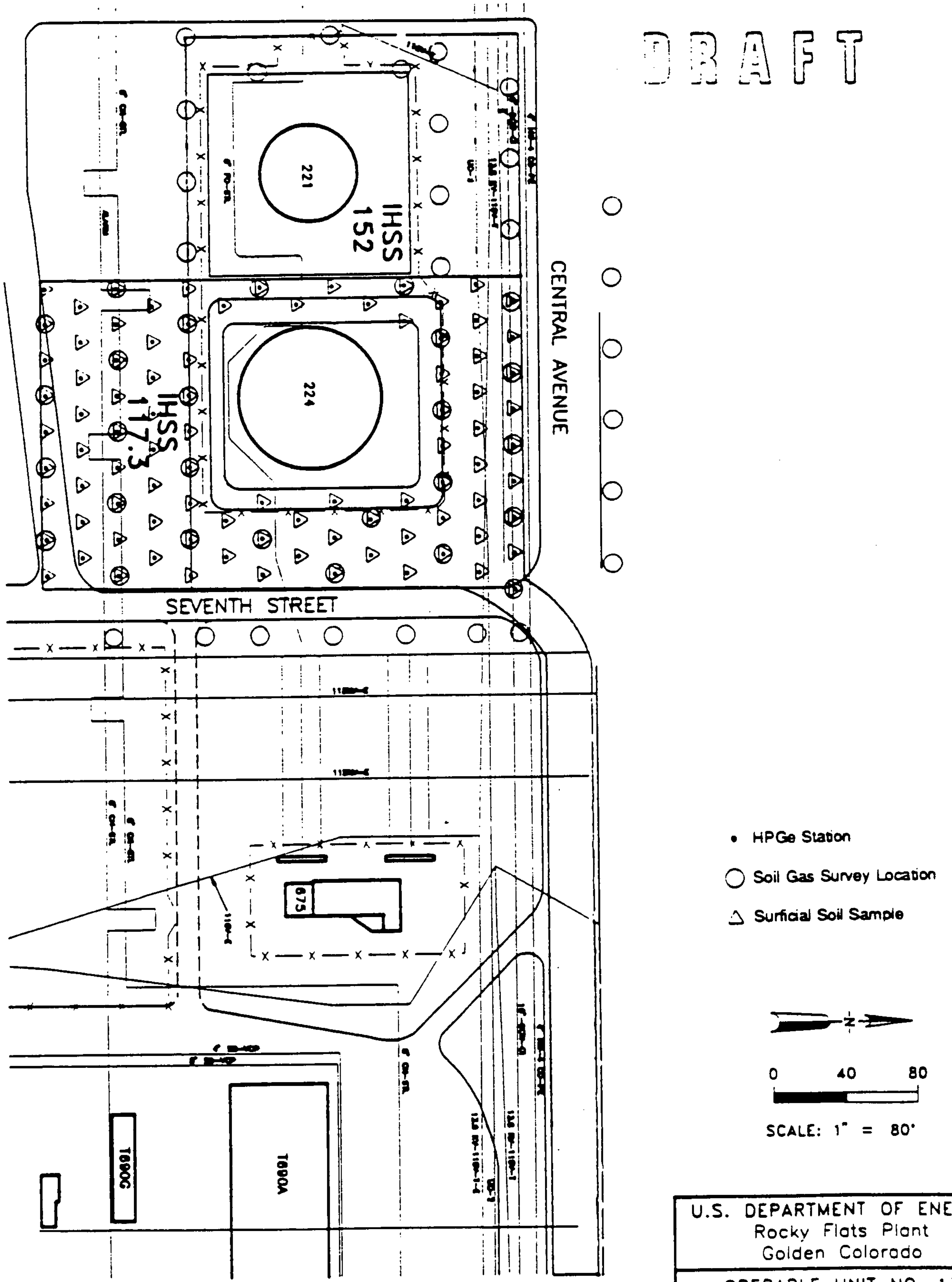
Indicated by Available Data

| | | | |
|---|---|---|---|
| total xylenes | acetone | toluene | 2-butanone |
| ethylbenzene | | | |

Analyses of groundwater samples from existing piezometers P214689, P115589, P115689, and P215789 will provide data which may be useful in assessing potential contamination associated with IHSS 117.2 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

#### 6.3.1.3 South Chemical Storage Site (IHSS 117.3)

Stage 1 sampling efforts for IHSS 117.3 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-5 and Table 6.3). The Stage 1 surface radiological and soil gas




Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe survey results.

