REMEDIAL INVESTIGATION AND FEASIBILITY STUDY PLANS FOR LOW PRIORITY SITES

VOLUME I

SITE DESCRIPTIONS, GROUPINGS AND PRIORITIZATION

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO

JUNE 1, 1988

ROCKWELL INTERNATIONAL
AEROSPACE OPERATIONS
ROCKY FLATS PLANT

DRAFT

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY PLANS FOR LOW PRIORITY SITES

VOLUME I

SITE DESCRIPTIONS, GROUPINGS AND PRIORITIZATION

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO

JUNE 1, 1988

ROCKWELL INTERNATIONAL
AEROSPACE OPERATIONS
ROCKY FLATS PLANT

DRAFT

LIST OF TABLES

LIST OF FIGURES

PLATES

LIST OF ACRONYMS and ABBRIVIATIONS

AEC	U.S. Atomic Energy Commission
ALO	U.S. Department of Energy Albuquerque Operations Office
ARMS	Aerial Radiological Measuring System
CCEI	Colorado Committee for Environmental Information
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (also called Superfund)
CDH	Colorado Department of Health
Ci	Curies
CSU	Colorado State University
dpm/g	decays per minute per gram
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Developmental Administration

FFSDIF	Federal Facility Site Discovery and Identification Findings
FIDLER	Field Instrument for Detecting Low Energy Radiation
G-M	Geiger-Mueller Detector
NPDES	National Pollutant Discharge Elimination System
PA	Preliminary Assessment
PSI	Preliminary Site Investigation
PSZ	Perimeter Security Zone
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act of 1976
SSMP	Site Specific Monitoring Plan
SWMU	Solid Waste Management Unit

1.0 INTRODUCTION

A comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions is in progress at Rocky Flats Plant. These investigations are pursuant to the U.S. Department of Energy (DOE) Comprehensive Environmental Assessment and Response Program (CEARP) and a Compliance Agreement finalized by representatives of DOE, U.S. Environmental Protection Agency (EPA) and the State of Colorado Department of Health (CDH) on July 31, 1986. The Agreement addresses hazardous and radioactive mixed waste management at the Rocky Flats Plant. The program developed by DOE, EPA, and CDH in response to the Agreement addresses RCRA and CERCLA issues and has been integrated with CEARP investigations.

CEARP is being implemented in five phases. CEARP Phase 1 (Installation Assessment) has already been completed at Rocky Flats Plant. CEARP Phase 1 evaluated compliance with environmental laws and ascertained the magnitude of potential environmental concerns. CEARP Phase 2 (Monitoring Plans and Remedial Investigations) will complete the evaluation of potential environmental concerns identified in CEARP Phase 1. It will also plan and implement sampling programs to understand potential contaminant sources and environmental pathways. Draft reports presenting results of CEARP Phase 2 remedial investigations for the high priority sites at Rocky Flats Plant have been completed. This document present plans for Remedial Investigations and Feasibility Studies (RI/FS) for all remaining (non-priority) sites. CEARP Phase 3 (Feasibility Studies) will evaluated remedial alternatives and develop remedial action plans to mitigate environmental problems identified as needing correction in CEARP Phase 2. A draft feasibility study report for the high priority sites has already been completed. CEARP Phase 4 (Remedial/Corrective Action) will design and implement

the site specific remedial actions selected on the basis of CEARP Phase 3 feasibility studies. Remedial design is already in progress, and remedial action planned is planned for the high priority sites. CEARP Phase 5 (Compliance and Verification) will implement monitoring and performance assessment of remedial action and will verify and document the adequacy of remedial actions carried out under CEARP Phase 4

CEARP Phase 2 consists of CEARP Phase 2a, Monitoring Plans, and CEARP Phase 2b, Remedial Investigations. CEARP uses a three-tiered approach in preparing monitoring plans: the CEARP Monitoring Plan (CGMP, DOE, 1986a), the Installation Generic Monitoring Plan (IGMP, DOE, 1987a), and Site Specific Monitoring Plans/Remedial Investigation Plans (SSMP/RIP). Each monitoring plan typically consists of: Sampling Plans, Data Management Plan, Health and Safety Plan, and Quality Assurance/Quality Control Plan.

Installation and site specific monitoring plans were submitted to EPA and CDH in February, 1987 (DOE IGMP, 1987a and 1987b). The IGMP is the Rocky Flats Plant Comprehensive Source and Plume Characterization Plan, and the SSMP is the Remedial Investigation (RI) Work Plan for the high priority sites at the 881 Hillside Area, and other priority sites including the 903 Pad, Mound, and East Trenches Areas. The SSMP also contained feasibility study and risk assessment plans for the priority sites plus sampling plans for the solar ponds and present landfill, two sites being closed under RCRA.

Of the 164 SWMU (Solid Waste Management Unit) and CERCLA sites at Rocky Flats Plant, 78 are classified as low priority sites. This plan addresses these sites. For convenience, all sites have been assigned a solid waste management unit reference number. The term "site" is interchangeably with the term "SWMU" throughout this document.

1.1 PLAN OVERVIEW

This Work Plan is organized in the following manner: Chapter 2 is the description of the Rocky Flats Plant facility and current conditions; including a discussion of previous investigations and regional and local features and their relevance as environmental pathways and/or receptors. Chapter 3 documents all available information for each site. This information is then related to probable environmental pathways and receptors and recommended further investigations for each site. The methodology for grouping and prioritizing the sites is presented in Chapter 4. Chapter 5 provides information on the rationale for a general facility sampling plan. Volume II contains appendices A through N. Appendices A through K consist of the specific sampling plans for Solid Waste Management Unit (SWMU) groups. Appendix L refers to the Hazards Ranking System used for the low priority sites. Appendix M contains the Feasibility Study and Risk Assessment Plan. Volume III is the Health and Safety Plan which describes the general field procedures and sampling techniques and their planned use at these SWMUs. The Quality Assurance Project Plan (QAPP) contained in Volume IV.

2.0 DESCRIPTION OF CURRENT SITUATION

This section provides background information on the environmental setting and plant operations at the Rocky Flats complex.

2.1 SITE HISTORY

The Rocky Flats Plant is a Government-owned and contractor-operated facility, which is part of the nationwide nuclear weapons production complex. This facility was located at Rocky Flats after the U.S. Government decided to expand its weapons capability in 1950 and has been in operations since 1951. The Plant was operated for the U.S. Atomic Energy Commission (AEC) from the Plant's inception until the AEC was dissolved in January 1975. At that time, responsibility for the Plant was assigned to the Energy Research and Development Administration, which was subsequently succeeded by the Department of Energy (DOE) in 1977. The Plant is operated under the direction of the DOE Albuquerque Operations Office (ALO). The prime operating contractor of the facility from 1951 until June 30, 1975, was Dow Chemical U.S.A., an operating unit of The Dow Chemical Company. Rockwell International was selected to succeed Dow Chemical U.S.A., beginning July 1, 1975, as the prime contractor responsible for operating the Rocky Flats Plant.

2.1.1 Plant Operations

Rocky Flats Plant's primary mission is to produce plutonium and other metal components for nuclear weapons. Key production activities involve component fabrication using plutonium, uranium, americium, and non-radioactive metals (principally beryllium and stainless steel). Parts made at the plant are shipped elsewhere for assembly. When a nuclear weapon is determined to be obsolete, components fabricated at the plant are returned to it for special processing to recover plutonium and

americium. The plant has specialized facilities and equipment for handling these materials, as well as personnel with extensive knowledge in the chemistry and fabrication of plutonium, beryllium and other materials that require special handling.

Both radioactive and nonradioactive wastes are generated in the production process. Current waste handling practices involve onsite and offsite recycling of hazardous materials and offsite disposal of solid radioactive materials at another DOE facility. However, both storage and disposal of hazardous and radioactive wastes occurred onsite in the past. Preliminary assessments under the DOE Comprehensive Environmental Assessment and Response Program (CEARP) identified some of the past onsite storage and disposal locations as potential sources of environmental contamination.

2.1.2 Previous Investigations

Various studies have been conducted at the Rocky Flats facility in order to assess the extent of radiological and chemical contaminant releases to the environment. A detailed description of the geology has been presented in previous studies: Dames and Moore, 1981; Malde, 1955; Robson, 1981; Scott, 1963, 1965, and 1972; Spencer, 1961; DOE, 1981; and Van Horn, 1972.

Aerial radiological surveys of the area surrounding the Rocky Flats Plant were conducted by EG&G, Inc., under an ERDA contract (EG&G, 1982). The Aerial Radiological Measuring System (ARMS), which measures terrestrial, gamma-radiation exposure rates, was used. The ARMS was also used to survey other ERDA facilities. A high-sensitivity detection system measures gamma radiation for gamma energy analysis and total gamma count rate. The data were then processed by computer into a map showing isoexposure contours three feet above the ground. A 200-square mile aerial survey was also made of the area outside the perimeter fence of

the Rocky Flats Plant. Radiation exceeding the natural background levels was not found outside the perimeter fence. However, elevated radiation levels have been noted within the operational area (SWMU Areas 116, 118, 120, 131, 161, 164.1, 173).

A series of investigations has been conducted at the Plant to characterize ground water, surface water, soils, air quality, and biota. A summary of investigations performed prior to 1987 remedial investigations is provided in the RCRA Part B Operating Permit Application (Rockwell International, 1986a). These programs include:

1) Several drilling programs beginning in 1961 that resulted in approximately 60 monitor wells by 1985;

2) An investigation of surface and ground water by the U.S. Geological Survey (Hurr, 1976);

3) Environmental, ecological, and public health studies which culminated in an Environmental Impact Statement (DOE, 1980);

4) An integrative report on groundwater hydrology using data from 1961 to 1985 (Hydro-Search, Inc., 1985);

5) A preliminary electromagnetic survey of the Plant perimeter (Hydro-Search, Inc., 1986);

6) A soil gas survey of the Plant perimeter and buffer zone (Tracer Research, Inc., 1986);

7) A review of historical waste disposal practices and prioritization of disposal sites based on reported waste disposal practices and on groundwater quality,

geophysical, and soil gas data (Rockwell International, 1986b and DOE, 1986b);

8) An initial site characterization including surface water monitoring and sampling, sediment sampling, and installation of 69 new monitor wells at the Plant (Rockwell International, 1986a, 1986d, and 1986e);

9) A remedial investigation of the 903 Pad, Mound, and East Trenches Areas performed in 1987 (Rockwell International, 1987b); and

10) Environmental monitoring programs addressing air, surface water, groundwater, and soils (Rockwell International, 1975-1985, 1986g, and 1987a).

The CEARP Phase 1 Installation Assessment for Rocky Flats Plant included analyses 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. CEARP Phase 1 identified a number of sites that could potentially have adverse impacts on the environment. Data collected during preparation of the RCRA Part B Operating Permit Application identified several additional potential sites. All potential sites at Rocky Flats Plant were designated as solid waste management units (SWMUs). These solid waste management units are divided into three categories. The first category includes those hazardous waste management units which will continue to operate and require a RCRA operating permit. The second category includes those hazardous waste management units that are being closed under RCRA interim status regulations and require a Post Closure Care Permit. The third category includes those inactive waste management units that are identified under Section 3004(u) of RCRA and CERCLA sites contain only radioactive wastes. For ease in referencing these units and

sites, and in accordance with RCRA terminology, each site is designated a Solid Waste Management Unit (SWMU) and assigned a reference number. No distinction is made in this document between RCRA and CERCLA sites.

Hydrogeological and hydrogeochemical characterizations of the entire Rocky Flats facility were performed in 1986 as part of the initial CEARP site characterization. Results of that investigation are presented in the RCRA Part B Permit Application for the Rocky Flats Plant. Analysis of these data has identified four areas which are the most probable sources of environmental contamination, with each area containing several sites. These areas are the 881 HIllside Area, the 903 Pad Area, the Mound Area, and the East Trenches Area. Sites on the 881 Hillside Area were selected as high priority sites because of the high concentrations of volatile organic compounds detected in groundwater, the relatively permeable soils and the Area's proximity to a surface water drainage.

A preliminary remedial investigation at the high priority sites (881 Hillside Area) was completed in July 1987 (Rockwell International, 1987a) and Phase II investigations were completed in March 1988 (Rockwell International, 1988a). A draft feasibility study for these sites was also completed in March 1988 (Rockwell International, 1988b). Remedial design has begun at the high priority sites and remedial action is planned in early 1989. Phase I remedial investigations at all other priority sites (903 Pad, Mound and East Trenches Areas) were completed in December 1987 (Rockwell International, 1987b). A feasibility study is in progress at these sites and Phase II investigations are planned this year.

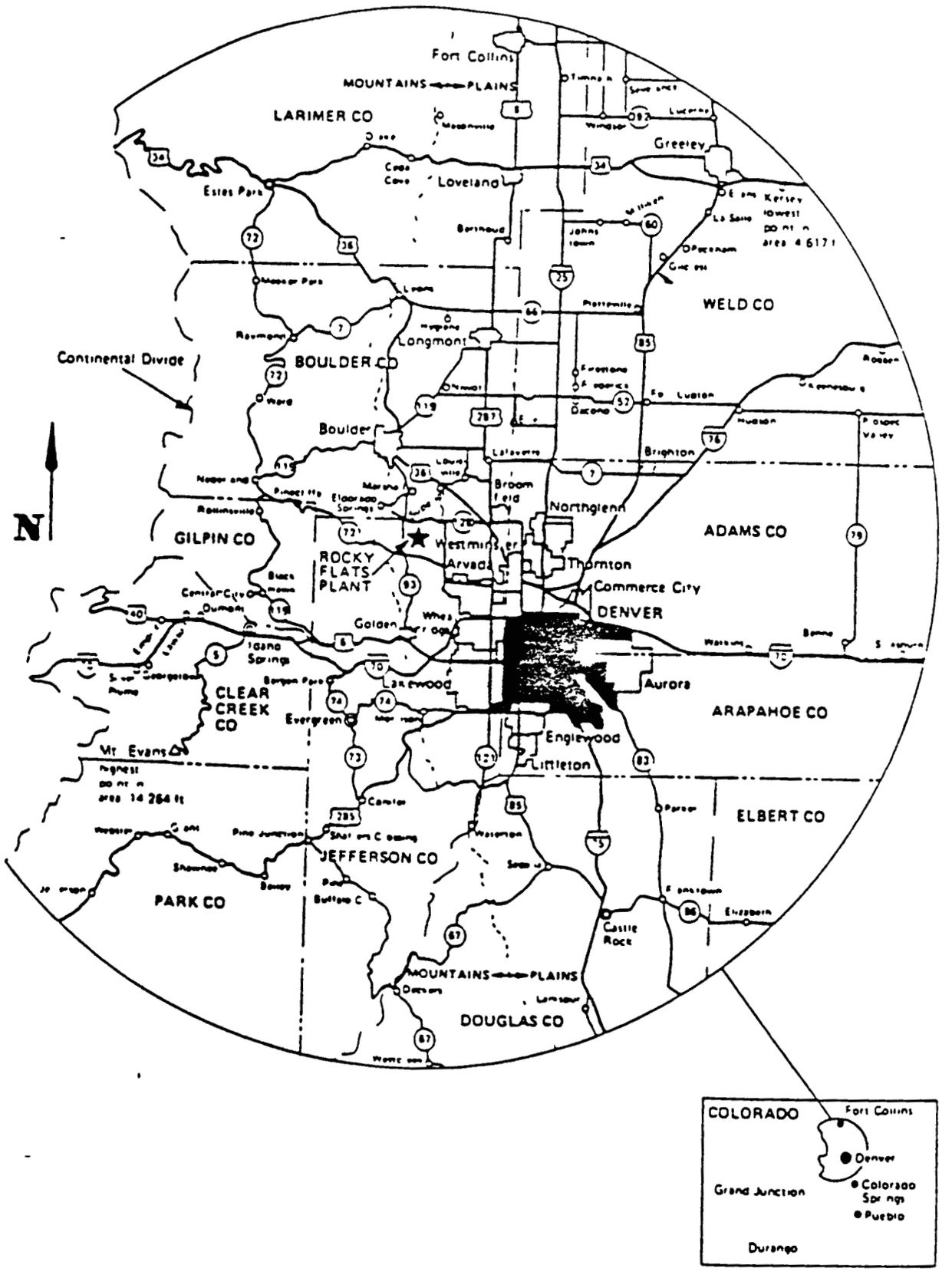
2.2 REGIONAL DESCRIPTION

A brief description and summary of the regional and environmental setting of the Rocky Flats Plan is included below to provide a basis for understanding contaminant pathways.

2.2.1 Socioeconomic Setting

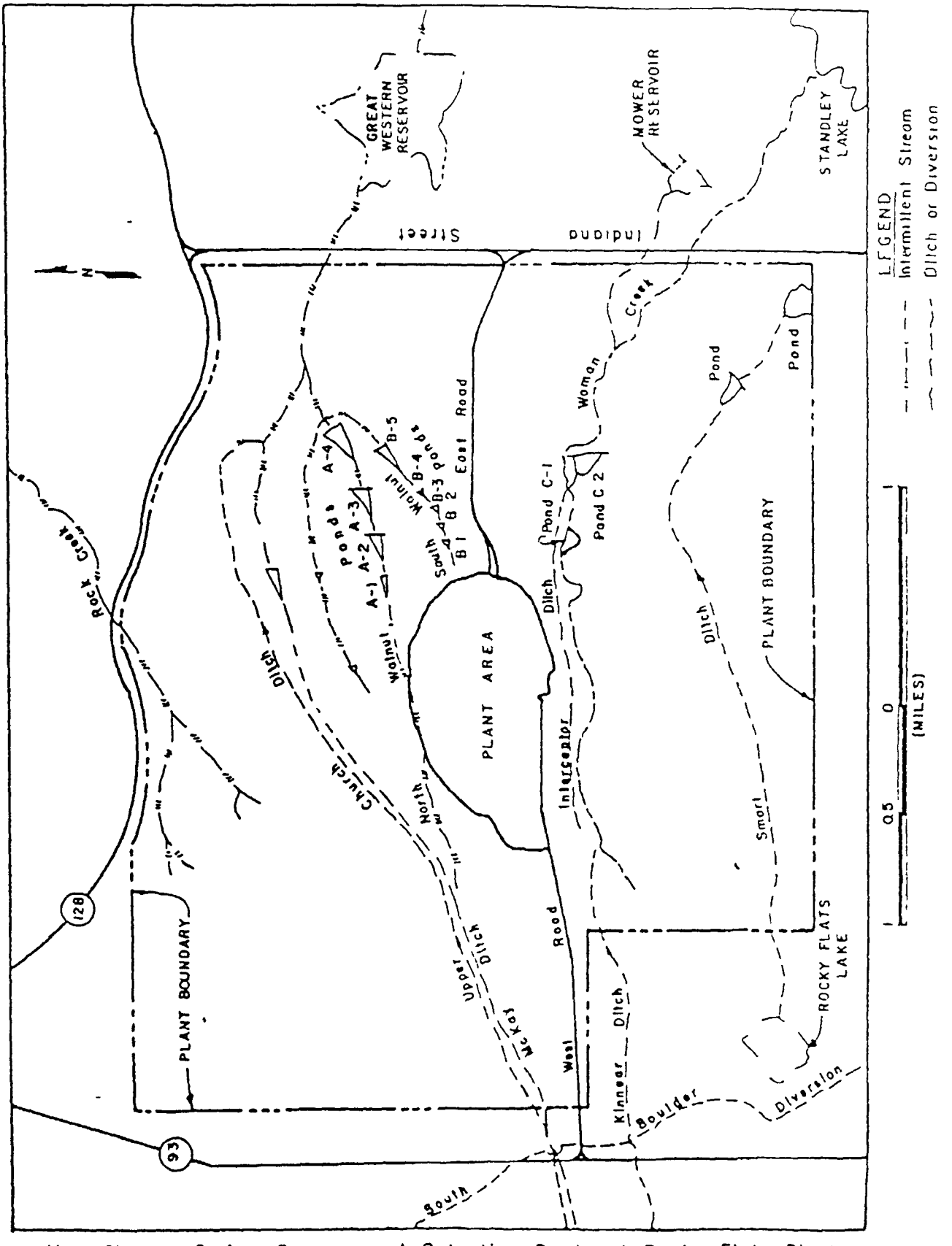
The Rocky Flats Plant is located in northern Jefferson County, Colorado, approximately 16 miles northwest of downtown Denver (Figure 2-1). The Plant consists of approximately 6,550 acres of federally owned land in Sections 1 through 4 and 9 through 15 of T2S, R70W, 6th principal meridian. Major buildings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

The area in the immediate vicinity of the Rocky Flats Plant is primarily agricultural or undeveloped. Prior to 1975 the buffer zone was used by its former owners for grazing cattle and horses. No grazing has been allowed since then. No major public facilities or institutions, such as schools, prisons, or hospitals are located within 5 miles of the Plant. There are four commercial/industrial facilities, within 5 miles of the Plant, The TOSCO Oil Shale Laboratory, Great Western Inorganics, Frontier Forest Products, the Jeffco Airport and Industrial Park, which employ 78, 16, 14 and 206 people respectively. Several populations centers are located within 10 miles, with the closest being the small community of Leyden, 3.3 miles south of the Plant. Within 9 to 12 miles are the communities of Broomfield, Arvada, Golden, and Boulder.



Rocky Flats Site Vicinity Map

Figure 2-1



Map Showing Surface Drainage and Retention Ponds at Rocky Flats Plant

Figure 2-2

2.2.2 Environmental Setting

Topography

The natural environment of the Plant site and vicinity is influenced primarily by its proximity to the Front Range of the Rocky Mountains. The Plant site is directly east of the north-south trending Rocky Mountains, with an elevation of approximately 6,000 feet above sea level. The Rocky Flats complex is located on a broad, eastward sloping plain of overlapping alluvial fans developed along the Front Range. These fans extend about 5 miles in an eastward direction with their origin to the west in the abruptly rising Front Range and terminate on the east at a break in slope to low rolling hills. The Continental Divide is about 16 miles west of the Plant. The Rocky Flats operational area is located on the eastern margin of a geologic plateau between two stream cut valleys: North Walnut Creek and Woman Creek. Exposed at the surface is the Rocky Flats Alluvium consisting of a topsoil layer underlain by 0 to 50 feet of clay, sandy clay, and clayey gravel.

Hydrology

Area hydrology is influenced by the thin permeable topsoil layer of the Rocky Flats alluvium. The result is little water retention in the soil, as is evidenced by sparse vegetation in the area. Surface water and groundwater flow is from west to east, originating in the Front Range mountains. Most groundwater eventually surfaces to join the natural streams traversing the site.

Three intermittent streams drain the plant: Rock Creek drains the northwest corner; Woman Creek drains the southern third, and North and South Walnut Creeks drain the remainder (Figure 2-2). Interceptor ditches have been constructed to collect and divert all runoff from the plant's operational areas. North and South

Walnut Creeks are small streams. North Walnut Creek flows to the north of the Plant and has a drainage area of about 1.2 miles^2 within the boundaries of the Plant. South Walnut Creek originates within the Plant and has a drainage area of about 0.46 miles^2. North Walnut Creek and South Walnut Creek join together onsite about 0.5 mile west of Indiana Avenue. From that point, Walnut Creek flows southeast into Great Western Reservoir. Great Western Reservoir supplies water to the City of Broomfield. However, most of the water in Great Western Reservoir comes from Church Ditch, which conveys water from Coal Creek (DOE, 1980). Woman Creek also originates west of the Plant, drains the south portion of the Rocky Flats Plant site, and flows eastward into Standley Lake. Standley Lake provides irrigation storage and the municipal water supply for the cities of Westminster, Thornton, and Northglenn.

Three series of retention ponds have been constructed within these three stream valleys to control and monitor the release of surface water contaminants. Four retention ponds designated as A-1, A-2, A-3, and A-4 are located on North Walnut Creek from west to east. Five retention ponds, located on South Walnut Creek, are designated as B-1, B-2, B-3, B-4, and B-5, from west to east). Two retention ponds are located on Woman Creek south and east of the plant. From west to east, they are designated ponds C-1 and C-2, respectively. Pond C-1 receives water from Woman Creek. Pond C-2, receives surface runoff water from the south interceptor ditch.

Prior to 1979, some of the ponds (A-1, B-1 to B-4 and C-1) were used to hold various wastes that contained nitrates and low levels of radioactivity (DOE 1986b). Studies have shown that the ponds have successfully provided residence time and holding capacity to allow materials to settle out, and in so doing have become infiltrated with those materials.

The ponds on Woman Creek and Walnut Creeks are classified as low priority SWMUs and are addressed in this work plan.

Hydrogeology

Geologic Units at the Rocky Flats Plant site in descending order are the Rocky Flats Alluvium, Valley-Fill Alluvium and Colluvium in stream channels, Arapahoe Formation, and the Laramie - Fox Hills aquifers. The major occurrence of groundwater is found in the Rocky Flats alluvium and colluvium in the valleys. Minor amounts occur in sandstone lenses in the Arapahoe Formation, and in the Laramie - Fox Hills Aquifer. (Refer to Figure 2-3).

The nearest groundwater well assumed to be used for drinking water with an alternate source available is located approximately two miles from the Plant site. About 50 rural wells within three miles serve an assumed population of 190 people (3.8 people per well), (DOE, 1986a).

Rocky Flats Alluvium - Rocky Flats Alluvium which underlies the Plant, dominates the hydrology of the Plant area. This alluvium is a broad planar deposit which consists of a topsoil layer underlain by 0 to 50 feet of clay, sandy clay, and clayey gravel. The Rocky Flats Alluvium Aquifer is relatively permeable. Recharge to the alluvium is from precipitation, snowmelt, and water losses from ditches, streams, and ponds that are cut into the alluvium. General water movement in the Rocky Flats Alluvium is from west to east and towards the drainages. Discharge from the alluvium occurs at minor seeps and springs in the colluvium that covers the contact of the Rocky Flats Alluvium and Arapahoe Formation along the edges of the valleys. Groundwater flow is controlled by buried channels in the bedrock where the alluvium is thickest. The water table in the Rocky Flats Alluvium rises in response to recharge during the spring and declines when recharge eases during the remainder of the year.

