KAISER-HILL
COMPANY

Industrial Area and Buffer Zone Sampling and Analysis Plan Modification 1

Environmental Restoration
Rocky Flats Environmental Technology Site

May 2004

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Approval received from
the Colorado Department of Public Health and Environment and
the U.S. Environmental Protection Agency
August 25, 2004.
Approval letter contained in the Administrative Record.

May 2004

EXECUTIVE SUMMARY

The Industrial Area (IA) and Buffer Zone (BZ) Sampling and Analysis Plan (SAP) (IABZSAP) describes surface and subsurface soil characterization and remediation confirmation sampling activities for Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), and Under Building Contamination (UBC) Sites at the Rocky Flats Environmental Technology Site (RFETS or Site). It is the Rocky Flats Cleanup Agreement (RFCA) decision document for accelerated action sampling in the IA and BZ.

The objective of the IABZSAP is to establish a sampling strategy that includes sampling, data analysis, and analytical methods, and accelerates laboratory and data analysis schedules.

The IABZSAP incorporates sampling and analysis methods with a data management approach that enables (1) determination of new sampling locations, (2) generation of near-real-time analytical results, (3) verification and validation (V&V) of field and analytical data, (4) evaluation of analytical results, and (5) integration of analytical results with Geographic Information System (GIS) technology to produce representations of action level (AL) exceedances, hot spots, potential remediation targets, and post-remediation sampling locations.

Methods for determining statistical, geostatistical, and biased characterization and post-remediation sampling locations are described. Use of field instrumentation, including high-purity germanium (HPGe) detectors and field x-ray fluorescence, along with on-site or off-site analytical laboratory support, will result in high-quality, near-real-time analytical results. These data will be immediately verified and validated so that data analysis and data interpretation can occur within a few days. Data analysis methods, used in accordance with project data quality objectives (DQOs), provide a consistent and reproducible method for determining AL exceedances and hot spots.

Routine surface and subsurface soil sampling methods are also described. In addition, supporting information, such as data management, health and safety (H&S), and quality assurance (QA) requirements, is included. Several appendices provide additional analytical and QA information, as well as a summary of existing historical and analytical data at IHSSs, PACs, and UBC Sites.

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ACRONYMS

AAESE	Accelerated Action Ecological Screening Evaluation
AHA	Activity Hazards Analysis
AIR	Air Database
AL	action level
ALF	Action Levels and Standards Framework for Surface Water, Ground Water, and Soils
ANOVA	Analysis of Variance
AOC	Area of Concern
AR	Administrative Record
ASD	Analytical Services Division
AST	Analytical Services Toolkit
bgs	below ground surface
BZ	Buffer Zone
CA	contamination area
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHWA	Colorado Hazardous Waste Act
cm/sec	centimeters per second
CMS/FS	Corrective Measures Study/Feasibility Study
COC	contaminant of concern
CPB	Closure Project Baseline
CPT	cone penetrometer testing
CRA	Comprehensive Risk Assessment
DNR	Department of Natural Resources
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQA	data quality assessment
DQO	data quality objective
EDD	Electronic Data Deliverable
EDDIE	Environmental Data Dynamic Information Exchange
EG&G	EG&G Rocky Flats, Inc.
EM	electromagnetic
EMC	Elevated Measurement Comparison
EMWD	environmental-measurement-while-drilling
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
EZ	exclusion zone
FDCM	Field Data Collection Module
FID	flame ionization detector
FIDLER	Field Instrument for the Detection of Low-Energy Radiation

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ACRONYMS

ft	foot
ft^2	square foot
ft^3	cubic foot
FY	fiscal year
GC/MS	gas chromatography/mass spectrometry
GIS	Geographic Information System
GPR	ground-penetrating radar
GPS	Global Positioning System
GRS	gamma ray spectrometer
Ha	alternative hypothesis
Ho	null hypothesis
H&S	health and safety
HASP	Health and Safety Plan
HDD	horizontal directional drilling
HNO_3	nitric acid
HPGe	high-purity germanium
HRR	Historical Release Report
IA	Industrial Area
IA Strategy	Industrial Area Characterization and Remediation Strategy
IABZSAP	Industrial Area and Buffer Zone Sampling and Analysis Plan
IAG	Interagency Agreement
ICP	inductively coupled plasma
IGD	Implementation Guidance Document
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IMP	Integrated Monitoring Plan
ISEDS	Integrated Sitewide Environmental Data System
ITPH	Interceptor Trench Pump House
ITS	Interceptor Trench System
IWCP	Integrated Work Control Program
K-H	Kaiser-Hill Company, L.L.C.
kg	kilogram
KOH	potassium hydroxide
lb	pound
LCS	laboratory control sample
LHSU	lower hydrostratigraphic unit
LIBS	laser-induced breakdown spectroscopy
LRA	Lead Regulatory Agency
µg/kg	micrograms per kilogram
m	meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mCi	millicurie
MDL	method detection limit
mg/kg	milligrams per kilogram

ACRONYMS

mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
MYAPC	Maine Yankee Atomic Power Company
N/A	not applicable
NaI	sodium iodide
NaOH	sodium hydroxide
nCi/g	nanocuries per gram
NFAA	No Further Accelerated Action
NLR	no longer representative
NPWL	New Process Waste Lines
OPWL	Original Process Waste Lines
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PA	Protected Area
PAC	Potential Area of Concern
PAH	polyaromatic hydrocarbon
PAM	Proposed Action Memorandum
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PDF	portable document format
PE	performance evaluation
PID	photoionization detector
PMJM	Preble's meadow jumping mouse
PPE	personal protective equipment
psig	pounds per square inch gauge
PU&D	Property Utilization and Disposal Yard
PVC	polyvinyl chloride
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
RADMS	Remedial Action Decision Management System
RBA	radiological buffer area
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual Radioactivity Computer Code
RFCA	Rocky Flats Cleanup Agreement
RFETS (or Site)	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RIN	report identification number

ACRONYMS

RL	reporting limit
RSOP	RFCA Standard Operating Protocol
RSP	Radiological Safety Procedure
RWP	Radiological Work Permit
SAP	Sampling and Analysis Plan
SED	Ecology Database
SEP	Solar Evaporation Ponds
SID	South Interceptor Ditch
SME	subject matter expert
SNL	Sandia National Laboratories
SOP	Standard Operating Procedure
SOR	sum of ratios
SSRS	Subsurface Soil Risk Screen
SVOC	semivolatile organic compound
SWD	Soil Water Database
UBC	Under Building Contamination
UCL	upper confidence limit
UHSU	upper hydrostratigraphic unit
VOC	volatile organic compound
WEMS	Waste and Environmental Management System
WIPP	Waste Isolation Pilot Plant
WRW	Wildlife Refuge Worker
V&V	verification and validation
XRF	x-ray fluorescence

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1.0 INTRODUCTION

The Industrial Area (IA) and Buffer Zone (BZ) Sampling and Analysis Plan (SAP) (IABZSAP) describes in-process soil characterization and remediation confirmation sampling and analysis activities for potential contaminant release sites in the IA and BZ Operable Units (OUs). These sites include 194 Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), and Under Building Contamination (UBC) Sites in the IA OU; 35 IHSSs and PACs in the BZ OU; and areas existing outside current IHSS, PAC, and UBC Site boundaries at the Rocky Flats Environmental Technology Site (RFETS or Site). The potential contaminant release sites are consolidated into 58 IA and 8 BZ IHSS Groups as shown on Figures 1 and 2.

The IABZSAP is the decision document used to guide sampling in the IA and BZ and streamline the decision process by providing one document for routine soil sampling and analysis activities throughout the IA and BZ. IABZSAP Addenda will supplement the IABZSAP by providing specific characterization plans and will be prepared when circumstances present characterization opportunities.

The IABZSAP includes innovative sampling, analysis, data evaluation, and data management methods. A key component of the IABZSAP is the "in-process" sampling approach that will accelerate characterization and remediation schedules. The in-process approach combines statistical methodologies with field analytical instruments and provides a way to determine, in the field, where and at what levels contamination is present. This results in being able to accomplish the following:

- Define contamination within an IHSS, PAC, or UBC Site;
- Determine the spatial boundaries of an Area of Concern (AOC), which is defined as the area where an action may be required. The AOC is the area that is evaluated for action through characterization and data aggregation and is initially the IHSS Group;
- Determine areas that exceed Rocky Flats Cleanup Agreement (RFCA) Action Levels and Standards Framework for Surface Water, Ground Water, and Soils (ALF) action levels (ALs);
- Determine the extent of hot spots;
- Determine when cleanup objectives are achieved; and
- Disposition individual IHSS, PAC, and UBC Sites.

The "in-process" sampling approach combines an approach to determine characterization and remediation confirmation sampling locations with the use of field analytical equipment. As samples are collected, they will be analyzed with field instrumentation, and a remedial decision will be made. If remediation is necessary, soil will be excavated. Samples of the remaining soil will be collected and analyzed with field instrumentation. Excavation and confirmation sampling will continue until remedial objectives are met.

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THIS TARGET SHEET REPRESENTS AN
OVER-SIZED MAP / PLATE FOR THIS DOCUMENT:
(Ref: 04-RF-01112; KLW-034-04)

Industrial Area and Buffer Zone Sampling and Analysis Plan Modification 1

Figure 1:

Industrial Area Groups

October 27, 2004

CERCLA Administrative Record Document, SW-A-005011

U.S. DEPARTEMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

GOLDEN, COLORADO

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THIS TARGET SHEET REPRESENTS AN OVER-SIZED MAP / PLATE FOR THIS DOCUMENT:
(Ref: 04-RF-01112; KLW-034-04)

Industrial Area and Buffer Zone Sampling and Analysis Plan Modification 1

Figure 2:

Buffer Zone IHSSs and PACs

April 6, 2004

CERCLA Administrative Record Document, SW-A-005011

U.S. DEPARTEMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

GOLDEN, COLORADO

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While standard statistical and biased methods will be used to determine sampling locations at many IHSSs, PACs, and UBC Sites, a geostatistical tool will also be used as appropriate to determine sampling locations. Statistical methods incorporate a hot spot identification and analysis methodology, and post-remediation confirmation sampling location methodology based on the size of the remediated area.

Data management methods will ensure that quality data are available to project personnel on a near-real-time basis, while also ensuring that Site data management protocols and requirements are met.

1.1 Regulatory Framework

RFCA, signed by the U.S Department of Energy (DOE), Colorado Department of Public Health and Environment (CDPHE), and U.S. Environmental Protection Agency (EPA) (the RFCA Parties) on July 19, 1996, provides the regulatory framework for the cleanup of RFETS (DOE et al. 1996). RFCA streamlines remediation of the Site through accelerated actions that include characterization, remediation, and closure of IHSSs, PACs, and UBC Sites.