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Golden Colorado

OPERABLE UNIT NO. 13
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**FIGURE 6-5**

**IHSS LOCATION & UTILITIES MAP W/ PROPOSED SAMPLING LOC'S IHSS 117.3 & 152**

surveys for this IHSS will be performed on triangular grid spacings of 20 feet and 40 feet, respectively. The soil gas survey of this IHSS will be performed in conjunction with that of IHSS 152 (Section 6.3.1.7). These surveys will be conducted over the entire area of the IHSS to the extent possible. The presence of Tank 224 and equipment associated with that tank will prevent the performance of these surveys over a portion of the IHSS within the berm for that tank.

The surface radiological survey will be performed with a tripod-mounted HPGe over the area of this IHSS that is outside the berm around Tank 224. Due to the fact that the area within the berm was disturbed considerably during the construction of Tank 224, it is not likely that surface contamination attributable to this IHSS would be detectable within the bermed area. Subsequent to the HPGe survey, surficial soil samples will be collected from each HPGe station for analysis of TAL metals. At 10 percent of these sampling sites, surficial soil samples will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. Two of these samples will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey of the area of IHSS 117.3 will analyze for the following compounds and will note any other compounds detected but which were not calibrated for:

<u>IAG Required</u>

| | | | |
|---|---|---|---|
| 1,1,1-trichloroethane | perchloroethene | benzene | carbon tetrachloride |
| dichloromethane | trichloroethene | | |

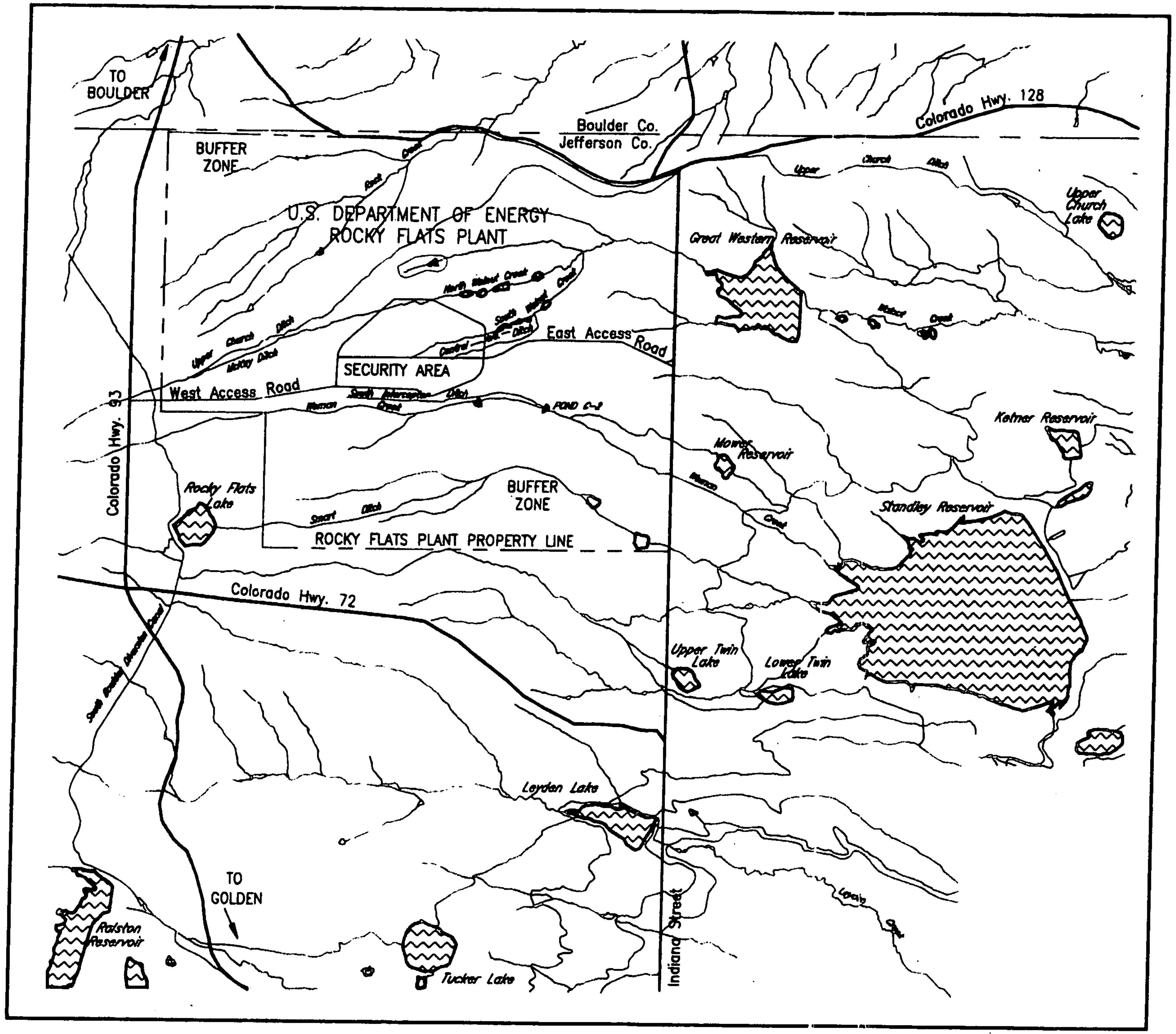
Because IHSS 152 also occurs in the same area as IHSS 117.3 and the soil gas surveys for both IHSSs will be performed together, the soil gas samples will also be analyzed for toluene and total xylenes.