ERA	PERIOD (Epoch)	AGE (Millions of Years)	FORMATION	THICKNESS (Feet (M - Meters))	GENERAL LITHOLOGY
CENOZOIC	QUATERNARY	3	Rocky Flats Alluvium and Colluvium	20 - 60 (6 - 15)	Conglomeritic boulders sand and clay
	TERTIARY: Pliocene, Miocene, Oligocene, Eocene, Paleocene	64	Not present in the Rocky Flats area		
		65	Denver Formation	0 - 800 (0 - 180)	Upper part Latite flows on Table Mountain Golden Lower part Tuffaceous sandstone siltstone, conglomerate
			Arapahoe Formation	270 - 450 (80 - 140)	Sand and Clay
			? ?	? ?	
MESOZOIC	CRETACEOUS: Upper		Laramie Formation	750 - 800 (230 - 240)	Upper Unit Shale Lower Unit Sandstone
			Fox Hills Sandstone	40 - 90 (12 - 27)	Sandstone
			Pierre Shale	7 300 (2 200)	Shale sandstone and minor silt
			Niobrara Shale	450 (140)	Shale, minor limestone
	CRETACEOUS: Lower		Benton Shale	500 (150)	Shale minor bentonite limestone and siltstone
			Dakota Group	320 (100)	Sandstone minor shale siltstone, and conglomerate
	JURASSIC	135	Morrison Formation	300 (90)	Claystone sandstone and limestone
			Ralston Creek Formation	35 - 120 (11 - 35)	Claystone, siltstone and limestone
			? ?	? ?	
	TRIASSIC	180	Lykins Formation	400 - 600 (120 - 180)	Siltstone minor limestone
		226	? ?	? ?	
PALEOZOIC	PERMIAN		Lyons Sandstone	200 - 250 (60 - 75)	Sandstone, minor conglomerate
	Pennsylvanian	270	Fountain Formation	800 - 1000 (240 - 300)	Sandstone, conglomerate and siltstone
	Mississippian				
	Devonian				
	Silurian	300			
	Ordovician		Not present in the Rocky Flats area		
	Cambrian				
PRECAMBRIAN		570	Crystaline Basement Complex	Unknown	Metamorphosed sedimentary volcanic and intrusive rocks mainly schist and gneiss

Intrusive Rocks

PALEOCENE	62	Ralston Dike	Monzonite

Figure 2-3 Geologic Time Scale and Stratigraphy in the Rocky Flats Area

The Rocky Flats Alluvium terminates east of the plant boundary therefore, does not supply water to wells located downgradient from the plant. However, the alluvium discharges water to the retention ponds and the underlying Arapahoe Formation.

Valley Fill Alluvium and Colluvium - Alluvium in the valleys and stream channels is usually coarse, better sorted and therefore more permeable than the Rocky Flats Alluvium. The alluvium in the stream channels is approximately 10 feet thick. Studies have indicated that groundwater movement in this valley-fill alluvium to be relatively rapid (Hurr, 1976). However, recent data indicates groundwater movement at much slower velocities (Blaha, Personal Comments, May 19, 1988).

Groundwater in the colluvium along the bottom of the valleys in the Rocky Flats Plant area is recharged by precipitation, percolation from streams during periods of surface-water runoff, and by seeps and springs discharging from the Rocky Flats Alluvium. Discharge from this valley-fill alluvium is by evapotranspiration and by seepage into other geologic formations and streams. The direction of groundwater flow generally is along the course of the stream. During periods of high surface-water flow, water is lost to bank storage in the alluvium and returns to the stream after runoff subsides.

The movement of groundwater into and out of the valley-fill alluvium varies along the length of the valleys. In the upper reaches of the valleys where the valley-fill is underlain by the Rocky Flats Alluvium, water moves from the valley-fill alluvium to the Rocky Flats Alluvium. Downstream, where the valley bottom is below the base of the Rocky Flats Alluvium, water moves from the Rocky Flats Alluvium to the valley-fill; groundwater flows from the valley-fill. Where the valleys have been cut into bedrock, water moves from the streams into the valley-fill and then recharges the underlying bedrock formation (DOE, 1986a).

Arapahoe Formation Aquifer - Underlying the Rocky Flats Alluvium are the continental deposits of the Arapahoe Formation. The Arapahoe consists of claystone with thin lenses of sandstone. It is approximately 270 feet thick at the Rocky Flats Plant area.

The permeable zones of the Arapahoe are lenticular sandstones within the claystone. These lenticular sand bodies are composed of fine grain sands and silts, and their hydraulic conductivity is low compared to the overlying Rocky Flats Alluvium.

The Arapahoe Formation is recharged by leakage from streams and groundwater movement from the overlying alluvial deposits. The main recharge area is under the Rocky Flats Alluvium, west of the Plant area, although some recharge from the valley-fill occurs along the stream valleys north and south of the Rocky Flats Plant (DOE, 1980). 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.

Ground water movement in the Arapahoe Formation is down dip to the east. Although there are a few seeps along the sides of some valleys where the Arapahoe Formation crops out, most of the groundwater flows eastward, out of the area. The major drainage is toward the South Platte River.

Laramie - Fox Hills Aquifer - Underlying the Arapahoe Formation is the Laramie Formation. The Laramie Formation is a continental deposit divided into two units: a sandstone unit and a shale unit. The sandstone unit is about 90 feet thick overlain by the shale unit, which is about 320 feet thick.

The Fox Hills Sandstone is a marine deposit of arenaceous shale grading up into a massive sandstone. The thickness generally ranges from 35 to 100 feet. Figure 2-3 illustrates the stratigraphic column in the area surrounding the Plant. The

lower sandstone unit of the Laramie Formation and the Fox Hills Sandstone are collectively called the Laramie-Fox Hills aquifer. The steeply dipping beds of the aquifer crop out west of the Rocky Flats Plant and quickly flatten toward the east. Recharge to the aquifer occurs along the rather limited outcrop area exposed to surface-water flow and leakage along the Front Range.

The Laramie-Fox Hills aquifer and the Arapahoe formation aquifer are separated by several hundred feet of relatively impermeable shale (the upper unit of the Laramie Formation); consequently, there is little, if any, hydraulic connection between the two aquifers. Furthermore, the recharge area for the Laramie-Fox Hills aquifer is considerably west of the Rocky Flats Plant. Therefore, Plant operations should have little or no effect on the Laramie-Fox Hills aquifer (Hurr, 1976).

Meteorology

The area surrounding the Rocky Flats Plant has a semiarid climate characteristic of much of the central Rocky Mountain region. Approximately forty percent of the 15-inch annual precipitation falls during the spring season, much of is as wet snow. Thunderstorms (June to August) account for an additional 30% of the annual precipitation. Autumn and winter are drier seasons, accounting for 19 and 11% of the annual precipitation, respectively. Snowfall averages 85 inches/year, falling from October through May (DOE, 1986a).

Special attention has been focused on dispersion meteorology surrounding the Rocky Flats Plant due to the remote possibility that significant atmospheric releases might affect the Denver metropolitan area. Studies of air flow and dispersion characteristic are available (Crow, 1974; Hodgin, 1984). The studies by Crow indicate that drainage flows (winds coming down off the mountains to the west) turn and move toward the north and

northeast along the South Platte River Valley to the west and north of Brighton, Colorado. Winds at the Rocky Flats Plant occasionally exceed 100 miles per hour, with dispersion of surface particulates toward the north and northeast along the South Platte River Valley to the west and north of Brighton, Colorado (DOE, 1986a).

Air Pathway

Air pathway studies at Rocky Flats Plant are performed continuously and reported annually in Annual Environmental Monitoring Reports (Rockwell International, 1975-1985, 1986g, and 1987a). In additional, the air pathway was further characterized by Rockwell International (1986f) in the "Rocky Flats Plant Radioecology and Airborne Pathway Summary Report".

Air samplers for routine ambient air monitoring at the Plant are located at various locations on and off Plant site. This ambient air program monitors only radionuclides. Conventional air quality parameters are monitored on site at a dedicated location inside the perimeter security fence west of the East Guard Gate.

The Plant Radioactive Ambient Air Monitoring Program (RAAMP) is comprised of 51 high-volume particulate air samplers which operate continuously. Twenty-three (23) of the 51 air samplers are within or directly adjacent to the Plant security area (onsite samplers), and 14 are located around the Plant property boundary (perimeter samplers). An additional 14 samplers (community samplers) are located in neighboring towns.

Data collected at Rocky Flats Plant indicate a low potential for significant human exposure to radioactive and nonradioactive airborne emissions from the Plant. All perimeter and community ambient air samplers have recorded mean annual plutonium concentrations at less than 0.4% of the Derived concentration

Guide (DCG), which is based on the DOE interim standard dose limit for all pathways of 0.1 rem/yr for a 50-year committed effective dose equivalent (Rockwell International, 1986g). This level is indistinguishable from fallout.

Biota

Plant and animal life is typical of that found in nearby areas. Several species of small mammals and larger animals inhabit the site. The small intermittent streams flowing through the site do not support large aquatic communities, but a variety of species are present because of the high, natural water quality. There are no threatened or endangered species at the Rocky Flats Plant.

Radiation

The background radioactivity in the Rocky Flats vicinity comes from natural and man-made sources. Natural background radiation in the general area is significantly higher than in the United States as a whole (Klement, et al., 1972; CDH, 1976). The higher natural background is due to the elevation of the area and the geologic deposits containing naturally radioactive materials such as uranium and thorium.

Man-made releases of long-lived radioisotopes have added to the background radiation. These contributions are a small fraction of the natural background radiation level. Fallout from past nuclear weapons testing in Nevada and New Mexico has contributed about the same background plutonium levels to the Rocky Flats area as in the rest of the United States. In addition to the background radiation discussed above, there is radiation from past releases of long-lived alpha activity from Rocky Flats. This radiation is greater near the Rocky Flats facility and drops off quickly with increasing distance from the Plant. The past

releases have led to some contamination of the surface water, pond sediments, and soil.

There have been two fires that have caused major damage to production buildings at Rocky Flats. These occurred in 1957 and 1969 and resulted in estimated environmental releases of 25,618 and 856 uCi of plutonium, respectively. In addition, there were three isolated fires that caused detectable releases in 1965, 1969, and 1972. Those fires resulted in releases of about 1,170; 20; and less than 2 uCi of plutonium, respectively (DOE, 1980).

In addition to releases of plutonium to the atmosphere, there have been past releases of radioactive material from the Plant to water effluents. These latter releases have contributed to an increase in radioactivity in the retention ponds on the site and in the immediate vicinity. Since the start-up of Plant operations in 1952 until December 21, 1973, water containing decontaminated process and laundry waste was released through the B-series ponds to South Walnut Creek. This creek joins North Walnut Creek, which flows into Great Western Reservoir. Discharge from cooling water blowdown and steam condensate were discharged to Pond A-1, while filter backwash water from the water treatment facility was discharged to Pond C-1. Most of these discharges have now been stopped. The Plant has been working on a zero total liquid discharge system since the late 1970's except in emergencies (Blaha, Personal Comments, May 19, 1988). However, treated sanitary liquid waste will continue to be discharged to Walnut Creek. While the water that flowed into Great Western Reservoir did not exceed applicable Radioactivity Concentration Guides set forth in ERDA Manual Chapter 0524, (1977), it did contain some low-level concentrations of plutonium and uranium. Most of the radioactive materials settled out in the ponds, resulting in measurable amounts of radioactivity in the pond sediments.

3.0 SOLID WASTE MANAGEMENT UNIT CHARACTERISTICS

This chapter presents the existing data for the low-priority solid waste management units (SWMUs) at the Rocky Flats Plant, illustrated on Plate 1 which can be found at the end of this chapter. The data were obtained from site visits, the "Comprehensive Environmental Assessment and Response Program Phase 1: Installation Assessment" (DOE, 1986a), "Rocky Flats Plant RCRA Part B Application" (DOE, 1986b & c), "Rocky Flats Plant Environmental Impact Statement" (DOE, 1980), existing technical literature as referenced, and site topographic and utility maps. Chemical and toxicological information were obtained from the "Superfund Public Health Evaluation Manual" (EPA, 1986), "Dangerous Properties of Industrial Materials" (Sax, 1984), and "Toxicology and Biological Monitoring of Metals in Humans" (Carson, 1986).

The first several sections of this chapter describe each SWMU with respect to Historical and Operational Information, Geographic Information, Site-Specific Pathways, and Recommended Further Action. A brief description of the toxicology of the contaminants is contained in each SWMU description and is summarized in Table 3-1.

Maps of the SWMUs at a scale of 1 inch equals 200 feet are located at the end of the chapter (Figures 3-1 through 3-12).

TABLE 3-1

ROCKY FLATS CHEMICAL TOXICITY SUMMARY TABLE

COMPOUND	ACCEPTABLE INTAKE[1]	SAX TOX[2]	CARCINO-GENICITY[3]	PERSISTENCE[4]
Americium	NE	3	A	High
Benzene	3.0×10^{-1}	3	A	Low
Beryllium	5.0×10^{-4}	3	B	High
Carbon Tetra-chloride	NE	3	B	High
Chromates	NE	3	A	High
1,1-Dichloro-ethylene	9.0×10^{-3}	3	C	High
Dichloro-methane	6.0×10^{-2}	3	B	High
Flouride	6.0×10^{-2}	3	NE	High
Lithium	NE	3	NE	High
Methyl Ethyl Ketone Peroxide	8.0×10^{-3}	3-2	NE	Low
Nitrates	NE	2	NE	Low
Plutonium	NE	3	A	High
Styrene	2.0×10^{-1}	3	NE	Moderate
Tetrachloro-ethylene	$2:0 \times 10^{-1}$	3	B	High
1,1,1-Trichloro-ethane	5.4×10^{-1}	2-1	NE	Moderate
Trichloro-ethylene	NE	3	B	High
Uranium	NE	3	A	High

Footnotes on following page

NE - Not Evaluated

1. Acceptable intake through oral route in mg/kg/day for non-carcinogenic effects (EPA, 1986).

2. Toxicity scores: 3 - Highly Toxic, 2 - Moderately Toxic, 1 - Low Toxicity (Sax, 1984).

3. EPA weight-of-evidence categories: A - Human Carcinogen, B - Probable Human Carcinogen, C - Possible Human Carcinogen (EPA, 1986).

4. Based on guidance from HRS Guidance Manual (EPA, 1984).

3.1 SWMU 115: ORIGINAL LANDFILL

3.1.1 Site History and Description

The original landfill was used to dispose of general wastes generated at the Rocky Flats Plant from 1952 to 1968. Ash containing an estimated 20 kilograms (kg) of depleted uranium (DOE, 1986b), produced when 60 kg of depleted uranium were inadvertently burned, and small quantities of various chemicals are buried in the landfill with approximately 2 million cubic feet of miscellaneous plant wastes. Many wastes such as solvents, paint, paint thinners, oil, pesticides, and cleaners, that were not considered hazardous at the time were probably disposed in the landfill. The landfill may originally have been used as a graphite dump which also received beryllium and/or uranium (Weston, 1986).

The northwestern corner of the landfill covers an evaporation/settling pond. The pond was used for backflushing of sand filters from the wastewater treatment plant that was located immediately north of the landfill.

Several drums can be seen on the north ridge of the landfill in aerial photographs taken in 1969. It appears that some of the drums are sealed, indicating that their contents were intact at the time of disposal. Few of the drums would still have their contents intact because of the handling of the drums during disposal and drum deterioration in the past 20 to 36 years.

The landfill is closed with adequate cover; however, it has no liner. The slope on the south side of the landfill was recently regraded to correct sloughing and erosion problems.

Two three-foot-diameter corrugated pipes protrude from the landfill. The one to the west appears to be connected to an

abandoned storm drain constructed of 15-inch vitrified clay pipe. The other manhole appears to be connected to a 36-inch reinforced concrete pipe which connects to several drainage pipes on the Plant and discharges to the east of the landfill. During a site visit in February 1988, water was heard flowing in this pipe.

Chemicals potentially present in the landfill include commonly used solvents such as petroleum distillates, 1,1,1-trichloroethane, dichloromethane, benzene, carbon tetrachloride, and trichloroethylene, and metals such as beryllium, uranium, lead, and chromium. All of these compounds are toxic and most of them are not readily degraded in the environment. In April 1986, the original landfill received a hazard ranking score of 15.03 for the total chemical migration mode and a score of 4.37 for the total radioactive migration mode.

3.1.2 Geographic Information

The original landfill is located south of the security-fenced area about 300 feet north of Woman Creek (Figure 3-1). The South Diversion Ditch collects runoff and any leachate from the landfill and carries it to a containment pond (C-2) on Woman Creek where it is held to prevent off-site releases.

Depth to water in the shallow aquifer varies seasonally between 10 and 20 feet. The soil between the landfill and the water table is permeable (Hurr, 1976). Two monitor wells (#57-86 and #70-86), each approximately 7 feet deep, are located between the landfill and Woman Creek. Readings taken of the air space by a Hnu meter in the well casing immediately after the protective cap had been removed indicated the presence of volatile organic compounds in the range of 10 to 20 ppm (Lewis, Personal Communication, 1988). No volatile organics were detected in the groundwater samples.

The surface of the landfill has a slope of 21% on the south side, grading downward into terrain with a slope of approximately 8%.

3.1.3 Site-Specific Pathways

The landfill has adequate cover to prevent contaminated materials in the landfill from being released into the atmosphere and to prevent direct contact with contaminated materials. There are no vents through the landfill to allow release of gas; therefore the entire air pathway is considered negligible.

A score of zero was given to the surface water route on the hazard ranking form because of containment Pond C-2. Seepage from the landfill or the interceptor ditch below the landfill would be contained in the Pond C-1. These ponds are being investigated as SWMUs 142.10 and 142.11.

Direct human contact with seepage is unlikely due to the restricted access to the area.

There appears to be no potential for fire or explosion.

The only potential contaminant pathway from the landfill is groundwater. The distance to the nearest drinking water well is approximately two miles southeast. There are about 50 rural wells within 3 miles serving a population estimated at 190. This landfill was given a hazard ranking of 26.00 for the groundwater chemical migration mode and 7.91 for the groundwater radioactive migration mode.

3.1.4 Recommended Further Action

There are a great number of unknowns concerning the materials deposited in the landfill and a potential for contaminants to

3.42 SWMU 196: Water Treatment Plant Backwash Pond - 100 Area

3.42.1 Site History and Description

Personnel interviewed in CEARP Phase I stated that during the early 1970s, backwash from the raw water treatment plant (Building 124) was collected in a pond on the south side of the building. This water would have contained flocculates (aluminum sulfate and lime), residual chlorine, and suspended solids. Reportedly, the pond dried up and was destroyed in the late 1970's when the new canal system that reroutes surface water around the plant site was constructed.

CERCLA findings were negative for the Federal Facility Site Discovery and Identification Findings (FFSDIF), the Preliminary Assessment (PA), and the Preliminary Site Investigation (PSI).

3.42.2 Geographic Information

Backwash from the raw water treatment plant was held in an unlined pond on the south side of Building 124, which is located on the southwestern portion of the Plant site.

This area is approximately 1,100 feet north of the Woman Creek drainage. The area is nearly flat and most surface water runoff would be directed easterly.

Rocky Flats Alluvium underlies this area, with a water table 6 to 9 feet below the surface. Monitor well 44-86 is located approximately 1,100 feet to the northeast.

3.42.3 Site Specific Pathways

This area is now paved and there is no wind affect to the past deposits. Therefore wind transportation of contaminants is negligible.

Any surface water runoff would be towards the east. Being paved and basically sealed from the atmosphere, there is little chance for surface water influence.

Rocky Flats Alluvium underlies this area approximately 6 to 9 feet based on upgradient and downgradient monitor wells. The materials introduced into the environment would not pose an environmental hazard. Therefore, it is doubtful if any environmental damage has occurred to the shallow groundwater aquifer.

3.42.4 Recommended Further Action

No further action is necessary.

migrate from the landfill. For these reasons, it is recommended that the landfill be investigated further through the use of monitor wells, surface water and sediment sampling, and sampling of any leachate. Additional information should be gathered concerning the materials deposited in the landfill and landfill cover construction.

3.2 SWMU 116: MULTIPLE SOLVENT SPILLS

3.2.1 Site History and Description

The multiple solvent spill site consists of two loading dock areas used prior to 1979 for nonradioactive solvent storage. Neither area was paved prior to 1979 (Lewis, personal communication, 1988). Both loading docks are still in use as storage areas. Solvent from a leaking drum may have infiltrated the soil at the south loading dock, SWMU 116.2. Additional leaks and spills are believed to have occurred at this site. The number of drums stored on the loading docks varied from year to year.

Releases of uranium and beryllium from adjacent buildings in 1953, 1960, and 1962 resulted in contamination of these areas (DOE, 1986b). Cleanup activities followed these incidents; however, small amounts of uranium and beryllium may still be present.

Information from other SWMUs indicates that carbon tetrachloride, 1,1,1-trichloroethane, and trichloroethylene have been used as solvents at Rocky Flats. Since the actual contents of the drums are not known, it is assumed that these chemicals may have been stored and may have leaked in these areas.

Carbon tetrachloride, 1,1,1-trichloroethane and trichloroethylene exhibit low, acute, oral lethal toxicity, however, they are associated with central nervous system depression and liver, kidney and cardiovascular effects. 1,1,1-Trichloroethane has not been shown to be carcinogenic though related compounds, 1,1,2-trichloroethane and trichloroethylene are carcinogenic to animals. Carbon tetrachloride and 1,1,1-trichloroethane are suspected human carcinogens. All of these compounds are highly

mobile and persistent in the environment. Uranium and beryllium are both toxic and persistent in the environment.

3.2.2 Geographic Information

SWMU 116.1 occupies an area of about 50 by 100 feet at the intersection of the northern edge of Building 447 and the western edge of Building 444. It is immediately south of SWMU 182, a RCRA closure site. The loading dock at SWMU 116.1 is a concrete pad and much of the surrounding area is paved with asphalt. Soil and gravel have been placed over the western half of the access road and overhead pipes and wires prevent use of this part of the access road. Drainage from this SWMU collects in the Plant storm sewer system.

SWMU 116.2 covers an area of about 30 by 50 feet in an alcove formed by the eastern edge of Building 447 and the southern edge of Building 444. This area is covered by asphalt and concrete. There are currently several structures in this area, including a nitrogen tank. Surface drainage from the area is handled by the Plant storm sewer system.

Both SWMUs are on the Rocky Flats Alluvium. Depth to the water table is estimated to be 8 to 10 feet through the permeable unsaturated zone.

3.2.3 Site-Specific Pathways

Since these areas were not paved during their use for nonradioactive solvent storage, any spilled solvent would have seeped into the soil, evaporated, or entered the surface water drainage system. Some of the solvents or hydrocarbons entering the soil would migrate in the direction of groundwater, leaving some residue in the soil.

3.2.4 Recommended Further Action

Additional background data is needed to determine the concentration and specific type of solvents which may have been stored and the estimated volumes of solvents that may have leaked in these areas. Sufficient concentrations of environmentally persistent chemicals spilled may be determined through soil samples taken from under the pavement and at the point of discharge of the storm drain.

3.3 SWMU 117: CHEMICAL STORAGE SITES
SWMU 117.1: NORTH SITE CHEMICAL STORAGE
SWMU 117.2: MIDDLE SITE CHEMICAL STORAGE
SWMU 117.3: SOUTH SITE CHEMICAL STORAGE

3.3.1 Site History and Description

This SWMU consists of three sites used for chemical storage prior to the mid 1970's (Figure 3-2). SWMU 117.1 was used as warehouse storage, SWMU 117.2 was used as a nonradioactive chemical storage facility, and SWMU 117.3 was used as storage for pallets, cargo containers and new drums. None of these areas were paved when they were used for storage.

SWMU 117.2 was primarily used to store drums containing acids, oils, soaps, and solvents. As many as three 1,200-pound hydrofluoric acid tanks and large quantities of hydrogen peroxide drums were stored in this area. The area is presently used for storage of nonradioactive and nonhazardous chemical compounds. Leaks and spills have occurred within the area outlined by a dotted line on Figure 3-2. SWMU 169, a buried 55-gallon drum of peroxide is within the boundaries of SWMU 117.2.

Based on information from other SWMUs and some knowledge of the processes used at Rocky Flats, it has been assumed that hydrochloric acid, hydrofluoric acid, nitric acid, paint thinners (benzene, dichloromethane), carbon tetrachloride, 1,1,1-trichloroethane, tetrachloroethylene and trichloroethylene were stored in SWMU 117.2. Spills of soaps and small spills of oil likely to have occurred at this SWMU would not present a toxic hazard on- or off-site. Moderately concentrated solutions of inorganic acids (hydrochloric, hydrofluoric and nitric) meet the RCRA characteristic of corrosivity. In a concentrated solution, these acids are irritants to skin, eyes and the respiratory tract. However, the quantities released at SWMU 117.2 would

rapidly be diluted and neutralized, thus losing their corrosivity characteristic and eliminating the potential for toxic exposure.

Benzene, dichloromethane, and other chlorinated solvents likely to have been used generally exhibit low, acute, oral toxicity but are suspected carcinogens and may cause liver, blood and kidney damage with chronic doses. Most of these chemicals are mobile and persistent in the environment.

3.3.2 Geographic Information

SWMU 117.2 is located east of Building 551 and west of Seventh Street between Sage and Central Avenues (Figure 3-2). SWMU 117.1 is to the north, encompassing an area which now includes Buildings 223 and 249. This area is traversed by several buried pipelines and cables. SWMU 117.3 is to the south and is now covered by tank 224.

The original slope of these three areas was to the east-northeast at about 4 percent. Surface water drainage enters ditches along the perimeters and enters the Plant storm sewer system.

These areas are located on the permeable Rocky Flats Alluvium, approximately 4 to 9 feet above the water table based on nearby monitor wells (19-86, 23-86 and 24-86).