RFCA provides the regulatory framework for DOE response obligations under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and corrective action obligations under the Resource Conservation and Recovery Act (RCRA). The RFCA accelerated action process incorporates the requirements of both CERCLA and RCRA characterization, remediation, and closure. The accelerated action process includes development of a SAP, characterization, remediation (if necessary), and development of a Data Summary or Closeout Report. This process also serves to provide documentation for the closure of IHSSs and PACs in the IA and BZ that are also RCRA units.

The RFETS Environmental Restoration (ER) Group will accelerate all IA and BZ OU activities to meet the Site goal of 2006 closure. To streamline schedules, using the in-process approach and reducing document preparation and review cycles, the IABZSAP combines the sampling and analysis requirements for the entire IA and BZ OUs into one document. This IA Characterization and Remediation Strategy (IA Strategy) (DOE 1999a) approach, while different from the standard Interim Measure/Interim Remedial Action (IM/IRA) or Proposed Action Memorandum (PAM) approach, incorporates all substantive requirements of the IM/IRA and PAM approaches. The IA Strategy approach accelerates document preparation and review times by consolidating IHSSs, PACs, and UBC Sites into groups that require significantly fewer documents. Figure 3 illustrates how the IA Strategy process compares to the IM/IRA and PAM processes.

After accelerated actions are complete, DOE will prepare a RCRA Facility Investigation/Remedial Investigation (RFI/RI) Report to describe the accelerated actions and conduct a Comprehensive Risk Assessment (CRA) to verify that potential contamination remaining at RFETS is within acceptable risk levels as defined by CERCLA and implemented through RFCA. The final Corrective Action

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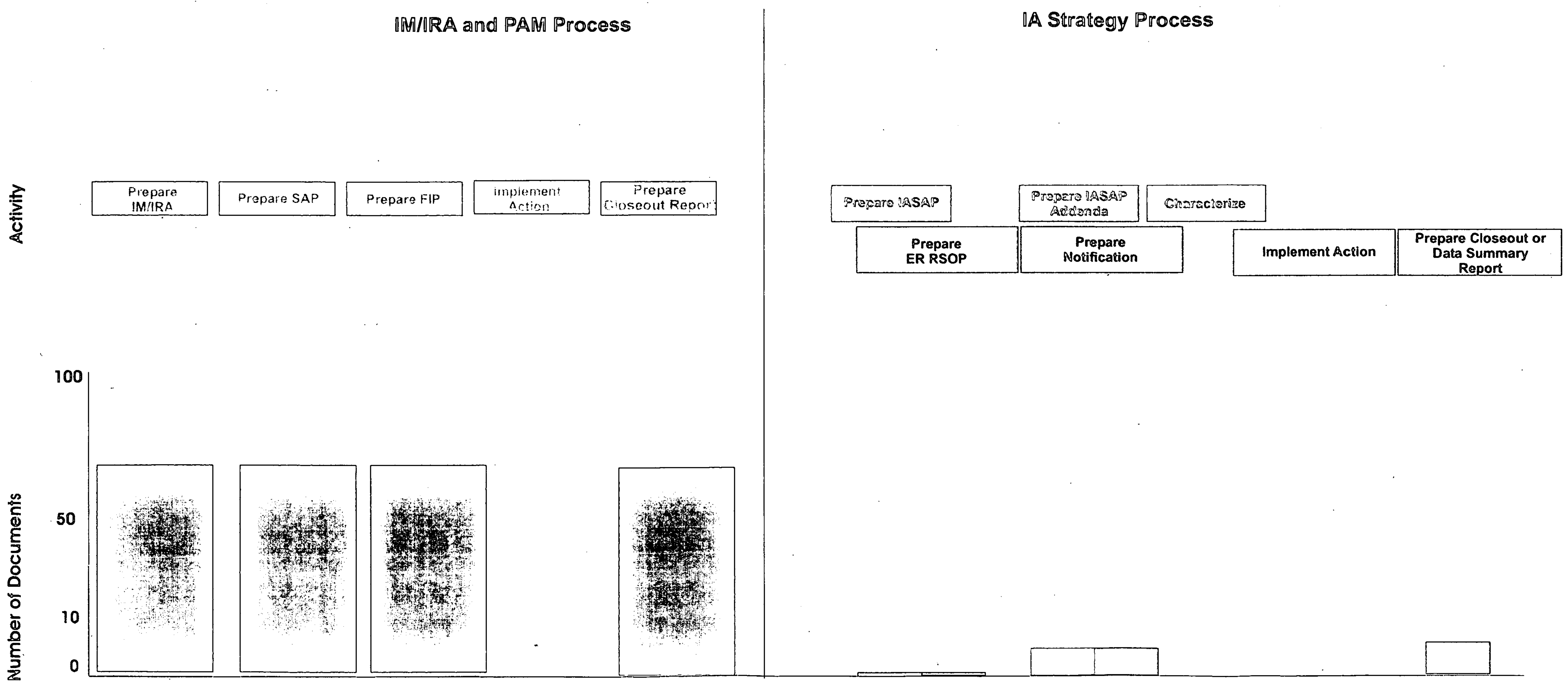
Figure 3
Industrial Area Strategy Process vs. IM/IRA and PAM Process



Decision/Record of Decision (CAD/ROD) will include, as necessary, post-closure monitoring and operation requirements, including five-year requirements for Site reviews to evaluate whether the remedies, including any institutional controls, are effective.

1.2 Purpose and Objectives

The purpose of the IABZSAP is to provide sampling and analysis methods and protocols for surface and subsurface soil characterization and post-remediation confirmation sampling and analysis in the IA and BZ OUs. The IABZSAP addresses the following:

- Characterization sampling for IHSSs, PACs, and UBC Sites in the IA and BZ OUs;
- Post-remediation confirmation sampling at IHSSs, PACs, and UBC Sites in the IA and BZ OUs; and
- Characterization sampling in areas outside IHSSs, PACs, and UBC Sites in the IA and BZ OUs for the CRA.

The IABZSAP approaches characterization of the IA and BZ as a single sampling project implemented over the period required to complete remediation of the IA and BZ OUs. It incorporates the contaminant release site consolidation strategy developed in the IA Strategy (DOE 1999a), including grouping of the 194 IA IHSSs, PACs, UBC Sites, and tanks based on decommissioning dependency, common contaminants of concern (COCs), and mutual proximity; and 35 BZ IHSSs and PACs based on common disposal methods, COCs, and mutual proximity. In addition to enhancing efficiency of the characterization and remediation effort, grouping acknowledges that IHSS designations represent the characterization starting points, but do not necessarily represent the actual boundaries of areas of contamination. By removing the constraint of the IHSS boundary, it enables characterization and remediation to proceed unencumbered by issues such as overlapping IHSSs and contaminant depth. Specific objectives of the IABZSAP include the following:

- Optimize resources by conducting sampling programs that support all appropriate decisions, including whether remediation is required, remedial objectives have been achieved, or a No Further Accelerated Action (NFAA) recommendation can be justified;
- Define data quality objectives (DQOs) for characterization and post-remediation confirmation sampling, and document the decisions and uses for which data are needed;
- Define a sampling strategy that supports DQO criteria for characterization, post-remediation confirmation sampling, and CRA sampling and analysis requirements so that each area will only be sampled once for characterization, as needed for in-process characterization, and once for post-remediation confirmation;
- Define sampling, data analysis, and analytical methods;

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- Ensure data are of the appropriate quality to support remediation decisions and CRA requirements;
- Define a sampling strategy that accelerates laboratory and data analysis schedules;
- Define a sampling strategy for IHSSs, PACs, and UBC Sites that is coordinated with the decommissioning schedule; and
- Define a sampling strategy for Original Process Waste Lines (OPWL), New Process Waste Lines (NPWL), sanitary sewer systems, and storm drains.

While the IABZSAP describes sampling methods for CRA sampling, specific CRA DQOs are described in the CRA Methodology. Separate CRA sampling addenda will be developed to describe CRA sampling in accordance with CRA DQOs.

The IABZSAP will be the current and complete decision document guiding characterization, confirmation sampling, and sampling for the CRA. Modifications to sampling methodologies, DQOs, and other elements that affect sampling strategies will be proposed to CDPHE and EPA for their approval. Modifications to the initial IABZSAP will be designated sequentially and documented in Appendix A.

The IABZSAP is designed to promote maximum sampling efficiency and quality at all suspected contaminant release sites, some of which have little, or no, starting-point data. Guided by the DQOs (Section 3.0) and the data acquisition and analysis process (Section 5.0), the sampling approach will adapt to changing conditions as new information is acquired. The anticipated frequent adjustments to the sampling approach will be implemented using the field modification process described in RFCA (Paragraph 130) (DOE et al. 1996). Points of contact for implementing the field modification process will be the Lead Regulatory Agency (LRA) Project Manager and the DOE Contractor Project Manager assigned to the sampling project.

1.3 IABZSAP Addenda

Although the IABZSAP approaches characterization of the IA and BZ as a single project, all IHSSs, PACs, and UBC Sites must be administratively dispositioned to achieve Site closure. The IABZSAP Addenda enable the IABZSAP to accommodate this obligation over the period required to complete remediation of the IA and BZ. The Addenda identify specific sites that will be characterized during a given interval, such as a fiscal year (FY), and serve as the beginning reference point to track all IHSSs, PACs, and UBC Sites from characterization through remediation and ultimately to Site closure.

Addenda will be developed as characterization opportunities arise. The Addenda scope will include:

- IHSS Group-specific potential contaminants of concern (PCOCs);
- IHSS Group-specific maps showing existing qualified data points (DOE 2000a);
- Starting-point sampling locations based on approved IABZSAP methodologies; and

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- Sampling methodology for each IHSS, PAC, or UBC Site.

CDPHE and EPA will have 14 calendar days to review and provide comments on IABZSAP Addenda. DOE will discuss and resolve regulatory agency comments before a final addendum is issued. The regulatory agencies can approve all or part of the Addenda. This will allow work to continue if specific issues require resolution. No response from the regulatory agencies during the 14-day period implies approval. Appendix B provides an example of the IABZSAP Addenda format. Volume 2 of the IABZSAP will contain the Addenda.

Table 1 lists the planned FY when each IA and BZ Group Addendum will be prepared based on the current Closure Project Baseline (CPB). Because the majority of IA and BZ OU characterization is dependent on the ability to sample IHSSs, PACs, and UBC Sites without obstructions, the Addenda schedule is closely tied to the decommissioning schedule. In general, the Addenda will be developed to coincide with the decommissioning of buildings for UBC Sites, and after demolition for associated IHSSs and PACs. Changes to the decommissioning schedule or circumstances that provide accelerated characterization opportunities will result in changes to the Addenda schedule.