Analyses of groundwater samples from existing well P418289 and piezometer P414189 will provide data which may be useful in assessing potential contamination associated with IHSS 117.3 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

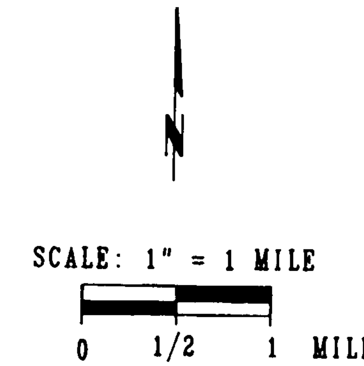
#### 6.3.1.4 Oil Burn Pit No. 1 (IHSS 128)

Stage 1 sampling efforts for IHSS 128 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-6 and Table 6.3). These activities will also provide data required for the evaluation of the portion of IHSS 134 that occurs in this location (see Section 6.3.1.5). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. A 20-foot grid spacing was selected for the soil gas survey because the precise location of these IHSSs is not known and areas of contamination associated with them are likely to be relatively small. It is believed that these sites are located beneath the current location of Sage Avenue (Figure 6-6). It is anticipated that these surveys can be conducted between Sage Avenue and the drainage ditch to the south and the parking lot to the north. One sampling location will also be established on Sage Avenue near the center of these IHSSs. This sampling location will require that an access hole be cut through the pavement on Sage Avenue. It is estimated that approximately 10 feet of artificial fill was placed over these IHSSs during the construction of Sage Avenue. Therefore, a boring drilled to a depth of approximately 10 feet will be required for the placement of a soil gas probe beneath Sage Avenue.

The surface radiological survey will be performed with a tripod-mounted HPGe instrument over unpaved areas. Due to the depth of fill under Sage Avenue, no HPGe measurements will be taken in the paved portion of these IHSSs. A sample of the soil present at the base of the artificial fill will be collected from within the boring drilled for the soil gas survey for analysis of radionuclides with a laboratory HPGe. The concentration of lithium and magnesium will also be measured. Subsequent to the HPGe survey, surficial soil samples will be collected from each