3.3.3 Site-Specific Pathways

Since the area of SWMU 117.2 is now paved, the quantities likely to have leaked or spilled cannot create releases to the air or have the potential for direct contact, fire, or explosion. The pavement also eliminates the surface water pathway.

The only potential pathway is groundwater with assumed use for drinking water. Contaminants would have entered the groundwater

more readily before the area was paved by percolation of precipitation into the soil.

3.3.4 Recommended Further Action

Surface and subsurface soil sampling should be conducted in the area of SWMU 117.2, concentrating in the dashed area (Figure 3-2) where leaks and spills were reported. Since no spills or contamination have been documented at SWMU 117.1 and SWMU 117.3, there appears to be no need to investigate them further.

3.4 SWMU 118: MULTIPLE SOLVENT SPILLS

3.4.1 Site History and Description

This SWMU includes two units resulting from leaks and spills from storage tanks (Figure 3-3). SWMU 118.1 is the result of leaks and spills of carbon tetrachloride during normal filling operations of a 5,000-gallon tank. Interviews during the CEARP Phase I investigation revealed a 100- to 200-gallon spill of trichloroethylene in the same area. The interviewees may have been mistaken and this may have actually been a spill of carbon tetrachloride (DOE, 1986b). No one recalled any cleanup operations associated with the spill; however, it appears that the practice at that time was to rinse the contaminated areas with large volumes of water (DOE, 1986a).

SWMU 118.2 is the result of overflows of organic solvents from several storage tanks. These tanks, located inside Building 776, overflowed in the 1970's. One of the tanks containing carbon tetrachloride also ruptured in June 1981. Most of the material from this incident drained into a sump and was collected and disposed as a hazardous waste. However part of it spilled onto the ground.

Carbon tetrachloride and trichloroethylene are animal carcinogens and suspected human carcinogens. Acute and chronic exposures can damage the heart, liver, kidneys, and central nervous system, though their acute, oral lethal toxicities are low. Carbon tetrachloride and trichloroethylene are highly mobile and persistent in the environment.

Other solvents which may have been stored at SWMU 118.2 include petroleum distillates, paint thinners (typically benzene and dichloromethane), 1,1,1-trichloroethane and methyl ethyl ketone. The persistence and toxicity of these compounds vary.

3.4.2 Geographic Information

SWMU 118.1 has been identified as a 50-foot by 180-foot area on the north side of Building 776 (Figure 3-2). The carbon tetrachloride was stored in a below-grade 5,000-gallon tank on the west side of Building 730. This tank was removed in 1981. SWMU 131 is within the boundaries of SWMU 118.1. SWMU 118.1 includes both paved and unpaved areas with variable slope.

SWMU 118.2 is a 30-foot by 70-foot area on the south side of Building 776. It includes both paved and unpaved areas.

Surface water run-off from both SWMUs enters the Plant storm sewer system. These areas are within the Rocky Flats Alluvium, approximately 8 feet above the water table. The nearest monitor well (22-86) is approximately 150 feet away.

3.4.3 Site-Specific Pathways

Materials spilled on paved areas were probably washed down with water and rinsed into the storm sewer system. The sewer may have discharged the liquids into North Walnut Creek on which the A-series ponds are located.

Materials spilled on unpaved areas may have entered the surface water system through run-off, or may have seeped into the soil where they might remain for some time until some or all of the material entered the groundwater system. Once in the groundwater system, the contaminants could eventually be discharged to the surface water system, the nearest being Walnut Creek.

3.4.4 Recommended Further Action

Soil and groundwater samples should be taken in the area of the spills around SWMU 118.1 and analyzed for chlorinated solvents

and their degradation byproducts, including carbon tetrachloride and trichloroethylene. Further research is required to identify the solvents stored in the tanks near SWMU 118.2.

3.5 SWMU 120 FIBERGLASS AREAS

120.1 North of Building 664

120.2 West of Building 664

3.5.1 Site History and Description

These sites were used for fiberglassing waste packing boxes (Figure 3-10). Persons interviewed mentioned that polyester resin, peroxide catalysts and cleaning solvents may have been spilled in these areas. No further information on specific types of fiberglass or solvents used in the area is available at this time.

Dates of operation are believed to be 1972 to 1979. Quantities of spilled materials, and concentrations remaining in the soil are unknown.

The primary hazardous constituent in most polyester resins used in fiberglassing systems is styrene monomer. It has a flash point of 90°F, and therefore is a RCRA waste due to ignitability. Methyl ethyl ketone peroxide is the usual catalyst for fiberglassing systems, and it is a listed RCRA hazardous waste for toxicity and reactivity. Cleaning solvents used at this site would probably have been similar to those used in the rest of the Rocky Flats Plant. Solvents may have included carbon tetrachloride, and/or trichloroethylene.

3.5.2 Geographic Information

SWMU 120.1 is an approximately 100-foot by 100-foot area north of Building 664. It is partially covered by a utility building and is fenced. SWMU 120.2 is approximately a 100- by 200- foot area west of Building 664. SWMU 120.2 is also within the boundaries of SWMU 161. Well 21-74 is located slightly east of SWMU 120.2.

Depth to bedrock in the area of SWMUs 120.1 and 120.2 is approximately 35 feet. Surficial alluvium in this area was unsaturated in October 1986. The nearest surface water is Woman Creek, which is 1000 feet from SWMU 120.1 and 750 feet from SWMU 120.2. The location and topography are shown in Figure 3-1.

3.5.3 Site-Specific Pathways

Most of the area of these SWMUs is currently covered with asphalt pavement. Although styrene and solvents are volatile, as long as the area remains paved over, the air pathway is negligible. The asphalt covering is also likely to keep surface water out of these SWMUs and consequently there should be no contamination by the surface water pathway.

As long as the area is paved, there is no potential for direct contact. The chance of fire or explosion is negligible due to pavement cover and probable low soil concentrations of materials.

Although the surficial materials are marked as unsaturated in the RCRA part B Permit Application, Volume VI, plate E-5, there is still some potential for groundwater contamination. The unsaturated zone may transport contaminants to the saturated zone via either the gas phase or the liquid phase.

3.5.4 Recommended Further Action

As styrene, methyl ethyl ketone peroxide and most solvents are RCRA wastes, the waste concentrations at these SWMUs should be determined by surface soil and sub-surface soil and water analysis.

Radiological surveys, (EG & G, 1982) indicate an area of significantly high radiation directly to the west and overlapping

this area. This area should be sampled in order to determine the source of this abnormality.

3.6 SWMU 128: OIL BURN PIT #1

3.6.1 Site History and Description

The oil burn pit was a land disposal unit 50 by 150 feet in which 10 drums of waste oil containing depleted uranium were burned in August 1956 (Figure 3-2). After the burning, the pits were covered with soil. The waste oils were generated in Buildings 444 and 881. The pit area contains approximately 70 cubic feet of depleted uranium residue.

Uranium is highly toxic, both chemically and radioactively. Soluble uranium is acutely toxic to the kidneys whereas insoluble uranium particles exhibit radiotoxicity to the lungs when inhaled. Its persistence in the environment, coupled with its radioactivity and toxicity, requires that all environmental releases be closely investigated.

3.6.2 Geographic Information

Building 335 is presently located over Oil Burn Pit #1. The oil burn pit is adjacent to SWMU 134, the Lithium Metal Destruction Site, (also under Building 335) and SWMU 171, the Solvent Burning Ground (east of Building 335).

Depth to groundwater is 10 to 20 feet through a permeable unsaturated zone. The facility slope is less than 3% with intervening terrain at 3.6%. The nearest surface water is North Walnut Creek which is 2100 feet from the site. The location and topography are shown in Figure 3-1.

3.6.3 Site-Specific Pathways

Air releases occurred during the burning over 30 years ago; however air releases cannot presently occur since the pit was

covered with soil and is now covered with a building. Accordingly, the air pathway is considered negligible.

The nearest surface water, North Walnut Creek, is an unlikely pathway for the contaminated oil since the pit was covered with soil and later a building. Additionally, the containment pond on Walnut Creek eliminates a surface water pathway.

There is no potential for direct contact, fire, or explosion.

The only potential pathway is groundwater with assumed use for drinking water. The distance to the nearest well is less than 2 miles. About 50 rural wells are located within 3 miles of the site, serving an estimated population of 190.

3.6.4 Recommended Further Action

Since groundwater is a potential pathway and there is no nearby monitor well, a groundwater monitoring system is recommended. Additionally soil samples should be taken to determine if there is a potential for future release to the groundwater.

3.7 SWMU 131: Radioactive Site, 700 Area Site #1

3.7.1 Site History and Description

SWMU 131 consists of an area north of Building 776 (Figure 3-3). Some time after the 1969 fire, this area was radioactively contaminated possibly with plutonium. The area has subsequently been covered with gravel. Plutonium is an alpha radiation emitter, and is highly toxic by ingestion and inhalation.

3.7.2 Geographic Information

Precise boundaries of SWMU 131 are not defined.

Depth to bedrock in the area of this SWMU is about 25 feet. The Rocky Flats Alluvium underlies this area. The October 1986 potentioniometric surface map shows a depth to groundwater of about 6 to 10 feet. Direction of groundwater flow in the area is to the north and northwest.

2.7.3 Site Specific Pathways

Air releases have not been detected, and are not expected to occur, therefore the entire air pathway is considered negligible.

Surface water releases are also unlikely, since the area has been paved.

Plutonium released from the 1969 fire would rapidly attach itself to the soil with little infiltration occurring. Therefore, the potential for transport along the groundwater pathway appears minimal.

3.7.4 Recommended Further Action

Since the extent of contamination is poorly defined at SWMU 131, field studies are required to determine the location and contaminant source concentration. Radiologic surveying may detect and help define the boundaries of any contamination. Soil samples should be taken to determine the concentrations and aerial extent of any contamination.

3.8 SWMU 133: ASH PITS

3.8.1 Site History and Description

From the 1950's until 1968, an incinerator located along the west access road near the Plant's original west boundary, was used to burn general plant wastes. The incinerator was small and had a 10- to 20-foot stack (Figure 3-4). Personnel interviewed for the CEARP Phase 1 investigation mentioned that depleted uranium chips were also burned in the incinerator. It is estimated that a total of 100 grams of depleted uranium was burned along with general combustible waste over a 16-year period (DOE, 1986b).

Ashes from the incinerator were put into pits adjacent to the incinerator or were pushed over the side of the hill into the Woman Creek drainage and the concrete wash pad area (SWMU 133.6). The ash pits were covered with fill. These ash pits are SWMUs 133.1, 133.2, 133.3, and 133.4. SWMU 133.5 is the remains of the demolished incinerator.

Uranium is highly toxic both chemically and radioactively. Soluble uranium is acutely toxic to the kidneys whereas insoluble uranium particles exhibit radiotoxicity to the lungs when inhaled. Its persistence in the environment, coupled with its radioactivity and toxicity, requires that all environmental releases be closely investigated.

Insufficient information was available from the CEARP Phase 1 investigation to calculate HRS scores.

3.8.2 Geographic Information

The ash pits are located south of the security fenced area and north of Woman Creek (Figure 3-4). The distance from the pits to Woman Creek varies from about 30 to 630 feet. Some of the pits

are located in relatively flat areas with slopes of less than 5%, other pits are on the hillside with slopes of almost 20%.

The pits are in Quaternary colluvial deposits derived from the Rocky Flats Alluvium deposits. They are 4 to 8 feet above groundwater levels. Analytical results from monitor well 56-86, located between the ash pits and Woman Creek, for the fourth quarter of 1987, were below the minimum detection limits.

3.8.3 Site-Specific Pathways

Before the pits were covered, the primary pathways would have been air and surface water. The covers, if still intact, now prevent surface water and air contamination, but allow contamination through the groundwater pathway. Contaminated groundwater could be discharged into Woman Creek, or to water supply wells.

3.8.4 Recommended Further Action

The concentration and types of contaminants in the pits must be established to determine if they are contaminant sources. If contaminants are detected, the limits of the pits and the groundwater pathway must be evaluated. The monitor well downgradient from the ash pits does not seem to be contaminated; however, information was not available to determine if the well was completed in a manner to monitor groundwater releases from the pits. During the next phase of study, well completion information should be gathered along with a careful examination of the cover materials and a radiological survey. The installation of additional monitor wells may be necessary to fully evaluate the sources and pathway for these SWMUs.

3.9 SWMU 134: Lithium Metal Destruction Site

3.9.1 Site History and Description

The Lithium Metal Destruction Site consisted of two shallow trenches within a 50- by 150-foot area (Figure 3-2). The trenches were filled with water and lithium metal (powder) was disposed by reaction with the water. The residues left from the reaction were then covered with soil.

The dates of operation were 1956 to 1970. It is believed that approximately 400 to 500 pounds of metallic lithium were disposed in this way as well as small amounts of metallic sodium, calcium, and magnesium (DOE 1986b).

These metals are hazardous due to their violent reaction with water (RCRA characteristic of reactivity). Since they have reacted with water during disposal they are no longer a reactive waste. The lithium metal, the only potentially toxic metal, upon reaction with water would have likely formed lithium hydroxide which would have reacted in the soil to ultimately form lithium carbonate. Lithium carbonate is moderately toxic to animal species with oral LD_{50}s ranging from 500 mg/kg (dog) to 531 mg/kg (mouse). In humans, very high doses (greater than 3,000 mg/kg) may be teratogenic and may cause cardiovascular effects. Lithium carbonate is used therapeutically as an antidepressant in doses up to 1800 mg/day.

In April 1986 this site received a hazard ranking score of 8 for the total chemical migration mode (DOE 1986a).

3.9.2 Geographic Information

Building 335 is presently located over the Lithium Metal Destruction Site. The lithium site is adjacent to SWMU 128 the

Oil Burn Pit #1 (also under Building 335), and SWMU 171 the Solvent Burning Ground (east of Building 335).

Depth to groundwater is 10-20 feet through a permeable unsaturated zone. The facility slope is less than 3% with intervening terrain 3.6%. The nearest surface water is North Walnut Creek which is 2100 feet from the site though a tributary is immediately adjacent to the site. The location and topography are shown in Figure 3-1.

3.9.3 Site Specific Pathways

No air releases were detected and could not presently occur; therefore the entire air pathway is considered negligible.

The nearest surface water, North Walnut Creek, is an unlikely pathway for the lithium since it was disposed in covered pits. Additionally, the containment pond located on Walnut Creek eliminates a surface water pathway.

There is no potential for direct contact, fire or explosion.

The only potential pathway is groundwater with assumed use for drinking water. The distance to the nearest well is approximately 2 miles. About 50 rural wells are located within 3 miles of the site serving an estimated population of 190. This site was given a hazard ranking of 13.47 for the groundwater chemical migration mode.

3.9.4 Recommended Further Action

The lithium residue is not a RCRA waste and it exhibits low human toxicity. It is likely that some or all of the contaminated soil was removed when Building 335 was constructed on the site. Building 335 also reduces infiltration through any remaining

portions of the pits. However, since this site is adjacent to SWMU 128, which will be sampled, it is recommended that soil and water samples taken for SWMU 128 be analyzed for total lithium.

3.10 SWMU 136: COOLING TOWER PONDS

3.10.1 Site History and Description

The Cooling Tower Ponds, located between Buildings 444 and 460 (Figure 3-1) were used as a land disposal unit from 1963 to 1969 to contain and evaporate water from the cooling towers near Building 444. Blowdown discharged into these ponds contained chromium and algicides. Lithium metal was occasionally destroyed in ponds 136.1 and 136.2. These ponds have since been covered with fill and may also have been used to bury small quantities of depleted uranium [the area around Pond 136.3 may have received low-level infiltration from uranium-machine tool storage (DOE, 1986b). An aerial radiological survey conducted in August 1981 indicated 2000 to 4000 counts per minute of manmade gross activity centered over 136.3 (EGG, 1982). The activity consisted of low energy scatter and had no identifiable photo peaks. Uranium may also be present at these sites.

The main contaminant of concern at this site is chromium. Chromium is expected to be found in both hexavalent and trivalent states. Hexavalent chromium is a suspected carcinogen and is readily absorbed through dermal contact. Both states of chromium are toxic through ingestion.

Uranium is highly toxic both chemically and radioactively. Both chromium and uranium are persistent in the environment and may or may not be mobile depending upon the species present.

3.10.2 Geographic Information

The Cooling Tower Blowdown Ponds are located in the southwestern portion of the plant. SWMUs 136.1 and 136.2 were approximately 25 feet by 25 feet. SWMU 136.3 was approximately 100 feet by 30 feet. Pond 136.1 is located north of Building 444 between the

building and the cooling tower. After a careful review of aerial photographs from years 1953 to 1986, it was determined that SWMU 136.1 and 136.2 were incorrectly located on the Inactive Waste Units Reference Map (DOE, 1986b). The units, as located on the photos from 1963 to 1968 are north-northeast of 136.3. This would locate the SWMUs along the eastern edge of Building 444 and not beneath the building as indicated by the map.

No information on removal and disposal of the pond material from the foundation of Building 460 is available. The portions which remain lie between Buildings 460 and 444 under a flat, paved parking lot. Surface water drains to the south toward Woman Creek at <3% slope.

3.10.3 Site Specific Pathways

No air releases were detected and could not presently occur from this SWMU since it is covered with asphalt. Also since it is paved, direct contact is not likely to occur.

The nearest surface water is Woman Creek. The creek may have received overflow from the pond area via surface water drainage or via footing drains. Woman Creek flows to a holding pond that is evaluated as SWMU 142.

Groundwater, which occurs in the alluvium approximately 15-30 feet below the surface, is considered a potential pathway. The ponds were unlined, therefore, infiltration from the ponds could have reached the groundwater table in this area. Groundwater could also discharge into surface drainages. Groundwater is used for drinking purposes with the nearest well located approximately two miles from the site, and about 50 rural wells occurring within three miles of the site.

3.10.4 Recommended Further Action

Radiometric, geophysical, and soil investigations should be implemented to determine the location, nature and extent of the ponds and possible contamination. The ponds may have been used to bury depleted uranium and, therefore, a radiometric survey may be an economical method to locate the ponds. Monitor wells should be installed to determine if groundwater contamination has occurred.

3.11 SWMU 139: CAUSTIC/ACID SPILLS

3.11.1 Historical and Operational Information

Operations in Buildings 771 and 774 have required the use of caustics and acids (Figure 3-3). During material transfers and tank fillings, there have been numerous small leaks and spills. Leaks and spills of caustics have also been reported to have occurred at the caustics receiving areas north and south of Building 774. The spills were washed down with water and the diluted material was carried away from the building into the storm sewer system (DOE, 1986b).

Moderately concentrated solutions of hydrochloric, hydrofluoric, nitric and sulfuric acids meet the RCRA characteristic of corrosivity. In a concentrated solution, these acids are irritants to skin, eyes and the respiratory tract. However, the quantities released at these SWMUs would rapidly be diluted and neutralized, thus rendering them harmless.

Caustics, (sodium hydroxide and potassium hydroxide) are corrosive and are irritants to the skin and eyes in a concentrated solution. However, the quantities of potassium and sodium hydroxide released to the environment from spills at this SWMU would rapidly be diluted and neutralized, thus rendered harmless. Once neutralized they would no longer meet the RCRA characteristic of corrosivity.

The only potentially toxic breakdown product is fluoride. Fluoride is toxic to humans, with an adult lethal dose estimated at 2.5 to 5.9 grams. Smaller chronic doses can lead to bone changes, dental defects and damage to the digestive system. The EPA chronic, acceptable oral intake is 0.06 mg/kg/day. It is unlikely that spills from this SWMU could ever create this sort of dose.

3.11.2 Geographic Information

SWMU 139.1, the hydroxide tank areas, are located south of Building 771 and north of Building 774. It covers an area of approximately 25 feet by 250 feet.

SWMU 139.2, the hydrofluoric acid tanks, are located at Building 714.

3.11.3 Site Specific Pathways

The buffering action of the soil would have quickly neutralized the spilled material, and the concentrations of the resulting by-products (sodium, potassium, sulfates, fluoride and nitrates) would have been benign and highly mobile in the environment. These materials would have entered the surface water and groundwater system and would be discharged into Standley Lake or to drinking water wells without consequence.

3.11.4 Recommended Further Action

The quantities likely to have spilled or leaked would rapidly be broken down and rendered non-hazardous. No further action is recommended.

3.12 SWMU 141: SLUDGE DISPERSAL

3.12.1 Site History and Description

Prior to 1983, sludge from the sewage treatment plant was collected in drying beds, dried, and shipped off-site for disposal as a radioactive waste. During packaging operations some of the dried sludge became airborne and was dispersed around the drying beds and eastward along both sides of the perimeter road. Between 1969 and 1972 the only radioactive effluent to enter the drying beds was radioactive laundry effluent. In 1972, plumbing changes were made and all wastes were subsequently channeled through the sewage treatment plant. The increased loading resulting from this change lead to increased radioactive levels in the sludge. In June 1972 an overflow incident in Building 701 contributed elevated levels of radioactive plutonium to the drying beds. Since 1983, the drying beds have been covered to prevent the particles from becoming airborne.

The drying beds are categorized as an active storage facility and are approximately 200 feet by 200 feet. Airborne particles of radioactive sludge spread outside the area, across the road and potentially into the B-Series ponds. It is this area that is SWMU 141.

Since all plant wastes were processed at this facility, there is a potential for contamination by a variety of chemicals, but particularly plutonium. Although plutonium is not harmful through direct contact, it is highly toxic through ingestion or inhalation.

3.12.2 Geographic Information

SWMU 141 is located east and south of the area surrounding Building 995 (Figure 3-5, 3-7). The area is underlain by

Quaternary colluvial deposits derived from the Rocky Flats Alluvium. Depth to and occurrence of groundwater directly beneath the site is unknown.

The site is bounded on the east and south by a steep slope. The east slope culminates in a low lying area where the B-Series ponds are located. The southern slope terminates at South Walnut Creek.

3.12.3 Site Specific Pathways

Fugitive dust could carry contaminants from the SWMU; hence, the air pathway will be considered.

The nearest surface water bodies are the B-Series Ponds and South Walnut Creek. Both the ponds and the creek could have received drainage from this site via run-off or direct deposition of airborne contaminant particles. The creek and the pond will be evaluated in SWMU 142.

Groundwater is considered a potential pathway because leachate from the drying beds could impact the shallow groundwater. Groundwater is used for drinking purposes with the nearest well located approximately two miles from the site, and about 50 rural wells occurring within three miles of the site.

3.12.4 Recommended Further Action

A gridded soil sampling procedure is recommended at this site and in the downgradient prevalent wind direction, in order to determine aerial extent of windblown contaminated particles. Since little is known about the occurrence of groundwater in the area, it is recommended that two alluvial monitor wells be installed in the site vicinity if contaminants are found in the

soil. A radiometric survey is also recommended to help establish potential hot spots in which to concentrate the sampling effort.

3.13 SWMU 142: RETENTION PONDS A,B, AND C SERIES

3.13.1 Site History and Description

There are three series of retention ponds: Series A located on North Walnut Creek includes four ponds; Series B located on South Walnut Creek includes five ponds; and Series C located on Woman Creek includes two ponds. These ponds have been assigned a reference number as follows:

REF. NO.		POND	FIGURE
142.1	-	A-1 Pond	3-7
142.2	-	A-2 Pond	3-7
142.3	-	A-3 Pond	3-7
142.4	-	A-4 Pond	3-6
142.5	-	B-1 Pond	3-7
142.6	-	B-2 Pond	3-7
142.7	-	B-3 Pond	3-7
142.8	-	B-4 Pond	3-7
142.9	-	B-5 Pond	3-6
142.10	-	C-1 Pond	3-8
142.11	-	C-2 Pond	3-8

The retention ponds are used primarily to capture and control surface water runoff and to allow sampling and analysis prior to reuse or release of the water downstream. Water from the ponds is periodically discharged under the NPDES permit and DOE radioactive limits in effect at the time. Some of the retention ponds have been on operation from 1952 to the present.

Prior to 1979, some of the ponds (A-1, B-1 to B-4 and C-1) were used to hold various wastes that contained nitrate, plutonium and uranium. The volume of waste held in the ponds is unknown. Ponds A-3, B-5 and C-2 were constructed after 1979. The size of the ponds varies with the seasonal changes in precipitation.

- **Series A Ponds**

As presented above, in the past from 1952 to 1979, Pond A-1 was used to hold various wastes that contained nitrates and radioactive substances. Presently, there are four Series A retention ponds (Figures 3-6 and 3-7). Ponds on North Walnut Creek are designated A-1, A-2, A-3 and A-4, from west to east. 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. For several years, laundry water containing low concentrations of plutonium was allowed to flow into the upper reaches of Walnut Creek. This practice, although long since discontinued, produced significant amounts of plutonium in stream sediments and the A-1 pond sediments (DOE, 1980). Pond A-1 also received discharges from the cooling tower blowdown and steam condensate which contained chromates and algicides. Pond A-2 received process wastewater and laundry waste water pumped from Pond B-2. Pond A-3 receives the North Walnut Creek stream flow and plant runoff from the northern portion of the plant site. Pond A-4 is designed for surface-water control and for additional storage capacity for overflow from Pond A-3. Discharges from Pond A-4 are in accordance with the plant NPDES permit.

- **Series B Ponds**

Five retention ponds are located in South Walnut Creek and are designated as B-1, B-2, B-3, B-4 and B-5, from west to east. Ponds B-1 and B-2 are reserved for spill control, whereas, pond B-3 receives effluent from the sanitary sewage treatment plant. The Rocky Flats Plant EIS (DOE 1980) states that Ponds B-1 and B-4 also received sanitary effluent from the sewage treatment plant. Ponds B-4 and B-5 receive surface runoff and occasionally collect discharge from Pond B-3. Since the start-up of the Plant operations in 1952 until December 21, 1973, water containing decontaminated process and laundry waste was released to four of

the B-series ponds (B-1 to B-4). Pond B-5 receives runoff from the central portion of the plant site and is used for surface water control in addition to collection of overflow from Pond B-4. Discharges from Pond B-5 are in accordance with the plant NPDES permit.