Table 1
IABZSAP Addenda Preparation Schedule

FY01		FY03	
IHSS Group	**Description**	**IHSS Group**	**Description**
100-4	UBC 123	000-1	IHSSs 165 and 176
100-5	Building 121 Securing Incinerator	000-2	OPWL
300-6	Pesticide Shed	300-2	UBC 331
400-10	Sandblasting/Fiberglassing/Radioactive Sites	400-5	Sump and Tank Leaks
500-6	Asphalt Surface Near Building 559	400-6	Radioactive Site South Area
500-7	Tanker Truck Release	400-7	UBC 442 Cluster
600-6	Former Pesticide Storage Area	500-2	Radioactive Site Building 551
700-12	Process Waste Spill	500-3	UBC 559 Cluster
		500-4	Middle Site Chemical Storage
		600-1	Temporary Waste Storage
		600-4	Radioactive Site Building 444 Parking Lot
		700-3	UBCs 776/777
		700-4	UBCs 771/774
		700-7	UBC 779
		900-1	UBC 991 Cluster
FY02		**FY04**	
IHSS Group	**Description**	**IHSS Group**	**Description**
000-1	SEP AOC	000-3	Sanitary Sewers and Storm Drains
300-1	Oil Burn Pit/Burning Grounds	100-1	UBC 122 – Medical Facility
300-3	UBC 371 – Plutonium Recovery	400-1	UBC 439 – Radiological Survey
300-4	UBC 374 – Waste Treatment	400-2	UBC 440 – Modification Center
400-7	UBC 442	400-4	Miscellaneous Dumping
400-8	UBC 441	500-1	Valve Vaults and Scrap Metal Storage
600-1	Temporary Waste Storage	500-5	Transformer Leak – Building 558
600-2	Storage Shed South of Building 334	600-3	Fiberglass Area
800-2	UBC 881 Cluster	600-5	Central Avenue Ditch Cleaning
800-4	UBC 886	700-2	UBC 707 Cluster
800-5	UBC 887	700-5	UBC 770 – Waste Storage Facility
800-6	UBC 889 Cluster	700-6	Buildings 712/713 and Hydroxide Tank Area
900-3	904 Pad	700-10	Laundry Tank Overflow
900-4&5	S&W Building 980 Contractor Storage Facility	NE-1	A-, B-, and C-Series Ponds
		700-1	Diesel Fuel in Subsurface Soil
		700-8	750 Pad
		800-3	UBC 883 Cluster

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2.0 SITE DESCRIPTION

The Site description includes information on the RFETS physical setting and the conceptual model.

2.1 Physical Setting

RFETS is located approximately 16 miles northwest of Denver, Colorado, in northern Jefferson County. The Site occupies approximately 10 square miles. Boundaries and major features are illustrated on Figure 4. Most of the buildings are located within an industrial complex of approximately 350 acres (the IA) surrounded by a BZ of approximately 6,150 acres. RFETS is a government-owned, contractor-operated facility.

The IA contains 400 buildings along with other structures, roads, and utilities, and is where the bulk of RFETS mission activities took place between 1951 and 1989 (DOE et al. 1996). Most of the buildings and associated structures were used for historic processing activities associated with weapons production. The BZ surrounds the IA. The inner BZ contained support facilities and the rest of the BZ was largely undisturbed.

Materials defined as hazardous substances by CERCLA, as well as materials defined as hazardous constituents by RCRA and/or the Colorado Hazardous Waste Act (CHWA), may have been released to the environment at various locations at RFETS. In the IA, releases were identified at 194 IHSSs, PACs, UBC Sites, and tanks, as illustrated on Figure 1, and at 99 IHSSs and PACs in the BZ. In the BZ, 35 sites, as shown on Figure 2, may require additional characterization under this SAP.

2.2 Conceptual Model

The Site conceptual model includes information on RFETS geology and hydrology.

2.2.1 Geology

In the IA and BZ, relatively flat-lying Quaternary surficial deposits overlie Cretaceous bedrock. The surficial deposits consist primarily of the Rocky Flats Alluvium and artificial fill materials (EG&G 1992). The alluvium ranges from more than 100 feet (ft) thick at the western edge of the BZ to 10 ft thick at the eastern edge of the IA, and consists of unconsolidated, poorly sorted coarse gravels, coarse sands, and gravelly clays with discontinuous lenses of clay, silt, and sand. The Rocky Flats Alluvium is truncated by erosion immediately east of the IA.

The alluvium unconformably overlies weathered claystone bedrock consisting of the Upper Cretaceous Arapahoe and Laramie Formations. The Arapahoe Formation is less than 50 ft thick in the central portion of the Site and consists of siltstones and claystones with sandstone lenses. In some areas, such as near the Solar Evaporation Ponds (SEP), better-sorted and coarser-grained sandstone is present. This sandstone may provide a preferential migration pathway; however, it is interrupted by erosion and does not provide an off-site pathway for groundwater and contaminant migration. The Laramie Formation unconformably underlies the Arapahoe Formation. The Laramie Formation is

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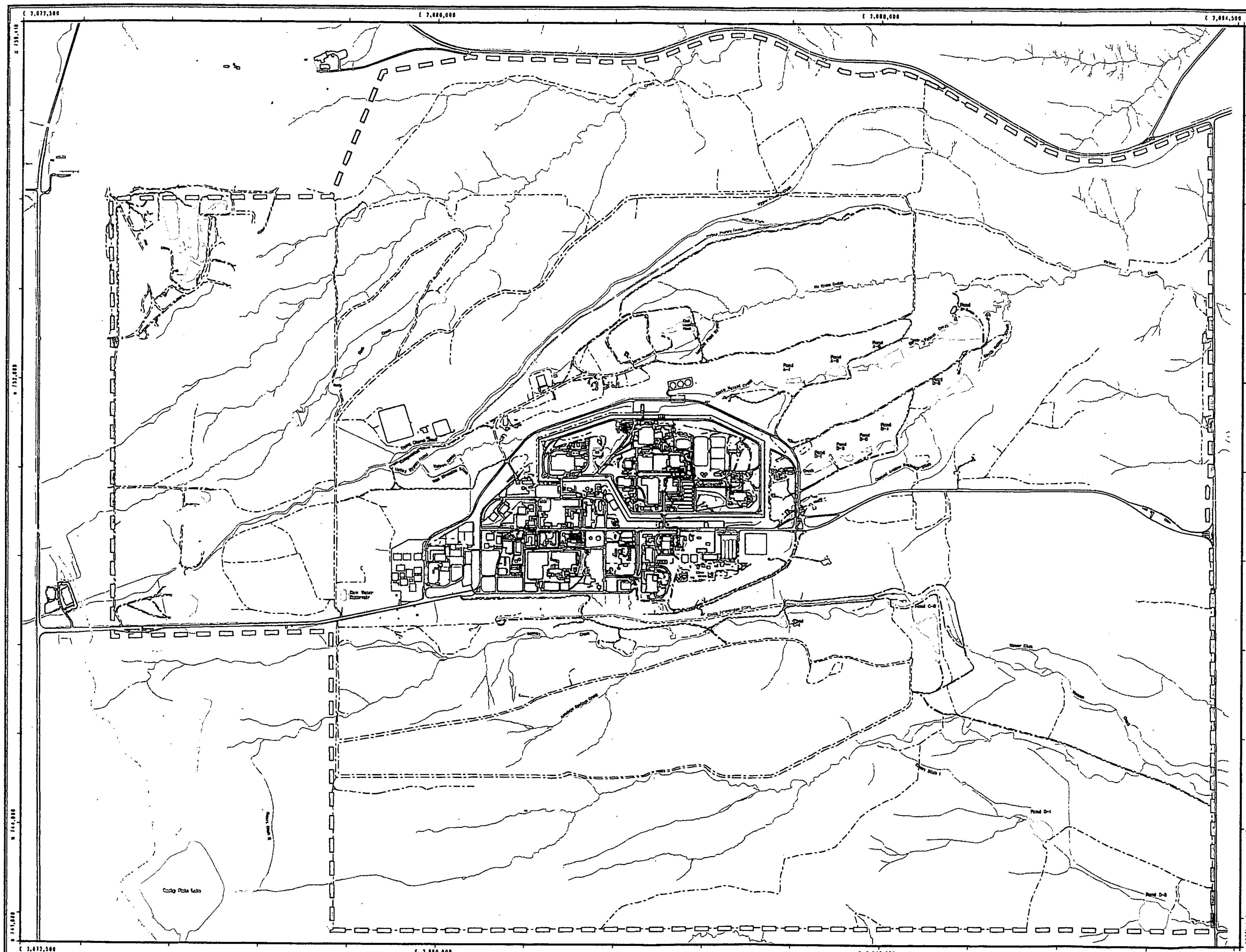

Figure 4

Rocky Flats Environmental Technology Site

EXPLANATION

Buffer Zone Boundary

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

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

Industrial Area Boundary data - Approved by Nick Demos (SSSOC, 303-966-4605).

Scale = 1 : 21430
1 inch represents approximately 1786 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2MHILL

Prepared for:

March 17, 2004

NT_Svr w:/projects/fy2003/ia_site/ia_site_fy04_04-0356.aml

600 to 800 ft thick and consists primarily of claystone with siltstone; fine-grained sandstone and coal lenses are also present (EG&G 1995a).

2.2.2 Surface Water Hydrology

Three intermittent streams drain RFETS: Rock Creek, Walnut Creek, and Woman Creek. The northwestern corner of RFETS is drained by Rock Creek, which flows northeast through the BZ to its off-site confluence with Coal Creek. No runoff from the IA drains into Rock Creek. North and South Walnut Creeks and an unnamed tributary drain the remaining northern portion of the BZ and IA. The confluence of North and South Walnut Creeks is below Ponds A-4 and B-5. The South Interceptor Ditch (SID), located between the IA and Woman Creek, collects runoff from the southern part of RFETS and ultimately diverts the water to Pond C-2. Water from Pond C-2 is monitored and discharged. Woman Creek is diverted under the SID, flows around Pond C-2, and then flows off site into the Woman Creek Reservoir.

2.2.3 Hydrogeologic Setting

Two hydrostratigraphic units are present within RFETS: the upper hydrostratigraphic unit (UHSU) and the lower hydrostratigraphic unit (LHSU). The UHSU consists of the unconfined, saturated Rocky Flats Alluvium and weathered Arapahoe and Laramie Formation bedrock, including sandstone lenses. This hydrostratigraphic unit contains most of the groundwater impacted by Site activities. The LHSU consists of the unweathered Arapahoe and Laramie Formations. These claystones and silty claystones act as an aquitard, inhibiting downward groundwater movement. The geometric mean of measured hydraulic conductivity values in the Rocky Flats Alluvium is approximately 10^{-4} centimeter per second (cm/sec). The LHSU conductivities are generally lower than those of the overlying UHSU because of the higher percentage of fine-grained material (EG&G 1995b).

Groundwater within the UHSU primarily flows from west to east along the bedrock contact with the underlying Arapahoe and Laramie Formation claystones. Groundwater elevations are highest in the spring and early summer when precipitation is high and evapotransporation is low. Groundwater elevations decline during the remainder of the year, and some areas of the UHSU in the IA are seasonally dry. Groundwater from the UHSU discharges at springs and seeps on the hillsides of the IA and BZ at the contact between the alluvium and bedrock, and where sandstone lenses subcrop in drainages, and does not migrate off site (EG&G 1995b).