SOURCE: EG&G 1991b

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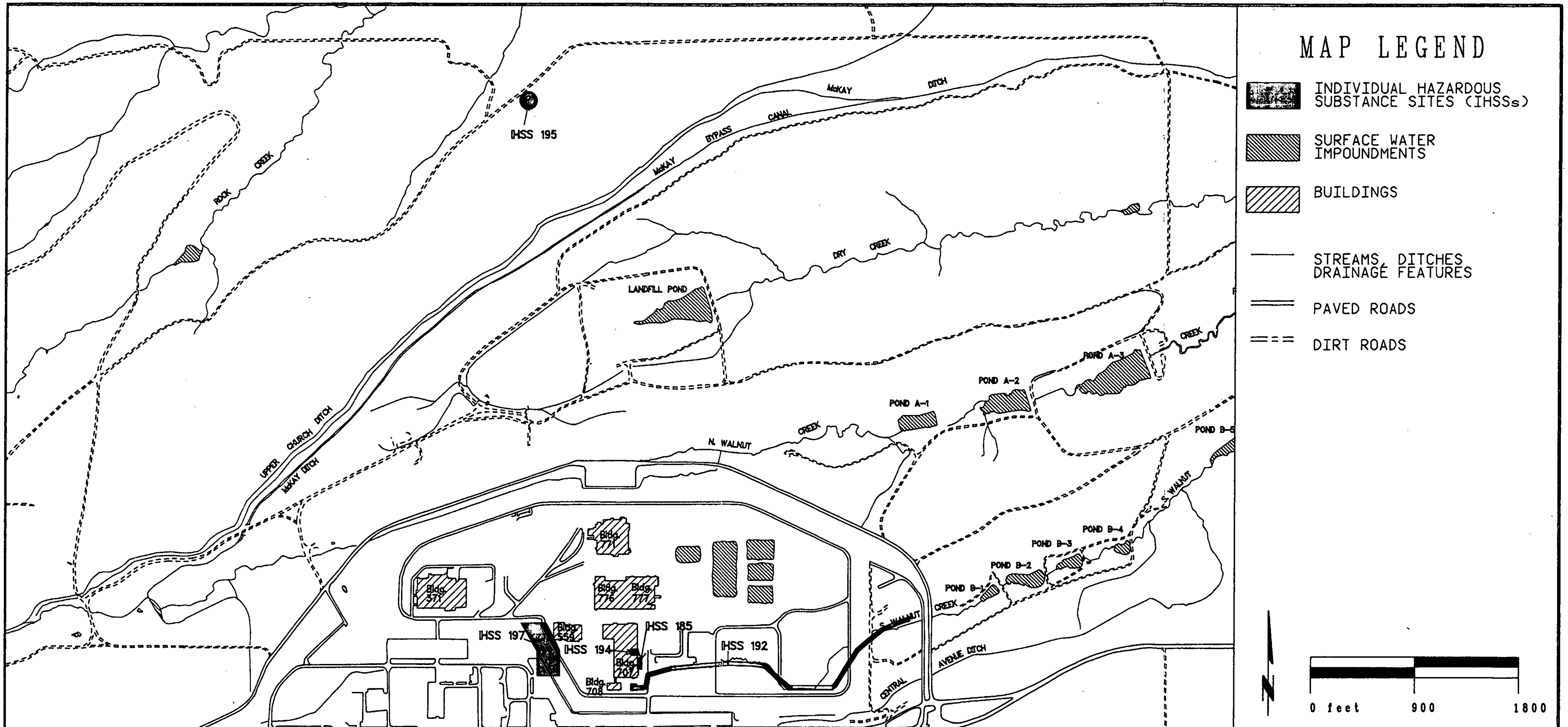
Location Map of Rocky Flats Plant and Vicinity