Past releases of radioactive material from the Plant to water effluents have contributed to an increase in radionuclides in the retention ponds. Between 1971 and 1973, pond reconstruction activities resulted in disturbances of the bottom sediment of the channel upstream of Pond B-1. This caused much of the upstream sediment to be transferred to the B-1 pond, increasing the total plutonium inventory in the B-series ponds, see Table 3.15.1-1 below.

TABLE 3.13.1-1

INVENTORY OF PLUTONIUM IN SEDIMENT OF B-SERIES PONDS

Pond	Total Inventory (curies)	
	1971	1973
B-1	0.085	2.900
B-2	0.027	0.040
B-3	0.019	0.040
B-4	0.005	0.005
TOTAL	0.136	2.985

Source: EIS (DOE 1980)

It is probable that several additional curies of plutonium remain trapped in the sediment within the waste discharge pipe and the inlet of Pond B-1. As can be seen from the figures, however, the plutonium suspended in the water was essentially all redeposited

in Pond B-1. This is in agreement with the CSU measurements, indicating that plutonium put into the water will quickly redeposit into the bottom sediments.

- **Series C Ponds**

The two C series ponds, C-1 and C-2, are located along Woman Creek, south and east of the plant, respectively. Pond C-1 receives stream flow from Woman Creek (Figure 3-8). 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 the plant site. Water in Pond C-2 is discharged to Woman Creek in accordance with the plant NPDES permit. Previously the only discharges to Woman Creek were cooling tower blowdown, which was discontinued in late 1974, and water-treatment-plant filter backwash, which was discontinued in 1975. Cooling tower blowdown contained chromates and algicides in aqueous solution.

- **Pond Discharges**

The discharges from the ponds are regularly monitored to document compliance with NPDES permit requirements. This permit requires monitoring of specific parameters at five pond locations. These discharge sites are located at ponds A-3, A-4, B-3, B-5 and C-2. Sanitary effluent limitations are placed on Pond B-3 (sewage effluent), and limitations for nitrate and pH are placed on Pond A-3. Limitations on sediment release apply to Ponds A-4, B-5 and C-2. In addition to NPDES permit requirements, all of these discharges are monitored for plutonium, americium, uranium, and tritium (DOE, 1986c).

Ponds A-3, A-4, B-5, C-1 and C-2 have downstream 24 hour time-composite samplers and Parshall flumes to monitor discharge. Continuous flow measurements and daily water quality samples are

collected at these sites. Ponds A-4, B-5, and Walnut Creek are monitored by totalizing flow meters.

Walnut Creek undergoes 24 hour composite sampling and contains two Parshall flumes. Woman Creek is grab-sampled monthly above Pond C-1.

- **NPDES Permits**

From the initial date of the previous permit (May 20, 1981), monitoring the discharge for NPDES limitations resulted in no violations in 1981, 1982 or 1983. One technical violation occurred in 1984, and one in 1985. The 1984 technical violation was due to runoff from spray irrigation carrying nitrates into the McKay ditch and bypassing the plant's retention ponds. The measured levels of nitrates were below discharge limits through designated outfalls; however, the discharge did not go through a designated outfall. The 1985 technical violation resulted when water was being transferred from retention Pond B-3 to retention Pond B-5. Measurements indicated that residual chlorine was slightly above discharge limits during transfer; however, none of the water was discharged from retention Pond B-5 until the residual chlorine dropped to an acceptable level.

The previous NPDES permit (EPA 1981) became effective on May 20, 1981 and expired on June 30, 1984. This permit was given an extension to December 26, 1984. The current permit became effective on December 26, 1984 and continues until December 20, 1988.

- **Water Quality**

The RCRA Part B Permit (DOE 1986c), indicates that Pond A-1 water contained plutonium at a concentration of 0.24 pCi/l and zinc at 4.21 mg/l. Pond A-2 water quality is similar to Pond A-1 with

plutonium concentrations of 0.17 pCi/l and zinc at 4.20 mg/l. Higher concentrations of U-233/234 (6.4 pCi/l) and U-238 (5.8 pCi/l) were observed in Pond A-2 relative to Pond A-1. Pond A-3 water contained elevated U-233/234 and U-238. Pond A-3 also contained manganese concentrations of 0.240 mg/l and strontium at 0.340 mg/l. Water quality of Pond A-4 is typical of upgradient background conditions.

Pond B-1 water quality is characterized by low major ion concentrations, moderately elevated U-233/234 (6.4 pCi/l) and U-238 (9.6 pCi/l). Plutonium concentrations are significantly elevated (4.2 pCi/l). In 1973, the plutonium inventory of the sediments was 2.9 curies in Pond B-1. The elevated concentration of plutonium in the water is indicative of a high plutonium residual to date. There are no metals with notably high concentrations and HSL organics were not present above detection limits. Contrary to the water quality of Pond B-1, Pond B-2 is characterized by background levels of radionuclides with the exception of plutonium whose concentration was 0.37 pCi/l. Pond B-3 contains relatively low major ion concentrations. Zinc is moderately elevated (0.58 mg/l), and radionuclides are at background levels with the exception of plutonium (0.08 pCi/l). Nitrate was present in Pond B-3 water at 13.4 mg/l. Pond B-4 which receives surface water runoff and occasional flow from Pond B-3 is characterized by levels of U-233/234 at 1.5 pCi/l and U-238 at 2.1 pCi/l. Nitrates were undetected and major ions are at relatively low concentrations. Strontium and zinc occurred at 0.31 mg/l and 0.36 mg/l, respectively. Only radionuclide data was available for Pond B-5 as of April 20, 1988. U-233/234 (2.6 pCi/l) and U-238 (2.1 pCi/l) were slightly elevated and all other radionuclides were at background levels.

"Trends in the Rocky Flats Surface Water Monitoring" (Rockwell International, 1986a) states that the maximum plutonium concentration from 1980 to 1985 in the C-2 pond was 0.05 pCi/l

(DOE, 1986c). The maximum discharge concentration of uranium below Pond C-2 was 2.8 pCi/l with an americium concentration at the C-2 discharge point being 0.02 pCi/l. The maximum detected tritium concentration in Pond C-1 was 1200 pCi/l. No sediment data were available on the C-1 and C-2 ponds. The report does note that nitrate concentrations increased slightly in Pond A-4, but remained nearly constant in Pond B-5 and C-2.

The pH was slightly basic in all of the ponds throughout the five year period and remained fairly constant. In Pond A-4 pH ranged from approximately 8.5 to 9.0 and averaged 8.8. In Pond B-5, pH again ranged from 8.5 to 9.0 and averaged 8.7. In Pond C-2, pH ranged from 8.0 to 8.5 and averaged 8.2. Maximum nonvolatile suspended solids concentrations in Pond B-5 were higher than those in Ponds A-4 and C-2 due to dam construction (Rockwell International, 1986a).

Water from the A and B series ponds is released to the North and South Walnut Creek tributaries. This water eventually empties into the Great Western Reservoir which supplies the drinking water for the community of Broomfield. The continual release of plutonium from the on-site ponds means there will be some addition of residual radiation to the off-site water systems, particularly in Walnut Creek leading from the B-series ponds and in the Great Western Reservoir.

- <u>Toxicology</u>

- Uranium is highly toxic both chemically and radioactively; soluble uranium is acutely toxic to the kidneys when ingested, whereas insoluble uranium particles exhibit radiotoxicity to the lungs when inhaled. It is persistent in the environment and may be mobile or may adsorb to soil particles depending on the species present.

- Plutonium is a toxic, radioactive metal that becomes deposited on bone surfaces when ingested. It is persistent in the environment and may be mobile or may adsorb to soil particles depending on the species present.

- HRS Evaluation

Because the plant is located on two separate surface water drainages with different public receptors, the overall HRS evaluation consists of two aggregate scores created from lumping sites with common receptors together. Aggregated scores for the Walnut Creek drainage and the Woman Creek drainage were achieved by taking the worst case situation. This technique is consistent with guidance provided in the EPA Users Manual. The chemical Migration Mode Scores for the two aggregated evaluations of the drainages at the Rocky Flats Plant exceed the 28.5 threshold for placement of sites on the National Priority List (NPL). The Walnut Creek drainage received the highest chemical Migration Mode Score, 53, in the CEARP Phase I Assessment (DOE 1986). The hazard contribution from radionuclides is comparatively small (i.e. the radionuclide Migration Mode Score is 9). The Woman Creek drainage received a chemical Migration Mode Score of 40 with a corresponding radionuclide Migration Mode Score of 6.

3.13.2 Geographic Information

The retention ponds are located outside the security-fenced area and within the original plant boundary except for the final pond in each series. The A-series ponds are located north to northwest of the Plant production area on North Walnut Creek. The B-series ponds are located east to northeast of the main production area on the South Walnut Creek tributary. The C-series ponds are located southeast of the Plant area on Woman Creek (Figure 3-6 and 3-7).

The Great Western Reservoir which supplies the drinking water for

The Great Western Reservoir which supplies the drinking water for the community of Broomfield lies approximately 1-1/4 miles downstream of the convergence point of North and South Walnut Creek. Standley Lake which supplies the municipal drinking water for the cities of Westminster, Thornton and Northglenn receives water from Woman Creek. Standley Lake is located approximately 2 miles downstream from the C-2 pond.

The Walnut Creek stream valley colluvium lies directly underneath the A and B series ponds. The Woman Creek colluvium lies underneath the C-series ponds.

3.13.3 Site Specific Pathways

The contaminants contained in the retention ponds are under water. However, the presence of VOC's would pose a concern about the atmospheric pathway.

The Walnut Creek and Woman Creek drainages, upon which the retention ponds are built received a high Hazardous Ranking Score based on their direct surface water pathways to the Great Western Reservoir and Standley Lake. These two water bodies provide the drinking water for approximately 132,700(DOE, 1980)[1] people who live in Broomfield, Thornton, Northglenn and Westminster. This represents a significant human receptor population that could be affected by chemical or radiological releases from the ponds.

The groundwater pathway could also be of significance. The retention ponds were constructed within the Walnut Creek and Woman Creek stream valleys. They lie directly on top of the valley-fill and stream colluvium. The ponds are not lined and a certain amount of infiltration through the sediments into the underlying colluvium is probable. The phenomena of seepage underneath dam structures via the permeable sediments is quite common. This

could also be a pathway for which contaminants contained within the pond could migrate.

The Walnut and Woman Creek surface waters and their associated stream valley colluvium have the same receptors, eg., Great Western Reservoir and Standley Lake.

3.13.4 Recommended Further Action

Information regarding the present concentration of contaminants in the retention ponds needs to be obtained. Current monthly monitoring programs provide water quality information for the A, B, and C series retention ponds as well as Woman and Walnut Creeks. These data need to be evaluated.

At present, there is no information to access the extent of infiltration through the pond sediments and seepage underneath the pond dams. Boreholes with subsequent subsurface soil sampling should be placed to evaluate the local stratigraphy (bedrock and alluvium) and the potential for aquifer contamination. This type of sampling would also provide relevant information concerning the hydraulic conductivity and vertical infiltration rates present in the pond bottoms and their localized alluvial aquifers.

Groundwater monitor wells should be installed at certain locations surrounding the ponds to determine if contaminant migration is occurring. Furthermore, monitor wells may also determine if the ponds are receiving other contaminants via groundwater migration from the Solar Ponds, the 903 Pad and Mound Area, and the 881 Hillside. Recent information pertaining to these sites needs to be evaluated prior to drilling any new wells.

The ponds could be receiving contamination from these High Priority Sites and in turn migration of these contaminants via the

surface water or groundwater pathways associated with the ponds could be occurring.

1- Source: EIS (DOE 1980)

3.14 SWMU 143: OLD OUTFALL

3.14.1 Site History and Description

From the early 1950's until 1974, process and/or laundry waste lines from Building 771 drained into North Walnut Creek from the old outfall (Figure 3-3). Contamination at the outfall resulted from the plutonium and other materials in discharged laundry water and water from laboratory sinks. By 1958, radioactivity levels of 17,400 dpm/g were detected in the soil at the outfall. Analyses of soil samples collected in 1970 indicated 100,000 dpm/g. As a result, the piping from Building 771 was corrected and 149 drums of soil were removed for off-site disposal (Owen, 1973).

Subsequent radiological monitoring of North Walnut Creek has not detected levels of radioactivity above applicable standards. The sodium, potassium, sulfate and nitrate discharged at the outfall would no longer be detectable.

Plutonium is a toxic radioactive metal that becomes deposited on bone surfaces. Its persistence in the environment, coupled with its radioactivity and toxicity, requires that all environmental releases be closely investigated.

3.14.2 Geographic Information

SWMU 143 is an outfall located northwest of Building 773 and 350 feet from North Walnut Creek (Figure 3-3). Drainage enters North Walnut Creek and backs up behind the A-series retention ponds (SWMUs 142.1, 142.2, 142.3, and 142.4).

This SWMU is located in the Valley Colluvium derived from the Rocky Flats Alluvium about 3 to 5 feet above the water table. The site is nearly flat.

3.14.3 Site-Specific Pathways

The surface water pathway is not considered because of the retention ponds on North Walnut Creek. These ponds are evaluated as part of SWMU 142.

The air pathway is not likely since the contaminated soil was removed. There is almost no potential for direct contact, fire, or explosion.

The primary pathway would be through the groundwater.

3.14.4 Recommended Further Action

Information pertaining to the types of waste discharged from the process waste line need to be obtained as available. A radiological survey should be performed. The survey should be conducted at the outfall and downstream of the outfall in North Walnut Creek. Monitor wells in conjunction with soil samples may be required if radioactivity is detected in the outfall area.

3.15 SWMU 148: WASTE SPILLS

3.15.1 Site History and Description

Several spills of nitrate wastes occurred around the outside of the Health Physics Laboratory, Building 123 (Figure 3-10). Dates and volumes of spills are unknown. Spilled wastes may have contained radionuclides. Radiometric surveys of the area have found radioactivity levels to be consistent with background levels (DOE, 1986b).

3.15.2 Geographic Information

The site is an approximately 200-foot^2 area surrounding Building 123 (Figure 3-10). The area is paved with asphalt.

The surface water from SWMU 148 would flow to the Central Avenue ditch. This drainage ditch runs to the east along the south side of Central Avenue and eventually to the wastewater treatment plant tributary to North Walnut Creek.

3.15.3 Site-Specific Pathways

Since the contamination is not believed to be volatile, materials would not be emitted to the air if dust is controlled at the site.

Fire and explosion hazard for these sites is expected to be negligible.

Woman Creek, located approximately 1,700 feet to the south, is the nearest surface water. SWMU 148 is located on level ground.

The Rocky Flats Alluvium underlies this area with the water table being approximately 8 to 10 feet below the surface. Groundwater

flow in this area is to the east. There is an alluvial monitor well (#44-86) located approximately 400 to 500 feet to the east of SWMU 148. Any infiltration of contaminants into groundwater may be detected by this well.

3.15.4 Recommended Further Action

Radiometric surveys of this area have found radioactivity levels to be consistent with background levels.

Nitrate has been detected in well 44-86 at 6.57 mg/l. It is difficult to determine if SWMU 148 is the source. Nitrates are extremely mobile in the environment and it is doubtful that any would exist presently.

A soil sampling boring needs to be performed to verify the presence or absence of contaminants at this site.

3.16 SWMU 151: FUEL OIL LEAK

3.16.1 Site History and Description

CEARP Phase I (DOE 1986) indicates that in August 1981, 200 gallons of #2 fuel oil from an underground tank was spilled north of Building 374 (Figure 3-2). According to interviews with Plant personnel this area was cleaned up. Information about the clean up was not available. It was reported that the spill covered an area 30 feet by 35 feet.

A visit to the site was made to assess the SWMU. The area around the cement platform which covers the underground fuel oil tank is unpaved and consists of dirt and gravel. Relatively small oil stained areas were observed around the concrete platform. Most of the stained areas were approximately one to three feet in diameter.

Number 2 fuel oil meets the RCRA ignitibility characteristics.

3.16.2 Geographic Information

The underground fuel oil tank is located approximately 100 feet north of Building 374. The area surrounding the tank is flat with no surface water features in the immediate vicinity. The Rocky Flats Alluvium groundwater table lies approximately 32 feet below the surface.

3.16.3 Site Specific Pathways

The spill that occurred in 1981 appears to have been cleaned up. The possibility of wind redistributing the oil is unlikely. The area is flat with very little possibility of the oil draining into Walnut Creek from the SWMU site.

The only plausible route would be through infiltration to the groundwater table and then via groundwater flow.

3.16.4 Recommended Further Action

Since this spill was cleaned, and fuel has not been detected in monitor wells to the north, the SWMU no longer meets the RCRA characteristic of ignitibility. The storage tank is handled separately as an active SWMU.

No further action is recommended.

3.17 SWMU 152: FUEL OIL TANK SPILL

3.17.1 Site History and Description

Site 152 is not associated with a solid waste management unit. It has been labeled by CEARP Phase I (DOE 1986) as SWMU 152 (Figure 3-2). However, this site consists of one 50 foot diameter surface fuel tank which contains #6 fuel oil. In January 1971, the fuel tank overflowed while being filled. Approximately 700 gallons of #6 fuel oil was contained within the diked area surrounding the tank. According to CEARP Phase I, the area was cleaned up and the oil was recycled. In February 1979, a similar spill of 400 gallons occurred.

No evidence of oil staining was observed during a site visit. Water from recent snow melt was contained in the dike area and no oil scum was observed floating on any of the water pools.

3.17.2 Geographic Information

The fuel tank is located south of Central Avenue and west of 7th Street. The tank is surrounded by a dike that is approximately six to eight feet in height and ten feet wide.

The area inside the dike consists of dirt and gravel. Based on the relatively large amount of water present during a site visit, it is not extremely permeable.

There is no surface water nearby with the exception of drainage ditch water outside of the berm area. The Rocky Flats Alluvium groundwater table lies approximately nine feet below the surface at this site.

3.17.3 Site Specific Pathways

The possibility that any of the fuel oil was redistributed by wind is very unlikely due to the saturation and evaporation qualities of the oil.

A 10 foot thick soil berm surrounds the tank and the surface water pathway appears to be negligible. No staining was observed in or around the site vicinity gutters.

The pathway of significance is the groundwater route. The water table is approximately nine feet below the fuel tank.

3.17.4 Recommended Further Action

No visual fuel oil contamination was observed during the site visit. Since this area was cleaned up the SWMU no longer meets the RCRA characteristic of ignitibility and there is no evidence of ongoing releases.

No further action is recommended.

3.18 SWMU 156: RADIOACTIVE SITE BURIAL

3.18.1 Site History and Description

This SWMU is divided into two separate sites. Both SWMU areas were used to place low-level plutonium-contaminated soil. The two areas are referred to as follows:

SWMU 156.1 - Building 334 Parking Lot
SWMU 156.2 - Soil Dump Area

SWMU 156.1 encompasses an area approximately 160 feet by 280 feet (Figure 3-2). The Soil Dump Area, SWMU 156.2, consists of an area 300 feet by 850 feet (Figure 3-7).

Personnel interviewed for the CEARP Phase I document mentioned that low-level plutonium-contaminated soil collected from around Building 774, was placed in the area now covered by the Building 334 parking lot. The person responsible for removing the soil from around Building 774 indicated that the soil was removed from the Building 334 parking lot area prior to construction of the parking lot. The soil was believed to have been placed east of the Triangle Area outside of the perimeter road. Personnel interviewed stated that 50 to 75 dump truck loads of dirt were deposited on the ridge north of the B-Series ponds. Another interviewee also said the dirt was from the excavation of some building. This information supports aerial photographic interpretations and statements from plant facility personnel relative to Building 334 parking lot construction.

The volume of plutonium in the soil is unknown.

A site visit verified the present existence of the Building 334 parking lot covering the SWMU 156.1 site.

Asphalt debris and concrete remains were observed in the north and south areas of site 156.2 respectfully. A piezometer labeled TH-14 has been installed in the northwest section of this area. No records as to why it was installed or how it was completed are presently available.

Plutonium is a toxic, radioactive metal that becomes deposited on bone surfaces when ingested. It is persistent in the environment and may be mobile or may adsorb to soil particles depending on the species present.

3.18.2 Geographic Information

SWMU 156.1 is presently covered by the Building 334 parking lot. It is situated approximately in the middle of the western half of the Plant production area. It is not located near any surface water drainages, lakes or ponds. The Rocky Flats Alluvium underlies this SWMU with the water table being approximately nine feet below the surface based on well 44-86 located approximately 500 feet to the south of this SWMU.

SWMU 156.2 is comprised of a triangular area outside the perimeter road and northeast of the main Plant area. It is situated on a flat ridge north of the B-Series ponds and south of the A-Series ponds. The Rocky Flats Alluvium is only 3 feet thick in this area. A road cut located at the western boundary of this SWMU reveals an outcrop of Arapahoe Sandstone. The depth of the water table is unknown.

The nearest surface water features are the B-Series ponds which are approximately 750 feet to the south. Monitor well #3-66 is located west of the main SWMU area. The Rocky Flats Alluvium appears to be dry at this well installation. This correlates with recent hydrological studies presented in the RCRA Part B

Document (DOE, 1986) which designates this area as an unsaturated surficial alluvium area.

3.18.3 Site Specific Pathways

The asphalt parking lot overlying SWMU 156.1 negates any atmospheric pathway for this site. Surface water routes should also be considered negligible due to its distant location to any surface water. The only pathway that seems possible for SWMU 156.1 is the Rocky Flats Alluvium groundwater.

Conversely, SWMU 156.2 is situated on a flat, relatively lightly vegetated area that is exposed to the high winds common to the area. The atmospheric migration of plutonium-contaminated soil is of concern at this site.

The nearest surface waters are the North and South Walnut creeks. Drainage patterns originating at both the north and south perimeter of the SWMU and leading to the Walnut creeks and their retention ponds were observed during the site visit. Periods of heavy rainfall could flush contaminants into these drainage pathways.

The area encompassing site 156.2 is assumed to be an unsaturated alluvium area. Infiltration of contaminant substances through the permeable Rocky Flats Alluvium has probably occurred. The presence of a bedrock high or a subcropping Arapahoe sand could explain the unsaturated condition observed.

In periods of heavy precipitation, contaminants could be flushed downward through the alluvium and then discharged by migration along the bedrock surface until final discharge onto the slopes or directly into North or South Walnut Creek (See Figure 3.18.1).

Figure 3.18.3-1

3.18.4 Further Recommendations

A radiation survey and soil samples should be taken to determine the concentration and amount of plutonium present and the possible presence of any contaminant substances at SWMU 156.2. If surface soil contamination is detected, air monitoring should be performed to determine if contamination via wind transport is occurring at site 156.2. There are no monitor wells located at either SWMU site. There is a need for such wells to further characterize the subsurface environment around SWMU 156.2. At least one soil sampling borehole should be drilled through the asphalt at SWMU 156.1 to determine the adequacy of the undocumented cleanup activity.

3.19 SWMU 157: RADIOACTIVE SITE

3.19.1 Site History and Description

This SWMU is comprised of two sites:

SWMU 157.1	the north area
SWMU 157.2	the south area

The CEARP Phase I Investigation (DOE 1986) states that prior to 1973, the soils around Building 439, 440, 442, 444, and 447 were known to contain low levels of uranium and chemical contamination. Building 439 and 440 had possible uranium and lathe coolant (hydraulic oil and carbon tetrachloride) infiltration from the uranium machine-tool storage facility. The laundry building, Building 442, was also potentially affected by radioactive and chemical materials, notably depleted uranium and beryllium. In 1964, Building 442 was contaminated with enriched uranium present in clothing from Building 883. In December 1963, rag-cleaning barrels stored near Building 442 either leaked or spilled. The liquid, reportedly solvents, drained into a ditch on the northeast side of the building. Radioactivity from metal shavings on the rags was detected as far east as the east end of Building 551. Cleanup operations reduced radioactivity in that area to background levels.

The area around Building 444 was also potentially affected by radioactive and chemical materials, notably depleted and enriched uranium and beryllium. An open ingot storage area and a small storage shed contributed to the radioactive contamination in the southeast corner of Building 444. Radioactivity above assumed background levels was not detected during the radiometric survey of the area.

The north area, site 157.1, encompasses an area approximately 150 feet by 300 feet. The south area, site 157.2, concerns an area 440 feet by 520 feet.

The volume of uranium, beryllium and other chemicals (possibly solvents) is unknown.

Plutonium is a toxic, radioactive metal that becomes deposited on bone surfaces when ingested. Uranium is highly toxic both chemically and radioactively. Soluble uranium is acutely toxic to the kidneys when ingested, whereas insoluble uranium particles exhibit radiotoxicity to the lungs when inhaled. Both are persistent in the environment and may be mobile or may adsorb to soil particles depending on the species present.

Carbon tetrachloride is an animal carcinogen and a suspected human carcinogen. Acute and chronic exposures can damage the kidneys, liver, lungs and central nervous system, though its acute, oral lethal toxicity is low. Carbon tetrachloride is highly mobile and persistent in the environment.

Beryllium is carcinogenic to animals and is a suspected carcinogen in humans. Chronic inhalation of beryllium dust has been shown to cause severe lung disease. Beryllium is highly stable in the environment.

3.19.2 Geographic Information

SWMU 157.1, the north area, is located north of Building 442 and south of Central Avenue. The SWMU is between 5th and 6th Streets and encompasses a 150 by 300 foot area.

SWMU 157.2, the south area, is around Buildings 439, 440, 444, and 447. This area is located south of Cottonwood Avenue and extends to Cactus Avenue and encompasses the area from 3rd Street

east to the railroad tracks (Figure 3-10) about 440 feet by 520 feet.

Presently, most of these SWMUs are paved with asphalt.

The SWMUs are situated in a relatively flat portion of the plant. Surface water drains to the Central Avenue ditch and eventually to North Walnut Creek.