To the west, where the alluvium is thickest, depth to the water table is 50 to 70 ft below ground surface (bgs). Depth to water generally decreases from west to east as the surficial material thins. Depth to water in the IA ranges from less than 2 to 22 ft. Engineered structures cause variations in water levels and saturated thickness. The impact of building footing drains, utility corridors, and other structures has not been evaluated; however, these structures are believed to impact groundwater flow (EG&G 1995b).

The majority of sampling activities in the IA and BZ will be conducted in Rocky Flats Alluvium. However, basements of some buildings in the IA extend into the weathered

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Arapahoe or Laramie Formation. Because of the deep basements, groundwater of the UHSU may be intercepted beneath some buildings.

2.3 Previous Studies

Before RFCA went into effect, the IHSSs were grouped into 16 OUs as part of the Rocky Flats Interagency Agreement (IAG) (DOE et al. 1991). The OU consolidation (prior to RFCA) established the BZ and IA OUs, and left OUs 1, 3, and 7 intact. OUs 5 and 6 remain in place with minor modifications. OUs 1, 3, 11, 15, and 16 have approved CAD/RODs.

In the IA, 194 IHSSs, PACs, UBC Sites, and tanks were further consolidated into 58 IHSS Groups (Figure 1) as part of the 1999 IA Strategy (DOE 1999a). Additionally, 35 BZ IHSSs and PACs were consolidated into 8 BZ IHSS Groups. Table 2 lists the pre-RFCA OUs, IHSSs, PACs, and UBC Sites in the IA and BZ OUs, as well as current IA and BZ IHSS Groups. Studies that provide information and data for IA and BZ sampling decision making are briefly summarized in the following sections. Studies at sites that have approved CAD/RODs are not included. Descriptions of IHSSs, PACs, and UBC Sites, based on previous studies, are included in Appendix C.

Numerous studies were conducted at RFETS and include RFI/RIs and risk assessments, IM/IRA studies, Corrective Measure Studies/Feasibility Studies (CMS/FSs), and remedial actions. Previous studies in the IA include RFI/RI studies initiated at all previous IA OUs, Phase I and II RFI/RIs and an IM/IRA at OU 4 (SEP), and a preremedial investigation at Bowman's Pond. Previous studies in the BZ include RFI/RIs at OU 1 (881 Hillside), OU 2 (903 Pad, Mound, and East Trenches), OU 5 (Woman Creek), and OU 6 (Walnut Creek); and an RFI/RI and IM/IRA at OU 7 (Present Landfill).

Table 2
Industrial Area and Buffer Zone Groups and Pre-RFCA Operable Units

IHSS Group	Current OU	Description	IHSS/PAC/UBC Site	Former OU Number
000-1	IA	SEP	000-101	OU 4
		Triangle Area	900-165	OU 6
		S&W Contractor Yard	900-176	OU 10
		ITS Water Spill (formerly 000-502)	900-1310	N/A
000-2	IA	OPWL	000-121	OU 9
		Valve Vault West of Building 707	700-123.2	OU 9
		Building 123 Process Waste Line Break	100-602	N/A
		Tank 29 - OPWL	000-121	OU 9
		Tank 31 - OPWL	000-121	OU 9
		Low-Level Radioactive Waste Leak	700-127	OU 9
		Process Waste Line Leaks	700-147.1	OU 9
		Radioactive Site 700 Area	000-162	OU 14
		Effluent Line	700-149.1	OU 9
000-3	IA	Sanitary Sewer System	000-500	N/A
		Storm Drains	000-505	N/A
		Old Outfall - Building 771	700-143	OU 6

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IHSS Group	Current OU	Description	IHSS/PAC/UBC Site	Former OU Number
		Central Avenue Ditch Caustic Leak	000-190	OU 13
000-4	IA	NPWL	000-504	N/A
000-5	BZ	Present Landfill	114	OU 7
100-1	IA	UBC 122 - Medical Facility	UBC 122	N/A
		Tank 1 - OPWL - Underground Stainless Steel Waste Storage Tank	000-121	OU 9
100-2	IA	UBC 125 - Standards Laboratory	UBC 125	N/A
100-3	IA	Building 111 Transformer PCB Leak	100-607	N/A
100-4	IA	UBC 123 - Health Physics Laboratory	UBC 123	N/A
		Waste Leaks	100-148	OU 13
		Building 123 Bioassay Waste Spill	100-603	N/A
		Building 123 Scrubber Solution Spill	100-611	N/A
100-5	IA	Building 121 Security Incinerator	100-609	N/A
300-1	IA	Oil Burn Pit No. 1	300-128	OU 13
		Lithium Metal Site	300-134(N)	OU 13
		Solvent Burning Grounds	300-171	OU 13
300-2	IA	UBC 331 - Maintenance	UBC 331	N/A
		Lithium Metal Destruction Site	300-134(S)	OU 13
300-3	IA	UBC 371 - Plutonium Recovery	UBC 371	N/A
300-4	IA	UBC 374 - Waste Treatment Facility	UBC 374	N/A
300-5	IA	Inactive D-836 HW Tank	300-206	OU 10
300-6	IA	Pesticide Shed	300-702	N/A
400-1	IA	UBC 439 - Radiological Survey	UBC 439	N/A
400-2	IA	UBC 440 - Modification Center	UBC 440	N/A
400-3	IA	UBC 444 - Fabrication Facility	UBC 444	N/A
		UBC 447 - Fabrication Facility	UBC 447	N/A
		West Loading Dock Building 447	400-116.1	OU 12
		Cooling Tower Pond West of Building 444	400-136.1	OU 12
		Cooling Tower Pond East of Building 444	400-136.2	OU 12
		Buildings 444/453 Drum Storage	400-182	OU 10
		Inactive Building 444 Acid Dumpster	400-207	OU 10
		Inactive Buildings 444/447 Waste Storage Site	400-208	OU 10
		Transformer, Roof of Building 447	400-801	N/A
		Beryllium Fire - Building 444	400-810	N/A
		Tank 4 - OPWL Process Waste Pits	000-121	OU 9
		Tank 5 - OPWL Process Waste Tanks	000-121	OU 9
		Tank 6 - OPWL Process Waste Floor Sump and Foundation Drain Floor	000-121	OU 9
		South Loading Dock Building 444	400-116.2	OU 12
400-4	IA	Miscellaneous Dumping, Building 460 Storm Drain	400-803	N/A
		Road North of Building 460	400-804	N/A
400-5	IA	Sump #3 Acid Site (Southeast of Building 460)	400-205	OU 10
		RCRA Tank Leak in Building 460	400-813	N/A
		RCRA Tank Leak in Building 460	400-815	N/A
400-6	IA	Radioactive Site South Area	400-157.2	OU 12
400-7	IA	UBC 442 - Filter Test Facility	UBC 442	N/A
		Radioactive Site North Area	400-157.1	OU 13
		Building 443 Oil Leak	400-129	OU 10
		Sulfuric Acid Spill Building 443	400-187	OU 12
400-8	IA	UBC 441 - Office Building	UBC 441	N/A
		Underground Concrete Tank	400-122	OU 12
		Tank 2 - Concrete Waste Storage Tank	000-121	OU 9

IHSS Group	Current OU	Description	IHSS/PAC/UBC Site	Former OU Number
		Tank 3 - Concrete Waste and Steel Waste Storage Tanks	000-121	OU 9
400-10	IA	Sandblasting Area	400-807	N/A
		Fiberglass Area West of Building 664	600-120.2	OU 12
		Radioactive Site West of Building 664	600-161	OU 14
500-1	IA	Valve Vaults 11, 12, 13	300-186	OU 13
		Scrap Metal Storage Site	500-197	OU 16
		North Site Chemical Storage Site	500-117.1	OU 13
500-2	IA	Radioactive Site Building 551	500-158	OU 13
500-3	IA	UBC 559 - Service Analytical Laboratory	UBC 559	N/A
		UBC 528 - Temporary Waste Holding Building	UBC 528	N/A
		Radioactive Site Building 559	500-159	OU 9
		Tank 7 - OPWL - Active Process Waste Pit	000-121	OU 9
		Tank 33 - OPWL - Process Waste Tank	000-121	OU 9
		Tank 34 - OPWL - Process Waste Tank	000-121	OU 9
		Tank 35 - OPWL - Building 561 Concrete Floor Sump	000-121	OU 9
500-4	IA	Middle Site Chemical Storage	500-117.2	OU 13
500-5	IA	Transformer Leak - 558-1	500-904	N/A
500-6	IA	Asphalt Surface Near Building 559	500-906	N/A
500-7	IA	Tanker Truck Release of Hazardous Waste from Tank 231B	500-907	N/A
600-1	IA	Temporary Waste Storage - Building 663	600-1001	N/A
600-2	IA	Storage Shed South of Building 334	400-802	N/A
600-3	IA	Fiberglass Area North of Building 664	600-120.1	OU 12
600-4	IA	Radioactive Site Building 444 Parking Lot	600-160	OU 14
600-5	IA	Central Avenue Ditch Cleaning	600-1004	N/A
600-6	IA	Former Pesticide Storage Area	600-1005	N/A
700-1	IA	Identification of Diesel Fuel in Subsurface Soil	700-1115	N/A
700-2	IA	UBC 707 - Plutonium Fabrication and Assembly	UBC 707	N/A
		UBC 731 - Building 707 Process Waste	UBC 731	N/A
		Tank 11 - OPWL - Building 731	000-121	OU 9
		Tank 30 - OPWL - Building 731	000-121	OU 9
700-3	IA	UBC 776 - Original Plutonium Foundry	UBC 776	N/A
		UBC 777 - General Plutonium Research and Development	UBC 777	N/A
		UBC 778 - Plant Laundry Facility	UBC 778	N/A
		UBC 701 - Waste Treatment Research and Development	UBC 701	N/A
		Solvent Spills West of Building 730	700-118.1	OU 8
		Radioactive Site 700 Area No. 1	700-131	OU 14
		Radioactive Site West of Buildings 771/776	700-150.2(S)	OU 8
		Radioactive Site South of Building 776	700-150.7	OU 8
		French Drain North of Buildings 776/777	700-1100	N/A
		Radioactive Site 700 Area Site # 4 Tank 9 - OPWL - Two 22,500-Gallon Concrete Laundry Tanks	700-132	OU 9
		Radioactive Site 700 Area Site # 4 Tank 10 - OPWL - Two 4,500-Gallon Process Waste Tanks	700-132	OU 9
		Tank 18 - OPWL - Concrete Laundry Waste Lift Sump	000-121	OU 9
		Solvent Spills North of Building 707	700-118.2	OU 8
		Sewer Line Overflow	700-144(N)	OU 8
		Sewer Line Overflow	700-144(S)	OU 8
		Transformer Leak South of Building 776	700-1116	N/A
		Radioactive Site Northwest of Building 750	700-150.4	OU 8
		Radioactive Site 700 Area Site #4	700-132	OU 8