Figure 2-2 July 1992

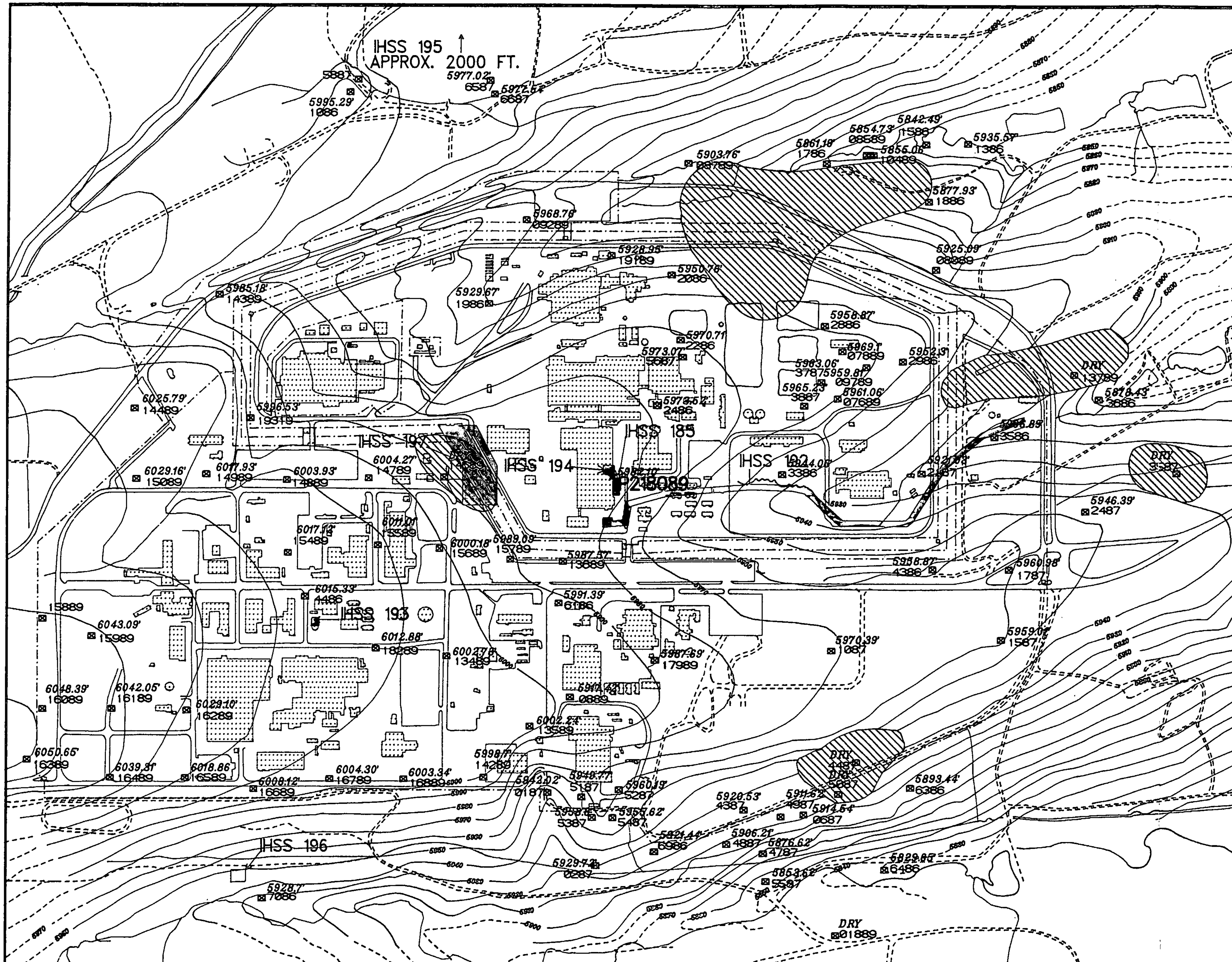



OPERABLE UNIT 16

LOW PRIORITY SITES

LOCATION MAP

Figure 2-3 October 1992




MAP LEGEND

5906.89'
1386
MONITORING WELL WITH WELL IDENTIFICATION NUMBER AND POTENTIOMETRIC SURFACE ELEVATION

WATER TABLE CONTOUR (DASHED WHERE INFERRED)