The Rocky Flats Alluvium underlies both of these SWMUs with the water table being approximately seven to nine feet below the surface.

3.19.3 Site Specific Pathways

The migration of contaminated soil by wind transport is negligible with the asphalt pavement presently covering 95% of both SWMU areas.

Infiltration of contaminants into the groundwater may have occurred prior to paving of the area. The water table underlying these areas is relatively shallow and the overlying soil is very permeable. Once contaminants enter the groundwater aquifer, migration to surface waters or to underlying Arapahoe Formation sandstone lenses could occur.

3.19.4 Recommended Further Action

Soil sampling underneath the asphalt and borehole sampling with monitor well installation will be performed to determine the extent of any contamination.

3.20 SWMU 158: RADIOACTIVE SITE - BUILDING 551

3.20.1 Site History and Description

According to CEARP Phase I (DOE 1986), an area approximately 200 feet by 250 feet was used to load boxed radioactive wastes into railroad container cars. Persons interviewed for the CEARP Phase I document indicated that residual radioactive contamination may have remained at the site from leaks and damaged boxes.

Uranium chips and shavings were discovered in an aluminum scrap pile near the warehouse in 1963 and 1964. These were removed and the grounds cleaned. In July 1963 and again in 1970 an area to the north of Building 551 received equipment and drums from off-site which contained uranium above the Rocky Flats acceptable level. In 1970, the entire shipment of 55-gallon drums was returned to that vendor. These and other minor incidents result in consideration of the areas around Building 551 as suspect.

Uranium is highly toxic both chemically and radioactively. Soluble uranium is acutely toxic to the kidneys when ingested, whereas insoluble uranium particles exhibit radio-toxicity to the lungs when inhaled. It is persistent in the environment and may be mobile or may adsorb to soil particles depending on the species present.

3.20.2 Geographic Information

SWMU 158 is designated and identified as the area north of Building 551 (Figure 3-2). This area is situated in the central portion of the Rocky Flats Plan.

The groundwater table in this area is approximately nine feet below the surface.

3.20.3 Site Specific Pathways

Buildings are located south, west, and east of this area with large holding tanks to the north; therefore, the possibility of dispersion of contaminants by wind appears to be minimal. The surface water pathway appears to be negligible. Direct contact with the contaminated soil may be a pathway depending on the concentration and type of contaminants still present at the site. The groundwater pathway is of concern because of the shallow aquifer underlying this SWMU.

3.20.4 Recommended Further Action

Further research into the validity of the CEARP Phase I investigation concerning this site needs to be conducted Building 551 should be located. If the building has been removed then key structures such as loading docks and their past location need to be determined.

After such initial investigations are completed, soil sampling should be performed to evaluate the possible presence of contaminant substances. Further sampling may be required depending on the results of soil sample analyses.

Presently, there are no monitor wells located within or relatively close to this area. A monitor well should be installed to determine if contamination exists in the Rocky Flats Alluvium groundwater.

3.21 SWMU 160: RADIOACTIVE SITE - BUILDING 444 PARKING LOT
SWMU 161: Building 664

3.21.1 Site History and Description

Personnel interviewed for the CEARP Phase I document indicate that sites within the 600 area (Figure 3-10) may have received low-level radioactive contamination from plutonium and uranium. Punctured and leaking waste drums and boxes containing both solid and liquid wastes contaminated with uranium and plutonium were stored in the area of the Building 444 parking lot. The area was cleaned up but infiltration is likely. Surface soil was removed from Building 444 parking lot and the areas east and west of the Building 444 parking lot and west of Building 664 in the early 1970's. Some of the people interviewed indicated small amounts of plutonium and uranium may have remained. No radioactivity above background levels was detected during the radiometric survey of the area (DOE 1986).

Soil staining was observed around the perimeter fence enclosing an area east of the Building 444 parking lot for construction of the new electrical substation. SWMU 160, the Building 444 parking lot, is an area approximately 480 feet by 580 feet in size. The area west of Building 664, SWMU 161, consists of an area 200 feet by 250 feet.

The volume of plutonium and uranium wastes that leaked is unknown.

Plutonium is a toxic, radioactive metal that becomes deposited on bone surfaces when ingested. Uranium is highly toxic both chemically and radioactively. Soluble uranium is acutely toxic to the kidneys when ingested, whereas insoluble uranium particles exhibit radiotoxicity to the lungs when inhaled. It is

persistent in the environment and may be mobile or may adsorb to soil particles depending on the species present.

3.21.2 Geographic Information

SWMU 160, the Building 444 parking lot is covered with asphalt and is flat. Woman Creek is about 1000 feet south of the site. The unpaved eastern area of the parking lot is presently undergoing excavation for the construction of an electrical substation.

The area west of Building 664, SWMU 161, is paved with asphalt. It has a gentle slope of approximately 2^{o} to the east. The nearest surface water is the Woman Creek drainage which is approximately 700 feet south of SWMU 161. The groundwater table of the Rocky Flats Alluvium is approximately 7 to 9 feet below the surface.

Monitor well 21-74 is located to the east of SWMU 161, but information on well construction and the intervals screened is questionable. An aerial radiological survey (EG&G, 1982) indicates the area west of Building 664 is characterized by abnormally high radiation.

3.21.3 Site Specific Pathways

The original surficial soil in place at the time of contamination was removed in the early 1970's. Plutonium is known to readily attach itself to soil and deep infiltration is probably absent. Most of the plutonium was probably removed with the soil removal that took place in the early 1970's. However, certain uranium compounds may have infiltrated deeper into the groundwater. The Rocky Flats Alluvium groundwater discharges into the Walnut and Woman creeks. In certain locations it also recharges the underlying Arapahoe Formation sands.

The areas contained within both of these SWMUs are 90% asphalt paved. The release or migration of contaminants by wind is relatively minimal. The only area that could be affected is the unpaved area of the future electrical substation.

3.21.4 Recommended Further Action

The areas in question have been paved and the topsoil layers removed prior to paving. Deep soil samples may reveal the presence and extent of contaminant infiltration. Stained soil areas observed around the electrical substation fence should be sampled. A substantial finding of contaminants may then warrant monitor well installation.

The high radioactivity area noted west of Building 664 should be investigated intensively. This area is characterized by a substantially high manmade gross alpha count. The EG&G (1981) survey and report also indicates a high count rate due to americium. At the time of this radiologic survey this area was unpaved.

At least one monitor well should be drilled in this area and subsurface soil sampling performed.

3.22 SWMU 162: RADIOACTIVE SITE - 700 AREA SITE # 2

3.22.1 Site History and Description

This site involves an area approximately 50 feet by 2,000 feet according to the CEARP Phase I Investigation (DOE, 1986). Personnel interviewed for the CEARP Phase I document indicated that during 1974, several radioactive spots on 8th Street were located during pavement monitoring. The street was paved over and has effectively immobilized the contaminated spots. Upon construction of the PSZ, portions of 8th Street were removed. It is not known how disposal of the asphalt was conducted.

No information as to what volume or type of radioactive compounds is available.

3.22.2 Geographic Information

Eighth Street begins at Cedar Avenue, runs north to Central Avenue and terminates at the perimeter security zone. It begins again east of Building 564 and continues north to Building 771.

Eighth Street is situated on a flat portion of the Plant site and it is paved.

There is no surface water within 1,000 feet of 8th Street.

The alluvial groundwater table underlies 8th Street 8 to 9 feet.

3.22.3 Site Specific Pathways

Eighth Street was repaved upon discovery of the radioactive spots. This effectively immobilized the contaminated areas. In turn, there appears to be no migration pathways.

3.22.4 Recommended Further Action

No further action is recommended.

3.23 SWMU 163: RADIOACTIVE SITE - 700 AREA SITE # 3

3.23.1 Site History and Description

This SWMU is divided into two areas (Figure 3-3):

SWMU 163.1	The Wash Area
SWMU 163.2	Buried Slab Area

Persons interviewed for the CEARP Phase I document mentioned that a location north of Building 774 was used to wash equipment contaminated with radioactivity. The effluent from the wash process flowed onto the ground. No radioactivity above background levels has been detected by a radiometric survey of this location.

A concrete slab contaminated with "direct count americium" was buried north of Buildings 771 and 774. The slab was later excavated and the contaminated portion of the slab was cut away and disposed of off-site. No radioactivity above background levels has been detected by a radiometric survey of this location.

The CEARP Document states that SWMU 163.1 encompassed an area 60 feet by 150 feet while SWMU 163.2 covered an area approximately 50 feet by 50 feet.

The volume of radioactive compounds and americium released to the environment is unknown. The date of the incidents is also unknown.

Americium is a highly toxic, radioactive metal that becomes deposited in bone tissue when ingested or in the lungs when inhaled. It is a gamma and alpha emitter and is very persistent in the environment.

3.23.2 Geographic Information

As noted previously, CEARP Phase I (DOE, 1986a) identified the Wash Area as being north of Building 774. The Buried Slab is located north of Buildings 771 and 774 according to CEARP Phase I (Figure 3-3).

These areas are located in the northern portion of the Plant within the Perimeter Security Zone (PSZ).

The nearest surface water, North Walnut Creek, is approximately 375 feet to the north, northwest of these SWMUs. Any surface water runoff would drain toward this tributary.

The Rocky Flats Alluvium underlies these SWMUs with the approximate depth to the shallow water table being 3 to 9 feet based on monitor wells located west and east of these two areas (wells 19-86, 20-86).

3.23.3 Site Specific Pathways

The radiological survey performed over these areas was completed in 1984. The area north of SWMU 163.1 was surveyed to the North Walnut Creek drainage and radiation levels above background were not detected (Hawes, Personal Communication, May 24, 1988). Indications are that no substantial atmospheric migration of contaminants are occurring based on the absence of a surface contaminant source.

Surface water runoff drains into North Walnut Creek and contaminants are contained in the A-Series retention ponds. Therefore, the surface water pathway is considered negligible. The A-Series ponds will be investigated (SWMU 142).

The shallow alluvium water table lies approximately 3 to 12 feet below these SWMU's. However, groundwater movement is predominantly towards the North Walnut Creek tributary. Contaminant movement to the east would be masked in monitor well 20-86 by the solar pond leakage.

3.23.4 Recommended Further Action

The areas in question have had some remedial cleanup. The contaminated slab was excavated and removed. Radiological surveys indicate no significant surface contamination exists.

3.24 SWMU 164: RADIOACTIVE SITE - 800 AREA SITE #2

3.24.1 Site History and Description

This SWMU is comprised of three contaminated areas within the 800 Area (Figure 3-10). The three areas of concern have been referenced as such:

164.1 - Concrete Slab
164.2 - Building 886 Spills
164.3 - Building 889 Storage Pad

SWMU 164.1 - Concrete Slab

In 1958, an area several hundred square feet in size, located northwest of Building 881 and southwest of Building 883, was radioactively contaminated from a concrete slab that had been removed from the east wall of Building 776. The slab was broken up, removed and the area was cleaned up. The area of concern is approximately 50 feet by 80 feet.

SWMU 164.2	Building 886 Spills
SWMU 164.3	Building 889 Storage Pad

Two other areas within the 800 area have also been contaminated with uranium. Spills involving uranium around Building 886 have resulted in possible infiltration under and around the building. A storage pad north of Building 889 was used to temporarily store uranium contaminated equipment prior to decontamination procedures. The volume and type of radioactive compounds is unknown.

A small quantity of contaminated soil was detected during a radiometric survey of the concrete slab area. The soil was removed and shipped off-site to an approved disposal facility.

SWMU site 161.2 is indicated to be an area approximately 100 feet by 200 feet. SWMU 161.3 covers an area approximately 60 feet by 60 feet.

3.24.2 Geographic Information

These three areas of contamination are all located inside of the 800 area and were viewed from outside the Perimeter Security Fence. The areas described above are presently covered by relatively new cement sidewalks and driveways. The entire area was overlain by cement structures. The cement appears to have been poured within the last 2 to 5 years and no cracking, upheaval or settling was observed.

The nearest surface water to these SWMUs is Woman Creek which is approximately 1500 feet south of 164.1.

The Rocky Flats Alluvium underlies the site with the water table ranging from 2 to 9 feet below these three areas.

3.24.3 Site Specific Pathways

At the time of the incidents presented above, the area around the 881 and 883 Buildings was unpaved. Presently the entire area around these two buildings is paved with cement. This situation eliminates the wind migration pathway.

A certain amount of contaminant infiltration into the soil around Building 886, and the storage pad north of Building 889 probably occurred. The volume of radioactive compounds that was spilled and the great extent is unknown.

The Rocky Flats Alluvium provides a pathway for contaminants to migrate.

Woman Creek is approximately 1500 ft south of the 800 area. The immediate area around the 800 area is relatively flat. To the south the slope drops steeply towards Woman Creek. When this area was unpaved, heavy rainfall may have been able to transport contaminants towards Woman Creek. With the area now paved this pathway appears negligible.

3.24.4 Recommended Further Action

No sampling information was available on the horizontal or vertical extent of contamination. Soil samples should be taken around the buildings of concern to determine if any contamination remains.

If soil samples around SWMUs 164.1, 164.2 and 164.3 reveal the presence of residual contamination, monitor wells should be installed and subsurface soil sampling conducted northwest of Building 881 and west of Building 886.

3.25 SWMU 165: TRIANGLE AREA

3.25.1 Site History and Description

From 1966 to 1975 a land storage site referred to as the Triangle Area was used for the surface storage of 55-gallon drums containing plutonium contaminated waste (Figure 3-11). By 1968, approximately 6,000 drums were in this area in addition to contaminated wastes from the 1969 fire. In January 1969, approximately 29 drums were found to be leaking with resultant levels of up to 200,000 dpm/100cm^2. The affected area, about 200 square feet of soil, was removed to a depth of 3 to 5 inches in March 1970 for off-site disposal.

By 1971, all of the drums had been transferred to cargo containers. Further leakage from the cargo containers resulted in an area approximately 1,000 square feet affected with levels from 2,000 to 200,000 dpm/100cm^2. The leaking cargo containers apparently involved two categories of wastes - incinerator ash heels and Fulflo filters.

In June 1973, a drum containing nitric acid solution leaked. The area affected was approximately 500 square feet, with levels ranging from about 2,500 dpm/100cm^2 to in excess of the range of the detection instrument (greater than 2,000,000 dpm/100cm^2). Approximately 40 drums of soil were removed for off-site disposal. A soil sample, taken after cleanup operations were completed, indicated 24 dpm/g. After the leaks were detected, a program was started to ship the contaminated soil and the cargo containers to an approved off-site disposal facility in Idaho. Beginning in October 1974, the Triangle Area was surveyed and mapped according to concentrations of radioactivity in the soil. Plutonium was found in isolated spots. The last cargo container was removed from the triangle area in mid-1975 and the area has

not been used since that time for radioactive waste storage. The Triangle Area encompasses an area of 53,750 feet^2.

Radiological surveys were performed over this area and contaminated soil was removed at two different times. The first soil removal occurred in 1975 when the cargo containers were removed, generating 10 drums of waste. This area was then resurveyed for surface activity during 1979 to 1980. Once again all identified contaminated soil was removed. The area was cleaned up to a level of 250 cpm as determined by a FIDLER probe. Remedial cleanup was undertaken at all areas that had FIDLER surface counts greater than 1,000 cpm (Blaha, Personal Comments, May 19, 1988).

3.25.2 Geographic Information

The triangle storage area is located east of the 207 Solar Evaporation Ponds. The area is not paved and is characterized by sparse vegetation. The surface dips gently to the east.

The area is located approximately 1000 feet from South Walnut Creek.

The Rocky Flats Alluvium underlies this SWMU with the water table estimated 2 to 9 feet below the surface, though Monitor well #29-86 located in the southeast section of the triangle area is unsaturated.

3.25.3 Site Specific Pathways

SWMU 165 is an unpaved soil area that is exposed to the high winds common to the Rocky Flats Plant. Migration of plutonium contaminated soil by wind transport has occurred and may still occur.

Heavy rainstorms could have caused surface runoff to drainages that emptied into North and South Walnut creeks and associated retention ponds.

Based on present monitor well data in the area, the Rocky Flats Alluvium in the Triangle Area appears to be unsaturated. However, contaminants could have infiltrated the soil and possibly migrate into underlying Arapahoe sands or discharging into the A or B-series retention ponds.

3.25.4 Recommended Further Action

This area is of concern based on the quantity of waste that was stored and known leakage of contaminants. Although the area has been cleaned up with soil removal in 1970, 1973, 1975, and 1979 to 1980, further sampling is warranted to determine the concentration and type of contaminants that may be present.

Information regarding the radiological surveys and the location of the past hot spots needs to be obtained and evaluated.

Presently there are two monitor wells (4-60 and 29-86) located within the triangle area. Details of the 4-60 well construction are incomplete. There is a discrepancy between the water levels of these two wells (i.e. depth to water, 1 1/2 ft vs 9 ft). The need for another alluvium well and a bedrock well is warranted to determine actual groundwater conditions.

3.26 SWMU 166 TRENCHES

166.1 - Trench A
166.2 - Trench B
166.3 - Trench C

3.26.1 Site History and Description

SWMUs 166.1 and 166.2 were trenches that received uranium and/or plutonium contaminated sludge from Building 995 (Figure 3-9). Materials in SWMU 166.3 are unknown, but may have included sewage sludge.

Dates of operation for these SWMUs are based on available aerial photographs. SWMU 166.1 was active from 1964 possibly until 1974. SWMU 166.2 was active from as early as 1959, but closure date is unknown. SWMU 166.3 was active from 1964, possibly until 1974 (DOE, 1986b). Soil samples have been collected from SWMU 166.1. Laboratory analyses indicates relatively low concentrations of uranium ^{233} and ^{234} ((0.87 pCi $\pm$0.16) and uranium ^{238} (0.79 pCi $\pm$0.16). However, the presence of volatile organic compounds (VOC's) 2-butanol, 1,1,1-TCA, TCE, and toluene were observed.

3.26.2 Geographic Information

All of these SWMUs are located on the plateau north of North Walnut Creek and southeast of the active landfill. SWMU 166.1 is an 80-foot by 230-foot area about 100 feet southeast of the present landfill. SWMU 166.2 is also an 80 feet x 230 feet area, about 50 feet south of SWMU 166.1. SWMU 166.3 is about 500 feet east of SWMU 166.1. Depth to bedrock is estimated to be 3-6 feet in this area.

3.26.3 Site Specific Pathways

No air releases were observed, nor are they expected to occur, therefore the air pathway is considered negligible.

The nearest surface water is North Walnut Creek which is about 600 feet southeast of these SWMUs. Since the SWMUs are all covered, the surface water pathway is believed to be negligible. Groundwater is the pathway of major concern, with an assumed use of drinking water. SWMU 166.2 is particularly subject to infiltration and percolation because it forms a depression.

3.26.4 Recommended Further Action

A geophysical survey should be conducted to determine if Trench B (SWMU 166.2) and Trench C (SWMU 166.3) exist and to define their boundaries.

Soil samples should be collected and analyzed for both radionuclides and VOC's.

If significant contaminants are found, monitor well installation may be warranted.

3.27 SWMU 169: WASTE DRUM PEROXIDE BURIAL

3.27.1 Site History and Description

This SWMU consisted of a leaking, 55-gallon drum of hydrogen peroxide buried in the chemical storage area (SWMU 117.2) east of Building 551 (Figure 3-2). SWMU 117.2 was used primarily to store drums containing acids, oils, soaps, and solvents. This area is paved and in use today for storage of nonradioactive and nonhazardous chemical compounds. At the time the drum was buried, the area was not paved.

Concentrated hydrogen peroxide meets the RCRA characteristic of reactivity. Highly concentrated hydrogen peroxide is a severe explosion hazard when exposed to heat, mechanical impact or various chemicals. Concentrations greater than 35% are severely irritating to skin, eyes, and the respiratory tract. Hydrogen peroxide is unstable and readily decomposes to water and oxygen in the environment. Accordingly, small releases to the environment are of no consequence, but large concentrated releases could be.

3.27.2 Geographic Information

SWMU 169 is located east of Building 551 and west of Seventh Street between Sage and Central Avenues (Figure 3-2). The precise location of the buried drum is not known.

The slope of the area surrounding SWMU 169 is to the east-northeast at about 4 percent.

This SWMU is located on the permeable Rocky Flats Alluvium, about 9 feet above the water table.

3.27.3 Site-Specific Pathways

The pathway that buried material would follow is into and with the groundwater. Since the drum was leaking when it was buried, most of the material has probably leaked from the drum and was rapidly degraded, rendering it non-hazardous. If any material is remaining in the drum, and the drum were to suddenly be breached, perhaps by some sort of excavation, the hydrogen peroxide could explode.

3.27.4 Recommended Further Action

If the drum and its contents are partially intact, drilling or other excavations in the area could cause an explosion (if the drum were accidentally contacted). Since the risk of leaving the drum to slowly leak its contents is lower than the risk of trying to remove it, it is recommended that SWMU 169 be studied no further and that excavations be prohibited in the general vicinity.

3.28 SWMU 171: SOLVENT BURNING GROUND

3.28.1 Site History and Description

The solvent burning ground was an area 50 feet by 50 feet used by Rocky Flats Plant fire fighters in the 1960's and 1970's for training purposes (Figure 3-2). The fire fighters burned waste solvents. The amount and types of solvents are unknown. The dates of operation were 1960's to 1970's.

The toxicity of these solvents cannot be determined since the types of solvents are unknown.

3.28.2 Geographic Information

The solvent burning ground was located east of Building 335, adjacent to SWMU 128: Oil Burn Pit #1 and SWMU 134: Lithium Metal Destruction Site.

This site is partially paved with the remainder consisting of a soil covering.

Depth to groundwater is 10 to 20 feet through the relatively permeable Rocky Flats Alluvium. The facility slope is 3% with intervening terrain of 3.6%. The nearest surface water is North Walnut Creek, 2100 feet from the site.

3.28.3 Site-Specific Pathways

Air releases occurred during the burnings. The area is covered, preventing air releases at this time.

The nearest surface water, North Walnut Creek, is an unlikely pathway since the solvents were burned and later buried.

Additionally, the containment pond on Walnut Creek eliminates a surface water pathway.

The quantities and types of chemicals that would have been used for this exercise would have probably burned completly or volatilized, which eliminates the groundwater pathway and the potential for direct contact, fire or explosion.

3.28.4 Recommend Further Action

It is likely that all of the solvents burned were either burned completely or volatilized. Therefore, there would be no detectable residue. No further action is recommended.

3.29 SWMU 172 - CENTRAL AVENUE WASTE SPILL

3.29.1 Site History and Description

During drum removal and cleanup of the 903 drum storage in 1968, plutonium contaminated oils and oils with lathe coolant (70 percent hydraulic oil and 30 percent carbon tetrachloride) were spilled along Central Avenue and Sixth Street (Figure 3-2). The spill is reported to have been a one day event which occurred when drums in the process of being loaded onto a truck for transportation were punctured by a fork lift. The puncture was unnoticed until they reached Building 771 for unloading. The wastes were spilled from the 903 drum storage area on Central Avenue to Sixth Street and on Sixth Street from Central Avenue to Building 771 where the wastes were taken for treatment. The road spans nearly three quarters of the plant boundary (Plate 1). Only west and northbound lanes were affected. Some time after spillage occurred, the asphalt was not removed but seal-coated in an apparent effort to contain the waste. The road has subsequently been completely resurfaced.

The route was approximately one mile long. The potentially impacted area included the entire length of roadway, including the associated drainages. The area was 12 to 25 feet wide but may extend beyond the lateral extent of the road as a result of runoff.

The volume of waste spilled is unknown but only one or two of the drums reportedly were damaged. Therefore, the volume of wastes probably is less than 100 gallons.

3.29.2 Geographic Information

The Central Avenue spill is located on a relatively flat portion of the plant site. The spill area begins near the old east gate and continues west, then north along Sixth Street to Building 771 at the north end of the plant. The road is drained by ditches along each side of the road. Surface water along Central Avenue drains into ditches then to the east toward the east gate.

Surface water along Sixth Street drains generally to the northeast towards Building 771 where it follows surface water drainage, presumably to North Walnut Creek.

3.29.3 Site Specific Pathways

The contaminants of concern are volatile organic compounds, especially carbon tetrachloride, and plutonium. Although plutonium is not hazardous through direct contact, it is highly toxic through ingestion, and therefore, any pathway which could lead to ingestion of this element is considered a potential pathway. Blowing plutonium and oil contaminated dust from the drainages along the road may be significant, particularly during grading of road shoulders and cleaning of drainage ditches. It is unlikely that any carbon tetrachloride is present in the near surface soils and hence no vapor emissions are likely.

The nearest surface waters are North and South Walnut creeks. The creeks could have received runoff from this spill area via the north and east surface water drainages. However, given the volume of the spill and the area over which it was distributed, the possibility that any contaminants have reached the waterways from this incident is small.

Contact via inhalation or ingestion could occur from the roads and soils in the spill area and also along the runoff path. Therefore, soils are considered a potential pathway.

Groundwater which occurs in the alluvium at a depth of between 10 and 40 feet is also considered a potential pathway. Infiltration from the spill could have reached the groundwater table in this area. However, it is considered unlikely that plutonium has reached groundwater since this element is readily adsorbed on soil particles. Local shallow groundwater could also potentially discharge into surface drainages. Groundwater is used for drinking purposes with the nearest well located approximately two miles from the site, and about 50 rural wells occurring within three miles of the site.

It is unlikely that releases to the air are significant.

3.29.4 Further Recommendations

Soil and radiological surveys are required to determine the nature and extent of contamination. Radiometric surveys will be conducted along the roadside in the surface water drainages to determine if plutonium has migrated from the roadway.

Soil and asphalt sampling will be initiated to determine the location of plutonium and/or volatile organic contamination in the roadway and adjoining surface water drainages. Samples will be taken at stopping and unloading points as they have the highest probability of contamination. Additional samples should be taken in the drainage west of Sixth Street.