IHSS Group	Current OU	Description	IHSS/PAC/UBC Site	Former OU Number
700-4	IA	UBC 771 - Plutonium and Americium Recovery Operations	UBC 771	N/A
		UBC 774 - Liquid Process Waste Treatment	UBC 774	N/A
		Radioactive Site West of Buildings 771/776	700-150.2(N)	OU 8
		Radioactive Site 700 North of Building 774 (Area 3) Wash Area	700-163.1	OU 8
		Radioactive Site 700 Area 3 Americium Slab	700-163.2	OU 8
		Abandoned Sump Near Building 774 Unit 55.13 T-40	700-215	OU 9
		Hydroxide Tank, KOH, NaOH Condensate	700-139(N)(b)	OU 8
		30,000-Gallon Tank (68)	700-124.1	OU 9
		14,000-Gallon Tank (66)	700-124.2	OU 9
		14,000-Gallon Tank (67)	700-124.3	OU 9
		Holding Tank	700-125	OU 9
		Westernmost Out-of-Service Process Waste Tank	700-126.1	OU 9
		Easternmost Out-of-Service Process Waste Tank	700-126.2	OU 9
		Tank 8 - OPWL - East and West Process Tanks	000-121	OU 9
		Tank 12 - OPWL - Two Abandoned 20,000-Gallon Underground Concrete Tanks	000-121	OU 9
		Tank 13 - OPWL - Abandoned Sump - 600 Gallons	000-121	OU 9
		Tank 14 - OPWL - 30,000-Gallon Concrete Underground Storage Tank (68)	000-121	OU 9
		Tank 15 - OPWL - Two 7,500-Gallon Process Waste Tanks (34W, 34E)	000-121	OU 9
		Tank 16 - OPWL - Two 14,000-Gallon Concrete Underground Storage Tanks (66, 67)	000-121	OU 9
		Tank 17 - OPWL - Four Concrete Process Waste Tanks (30, 31, 32, 33)	000-121	OU 9
		Tank 36 - OPWL - Steel Carbon Tetrachloride Sump	000-121	OU 9
		Tank 37 - OPWL - Steel-Lined Concrete Sump	000-121	OU 9
		Caustic/Acid Spills Hydrofluoric Tank	700-139.2	OU 8
		Concrete Process 7,500-Gallon Waste Tank (31)	700-146.1	OU 9
		Concrete Process 7,500-Gallon Waste Tank (32)	700-146.2	OU 9
		Concrete Process 7,500-Gallon Waste Tank (34W)	700-146.3	OU 9
		Concrete Process 7,500-Gallon Waste Tank (34E)	700-146.4	OU 9
		Concrete Process 7,500-Gallon Waste Tank (30)	700-146.5	OU 9
		Concrete Process 7,500-Gallon Waste Tank (33)	700-146.6	OU 9
		Radioactive Site North of Building 771	700-150.1	OU 8
		Radioactive Site Between Buildings 771 and 774	700-150.3	OU 8
700-5	IA	UBC 770 - Waste Storage Facility	UBC 770	N/A
700-6	IA	Buildings 712/713 Cooling Tower Blowdown	700-137	OU 8
		Caustic/Acid Spills Hydroxide Tank Area	700-139.1(S)	OU 8
700-7	IA	UBC 779 - Main Plutonium Components Production Facility	UBC 779	N/A
		Building 779 Cooling Tower Blowdown	700-138	OU 8
		Radioactive Site South of Building 779	700-150.6	OU 8
		Radioactive Site Northeast of Building B779	700-150.8	OU 8
		Effluent Line	700-149.2	OU 9
		Transformer Leak - 779-1/779-2	700-1105	N/A
		Tank 19 - OPWL - Two 1,000-Gallon Concrete Sumps	000-121	OU 9
		Tank 20 - OPWL - Two 8,000-Gallon Concrete Sumps	000-121	OU 9
		Tank 38 - OPWL - 1,000-Gallon Steel Tank	000-121	OU 9
700-8	IA	750 Pad - Pondcrete/Saltcrete Storage	700-214	OU 10
700-10	IA	Laundry Tank Overflow - Building 732	700-1101	N/A
700-11	IA	Bowman's Pond	700-1108	N/A
		Hydroxide Tank, KOH, NaOH Condensate	700-139.1(N)(a)	OU 8
700-12	IA	Process Waste Spill - Portal 1	700-1106	N/A
800-1	IA	UBC 865 - Materials Process Building	UBC 865	N/A

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IHSS Group	Current OU	Description	IHSS/PAC/UBC Site	Former OU Number
		Building 866 Spills	800-1204	N/A
		Building 866 Sump Spill	800-1212	N/A
		Tank 23 - OPWL	000-121	OU 9
800-2	IA	UBC 881 - Laboratory and Office	UBC 881	N/A
		Building 881, East Dock	800-1205	N/A
		Tank 24 - OPWL - Seven 2,700-Gallon Steel Process Waste Tanks	000-121	OU 9
		Tank 32 - OPWL - 131,160-Gallon Underground Concrete Secondary Containment Sump	000-121	OU 9
		Tank 39 - OPWL - Four 250-Gallon Steel Process Waste Tanks	000-121	OU 9
800-3	IA	UBC 883 - Roll and Form Building	UBC 883	N/A
		Valve Vault 2	800-1200	N/A
		Tank 25 - OPWL - 750-Gallon Steel Tanks (18, 19)	000-121	OU 9
		Tank 26 - OPWL - 750-Gallon Steel Tanks (24, 25, 26)	000-121	OU 9
		Radioactive Site South of Building 883	800-1201	N/A
800-4	IA	UBC 886 - Critical Mass Laboratory	UBC 886	N/A
		Tank 21 - OPWL - 250-Gallon Concrete Sump	000-121	OU 9
		Tank 22 - OPWL - Two 250-Gallon Steel Tanks	000-121	OU 9
		Tank 27 - OPWL - 500-Gallon Portable Steel Tank	000-121	OU 9
		Radioactive Site #2 800 Area, Building 886 Spill	800-164.2	OU 14
800-5	IA	UBC 887 - Process and Sanitary Waste Tanks	UBC 887	N/A
		Building 885 Drum Storage	800-177	OU 10
800-6	IA	UBC 889 - Decontamination and Waste Reduction	UBC 889	N/A
		Radioactive Site 800 Area Site #2 Building 889 Storage Pad	800-164.3	OU 14
		Tank 28 - Two 1,000-Gallon Concrete Sumps	000-121	OU 9
		Tank 40 - Two 400-Gallon Underground Concrete Tanks	000-121	OU 9
900-1	IA	UBC 991 - Weapons Assembly and R&D	UBC 991	N/A
		Radioactive Site Building 991	900-173	OU 8
		Radioactive Site 991 Steam Cleaning Area	900-184	OU 8
		Building 991 Enclosed Area	900-1301	N/A
		Explosive Bonding Pit	900-1307	N/A
900-2	BZ	Oil Burn Pit No. 2	900-153	OU 2
		Pallet Burn Site	900-154	OU 2
900-3	IA	904 Pad, Pondcrete Storage	900-213	OU 10
900-4&5	IA	S&W Building 980 Contractor Storage Facility	900-175	OU 10
		Gasoline Spill Outside of Building 980	900-1308	N/A
SW-2	IA	Original Landfill	SW-115	OU 5
		Water Treatment Plant Backwash	SW-196	OU 16
900-11	BZ	903 Pad	112	OU 2
		Hazardous Disposal Area	900-140	OU 2
		903 Lip Area	900-155	OU 2
		East Firing Range and Target Area	SE-1602	N/A
900-12	BZ	Trench T-5	NE-111.2	OU 2
		Trench T-6	NE-111.3	OU 2
		Trench T-8	NE-111.5	OU 2
		Trench T-9	NE-111.6	OU 2
		Trench T-10	NE-111.7	OU 2
		Trench T-11	NE-111.8	OU 2
NE-1	BZ	Pond A-1	NE-142.1	OU 6
		Pond A-2	NE-142.2	OU 6
		Pond A-3	NE-142.3	OU 6

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IHSS Group	Current OU	Description	IHSS/PAC/UBC Site	Former OU Number
		Pond A-4	NE-142.4	OU 6
		Pond A-5	NE-142.12	OU 6
		Pond B-1	NE-142.5	OU 6
		Pond B-2	NE-142.6	OU 6
		Pond B-3	NE-142.7	OU 6
		Pond B-4	NE-142.8	OU 6
		Pond B-5	NE-142.9	OU 6
		Pond C-1	NE-142.10	OU 6
		Pond C-2	NE-142.11	OU 6
		North Firing Range	NW-1505	N/A
NE-2	BZ	Trench 7	NE-111.4	OU 2
		Ryan's Pit (Trench 2)	900-109	OU 2
NE/NW	BZ	East Spray Field - Center Area	NE-216.2	OU 2
		East Spray Field - South Area	NE-216.3	OU 2
		Diesel Spill at Pond B-2 Spillway	NE-1404	N/A
		Trench T-12 Located at OU 2 East Trenches	NE-1412	N/A
		Trench T-13 Located at OU 2 East Trenches	NE-1413	N/A
		PU&D Yard - Drum Storage	NW-174a	N/A
		OU 2 Treatment Facility	NE-1407	N/A
SW-1	BZ	Recently Identified Ash Pit	SW-1701	N/A
		Recently Identified Ash Pit	SW-1702	N/A
		Ash Pit 1	SW-133.1	OU 5
		Ash Pit 2	SW-133.2	OU 5
		Ash Pit 4	SW-133.4	OU 5
		Incinerator	SW-133.5	OU 5
		Concrete Wash Pad	SW-133.6	OU 5

2.3.1 OU 2 - 903 Pad, Mound, and East Trenches

OU 2 consists of 22 IHSSs and PACs located in the southeastern portion of the IA and adjacent BZ as shown on Figure 5. Descriptions of each IHSS are presented in Appendix C. The OU 2 Phase I RFI/RI program was completed in 1987, and the Phase II RFI/RI was performed in 1991 through 1993. The following investigations were conducted:

- Geophysical surveys (electromagnetic [EM], resistivity, and magnetometer);
- Soil gas surveys;
- Surface soil sampling;
- Subsurface soil sampling;
- Aquifer testing;
- Surface water and seep sampling; and
- Air monitoring for long-lived alpha, plutonium, and volatile organic compounds (VOCs).