PAVED ROADS

DIRT ROADS

STREAMS, INTERMITTENT STREAMS, DITCHES, DRAINAGE FEATURES

SECURITY FENCE

OU16 IHSS BOUNDARIES

UNSATURATED MATERIAL

BUILDINGS

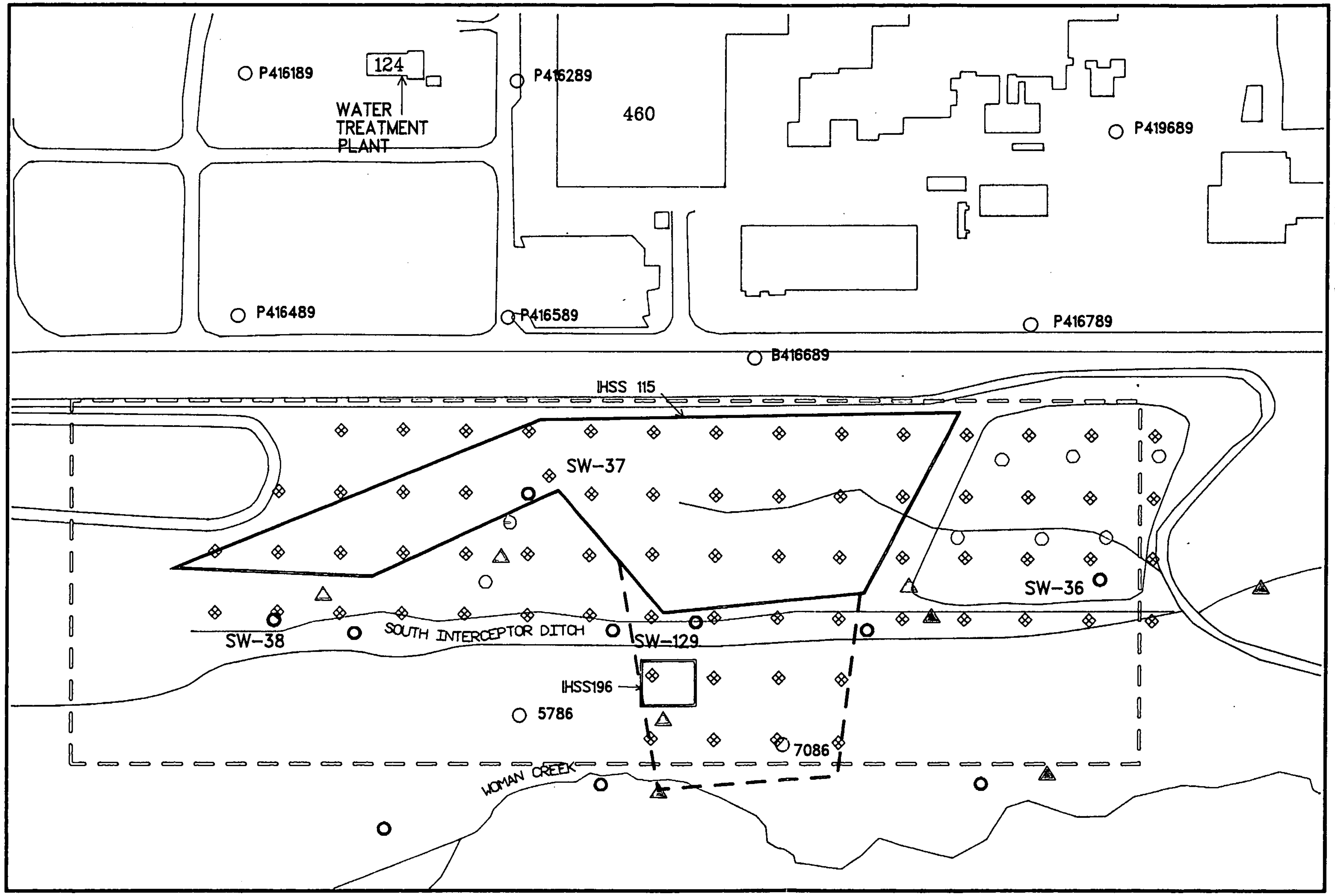
★ GROUNDWATER MONITORING WELL - P218089

N

0 FEET 600 1200

ROCKY FLATS PLANT
POTENTIOMETRIC SURFACE MAP
UPPERMOST AQUIFER
APRIL 1990

Figure 2-9 October 1992




## MAP LEGEND

- EXISTING SURFACE WATER SAMPLING LOCATION
- EXISTING ALLUVIAL GROUNDWATER MONITORING WELL
- PROPOSED WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- SOIL GAS SAMPLES
- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED SURFACE WATER LOCATION
- IHSS 115 BOUNDARY
- IHSS 196 BOUNDARY
- PRELIMINARY EXTENSION OF THE LANDFILL BASED ON A SITE RECONNAISSANCE
- SURFACE DISTURBANCE EAST OF LANDFILL
- 1990 GERMANIUM SURVEY BOUNDARY AROUND OLD LANDFILL

0 feet 200 400

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PROPOSED SAMPLING AND WELL LOCATIONS
IHSS 115 - ORIGINAL LANDFILL

OU15 OCTOBER 1992

FIGURE 3-4