3.30 SWMU 173: RADIOACTIVE SITE - 900 AREA BUILDING 991 AND VAULTS 996, 997, 998, AND 991

3.30.1 Site History and Description

Building 991 and associated vaults (Figure 3-5) have been in operation since 1952. Incidents involving small quantities of plutonium, uranium, and beryllium have been noted in Building 991. Routine radiological surveys indicate that, with the exception of Vault 996, which may be slightly contaminated with uranium, the vaults remain free of radionuclide contamination. An aerial radiological survey conducted in August 1981 indicates 8,000 to 16,000 counts per minute of manmade gross activity and 1,000 to 2,000 counts per minute due to americium centered on Building 991. As noted on Rockwell Drawing 13810, the floors of the vaults are approximately 20 to 30 feet below the ground surface and groundwater seepage appears to be into the vaults as evidenced by salt accumulation on the inside of the tunnel. Access to this site is severely restricted due to security concerns.

3.30.2 Geographic Information

Building 991 is located in the southeastern portion of the Perimeter Security Zone (see Figure 3-5). Detailed inspection of the unit has not been possible due to security concerns. Surface water located near the site appears to drain to the east into South Walnut Creek. Surface water stands in a ditch located present on the southern and eastern edges of the unit. This ditch drains east toward South Walnut Creek.

3.30.3 Site Specific Pathways

No air releases were detected or would be expected to occur from this underground leakage. Also the leakage contained no volatile components. Hence, the air pathway is considered negligible.

The nearest surface water is South Walnut Creek. Since the contamination is contained in Building 991 and underground vaults, surface water contamination is therefore considered negligible, unless foundation drains around the building are discharged to the surface water drainage.

Soil is in direct contact with the structures and could be considered a pathway. However, surface soil contamination is considered possible around the perimeter of Building 991.

Groundwater contamination is considered possible based on available information. Leakage from the building and underground vaults might enter the groundwater through fractures in the foundations of the building, vaults and hallways. Groundwater is used for drinking purposes with the nearest well located approximately two miles from the site, and about 50 rural wells occurring within three miles of the site. Groundwater could also potentially discharge into surface drainages.

3.30.4 Recommended Further Action

Since the tunnels and vaults are buried deep into the northern hillside, probably below the water table, cluster wells (1 bedrock, 1 alluvium), will be installed around the structure. These wells will be installed to determine the vertical hydraulic gradient.

Additionally, a radiometric survey will be conducted to investigate possible radionuclide contamination of the soil from spills around the outside of the building.

3.31 SWMU 184: BUILDING 991 STEAM CLEANING AREA

3.31.1 Site History and Description

A location near Building 992 (Figure 3-5) may have been used to steam clean radionuclide-contaminated equipment and drums between 1953 and 1978. The rinse water was collected in a sump for treatment in the original process waste system. Radiometric surveys have not detected radioactivity above background levels.

3.31.2 Geographic Information

SWMU 184 is a 50-square-foot area in the southeast part of the Perimeter Security Zone, near Building 992 and within the area of SWMU 173 (Figure 3-5).

The area has a very slight slope to the south where ditches collect runoff and discharge it to South Walnut Creek. The pavement overlies Rocky Flats Alluvium and is about 13 feet above the shallow water table. The nearest water supply is about 2 miles west of SWMU 184.

3.31.3 Site-Specific Pathway

At the time of the steam cleaning operation, the surface water and air pathways may have been important routes for contaminant migration. Because of the negative findings of radiometric surveys, these pathways are considered to be of little concern. Contaminated soil and groundwater may have resulted from rinse water traveling through cracks in the pavement. Water passing through contaminated soil could further contaminate the groundwater. Contaminated groundwater could be discharged into surface water features, such as South Walnut Creek.

3.31.4 Recommended Further Action

Contamination from SWMU 184 may have been rather limited as compared to the potential contamination from SWMU 173. Because the contaminants and pathways are the same, the actual contaminant source would be difficult to determine. For these reasons, it is recommended that investigations for SWMU 184 be combined with those for SWMU 173.

3.32 SWMU 185: SOLVENT SPILL

3.32.1 Site History and Operation

A five-gallon spill of 1,1,1-trichloroethane resulted when a fork-lift punctured a 55-gallon drum at the southeast loading dock of Building 707 on November 10, 1986. The Rocky Flats Fire Department was notified and the three-inch gash was sealed. The drum was placed in an overpack drum and sent to Rocky Flats' Hazardous Waste Group for disposal.

Oil Dry, a commercial absorbent, was used to clean up the spill. The absorbent was placed in a waste drum for disposal at an approved off-site facility.

3.32.2 Geographic Information

SWMU 185 is a 30- by 60-foot area at the southeast loading dock of Building 707, within the Perimeter Security Zone (Figure 3-2). The area is paved and includes a drain into the plant storm sewer system which discharges to North Walnut Creek.

The SWMU is on the Rocky Flats Alluvium, about 8 feet above the water table.

3.32.3 Site-Specific Pathways

Since the loading dock area was paved at the time of the spill, the pathway for contaminant migration would be into the storm sewer system and into the surface water. Since the spill was small and was cleaned up promptly and properly, it is unlikely that any of the 1,1,1 trichloroethane entered the surface water.

3.32.4 Recommended Further Action

Since the spill was cleaned up immediately and the punctured drum and absorbent material disposed of properly, it is recommended that no further studies be made of SWMU 185.

3.33 SWMU 187: ACID LEAKS (2) - 400 AREA

3.33.1 Site History and Description

In September 1970, approximately 1,500 gal of sulfuric acid was spilled inside Building 443 and drained eastward from the building. This acid was captured in an earthen trap dug in an open field and neutralized with lime (DOE 1986a). The trap is now covered by buildings.

Personnel interviewed in CEARP Phase I mentioned that another acid leak occurred north of Building 444. Several hundred gallons of acid leaked from a tank and flowed along Central Avenue in the drainage ditch. Details on cleanup operations are not known.

3.33.2 Geographic Information

The spill in September of 1970 occurred inside Building 443 and then drained east and out of the building. The area inside the building is constructed of concrete and no seepage occurred through the floor. The area outside the building was unpaved.

The surface water drains to the Central Avenue ditch. Building 443 and its surroundings are situated on a broad flat area.

The area of concern is underlain by the Rocky Flats Alluvium. Depth to groundwater is approximately 9 feet. There is a monitor well (#44-86) located directly to the east of Building 443.

The second acid spill occurred outside of Building 444. CEARP Phase I indicated that the spill flowed along the Central Avenue drainage ditch. The time of this spill is unknown and likewise the physical state of the surrounding area. It is assumed that

this area was unpaved. Groundwater underlies the site at a depth of approximately 9 to 11 feet.

3.33.3 Site Specific Pathways

The acids would be adsorbed by the soil and with the passing of time pose little threat of being volatile and capable of wind transport. The areas of concern are now paved over with asphalt eliminateing the atmospheric pathway.

The Building 443 spill was contained in an earthen trap dug in the open field at the time of the spill, which contained the acid. Both spills drained north away from Woman Creek.

The groundwater table lies approximately 9 feet below these two sites. The buffering action of the soil would neutralize the acids spilled.

3.33.4 Recommended Further Action

These acids would have been neutralized by the buffering action of the soil, and the resulting by-products would have been benign and highly mobile in the environment. No environmental hazard should remain. No further action is recommended.

3.34 SWMU 188: ACID LEAK - 300 AREA

3.34.1 Site History and Description

Personnel interviewed in CEARP Phase I mentioned that a drum containing a mixture of nitric acid and hydrochloric acid leaked near the east gate of Building 374 in 1983.

The CERCLA Preliminary Assessment (PA), the Preliminary Site Investigation (PSI) and the Federal Facility Site Discovery and Identification Findings (FFSDIF) findings were all negative for this site. Therefore, a Hazardous Ranking System (HRS) Migration Mode Score was not calculated.

3.34.2 Geographic Information

The location of this acid leak was near the east gate of Building 374. This area is relatively flat and was unpaved at the time of the incident.

North Walnut Creek flows approximately 1,000 feet to the north of this area.

The groundwater varies in this area between 13 and 23 feet below the surface. There are two monitor wells (6-81 and 7-81) located north, behind Building 374.

3.34.3 Site Specific Pathways

The drainage direction in this area is to the east.

The leaking acid would have had to travel a considerable distance to the north to reach any surface water. Therefore, the surface water pathway is negligible, due to adsorption properties of the soil.

The acid would have been quickly neutralized by the buffering action of the soil. Any migration towards the groundwater would consist of a non-hazardous by-product.

3.34.4 Recommended Further Action

This acid would have been quickly neutralized by the buffering action of the soil, and the resulting by-products would have been benign and highly mobile in the environment. No environmental hazard should remain.

The CERCLA finding was negative for FFSDIF, PA, and PSI; therefore, a HRS Migration Mode Score is not calculated.

No further action is warranted.

3.35 SWMU 189: MULTIPLE ACID SPILLS - 800 AREA

3.35.1 Site History and Description

Personnel interviewed in CEARP Phase I mentioned acid spills both north and west of Building 881. Spilled material was washed down with water to dilute the acid and disperse it on the ground.

The CERCLA finding was negative for FFSDIF, PA, and PSI; therefore, a HRS Migration Mode Score was not calculated.

3.35.2 Geographic Information

As stated above, the two acid spills were north and west of Building 881, located in the southeast area of the Plant site. The areas north and west of Building 881 were assumed to be unpaved at the time of the incidents.

Woman Creek is located approximately 600 feet south of the west acid spill and approximately 900 feet south of the north acid spill.

There are two monitor wells (#60-86 and 69-86), situated south of Building 881.

3.35.3 Site Specific Pathways

The areas north and west of Building 881 are presently paved, thus eliminating the atmospheric pathway.

It is highly unlikely that the acid could have drained as far as Woman Creek, though it would have been contained by the C-Series retention ponds.

It is certain that acid infiltrated the soil, however, the buffering action of the soil would result in a benign by-product. This by-product is highly mobile and is unlikely to still remain.

3.35.4 Recommended Further Action

The dilute acids would have been quickly neutralized by the buffering action of the soil, and the resulting by-products would have been benign and highly mobile in the environment. No environmental hazard should remain.

No further action is recommended.

3.36 SWMU 190: CAUSTIC LEAK - 400 AREA

3.36.1 Site History and Description

In 1978, approximately 1,000 gallons of concentrated sodium hydroxide were accidentally released from the steam plant catch basin to the Central Avenue ditch. This liquid was diverted to retention pond B-1 on South Walnut Creek for temporary containment and neutralization. Several actions were taken that prevented the material from leaving the Plant. After alum was added to neutralize the contents of retention pond B-1, the liquid in the pond was transferred to the 207 solar evaporation pond B-North (DOE 1986a).

CERCLA finding was negative for FFSDIF, PA, and PSI; therefore, a HRS Migration Mode Score was not calculated.

3.36.2 Geographic Information

The Central Avenue ditch drains eastward towards the B-1 retention pond.

The B-1 retention pond is a surface water structure used to contain plant runoff. It is constructed on South Walnut Creek.

The Central Avenue ditch is approximately nine to fourteen feet above groundwater.

3.36.3 Site Specific Pathways

Since the caustic spill was properly managed the migration pathways were limited to the surface water pathway. Any caustic liquid would have been neutralized by the buffering action of the soil. The resultant by-product would not be a health risk.

3.36.4 Recommended Further Action

Any sodium hydroxide remaining in the environment would have been neutralized by the buffering action of the soil. No environmental hazard should remain.

3.37 SWMU 191: HYDROGEN PEROXIDE SPILL - 400 AREA

3.37.1 Site History and Description

In April 1981, a 55-gallon drum of hydrogen peroxide was dropped at the corner of 5th Street and Central Avenue. The drum ruptured, and the liquid was contained in a hole dug at this location. The hole was subsequently covered (DOE 1986a).

The CERCLA finding was negative for FFSDIF, PA, and PSI; therefore a HRS Migration Mode Score is not calculated.

3.37.2 Geographic Information

The location of this incident was at the corner of 5th Street and Central Avenue. This area is flat and at the time of the accident the peroxide was contained in a hole dug in the soil.

Woman Creek is approximately 1,100 feet to the south of this area.

The Rocky Flats Alluvium underlies this SWMU with the depth to groundwater approximately 9 feet. There is an alluvium monitor well (44-86) located approximately 75 feet south of the intersection of Central Avenue and 5th Street.

3.37.3 Site Specific Pathways

This area has been paved since the time of the spill. Any residual contamination in the surface soil would be covered making the atmospheric and surface water pathways negligible.

Groundwater underlies this area at a depth of approximately 9 feet. The buffering action of the soil would have neutralized

this spill. Therefore, any by-product of the peroxide that may have infiltrated the groundwater would not pose a threat.

3.47.4 Recommended Further Action

This spill would have been neutralized by the buffering action of the soil. No environmental hazard should remain.

No further action is recommended.

3.38 SWMU 192: ANTIFREEZE DISCHARGE

3.38.1 Site History and Description

In December 1980, approximately 155 gallons of 25% ethylene glycol (antifreeze) was released from a chiller unit into a floor drain in Building 708. The flow was contained by diverting the storm water system discharge into retention pond B-1 (PC 1985c).

The CERCLA findings are negative for the FFSDIF, the PA and the PSI. Ethylene glycol is easily degraded in the environment and in this quantity presents no hazard.

3.38.2 Geographic Information

The discharged antifreeze was contained in the B-1 retention pond. This pond is located east of the Rocky Flats Plant production area. The pond was constructed on the South Walnut Creek drainage and is unlined. This pond is under investigation (SWMU 142).

3.38.3 Site Specific Pathways

Pathways out of the B-1 pond are primarily limited to the surface water and groundwater. Evaporation is of minor importance.

Water from Pond B-1 is discharged to ponds B-4 and B-5. Water is then discharged into South Walnut Creek from pond B-5 in accordance with NPDES requirements.

The amount of infiltration into the underlying stream, valley colluvium aquifer is unknown. However, it is certain that some migration occurs.

3.38.4 Recommended Further Action

The ethylene glycol introduced into the environment from this spill would easily be degraded in the environment to non-hazardous by-products. No environmental hazard should remain.

3.39 SWMU 193: STEAM CONDENSATE LEAK - 400 AREA

3.39.1 Site History and Description

In November 1979, a steam condensate line between Building 443 and a valve pit north of the gasoline storage tank leaked. Water analyses indicated a low concentration (0.135 ppm) of amines. This line was taken out of service and the condensate was rerouted through a different system (PC 1985b).

CEARP Phase I indicates negative findings for the FFSDIF, PA and PSI of this SWMU. There is no evidence of a hazardous release.

3.39.2 Geographic Information

The steam condensate line between Building 443 and the valve pit are situated on a relatively flat portion of the Plant Site. The area between Building 443 and the valve pit is paved.

The nearest surface water is Woman Creek located approximately 1,200 feet to the south.

The Rocky Flats Alluvium underlies this area. Depth to groundwater is approximately 9 feet.

3.39.3 Site Specific Pathways

No pathways are of concern since there is no evidence of a hazardous release.

3.39.4 Recommended Further Action

The amines introduced into the environment from this leak would no longer be detectable and no environmental hazard should remain. No further action is warranted.

3.40 SWUM 194: STEAM CONDENSATE LEAK - 700 AREA

3.40.1 Site History and Description

In September 1979, a steam condensate line broke near Building 707 and water from this line flowed through pond B-4 into Walnut Creek.

The CERCLA findings for the FFSDIF, PA, and PSI were all negative.

3.40.2 Geographic Information

Building 707 is located within the Perimeter Security Zone (PSZ), in approximately the middle of the Plant site. The area is paved with the nearest surface water being South Walnut Creek and the B-Series retention ponds.

The B-4 retention pond is located east of the main Plant site on South Walnut Creek.

3.40.3 Site Specific Pathways

No pathway is of concern since there is no evidence of a hazardous release.

3.40.4 Recommended Further Action

This leak did not present any environmental hazard. Therefore, no further action is warranted.

3.41 SWMU 195: NICKEL CARBONYL DISPOSAL

3.41.1 Site History and Description

Personnel interviews suggested that several cylinders of nickel carbonyl were destroyed in a hole drilled onsite south of Lindsay Ranch. The valves were opened and the cylinders were lowered into the hole by ropes. After 24 hours, the cylinders were removed, punctured by small arms fire, and buried in the present onsite landfill. Two cylinders were wedged in the hole and were buried in place, presumably empty.

The CEARP Phase 1 investigation indicated that CERCLA findings were negative for the FFSDIF, PA, and PSI. A Hazardous Ranking Migration Mode Score was not calculated.

3.41.2 Geographic Information

The exact location of the borehole in which the nickel carbonyl bottles were buried is unknown. Lindsay Ranch is located approximately northeast of the Plant production area. This area is characterized by broad open fields used primarily for agriculture.

3.41.3 Site Specific Pathways

Nickel carbonyl is highly volatile, and the venting of these cylinders allowed the substance to dissipate into the atmosphere. It is no longer detectable.

3.41.4 Recommended Further Action

Nickel carbonyl is highly volatile and venting these cylinders in the borehole would not result in a long term environmental hazard. No further action is recommended.

3.43 SWMU 197: SCRAP METAL SITES - 500 AREA

3.43.1 Site History and Description

During the CEARP Phase I interviews, it was stated that two scrap metal disposal sites (nonradioactive, nonhazardous, nonprecious metals) southwest of Building 559 were removed in the early 1980's when the personnel security zone (PSZ) was constructed. It was further stated that one of these sites may have received used transformers that contained PCBs. However, no transformers were found during the excavation (PC 1985c).

The residue from these sites was monitored to determine the presence of radioactivity and was found to be clean. Though nonradioactive, the residue was placed in the present landfill.

The PA, PSI and FFSDIF CERCLA findings were all negative for this site. No hazardous ranking score was calculated.

3.43.2 Geographic Information

The area of concern lies southwest of Building 559, in the central portion of the Plant site. This area is nearly flat with no surface water identified in the vicinity. North Walnut Creek, located 1,500 feet to the north, is the nearest surface water feature.

Approximately 750 feet to the west of Building 559 are two monitor wells (23-86 and 24-86). One well is screened in the shallow Rocky Flats Alluvium, and the other is a bedrock monitor well. The water table in the shallow monitor well (24-86) is approximately eight feet. It is estimated that the water table under the historic scrap metal sites varies between 7 and 9 feet.

3.43.3 Site Specific Pathways

According to CEARP Phase I the area southwest of Building 559 was cleaned up and the residue placed of in the present landfill. No transformers were found during the excavation, which results in some doubt about the accuracy of the testimony.

If indeed, transformers were stored in this area historically, the major pathway would be that of direct contact and via groundwater migration.

3.43.4 Recommended Further Action

It is doubtful that transformers were stored at this site. No transformers were uncovered during excavation activities, nor was any leakage occurring from transformers reported. All CERCLA findings were negative, however it is recommended that soil samples be taken to confirm CEARP Phase I information.

3.44 SITE 199: OFFSITE SOIL CONTAMINATION

4.44.1 Site History and Description

While the Rocky Flats Plant has not disposed of any hazardous wastes offsite, except at EPA-approved facilities, or at other DOE-owned locations, some contaminants have been released accidentally, and from NPDES-permitted discharges. During the period between July, 1958 and June, 1968, the site known as the 903 area was used to store 55-gallon drums of oil contaminated with plutonium. Some of the drums corroded, allowing the contents to leak, contaminating the soil. Winds redistributed the contaminated soil downwind and offsite until the asphalt cover over the storage area was completed in November, 1969.

Offsite deposition of plutonium due to storage and subsequent removal of barrels containing plutonium-contaminated machining oil (DOE RFEIS, 1980) occurred on lands east and southeast of the Plant. Lands directly east of the Plant, across Indiana Avenue, received the greatest concentration of these materials.

Offsite soil sampling has shown that, in general, plutonium concentrations in soils are less than 50% of the EPA-proposed screening level (EPA, 1977). This screening level is based upon proposed exposure dose levels of 1 mrad to lung and 3 mrad to bone. The Rocky Flats Plant EIS (DOE, 1980) reported that the highest concentrations did not exceed 35% of the proposed levels. In May of 1975, a suit was filed against Rockwell International, Dow Chemical, and the United States of America. The complaint alleged that contamination on private lands offsite had caused loss of land values and loss of full use of the land. The case was settled by the plaintiffs in December of 1984 and dismissed in July of 1985.

As part of the settlement, certain of the plaintiffs' lands were transferred to the City of Broomfield for future reservoir expansion, and to Jefferson County for use in its open space program. The Settlement Agreement, as amended in July, 1985, requires very specific remedial actions on plaintiffs' lands offsite. Rockwell is required to conduct "...soil sampling, mixing, reseeding (or other processes) and testing... as are necessary to reduce any such concentrations of plutonium in soil on such lands to or at below the state standard." The state has adopted special construction technique requirements for lands with plutonium concentrations greater than 2 disintegrations per minute per gram (dpm/g) of soil which is approximately equal to 1 pCi/g. This concentration level is far below the proposed EPA screening level of 20 pCi/g derived from the proposed dose levels. The United States and Rockwell have reserved their rights to challenge the applicability or validity of the state construction standard in other contexts. The July amendment to the Settlement Agreement requires:

"1. spring ground preparation (plowing and disking)..."
"2. drilling grass seed..."
"3. supplemental mulch;..."
"4. timely irrigation..."
"4. weed control."

Precautions required in the Agreement include the use of portable air samplers downwind with a control level of 0.02 pCi/m3; wind velocities must be less than 15 miles per hour and soil moisture greater than 15%; and a fugitive dust control permit must be obtained from Colorado Department of Health (CDH). These are all strictly complied with.

Court ordered soil sampling was conducted on the affected lands according to CDH sample collection protocol and analyze by an

independent laboratory for plutonium. Those areas that had concentrations above the state standard of 2 dpm/g were delineated. These lands are located in Section 7, west and south of Great Western Reservoir; and in Section 18, west of Mover Reservoir, and are all lands transferred to the City of Broomfield and to Jefferson County. These are the only lands for which the remedial action ordered by the court applies. On May 28, 1986, Jefferson County requested that the actions be undertaken on their lands. Approximately 60 acres of Broomfield land in the north half of Section 7, between Great Western Reservoir and Indiana Street contains concentration levels above the state standard. Broomfield has not yet requested that their lands be remediated.

In June and July of 1986, 100 acres of Jefferson County land in Section 7 was chisel-plowed to a 12 inch depth in strips, 150 feet wide with 150 feet between strips. Subsequent testing according to CDH sampling protocol and analysis by an independent laboratory indicated that the plowing had successfully reduced the surface plutonium concentrations below the state standard. Native grasses were seeded in the Fall of 1986.

In June and July of 1987, the native grass seeding was judged to have been unsuccessful and the strips were re-plowed to kill weeds and prepare a seedbed for a cove crop of sorghum. At that time, 10 acres of Jefferson County land in Section 18 were plowed. Testing confirmed that the plowing was successful in reducing the surface plutonium concentrations below the state standard.

During November and December of 1987, weeds were controlled on the 100 acres in Section 7 and the 10 acres in Section 18 were disked to control weeds, planted to winter wheat and mulched.

Seeding of grasses was completed in April of 1988 on all lands that had been plowed in Sections 7 and 18.

In April and May of 1988, some weed control was applied. Pending the successful establishment of grasses, the intermediate strips will be plowed on the remaining 110 acres and planted with native grasses in the spring of 1989. Jefferson County lands should be complete in 1990.

3.44.2 Geographic Information

The plutonium-contaminated soil areas are in Section 7, west and south of Great Western Reservoir; and in Section 18, west of Mower Reservoir. The nearest surface water to the soil area in Section 7 is Great Western Reservoir.

Little information is available about the groundwater movement in this area, but structure contour maps indicate drainage and consequently groundwater movement to be toward Great Western Reservoir.

This reasoning also pertains to the Section 18 contaminated soil and Mower Reservoir.

3.44.3 Site-Specific Pathways

The primary pathway of concern is air. Measures have been taken to reduce the surface contaminant levels to below State standards, therefore this pathway is negligible.

3.44.4 Recommended Further Action

For those parcels of land for which remedial actions have been implemented and subsequent testing performed, no further actions

are necessary. For those areas in which State standards were exceeded but no remedial action has yet taken place, verification sampling will be implemented after completion of the remediation efforts.

3.45 SITE 200: GREAT WESTERN RESERVOIR

3.45.1 Site History and Description

From the opening of the Plant in 1952 through December 21, 1973, water containing decontaminated process waste and laundry waste was discharged through the B-series ponds to South Walnut Creek (SWMUs 142.5 through 142.9). Cooling water blowdown and stream condensate were discharged to the A-series ponds (SWMUs 142.1 through 142.4) which feed North Walnut Creek. South Walnut Creek joins North Walnut Creek below the ponds and feeds Great Western Reservoir.

While the concentrations of radioactive materials in the water which flowed to Great Western Reservoir did not exceed applicable Radioactivity Concentration Guides established by ERDA Manual Chapter 0524 (1977), it did contain low levels of plutonium, uranium, and americium which have settled in the sediments of the A- and B-series holding ponds (SWMUs 142.1 through 142.9), Walnut Creek, and Great Western Reservoir. Most of this radioactive material settled out in the holding pond sediments.

Reconstruction of the holding ponds between 1970 and 1973 resuspended some of the radioactive materials which had settled to the sediments of the ponds and released some of this material to Great Western Reservoir. Results of a sediment grab study at Great Western Reservoir, performed by the U.S. EPA in 1973, showed an average plutonium concentration of 1.4 pCi/g in Great Western Reservoir, or about 0.1% of the levels found in Pond B-1 sediments. This level of plutonium approximates the concentrations found in the soil in the area of Great Western Reservoir, indicating that airborne transfer of plutonium may be responsible for the plutonium deposits in the reservoir as well.

Sediment cores from Great Western Reservoir were studied by

Batelle Northwest Laboratories in 1974. These cores revealed an increase in plutonium concentrations in the sediment record during the period from 1970 to 1973, correlating to the pond reconstruction activities.