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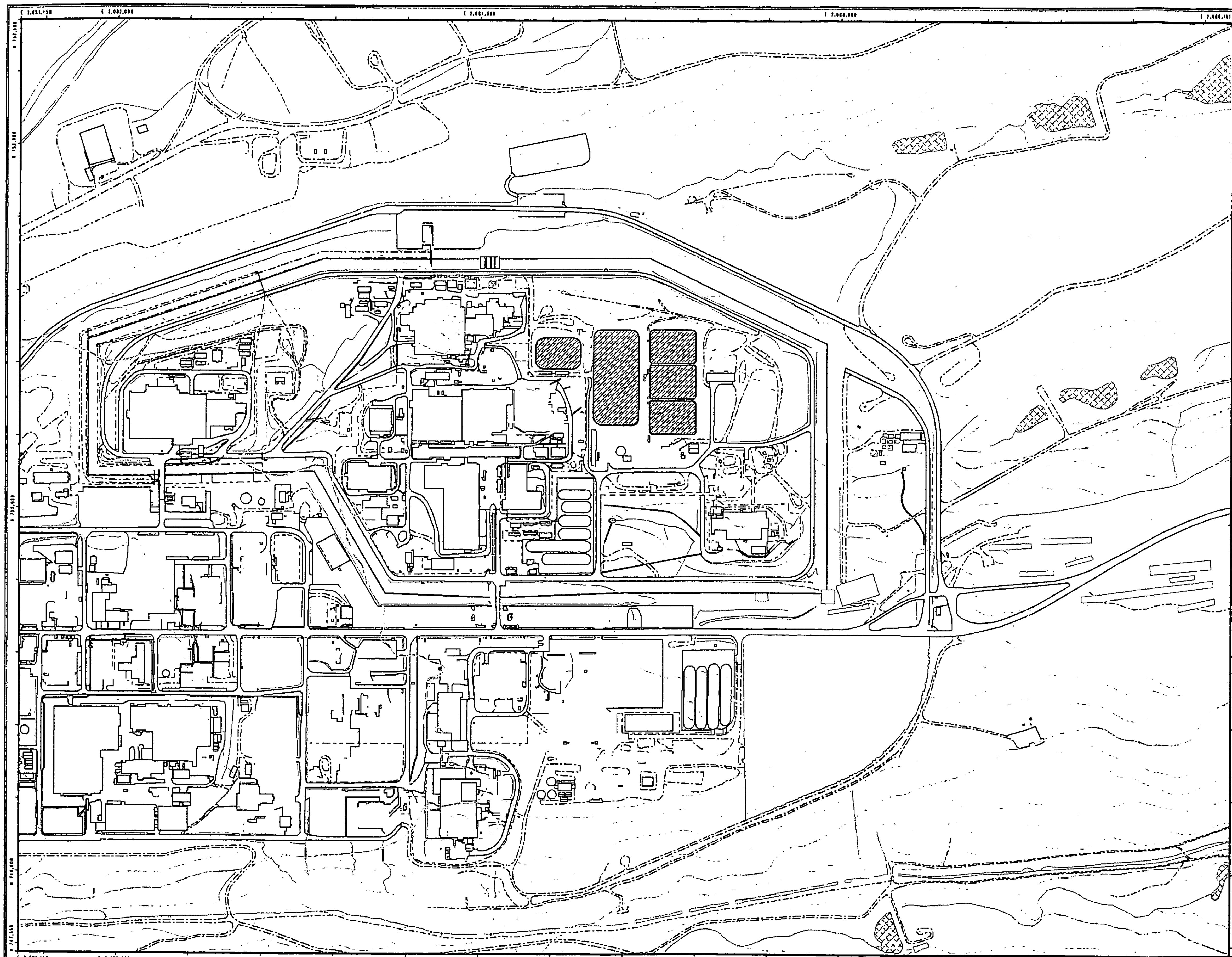

Figure 5
Individual Hazardous Substance Sites Operable Unit 2

EXPLANATION

Operable Unit 2

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

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

Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Individual Hazardous Substance Sites (IHSS)
OU1 - RFI/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600 Ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2M HILL

Prepared for:

October 13, 2003

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Results of these studies are available in the Final Phase II RFI/RI Report for 903 Pad, Mound and East Trenches Area, Operable Unit No. 2 (DOE 1995a).

2.3.2 OU 4 - SEP (IHSS 101)

The SEP (IHSS 101) are located on the northeastern side of the Protected Area (PA) and consist of five surface impoundments: Ponds 207-A, 207-B North, 207-B Center, 207-B South, and 207-C (Figure 6). The major features in IHSS 101 are the SEP, former Original Pond, Interceptor Trench System (ITS), and areas in the immediate vicinity including IHSS 176 (S&W Contractor Storage Yard) and IHSS 165 (Triangle Area) (DOE 1995b).

The SEP were used to store and evaporate low-level radioactive process wastes and neutralized acidic wastes containing high levels of nitrate and aluminum hydroxide. The SEP also received additional waste including treated sanitary effluent, aluminum scrap, alcohol wash solutions, drums of radiography solutions, leachate from the RFETS sanitary landfill, ITS groundwater, saltwater, personnel decontamination wash water, hydrochloric and nitric acids, and hexavalent chromium and cyanide wastes.

The Original Pond was constructed in 1953 and used until 1956. Pond 207-A was placed in service in 1956. Ponds 207-B North, Center, and South were placed in service in 1960, and Pond 207-C was constructed in 1970 (DOE 1995b).

In the 1980s, SEP use was phased out and transfer of process wastewater into the ponds ceased in 1986. Cleanup activities began in 1985 to drain and treat the liquid waste and process the pond sludges (DOE 1995b). All SEP were drained and sludge was removed in 1995.

Contamination in surface soil was investigated by conducting a gamma survey and collecting 72 soil samples in the SEP area and 38 soil samples in IHSS 176. Metal and radionuclide concentrations that exceeded background levels were located in the immediate vicinity of the ponds, primarily on the berms between ponds. In the SEP area, the maximum concentration of beryllium was 9.6 milligrams per kilogram (mg/kg), above the RFCA Tier II AL. Cadmium was detected at 382 mg/kg, well below the Tier II AL. The highest activities of americium-241 were present on the berms of Pond 207-A, with a maximum value of 220 picocuries per gram (pCi/g), above the Tier I AL. Americium-241 was present in other surface soil ranging from 0.5 to 27 pCi/g, with the majority of activities below 10 pCi/g.

The distribution of plutonium-239/240 in surface soil was similar to americium-241. However, all activities were below the Tier II AL and ranged from 56 pCi/g on the southwestern berm of Pond 207-A to below 20 pCi/g elsewhere in the area. Uranium-233/234 activities were below the Tier II AL and ranged from 1.24 to 41 pCi/g. Only 2 of 39 sample activities exceeded 8 pCi/g. Uranium-235 activities were below the Tier II AL and ranged from 0.09 to 2.3 pCi/g. Uranium-238 activities were also below the Tier II AL and ranged from 1.27 to 27 pCi/g.

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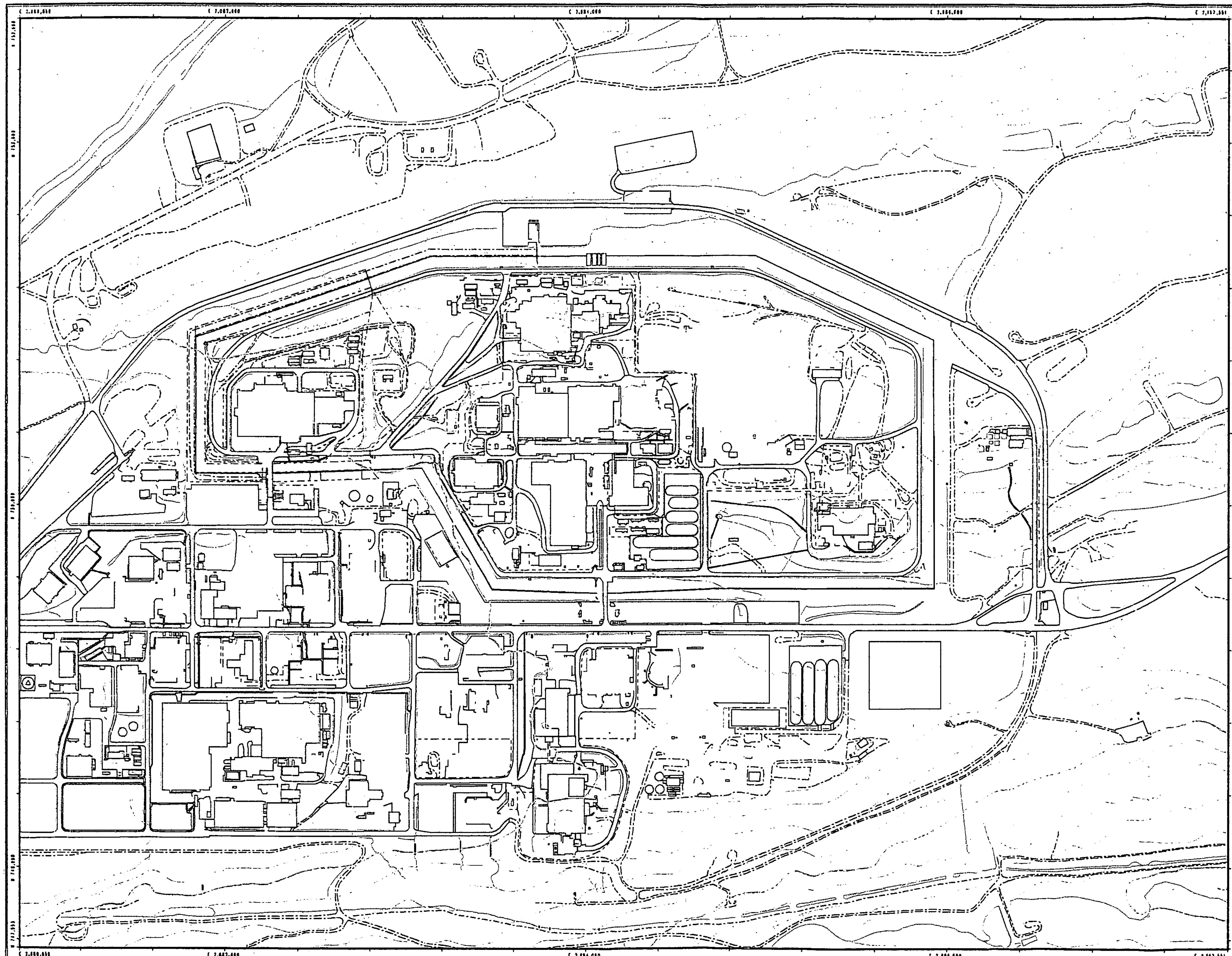

Figure 6
Individual Hazardous Substance Sites Operable Unit 4

EXPLANATION

Operable Unit 4

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

Buildings, fences, hydrographic, roads and other structures from 1994 aerial fly-over data captured by [illegible], Las Vegas. Digitized from the orthophotographs. 1/95

Topographic contours were derived from digital elevation model (DEM) data by [illegible] using [illegible] to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, [illegible] 1994 Aerial Flyover at 4 - 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600 Ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2M HILL

Prepared for: [illegible]

October 13, 2003

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Subsurface contaminants in the SEP area that exceeded background activities or concentrations include nitrate, zinc, americium-241, plutonium-239/240, radium-226, tritium, uranium-233/234, uranium-235, and uranium-238. Of these, only americium-241 activities were above the Tier II AL, with the activity of one sample at 44.68 pCi/g.

Six interceptor trenches and associated sumps were installed on the SEP hillside in 1971. Some of the trenches and sumps were destroyed during construction of the Perimeter Security Zone and the rest were abandoned in-place. The ITS was installed in 1981 and consists of gravel-filled trenches approximately 1 ft wide, ranging in depth from approximately 1 to 27 ft bgs. Water collected in the ITS flowed by gravity to the Interceptor Trench Pump House (ITPH) located near North Walnut Creek. Until 1993, the collected water was pumped from the ITPH to Pond 207-B North. In 1993, three 750,000-gallon modular storage tanks were installed on the northern side of North Walnut Creek. At that time, the ITS water was temporarily stored in the modular storage tanks and then pumped to Building 374 for evaporation (DOE 1995b).

In 1999, the SEP plume groundwater collection and treatment system was installed to intercept the nitrate- and uranium-contaminated groundwater originating in the SEP area. The new system collects water from the preexisting ITS and additional groundwater believed to be flowing beneath the ITS, and diverts the water to a treatment cell. The groundwater collection system extends approximately 1,100 ft in an east-west direction along the North Perimeter Road. Construction was restricted to the disturbed area around the North Perimeter Road to reduce impacts to Preble's meadow jumping mouse (PMJM) habitat.

The Triangle Area (IHSS 165) is located between Perimeter Road on the north and Spruce Avenue on the south. From 1966 to 1975, the unpaved Triangle Area was used as a storage area for drums containing miscellaneous wastes. By December 1968, approximately 5,000 drums were stored at this location. The majority of drums contained scrap materials, including graphite molds, crucibles, incinerator ash heels, crucible heels, Raschig rings, and combustible wastes. Other drums contained waste and residues from the May 1969 fire in Building 776.

Fifteen surface soil samples were collected and analyzed. One sample contained Aroclor-1254 (a polychlorinated biphenyl [PCB]) above the detection limit at 425 micrograms per kilogram (μg/kg). Five metals were present at concentrations above background screening levels. Most concentrations were very near background levels, except for one chromium concentration at 35 mg/kg and one zinc concentration at 117 mg/kg. Radionuclides were frequently detected above background screening levels. The maximum americium-241 activity was 3.24 pCi/g, and the maximum plutonium-239/240 activity was 15.2 pCi/g. All activities were well below RFCA Tier II ALs. The OU 6 RFI/RI concluded that the risk posed by this IHSS was minimal and remediation was not warranted (DOE 1996a).

2.3.3 OU 5 - Woman Creek Priority Drainage

OU 5 consists of 11 IHSSs, geographically located along or within the drainage area of Woman Creek, as shown on Figure 7. These IHSSs include the Original Landfill (IHSS 115); Ash Pits, Former Incinerator Area, and Concrete Wash Pad (IHSSs 133.1 through 133.6); Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11); and a Surface

35

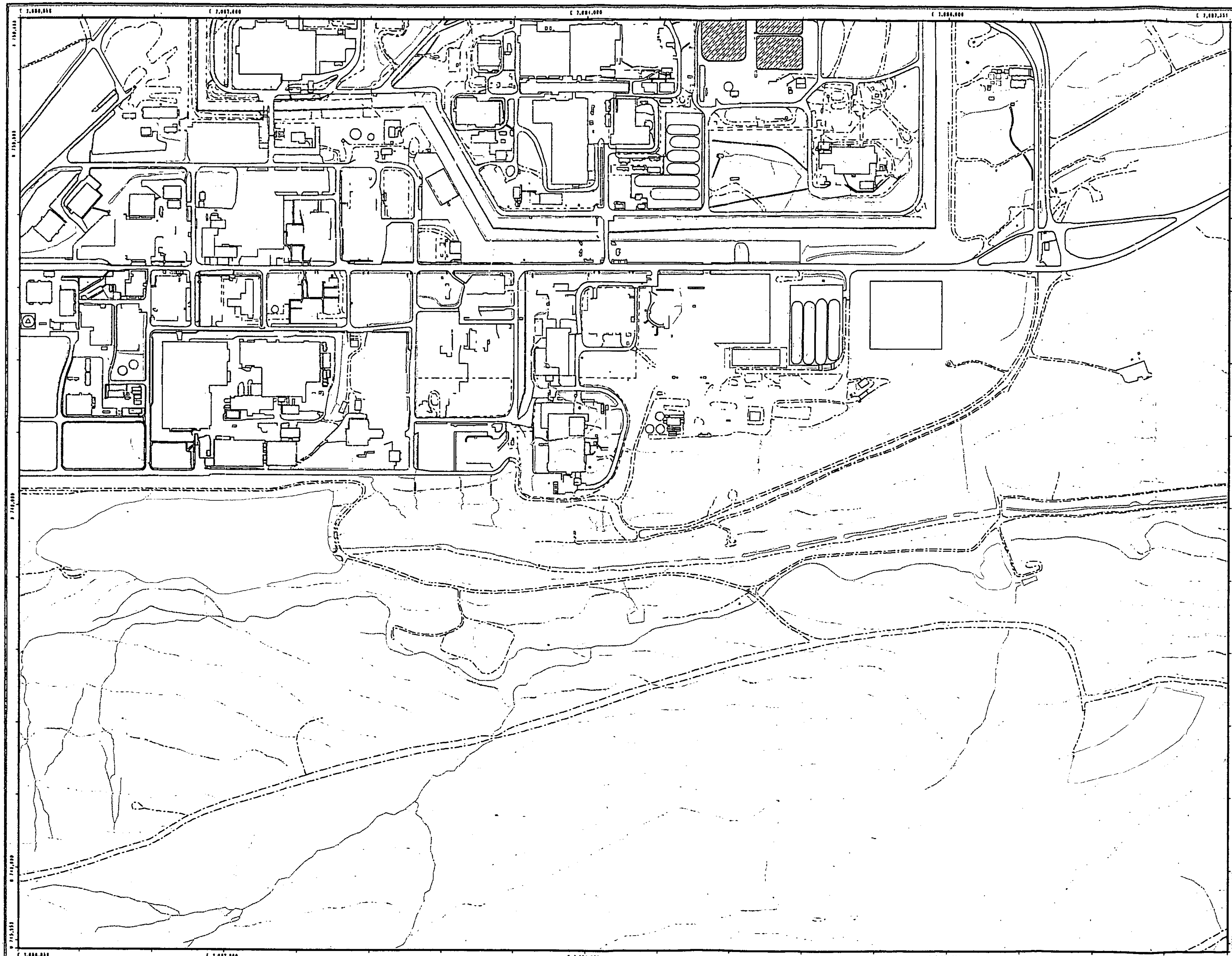

Figure 7
Individual Hazardous Substance Sites Operable Unit 5

EXPLANATION

Operable Unit 5

Standard Map Features

Buildings and other structures

Solar Evaporation Ponds (SEPs)

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Topographic Contour (20-Foot)

Rocky Flats Environmental Technology Site boundary

Paved roads

Dirt roads

DATA SOURCE BASE FEATURES:

Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by:

Prepared for:

October 13, 2003

NT_Svr w:/projects/fy2004/04-0020/ou5-old.aml

Disturbance (IHSS 209). Investigations were conducted in 1992 and 1993 and during 1994 and 1995, and included the following:

- Visual inspections;
- Geophysical surveys (EM frequency domain and magnetometer);
- Soil gas surveys;
- Surface radiological surveys using Field Instruments for the Detection of Low-Energy Radiation (FIDLERs);
- Surface soil sampling;
- Subsurface soil sampling;
- Surface water sampling;
- Cone penetrometer testing (CPT) surveys;
- Groundwater sampling;
- Video camera survey of storm-sewer systems; and
- Ambient air monitoring.

Results of these studies are available in the Final Phase I RFI/RI Report for Woman Creek Priority Drainage, Operable Unit 5 (DOE 1996b).

Original Landfill (IHSS 115)

The Original Landfill (IHSS 115) is located on the steep, south-facing hillside immediately south of the West Access Road and north of Woman Creek, as shown on Figure 8. The Original Landfill is unlined and was operated from 1952 to 1968 to dispose of general Site wastes.

An estimated 2 million cubic feet (ft^3) of miscellaneous Site wastes are buried at this location. The waste may include solvents, paints, paint thinners, oil, pesticides, cleaners, construction debris, waste metal, and glass. Beryllium and/or uranium wastes and used graphite were also disposed at this location. It was reported that ash containing an estimated 20 kilograms (kg) of depleted uranium was also buried in the landfill (DOE 1996b). The nature and extent of contamination in IHSS 115 is documented in the Phase I RFI/RI Report for the Woman Creek Priority Drainage, Operable Unit 5 (DOE 1996b).

Because the Original Landfill is located on a steep slope, subsidence and erosion are occurring, and debris is exposed at the surface. The area is periodically monitored to ensure that corrective actions are taken as necessary to mitigate issues caused by subsidence and erosion.