A further study of Great Western Reservoir sediments was performed by G. H. Setlock of Rockwell International in 1983. In addition to confirming the previous EPA and Battelle studies, results of this study indicated that the plutonium contamination in the sediment has been buried by subsequent deposition, and that there is no evidence of post-depositional migration through the sediment column.

In 1973, between 100 to 500 curies of tritium were accidently released from the Rocky Flats Plant to the environment after some contaminated parts were unknowingly sent to the Plant for disassembly. EPA estimates that 56 curies of tritium were released to Great Western Reservoir. Tritium levels in Great Western Reservoir waters had returned to approximately background levels by the end of 1976 and remain at or near background levels today. Tritium contamination in sediments has not been studies.

The total alpha activities of the water and sediments of Great Western Reservoir are dominated by the radioactive decay chain of uranium from natural sources. Naturally occurring radium-226 concentrations represent a greater contribution to public radiation exposure than the traces of plutonium-239.

3.45.2 Geographic Information

Great Western Reservoir (site 200) is located approximately 1.5 miles east of the Plant site. This reservoir receives water from the north and south forks of Walnut Creek, both of which flow east from the plant site. Great Western Reservoir, which has a volume of 3,250 acre-feet, is used as part of the municipal water

supply for the City of Broomfield and has the capacity to support about 14,500 persons.

3.45.3 Site-Specific Pathways

The surface water pathway is not considered a problem. Studies by the CSU (DOE, 1980) indicate plutonium rapidly attaches itself to pond and reservoir sediments limiting any migration through the water. Furthermore, the contaminated sediments are buried thus further limiting the migration of any contaminants into the municipal water receptors.

The groundwater movement underlying the Great Western Reservoir is towards the east. As stated above, studies indicate that plutonium readily adheres to sediments limiting any migration. Therefore, the groundwater pathway is considered negligible.

3.45.4 Recommended Further Action

At present further sampling and analyses of sediments and water from this reservoir is unwarranted as shown by the studies described in Section 3.45.1.

3.46 SITE 201: Standley Lake

3.46.1 Site History and Description

Small levels of radioactive materials may have been released to Standley Lake through both airborne transport and waterborne releases from the Rocky Flats Plant. From 1952 to 1973, filter backwash from the water treatment facility was discharged through Pond C-1 (SWMU 142.10) to Standley Lake by way of Woman Creek. No discharges other than collected runoff and groundwater seepage are presently made to the Woman Creek drainage. EPA studies in 1970 and 1973, a Battelle study in 1974, and a Rockwell International study in 1984 demonstrate that the plutonium levels in the sediments of Standley Lake remain at low levels consistent with atmospheric fallout from weapons testing in Nevada and in the 1950's and early 1960's.

Results of the EPA sediment grab study (2 surface grab samples and 2 sediment cores) performed at Sandley Lake in September 1970 detected a maximum plutonium concentration of 0.37 pCi/g. In a similar study in September 1973 in which 17 grab samples (top 6 inches) and 8 core samples were taken, the maximum contaminant level detected by the EPA was 0.17 pCi/g. A PNL study in May 1974, taking 8 grab samples, found a maximum plutonium concentration of 0.29 pCi/g. A more extensive sediment study in 1984 in which 63 grab samples and two 20-inch cores were taken found a maximum plutonium concentration of 0.61 pCi/g.

The total alpha activities of the water and sediments of Standley Lake are dominated by the radioactive decay chain of uranium from natural sources. Naturally occurring radium-226 concentrations represent a greater contribution to public radiation exposure than the traces of plutonium-239.

3.47.2 Geographic Information

Standley Lake (SWMU 201) is a large body of water (43,000 acre-feet) located about 2 miles southeast of the Plant. Woman Creek is a tributary of Standley Lake. The majority of water flowing into Standley Lake is from Clear Creek via an irrigation ditch. This reservoir is used as a part of the municipal water supplies for the communities of Westminster, Northglenn, and Thornton.

3.46.3 Site-Specific Pathways

The surface water pathway is not considered a problem. Studies by the CSU (DOE, 1980) indicate plutonium rapidly attaches itself to pond and reservoir sediments limiting any migration through the water. Furthermore, the contaminated sediments are buried thus further limiting the migration of any contaminants into the municipal water receptors.

The groundwater pathway is considered negligible due to the rapid adherence to sediments characteristic of plutonium.

3.46.4 Recommended Further Action

Standley Lake may have received radioactive contamination from airborne transport and waterborne transport as discharges through Pond C-1 by way of Woman Creek. The contamination investigations at Standley Lake demonstrate that the plutonium levels in the sediments are at low levels consistent with atmospheric fallout from the Nevada weapons testing of the 1950's and early 1960's.

At present further sampling and analyses of sediments and water from this reservoir is unwarranted.

3.47 SITE 202: Mower Reservoir

3.47.1 Site History and Description

Releases of radioactive materials in water effluents from the Rocky Flats Plant have contributed to an increase in the background radiation in the sediments of the streams and reservoirs on and in the vicinity of the Plant.

Little documentation exists on Mower Reservoir. It is a small reservoir located southeast of the Plant. Concentrations of radioisotopes in sediments from this reservoir would not be expected to exceed those found in either Great Western Reservoir or in Standley Lake (refer to SWMU 200 and 201, sections 3.45 and 3.46) which were demonstrated to be at low levels consistent with atmospheric fallout from the Nevada weapons testing of the 1950's and 1960's.

3.47.2 Geographic Information

Mower Reservoir is a small body of water that receives water from Woman Creek via an irrigation ditch originating on the Plant. It is located about 2 miles southeast of the Plant.

3.47.3 Site-Specific Pathways

The surface water pathway is not expected to be a problem because studies by the EPA at Great Western Reservoir and Standley Lake have shown that there is no evidence of contaminant migration from the sediments.

The groundwater pathway is considered negligible based on the conclusions stated previously for sites 200 and 201.

3.47.4 Recommended Further Action

At present further sampling and analyses of sediments and water from this reservoir is unwarranted.

LEGEND

FIGURE 3-1 TO 3-11

SWMU 00 = LOCATION AND IDENTIFICATION NUMBER FOR SOLID WASTE MANAGEMENT UNIT

= MONITOR WELL COMPLETED IN BEDROCK

= MONITOR WELL COMPLETED IN ALLUVIUM

▲ = MONITOR WELL COMPLETED IN ALLUVIUM AND BEDROCK.

(000) = BUILDING NUMBER

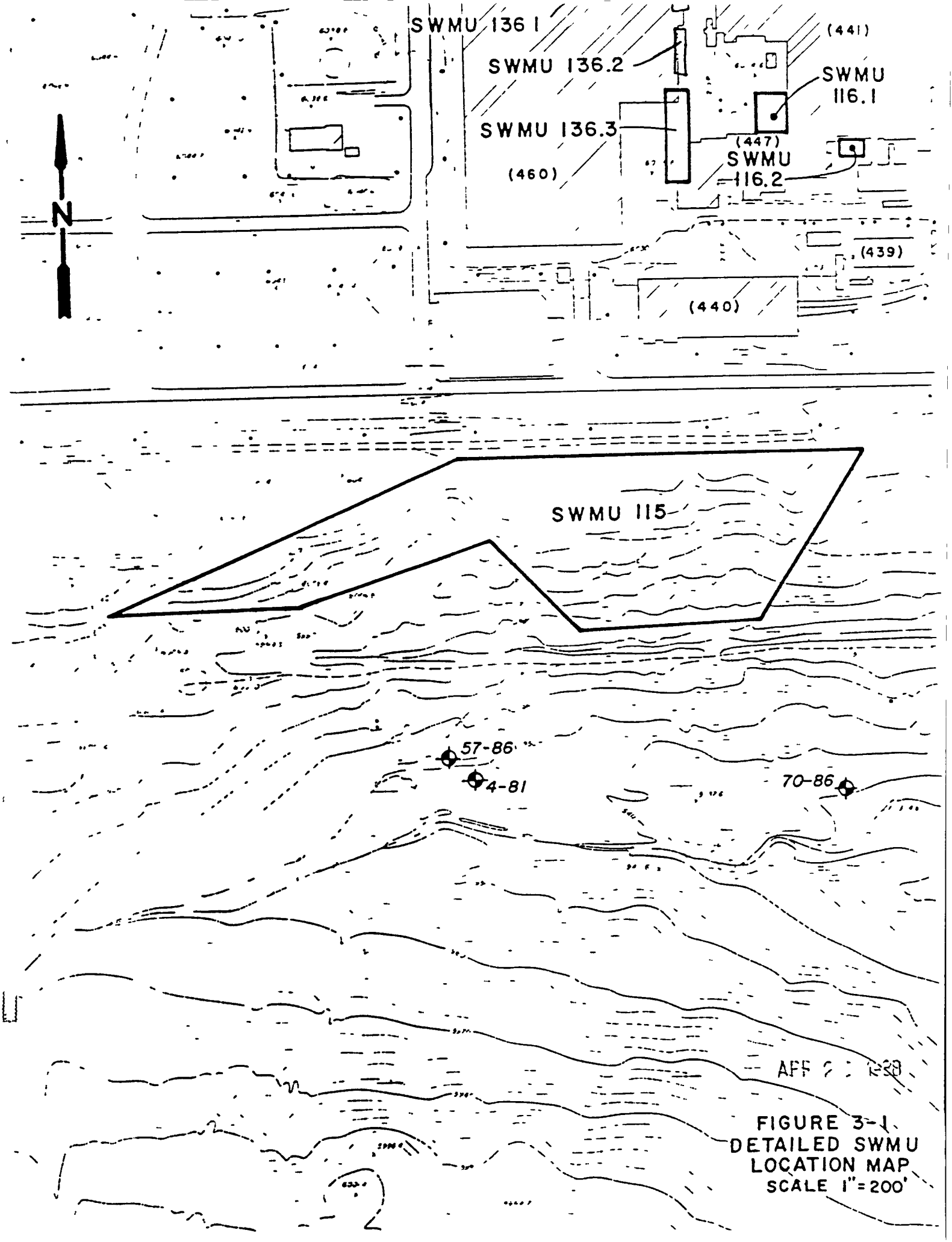


FIGURE 3-1
DETAILED SWMU
LOCATION MAP
SCALE 1"=200'

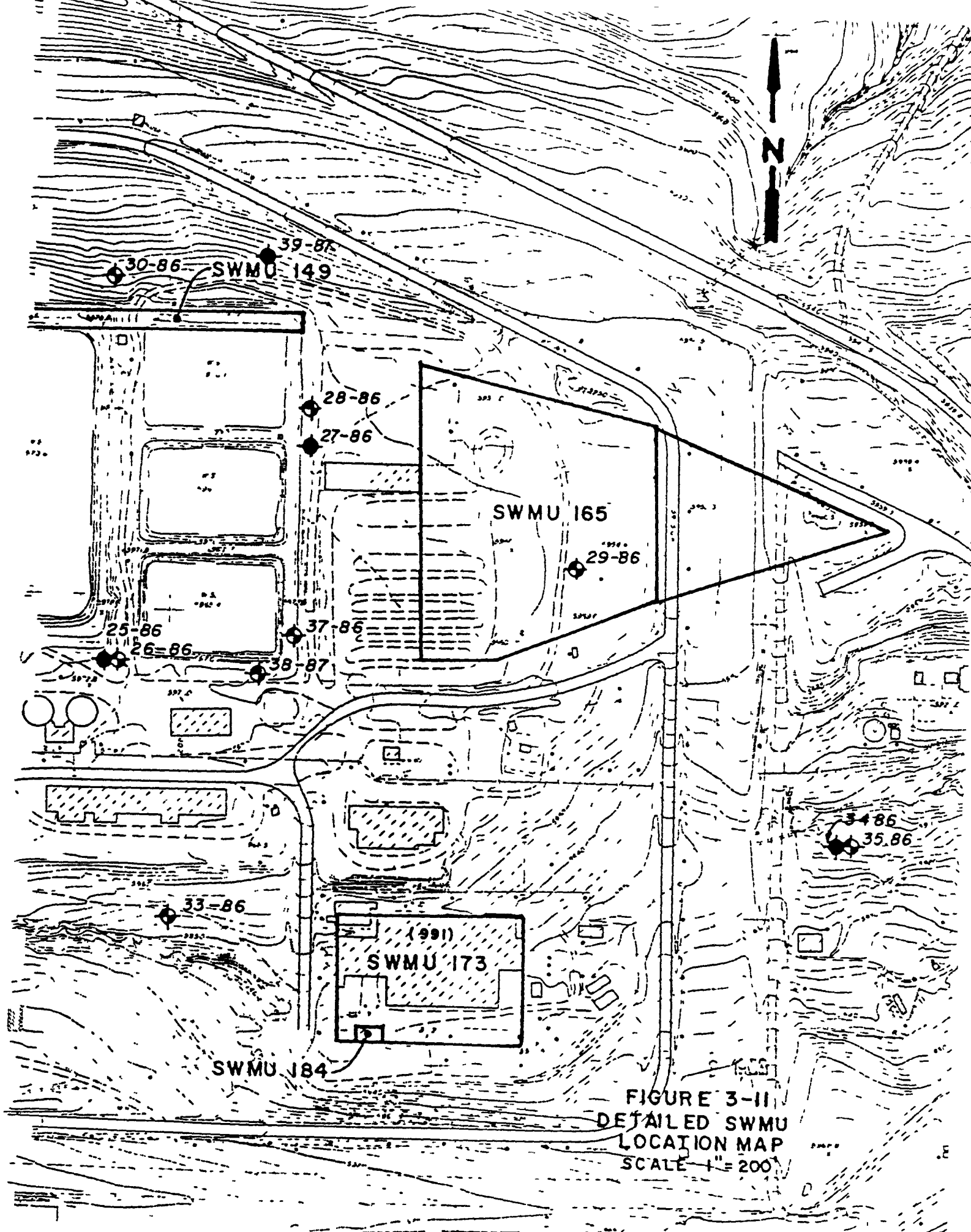


FIGURE 3-11
DETAILED SWMU
LOCATION MAP
SCALE 1" = 200'

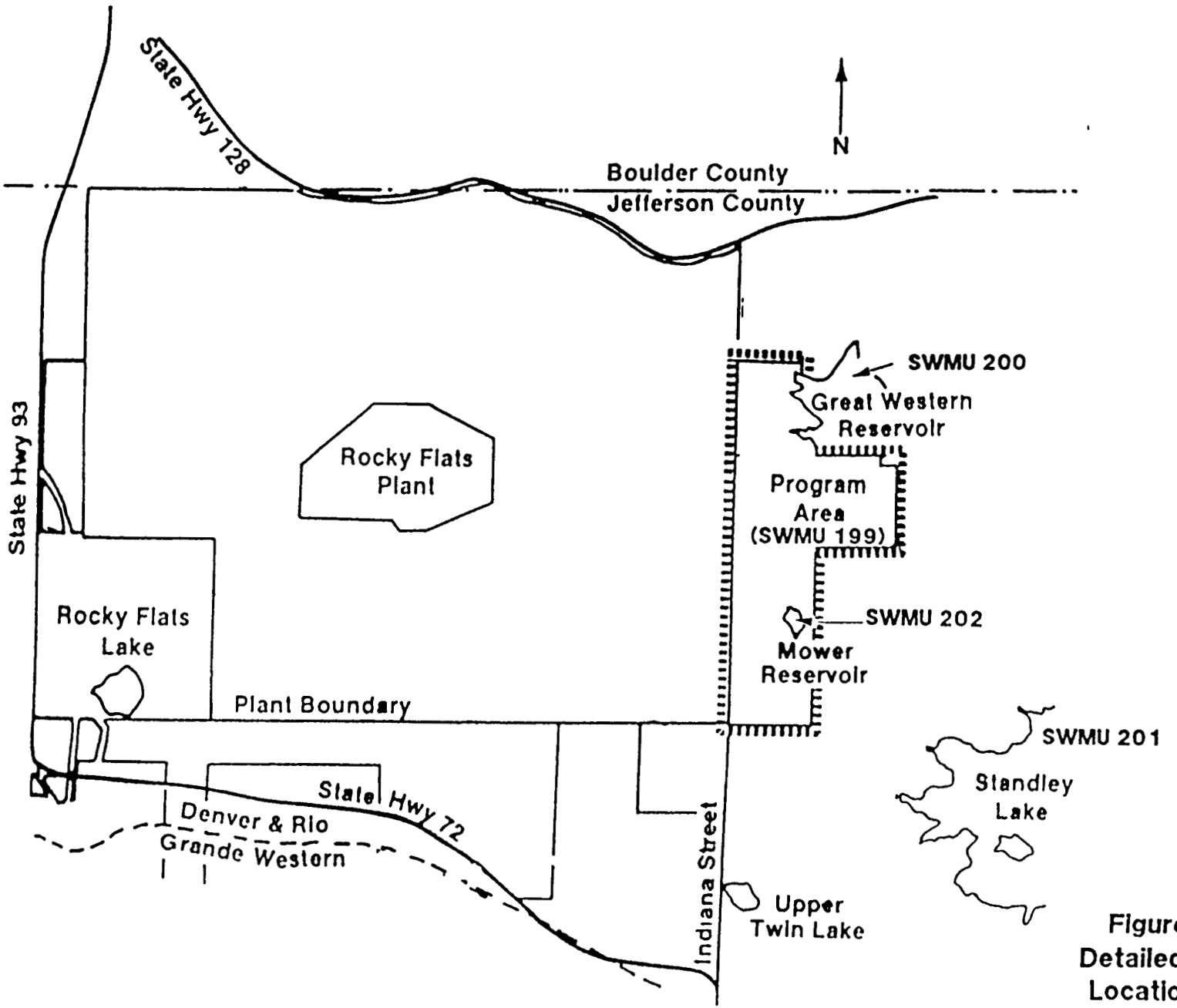


Figure 3-12
Detailed SWMU
Location Map

4.0 GROUPING OF SITES

There are 103 SWMU (Solid Waste Management Units) and CERCLA sites at the Rocky Flats Plant. Of these sites, 29 are classified as priority sites and 74 are classified as non-priority sites. There are also 4 offsite areas (Great Western Reservoir, Standley Lake, Mower Reservoir and some sections of land east of Indiana Street) on which radionuclides from the Plant may have been deposited.

Remedial investigations and feasibility studies have been completed at the 12 high priority sites (881 Hillside Area), and are in progress at the 17 other priority sites (903 Pad, Mound and East Trenches Areas). The sites addressed in this plan include all remaining SWMU and CERCLA sites. These sites are classified as low priority sites. All sites have been assigned a site/SWMU reference number. The term "site" is used interchangeably with the term "SWMU" throughout this chapter.

Because the SWMUs are located in a relatively small geographic area, and many have similar potential contaminants, they share a common environmental setting and the contaminants may interact with each other. To fully understand the problems at each SWMU, it is necessary to evaluate the data from surrounding, similar SWMUs together. For this reason, and the fact that it is more cost-effective to reduce the number of investigations, SWMUs were assigned to twelve groups (Table 4-1). Sampling plans were prepared for 11 of the 12 groups, rather than for each SWMU individually.

The following sections describe the methodology used to group SWMUs and to prioritize them for remedial investigations.

TABLE 4-1. SWMU GROUPINGS

GROUP	SOLID WASTE MANAGEMENT UNIT
	SITES FOR REMEDIAL INVESTIGATION
A	142.1, 142.2, 142.3, 142.4
B	141, 142.5, 142.6, 142.7, 142.8, 142.9, 156.2
C	142.10, 142.11
D	115, 133.1 through 133.6
E	117.2, 118.1, 118.2, 120.1, 120.2
F	166.1, 166.2, 166.3
G	116.1, 116.2, 128, 134, 136.1, 136.2, 136.3, 157.1, 157.2
H	131, 143, 156.1, 158, 160, 161, 164.1, 164.2, 164.3
	SITES FOR VERIFICATION SAMPLING
I	165, 173, 184
J	172
K	148, 197, 199
	SITES REQUIRING NO FURTHER ACTION
L	117.1, 117.3, 139.1, 139.2, 151, 152, 162, 163.1, 163.2, 169, 171, 185, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 200, 201, 202

4.1 Methodology

The factors considered in dividing the SWMUs into groups were: location, similar contaminants, and applicable pathways. Table 4-2 lists the SWMU, recommended action, and constituents that should be analyzed for. Recommended action reflects the applicable pathways, for example: a site in which groundwater is an applicable pathway would require sampling of groundwater and perhaps soil sampling. The constituents recommended for analysis reflect the contaminants which are known, or suspected, to be at the site. Table 4-3 summarizes the principal contaminants suspected at each SWMU.

Those sites not recommended for further action are classified SWMU Group L. The basis for this recommendation can be found in Chapter 3.0, Solid Waste Management Units Characteristics.

4.2 Prioritization

The EPA's Hazard Ranking System (HRS) and DOE's Modified Hazard Ranking System (mHRS) were used as a basis to prioritize the low priority SWMU groupings to determine which groups should be investigated first. The HRS and mHRS were also used as a basis to separate high priority SWMUs from low priority SWMUs. The results of the initial ranking scores are contained in the CEARP Phase I Installation Assessment (DOE, 1986a) and included the following low priority SWMUs: original landfill, cooling tower blowdown ponds, lithium metal destruction site, and Woman and Walnut Creek pathways (comparable to the retention pond SWMUs 142.1 through 142.11).

The HRS was developed by the EPA to provide a means for applying uniform technical judgment regarding the potential hazards presented by a facility. The HRS does not adequately deal with radiation hazards so under the direction of the DOE, the mHRS was

TABLE 4-2 RECOMMENDED SWMU INVESTIGATION ACTIONS

SWMU NUMBER	SWMU NAME	RECOMMENDED ACTION						TYPE OF WASTE			ASSIGNED SWMU GROUP
		NO ACTION	BACKGROUND DATA	SOIL SAMPLING	G/W SAMPLING	SUR WATER SAMPLING	SEDIMENT SAMPLING	RADIO-ACTIVE	CHEMICAL	MIXED	
115	Original Landfill		I	I	I	I	I			I	D
16 1	West Loading Dock Solvent Spill			I					I		G
16 2	South Loading Dock Solvent Spill			I					I		G
117 1	North Site Chemical Storage	I							I		L
17 2	Middle Site Chemical Storage			I					I		E
17 3	South Side Chemical Storage	I									L
18 1	Solvent Spill N of Bldg 730			I	I					I	E
118 2	Solvent Spill S of Bldg 776			I	I	I				I	E
20 1	Fiberglass area N of Bldg 664			I						I	E
20 2	Fiberglass area W of Bldg 664			I						I	E
128	Oil Burn Pit #1				I					I	G
131	Radioactive Site-700 Area Site #1			I				I			H
133	Ash Pits 133 1-133 6		I	I	I			I			D
134	Lithium Metal Test Site								I		G
136 1	Cooling Tower Pond NE Corner Bldg 469			I	I		I	I			G
136 2	Cooling Tower Pond W Corner Bldg 460			I	I		I	I			G
136 3	Cooling Tower Pond S Corner Bldg 460			I	I		I	I			G
139 1	Hydroxide Tank Spill Area	I									L
139 2	Hydrofluoric Acid Spill Areas	I									L
141	Sludge Dispersal			I	I			I		I	B
142 1	Retention Pond A-1		I		I	I	I			I	A
142 2	Retention Pond A-2		I		I	I	I			I	A
142 3	Retention Pond A-3		I		I	I	I			I	A
142 4	Retention Pond A-4		I		I	I	I			I	A
142 5	Retention Pond B-1		I		I	I	I			I	B
142 6	Retention Pond B-2		I		I	I	I			I	B
142 7	Retention Pond B-3		I		I	I	I			I	B
142 8	Retention Pond B-4		I		I	I	I			I	B
142 9	Retention Pond B-5		I		I	I	I			I	B
42 10	Retention Pond C-1		I		I	I	I			I	C
42 11	Retention Pond C-2		I		I	I	I			I	C
143	Old Outfall			I	I			I			H
148	Waste Spills	I									L
151	Fuel Oil Leak	I		I							L
152	Fuel Oil Tank	I									L
156 1	Rad Soil Burial- Bldg 334 Pkg Lot										H
156 2	Rad Soil Burial- Soil Dump Area		I	I	I					I	B
157 1	Radioactive Site- North Area			I	I			I			G
157 2	Radioactive Site- South Area			I	I			I			G
158	Radioactive Site- Bldg 551		I	I	I			I			H
160	Radioactive Site- Bldg 444 Pkg Lot			I				I			H
161	Radioactive Site- Bldg 664			I				I			H
162	Radioactive Site- 700 Area Site #2	I						I			L
163 1	Radioactive Site- 700 Area Site #3	I						I			L
163 2	Radioactive Site- 700 Area Site #3	I						I			L
164 1	Rad Site- 800 Area Site #2, Concrte S			I				I			H
164 2	Rad Site- 800 Area Site #2, Bldg 886			I				I			H
164 3	Rad Site- 800 Area Site #2, Bldg 886			I				I			H

TABLE 4-2(cont) RECOMMENDED SWMU INVESTIGATION ACTIONS

SWMU NUMBER	SWMU NAME	RECOMMENDED ACTION: NO ACTION	BACKGROUND DATA	SOIL SAMPLING	G/W SAMPLING	SOR WATER SAMPLING	SEDIMENT SAMPLING	TYPE OF WASTE: RADIO-ACTIVE	CHEMICAL	MIXED	ASSIGNED SWMU GROUP
165	Triangle Area		X	X	X			X		X	I
5 1	Trench A		X	X	X					X	F
5 2	Trench B		X	X	X					X	F
106 3	Trench C		X	X	X					X	F
169	Waste Drum Peroxide Burial	X							X		L
171	Solvent Burning Ground	X							X		L
172	Central Avenue Spill Area		X	X						X	J
173	Radioactive Site- 900 Area			X	X			X			I
184	Bldg 991 Steam Cleaning Area			X	X			X			I
185	Solvent Spill	X							X		L
187	Acid Leaks	X							X		L
188	Acid Leak	X							X		L
189	Multiple Acid Spills	X							X		L
190	Caustic Leak			X					X		K
191	Hydrogen Peroxide Spill	X							X		L
192	Antifreeze Discharge			X					X		K
193	Steam Condensate Leak	X							X		L
194	Steam Condensate Leak	X							X		L
195	Nickel Carbonyl Disposal	X							X		L
196	Water Treatment Plant Backwash Pond	X							X		L
197	Scrap Metal Sites	X		X					X		K
199	Land Surface Contamination			X				X			K
200	Great Western Reservoir	X						X			L
201	Standle Lake	X						X			L
202	Mower Reservoir	X						X			L

TABLE 4 3 Principal Contaminants at Low Priority SWMUs

SECTION NUMBER	SWMU NUMBER	SWMU NAME	FIGURE NUMBER	CONTAMINANT	GROUP ASSIGNMENT
1	115	Original Landfill	3-1	Depleted uranium ash	D
3 2	116 1	West Loading Dock Solvent Spill	3-1	Solvents, hydrocarbons	G
	116 2	South Loading Dock Solvent Spill	3-1	Solvents, hydrocarbons	G
3	117 1	North Site Chemical Storage	3-1	Acids, solvents	L
	117 2	Middle Site Chemical Storage	3-2	Acids, solvents	E
	117 3	South Site Chemical Storage	3-2	Acids, solvents	L
4	118 1	Solvent Spill W of Bldg 730	3-2	Carbon Tetrachloride, TCE	E
	118 2	Solvent Spill S of Bldg 776	3-2	Carbon Tetrachloride, TCE	E
3 5	120 1	Fiberglass area N of Bldg 664	3-10	Peroxides, solvents	E
	120 2	Fiberglass area W of Bldg 664	3-3	Peroxides, solvents	E
6	123	Oil Burn Pit #1	3 2	Waste oils, uranium	G
3 7	131	Radioactive Site-700 Area Site #1	3-2	Plutonium	H
3 8	133	Ash Pits 133 1--133 6	3-4	Uranium	D
9	134	Lithium Metal Test Site	3-2	Lithium metal	G
10	136 1	Cooling Tower Pnd NE Corner Bldg 469	3-1	Lithium, uranium, chromium	G
	136 2	Cooling Tower Pond W of Bldg 460	3-2	Lithium, uranium, chromium	G
	136 3	Cooling Tower Pond S of Bldg 460	3-2	Lithium, uranium, chromium	G
11	139 1	Hydroxide Tank Spill Areas	3-2	K-, Na-hydroxide, acids	L
	139 2	Hydrofluoric Acid Spill Areas	3-2	K-, Na-hydroxide, acids	L
3 12	141	Sludge Dispersal	3-2	Radioactive soils	B
13	142 1	Retention Pond A-1	3-2	Nitrates, plutonium, uranium	A
	142 2	Retention Pond A-2	3-2	Nitrates, plutonium, uranium	A
	142 3	Retention Pond A-3	3-2	Nitrates, plutonium, uranium	A
	142 4	Retention Pond A-4	3-2	Nitrates, plutonium, uranium	A
	142 5	Retention Pond B-1	3-2	Nitrates, plutonium, uranium	B
	142 6	Retention Pond B-2	3-2	Nitrates, plutonium, uranium	B
	142 7	Retention Pond B-3	3-2	Nitrates, plutonium, uranium	B
	142 8	Retention Pond B-4	3-2	Nitrates, plutonium, uranium	B
	142 9	Retention Pond B-5	3-2	Nitrates, plutonium, uranium	B
	142 10	Retention Pond C-1	3-2	Nitrates, plutonium, uranium	C
	142 11	Retention Pond C-2	3-2	Nitrates, plutonium, uranium	C
14	143	Old Outfall	3-2	Rad, sulfate, nitrate	H
3 15	148	Waste Spills	3-2	Rad compounds	L
16	151	Fuel Oil Leak	3-2	Hydrocarbons	L
17	152	Fuel Oil Tank	3-2	Hydrocarbons	L
3 18	156 1	Rad Soil Burial - Bldg 334 Pk Lot	3-2	Plutonium	H
	156 2	Rad Soil Burial - Soil Dump Area	3-2	Plutonium	B
19	157 1	Radioactive Site - North Area	3-2	Uranium, beryllium	G
	157 2	Radioactive Site - South Area	3-2	Uranium, beryllium	G
3 20	158	Radioactive Site, Bldg 551	3-2	Mixed wastes	H
21	160	Radioactive Site, Bldg 444 Pkg Lot	3-10	Plutonium, uranium	H
22	161	Radioactive Site, Bldg 664	3-10	Plutonium, uranium	H
3 23	162	Radioactive Site, 700 Area Site # 2	3-3	Radioactive compounds	L
24	163 1	Rad Site, 700 Area, # 3, Wash Area	3-3	Rad compounds, americium	L
24	163 2	Rad Site, 700 Area, # 3, Buried Slab	3-3	Rad compounds, americium	L
3 25	164 1	Rad Site, 800 Area Site #2, Concrt Sl	3-10	Rad compounds	H
	164 2	Rad Site, 800 Area St #2, Bldg 886 S	3-10	Rad compounds	H
	164 3	Rad Site, 800 Area St #2, Bldg 889 S	3-10	Rad compounds	H

TABLE 4-3(cont) Principal Contaminants at Low Priority SWMUs

SECTION NUMBER	SWMU NUMBER	SWMU NAME	FIGURE NUMBER	CONTAMINANT	GROUP ASSIGNMENT
3 26	165	Triangle Area -	3-11	Plutonium, Organics	I
3 27	166 1	Trench A	3-9	Uranium, plutonium, chemicals,	F
	166 2	Trench B	3-9	Uranium, plutonium, chemicals	F
	166 3	Trench C	3-9	Uranium, plutonium, chemicals	F
3 28	169	Waste Drum Peroxide Burial	3-2	Hydrogen peroxide	L
3 29	171	Solvent Burning Ground	3-2	Solvents	L
3 30	172	Central Avenue Waste Spill	Plate 1	Plutonium, waste oils	J
3 31	173	Radioactive Site - 900 Area	3-5	Plutonium, beryllium	I
3 32	184	Bldg 991 Steam Cleaning Area	3-5	Rad compounds	I
3 33	185	Solvent Spill	3-2	Trichloroethylene	L
3 34	187	Acid Leaks (2) - 400 Area		Sulfuric acid	L
3 35	188	Acid Leak - 300 Area		Nitric-, hydrochloric acid	L
3 36	189	Multiple Acid Spills		Acids	L
3 37	190	Caustic Leak		Sodium hydroxide	K
3 38	191	Hydrogen Peroxide Spill		Hydrogen peroxide	L
3 39	192	Antifreeze Discharge		Ethylene glycol	K
3 40	193	Steam Condensate Leak - 400 Area		Amines	L
3 41	194	Steam Condensate Leak - 700 Area			L
3 42	195	Nickel Carbonyl Disp		Nickel carbonyl	L
3 43	196	Water Treatment Plant Backwash Pond		Sulfates, lime	L
3 44	197	Scrap Metal Sites		Organics, PCB s	K
3 45	199	Land Surface Contamination		Rad compounds	K
3 46	200	Great Western Reservoir		Rad compounds	L
3 46	201	Standley Lake		Rad compounds	L
3 46	202	Mower Reservoir		Rad compounds	L

developed to account for the hazards associated with radioactive contaminants. The scoring is accomplished by examining three hazard modes, the Migration Mode, the Fire/Explosion Mode and the Direct Contact Mode. The Migration Mode Score is the result of evaluation of the groundwater, surface water and air migration routes. Guidance for the application of the HRS is contained in EPA Directive No. 9355.0-3, "Uncontrolled Hazardous Waste Site Ranking System - A Users Manual", 1984 and "A Ranking System for Sites with Mixed Radioactive and Hazardous Wastes", DOE, 1985.

The HRS and mHRS consider the toxicity, persistence and quantity of contaminants present; contaminant containment; contaminant pathways; and the affected populations. However, since there is very little quantitative information available for these SWMUs, numerous assumptions were made for the evaluation. Therefore, the scores determined by the HRS and mHRS are only to indicate relative potential hazards and are not necessarily final HRS scores. The relative ranking and scores assigned to SWMU groups may change as additional data become available during the site investigations. The prioritization will be updated following completion of the investigations described in the Work Plan (Appendices A-L). At that time, no further action, Phase II remedial investigations, and/or feasibility studies will be recommended based on the results of the investigations proposed in this plan.

Most of the SWMU groups contain SWMUs with the same or very similar hazards. However, some groupings were based on SWMU proximity and contain relatively hazardous SWMUs in conjunction with SWMUs that present very little or insignificant threats to human health or the environment. For SWMUs where this disparity occurs, SWMUs were prioritized within the group.

All of the preliminary HRS and mHRS scores are for the total migration mode (chemical and radioactive) for groundwater,

surface water and air. All of the groupings, other than A, B and C, were given surface water migration route scores of zero since this is considered collectively in the retention ponds in SWMU Groups A, B, and C. Air route migration scores were also zero for all of the SWMUs since there was no analytical evidence of release to the air. Direct contact and fire/explosion modes are considered negligible for all of the groups listed since the SWMUs are inaccessible and are not believed to contain explosive or pyrophoric materials. Accordingly, all SWMUs except A, B and C scored positively only in the groundwater migration mode.

In general, the radioactive migration scores may be low since information was not available to calculate a maximum potential release, therefore the scores were based entirely on observed or measured release. Further information on specific scoring of SWMU groups is contained in Appendix N, Hazard Ranking Score Sheets for Low Priority SWMU Groups.

The following is a list of the SWMU groups, their preliminary HRS and mHRS scores, and the rationale for their categorization. Table 4-4 summarizes the results.

Sites Planned for Remedial Investigation

The highest priority of these SWMU groups are SWMU Groups A and B, North and South Walnut Creek Retention Ponds and adjacent SWMUs. These SWMUs were evaluated together since their effluents combine in Walnut Creek which discharges to Great Western Reservoir. The preliminary HRS and mHRS scores for these groups are 51-chemical and 8 radioactive, the same aggregate scores received by Walnut Creek in CEARP Phase I. This grouping represents all surface water releases from the northern area of the Plant in addition to discharges made directly to the ponds. In addition to the B-series ponds, SWMU Group B contains the

TABLE 4-4 LOW PRIORITY SITES HAZARDS SCORES

GROUP	NO OF SITES	SCORE CHEM	SCORE RAD	SCORE TOTAL
A	4	51	8	51
B	7	51	8	51
C	2	37	6	37
D	7	17	5	17
E	5	16	0	16
F	3	13	5	13
G	9	13	0	13
H	9	6	6	6
I	3	20	6	20
J	1	8	3	8
K	3			
L	25			

sludge dispersal area and the soil dump area because these sites are located near the ponds.

SWMU Group C, Woman Creek retention ponds, was given preliminary HRS and mHRS scores of 37 chemical and 6 radioactive. Aggregated Woman Creek received scores of 40 chemical and 6 radioactive in CEARP Phase I, slightly higher since an air release from a priority SWMU (903 Pad) was scored in this group in CEARP Phase I. This group represents all surface water discharges from SWMUs in the southern area of the Plant in addition to discharges made directly to the ponds. The effluent from the ponds flows to Standley Lake. This group received lower HRS scores than the Walnut Creek ponds since the nearest drinking water sources are not as close.

SWMU Group I, the vaults and steam cleaning area around Building 991, and the triangle area, was given preliminary HRS and mHRS scores of 20 chemical and 6 radioactive. These scores are the result of spills at the Triangle area and groundwater contamination. The groundwater contamination may be due in part to the vaults. The chemical scoring is a result of the presence of nitrates and the potential presence of volatile organic compounds and beryllium.

SWMU Group D, the old landfill and the ash pits, received preliminary HRS and mHRS scores of 17 chemical and 5 radioactive. The old landfill received scores of 15 chemical and 5 radioactive in CEARP Phase I, slightly lower since quantity estimates did not include the ash pits. Despite the relatively low HRS score, this is classified as a first priority group since any landfill potentially contains hazardous materials. In addition, Group D may contribute surface water contaminants to SWMU Group C which is not reflected in its own HRS score. However, water samples from a well drilled adjacent to the landfill have been clean.

Within this group, investigations of the landfill would have a higher priority than the ash pits.

SWMU Group E, chemical spill sites, was given preliminary HRS and mHRS scores of 16 chemical and 0 radioactive. The SWMUs in Group E received these scores since the contaminants spilled are the same as ones that have been detected in groundwater. Additionally, the chlorinated solvents that were spilled are carcinogenic, highly mobile and persistent.

The next priority group is the sludge disposal trenches, SWMU Group F. The trenches received preliminary HRS and mHRS scores of 13 chemical and 5 radioactive. The trenches may be significant since little investigation has occurred and the contents may be hazardous.

Sites Planned for Verification Sampling

Sampling at sites in groups G, H, J, K will be performed to verify prior cleanup.

SWMU Group G, mixed waste spill sites, also received preliminary HRS and mHRS scores of 13 chemical and 5 radioactive . The chemicals involved in these sites are similar to those found in SWMU Group E, though in apparently smaller quantities. Most of these sites have undergone some cleanup activity, primarily for radioactive contamination.

The radioactive leaks and spills comprising SWMU Group H received preliminary HRS and mHRS scores of 6 chemical and 6 radioactive. The chemical scoring was due to nitrates. Most of these sites have undergone cleanup operations and show no radioactive surface contamination above background.

The Central Avenue spill, SWMU Group J, received preliminary HRS and mHRS scores of 8 chemical and 3 radioactive. This is not considered a priority since the spill was relatively small and is well contained.

Group K consists of three low priority SWMU sites: SWMU 148 (radiation spills near the Health Physics Laboratory), SWMU 197, Scrap Metal Sites-500 Area, and Site 199, Offsite Land Surface Contamination. These sites require a limited number of verification samples. SWMU 197 is the scrap metal site (nonradioactive, nonhazardous, nonprecious metals) southwest of Building 559 that may have been used to store old transformers that contained PCBs. SWMU 199 consists of an offsite contaminated soil area in Section 7 west and south of Great Western Reservoir and another area in Section 18 west of Mower Reservoir. Remediation has been performed at various areas within both sections.

Sites for No Further Action

Group L is the group for which no further action is recommended. Included in this category are SWMUs 117.1, 117.3, 139.1, 139.2, 151, 152, 162, 163.1, 163.2, 169, 171, 185, 187, 188, 189, 190, 191, 192, 193, 194, 195, and 196. These SWMUs are not believed to have ongoing releases for one or several of the following reasons: clean-up activity was effectively performed, contaminants released would have been rapidly degraded to non-hazardous breakdown products, contaminants released would have rapidly dissipated and are no longer detectable, and/or the release was adequately contained. For detailed information on why the specific SWMUs were recommended for no further action, refer to the individual SWMU descriptions in Chapter 3.

Also included in this group are Sites 200, 201, and 202, the offsite reservoirs which may have received accidental releases

from the Plant. Investigations have shown that the contamination levels have been reduced by remediation or are immobilized in the sediments. Additional information on the recommendations for each of these sites are contained in the individual SWMU descriptions in Chapter 3.

5.0 SITE-SPECIFIC SAMPLING PLANS

The goal of a remedial investigation is to collect sufficient data to support the conclusion that remedial action is not required to support preparation of feasibility studies for possible alternative remedial actions. For most of the SWMUs in this work plan, very little information is currently available. Therefore, the SWMU Group sampling plans contained in Appendices A through K are for an initial phase remedial investigation.

Analysis of initial phase data is required prior to scoping the entire remedial investigation. However, additional tasks are described for some SWMUs where the need for further actions is considered likely. In some cases, the initial phase proposed may indicate that no additional investigations are necessary.

The sampling plans in Appendices A through K address sources and pathways of the group in general, and, in some instances, individual SWMUs in detail. Existing data and established sampling points and methods are incorporated into the investigations.

The investigative techniques or procedures are detailed in the Quality Assurance Project Plan (Volume IV). The safety procedures to be followed in conducting field investigations are specified in the Health and Safety Plan (Volume III).

REFERENCES

Blume, 1972: Blume, John A. "Seismic and Geiologic Investigations and Design Criteria for Rocky Flats Plutonium Recovery and Waste Treatment Facility". JABE-CFB-01. John A. Blume & Associates, Engineers, San Francisco, California. September 1972.

Blume, 1974: Blume, John A. "Seiesmic and Geologic Investigations and Design Criteria for Rocky Flats Plutonium Recovery and Waste Treatment Facility." JABE-CFB-01. John A. Blume & Associates, Engineers, San Francisco, California. September 1972; revised June 1974.

Carson 1986: Carson, E.L. and Ellis, H.V., McCann, J.L.: "Toxicology and Biological Monitoring of Metals in Humans, 1986.

CDH, 1976: Colorado Department of Health 1976, "A Risk Evaluation for the Colorado Plutonium-In-Soil Standards. January 1976.

Dames and Moore 1981: Dames and Moore, "Geologic and Seismologic Investigations for Rocky Flats Plant," Vols. 1,2, and 3, Dames and Moore, Los Angeles, California, 1981.

DOE 1980: U.S. Department of Energy, "Final Environmental Impact Statement": Rocky Flats Plant Site, Golden, Jefferson County, Colorado, "Vols 1,2 and 3. DOE Report EIS-0064, April 1980.

DOE 1986 a: U.S. Department of Energy Comprehensive Environmental Assessment and Response Program", Phase I: Installation Assessment Rocky Flats Plant, April 1986.

DOE 1986 b: U.S. Department of Energy, "Resource Conservation and Recovery Act 3004 (u) Waste Management Units", Appendix I, Vol. I, November 1986. (For U.S. DOE - Rocky Flats Plant)

DOE 1986 c: U.S. Department of Energy, "Resource Conservation and Recovery Act Part B - Operating Permit Application", Vol. VI November 1986. (For U.S. DOE - Rocky Flats Plant)

Dow 1972: Dow Chemical Annual Report; "Environmental Safeguard '71. RFP-ENV-71B. Rocky Flats Div., Golden, Colorado. March 10, 1972.

EG&G 1982: EG&G Energy Measurements Group; "An Aerial Radiological Survey of the United States Department of Energy's Rocky Flats Plant, September 1982.

EPA 1986: U.S. Environmental Protection Agency, "Superfund Public Health Evaluation Manual", EPA/540/1-86/060, October 1986.

EPA 1984: U.S. Environmental Protection Agency, "Uncontrolled Hazardous Waste Site Ranking System, "- A Users Manual (HW-10)," 1964.

ERDA 1975: U.S. Energy Research and Development Administration, "Environmental Assessment for the Removal of Contaminated Soil at the Rocky Flats Plant," Rocky Flats Plant, Golden, Colorado unnumbered report, Dec. 1975.

Hawlay 1985: K.A. Hawlay and B.A. Napier, "A Ranking System for Sites with Mixed Radioactive and Hazardous Wastes," Pacific Northwest Laboratory, February 1985.

Hodgin 1984: C.R. Hodgin, "A Model for Asymmetrical Plume Growth and Dispersion in Complex Terrain, " Fourth Joint Conference on Applications of Air Pollution Meteorology, Portland, Oregon, American Meteorological Society, October 1984.

Hurr 1976: R.T. Hurr, "Hydrology of a Nuclear-Processing Plant Site, Rocky Flats, Jefferson County, Colorado, "U.S. Geological Survey Open-File report 76-268, 1976.

Hydro-Search, Inc., 1985: "Hydrogeologic Characterization of the Rocky Flats Plant, Golden, Colorado, Project No. 1520, December 9, 1985, pg. 55.

Klement, et al 1972: Klement, A.W., Jr.; C.R. Miller; R.P. Minx; and B. Shleien. "Estimates of Ionizing Radiation Doses in the United States 1960-2000. EPA Report ORP/CSD 72-1. U.S. Environmental Protection Agency, Rockville, Maryland, 1972.

Krey 1970: P.W. Krey and E.P. Hardy, "Plutonium in Soil Around the Rocky Flats Plant," Health and Safety Laboratory, Atomic Energy Commission report HASL-235, 1970.

Krey 1972: P.W. Krey and B.T. Krajewski. "Plutoniuum Isotopic Ratios at Rocky Flats," Health and Safety Laboratory, Atomic Energy Commission report HASL-249, 1972.

Malde 1955: H.E. Malde, "Surficial Geology of Louisville Quadrangle, Colorado," U.S. Geological Survey Bulletin 996-E, pp. 217-257, 1955.

Martell, and Poet 1972: Martell, E.A. and S.E. Poet: "Plutonium-239 and Americium-241 Contamination in the Denver Area." Health Physics v. 23, p. 537. October 1972.

Robson 1981: S.G. Robson, A. Wacinski, S. Sawistowski, and J.C. Romero, "Geologic Structure, Hydrology, and Water Quality of the Laramie-Fox Hills Aquifer in the Denver Basin, Colorado," U.S. Geologic Survey Hydrological Atlas Map HA-650, 1981.

Scott 1963: G.R. Scott, "Quaternary Geology and Geomorphic History of Kassler Quadrangle, Colorado," U.S. Geological Survey Professional Paper 421-A, 1963.

Scott 1965: G.R. Scott and W.A. Cobban, "Geologic and Biostratigraphic Map of the Pierre Shale Between Jarre Creek and Loveland, Colorado," U.S. Geological Survey Miscellaneous Geologic Inventory Map I-439.

Scott 1972: G.R. Scott, "Geologic Map of the Morrison Quadrangle, Jefferson County. Colorado," U.S. Geological Survey Miscellaneous Geologic Inventory Map I-790-A, 1972.

Spencer 1961: F.D. Spencer, "Bedrock Geology of Louisville, Quadrangle Colorado," U.S. Geologic Survey Geologic Quadrangle Map GQ-151. 1961.

Van Horn 1972: R. Van Horn, "Bedrock Geology of the Golden Quadrangle, Colorado," U.S. Geological Survey Quadrangle Map GQ-103, 1972.

CONTOUR INTERVAL 25 FEET

SCALE: 1" = 500'

SWMU GROUPINGS

GROUP	SOLID WASTE MANAGEMENT UNITS
SITES FOR REMEDIAL INVESTIGATION	
A	142.1, 142.2, 142.3, 142.4
B	141, 142.5, 142.6, 142.7, 142.8, 142.9, 142.10
D	115, 133.1 THROUGH 133.6
E	117.2, 118.1, 118.2, 120.1, 120.2
F	166.1, 166.2, 166.3
I	165, 173, 184
SITES FOR VERIFICATION SAMPLING	
G	116.1, 116.2, 128, 134, 136.1, 136.2, 136.3, 157.1, 157.2
H	131, 143, 158, 160, 161, 163.1, 164
J	172
K	148, 197*, 199*
SITES REQUIRING NO FURTHER ACTION	
* L	117.1, 117.3, 139.1, 139.2, 151, 152, 162, 163.1, 163.2, 169, 171, 185, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 200, 201, 202

*= SWMU NOT SHOWN ON THIS MAP

NOTE:

THE LOCATIONS PLOTTED ON THIS MAP ARE BASED ON AERIAL PHOTOGRAPHS AND FIGURE 1, REVISION 0, ROCKY FLATS PLANT, GOLDEN, CO. "INACTIVE WASTE SITES REFERENCE MAP" PREPARED BY C.E.N. & ASSOCIATES, DENVER, CO. DATED NOVEMBER 25, 1986.

ASI
2620 SAN MATEO N.E. SUITE D
ALBUQUERQUE, NEW MEXICO 87110

PLATE I
ROCKY FLATS PLANT
GOLDEN COLORADO

MAY 31 1988

LOW PRIORITY
SOLID WASTE MANAGEMENT
UNIT REFERENCE MAP

DESIGN		REVISIONS		
DESIGNED BY: S M DATE 4-88	NO.	DATE	REMARKS	BY
DRAWN BY: J D R DATE 4-88	1	5-88	SITES ELIMINATED	JDR
CHECKED BY: S M DATE 4-88				
PROJECT NO. 667	SHEET OF			

CONTOUR INTERVAL 25 FEET

SCALE: 1" = 500'

SWMU GROUPINGS

GROUP	SOLID WASTE MANAGEMENT UNITS
SITES FOR REMEDIAL INVESTIGATION	
A	142.1, 142.2, 142.3, 142.4
B	141, 142.5, 142.6, 142.7, 142.8, 142.9, 142.10
D	115, 133.1 THROUGH 133.6
E	117.2, 118.1, 118.2, 120.1, 120.2
F	166.1, 166.2, 166.3
I	165, 173, 184
SITES FOR VERIFICATION SAMPLING	
G	116.1, 116.2, 128, 134, 136.1, 136.2, 136.3, 157.1, 157.2
H	131, 143, 158, 160, 161, 163.1, 164
J	172
K	148, 197*, 199*
SITES REQUIRING NO FURTHER ACTION	
* L	117.1, 117.3, 139.1, 139.2, 151, 152, 162, 163.1, 163.2, 169, 171, 185, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 200, 201, 202

*= SWMU NOT SHOWN ON THIS MAP

NOTE:

THE LOCATIONS PLOTTED ON THIS MAP ARE BASED ON AERIAL PHOTOGRAPHS AND FIGURE 1, REVISION 0, ROCKY FLATS PLANT, GOLDEN, CO. "INACTIVE WASTE SITES REFERENCE MAP" PREPARED BY C.E.N. & ASSOCIATES, DENVER, CO. DATED NOVEMBER 25, 1986.

ASI
2620 SAN MATEO N.E. SUITE D
ALBUQUERQUE, NEW MEXICO 87110

PLATE I
ROCKY FLATS PLANT
GOLDEN COLORADO

MAY 31 1988

LOW PRIORITY
SOLID WASTE MANAGEMENT
UNIT REFERENCE MAP

DESIGN		REVISIONS		
DESIGNED BY: S M DATE 4-88	NO.	DATE	REMARKS	BY
DRAWN BY: J D R DATE 4-88	1	5-88	SITES ELIMINATED	JDR
CHECKED BY: S M DATE 4-88				
PROJECT NO. 667	SHEET OF			