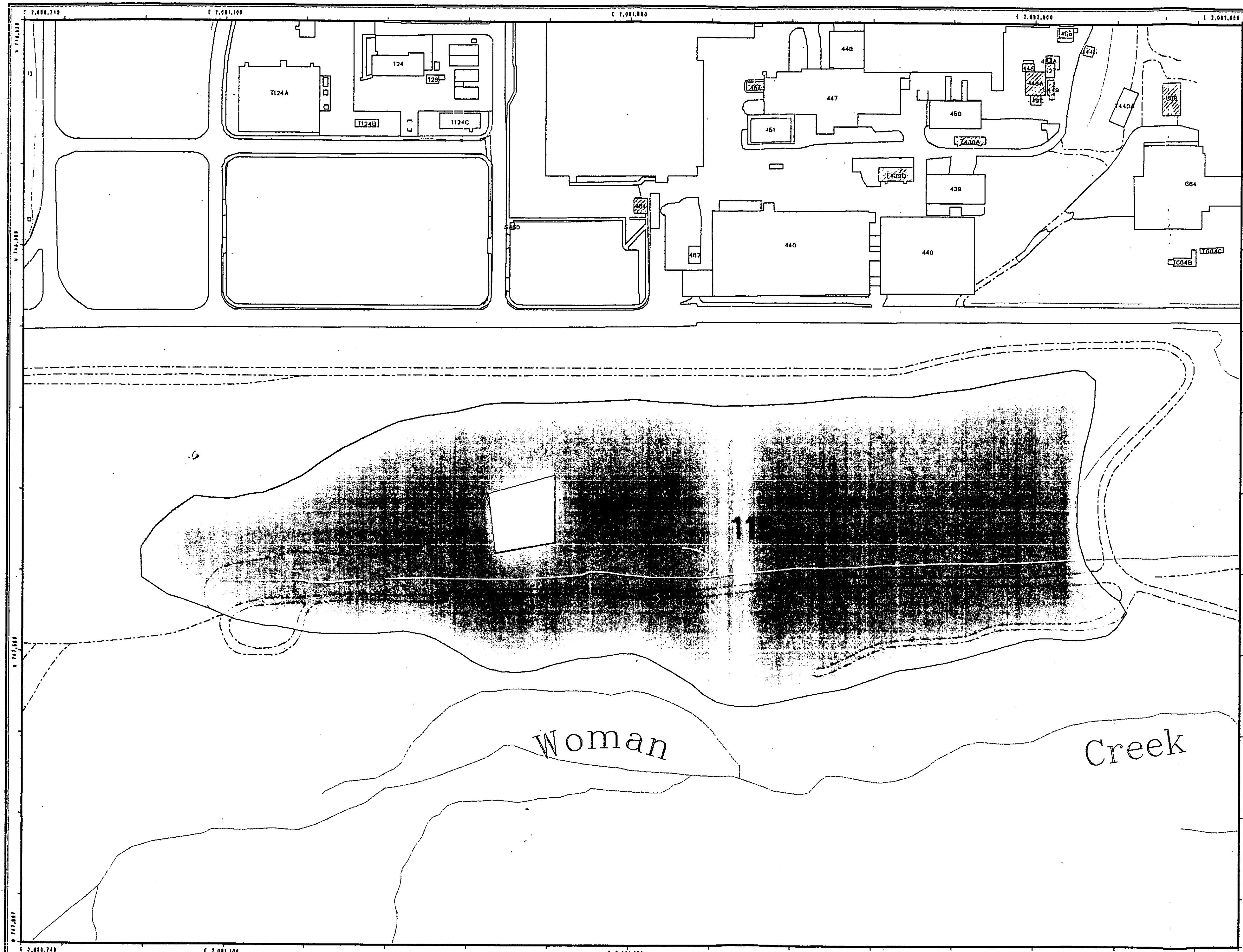

Figure 8

Original Landfill

EXPLANATION

IHSS 115 - Original Landfill

IHSS 196 - Water Treatment Backwash Pond

Standard Map Features

Buildings and other structures

Demolished buildings and Other Structures

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Paved roads

Dirt roads

DATA SOURCE BASE FEATURES:

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

Data Source:
Individual Hazardous Substance Site (IHSS) - Approved by Nick Demos (RMRS, 303-966-4605).

Scale = 1 : 2050
1 inch represents approximately 171 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2M HILL

Prepared for:

March 17, 2004

NT_Svr w:/projects/fy2k/2k-0409/ihss-115-196_fig8.aml

2.3.4 OU 6 - Walnut Creek Priority Drainage

OU 6 consisted of 19 IHSSs located within or adjacent to the Walnut Creek drainages, as shown on Figure 9. The Phase I field investigation was conducted during 1992 and 1993. Descriptions of each IHSS are presented in Appendix C. Investigations included the following:

- Surface radiological surveys using 17-point FIDLER and high-purity germanium (HPGe) instruments;
- Soil gas surveys;
- EM survey (IHSSs 166.1 through 166.3);
- Surface and subsurface soil sampling;
- Soil classification survey;
- Vertical soil profiling;
- Sediment sampling;
- Surface water sampling; and
- Groundwater sampling (alluvial and bedrock).

Results of these studies are available in the Final Phase I RFI/RI Report, Walnut Creek Priority Drainage, Operable Unit 6 (DOE 1996a).

Investigation into and documentation of the nature and extent of contamination at the OU 6 IHSSs are presented in the Final Phase I RFI/RI Report, Walnut Creek Priority Drainage, Operable Unit 6 (DOE 1996a). Former OU 6 IHSSs that were transferred to the IA are IHSS 143 (Old Outfall Area) and IHSS 165 (Triangle Area). IHSS 165 is described in Section 2.3.2. The following brief description of IHSS 143, which will be evaluated as part of IHSS Group 000-3, was summarized from the OU 6 RFI/RI Report (DOE 1996a).

IHSS 143 (Old Outfall Area) is located northwest of Building 773 (Guard Station) within the PA. This approximately 30,000-square-foot (ft^2) area was formerly used as a catch basin for liquids primarily from the laundry holding tanks in Building 771. The Old Outfall Area was covered with an unknown quantity of fill material. Sources of discharge to the Old Outfall Area from Building 771 included the analytical laboratory and radiography sinks, personnel decontamination showers, and runoff from the building roof and ground surface around the building. From mid-1953 through mid-1957, 4.4 million gallons of liquid were released into the Old Outfall Area. Approximately 2.23 millicuries (mCi) plutonium were released with these liquids (DOE 1996a).

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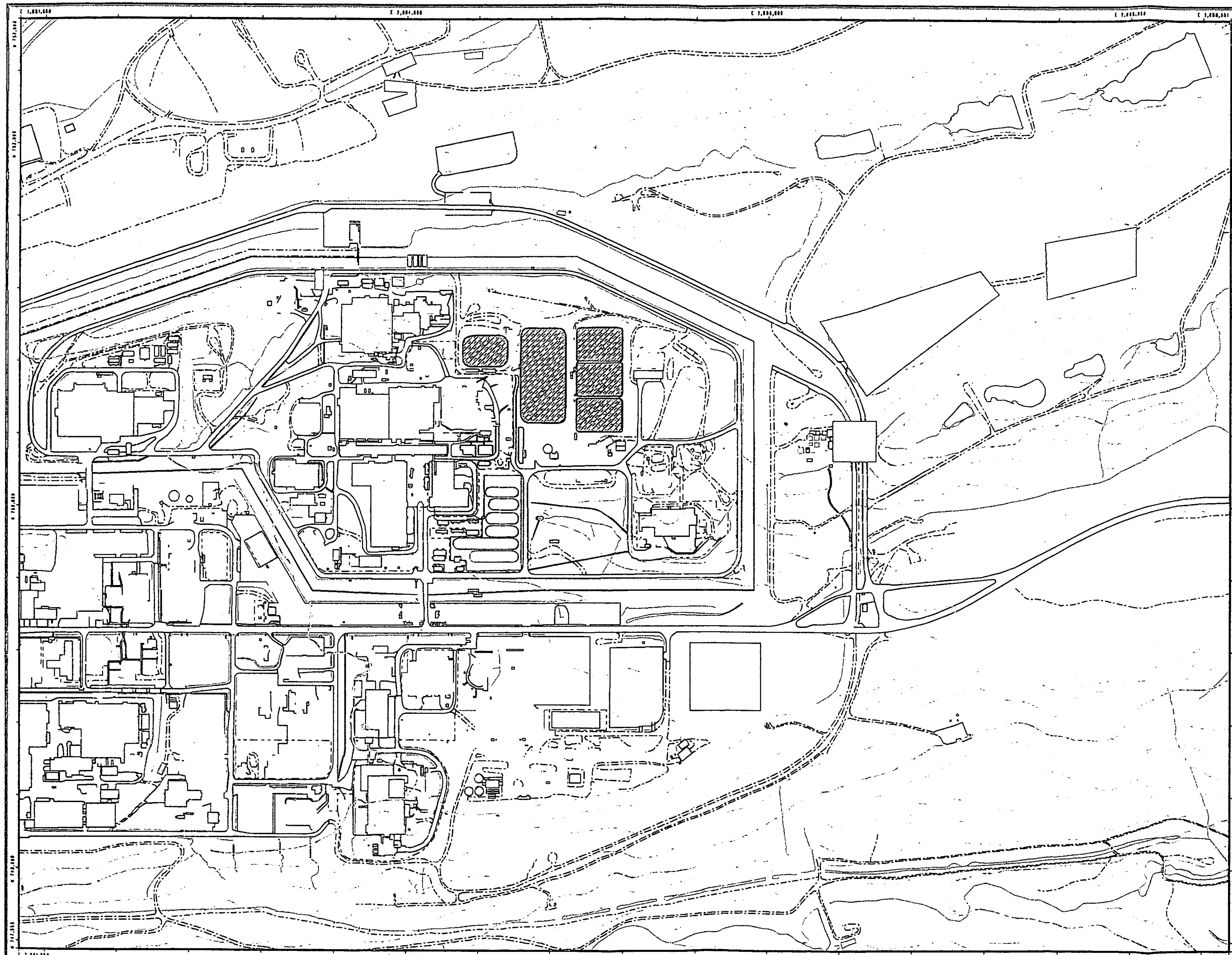

Figure 9 Individual Hazardous Substance Sites Operable Unit 6

EXPLANATION

Operable Unit 6

Standard Map Features

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

Individual Hazardous Substance Sites (IHSS)
OU1 - RFI/RI Phase III Report
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by:

Prepared for:

January 28, 2004

NT_Svr w:/projects/fy2004/04-0020/ou6-old.aml

Because of occasional equipment problems associated with the Building 771 holding tanks, periodic releases from the tanks to the Old Outfall Area occurred between 1957 and 1965. During this time, 434,000 gallons of liquid containing 0.25 mCi plutonium were released to the Old Outfall Area (DOE 1996a). Three semivolatile organic compounds (SVOCs) were detected at maximum concentrations of 450 µg/kg benzoic acid, 220 µg/kg bis(2-ethylhexyl)phthalate, and 85 µg/kg dibenzofuran. These concentrations are well below RFCA Tier II ALs. Plutonium-239/240 was detected at a maximum activity of 0.52 pCi/g, also well below the Tier II AL. The OU 6 RFI/RI concluded that the risk posed by this IHSS was minimal and remediation was not warranted (DOE 1996a).

2.3.5 OU 7 - Present Landfill

OU 7 consisted of four IHSSs located north of the IA, as shown on Figure 10. Investigations were conducted at OU 7 during the early 1990s and included the following:

- Surface and subsurface soil sampling and analysis from within and around the Present Landfill and East Landfill Pond;
- CPT survey;
- Soil gas measurements; and
- Groundwater and surface water sampling and analysis.

The results of these investigations are available in the Revised Draft IM/IRA Decision Document and Closure Plan (DOE 1996c).

2.3.6 OU 8 - 700 Area

OU 8 consisted of 25 IHSSs located in the 700 Area, as shown on Figure 11. Investigations were conducted at OU 8 during 1994 and 1995. Analytical results of surface and subsurface soil sampling are presented in the RFETS IA Data Summary Report (DOE 2000a). Investigations included the following:

- Surface radiological surveys at 25 IHSSs using HPGe and sodium iodide (NaI) instruments;
- Geophysical survey at IHSS 163.2;
- Air sampling at 25 IHSSs;
- Surface soil sampling at 110 locations;
- Soil gas surveys at 41 locations;
- Asphalt sampling at 6 locations; and
- Sediment sampling at 7 locations.

41

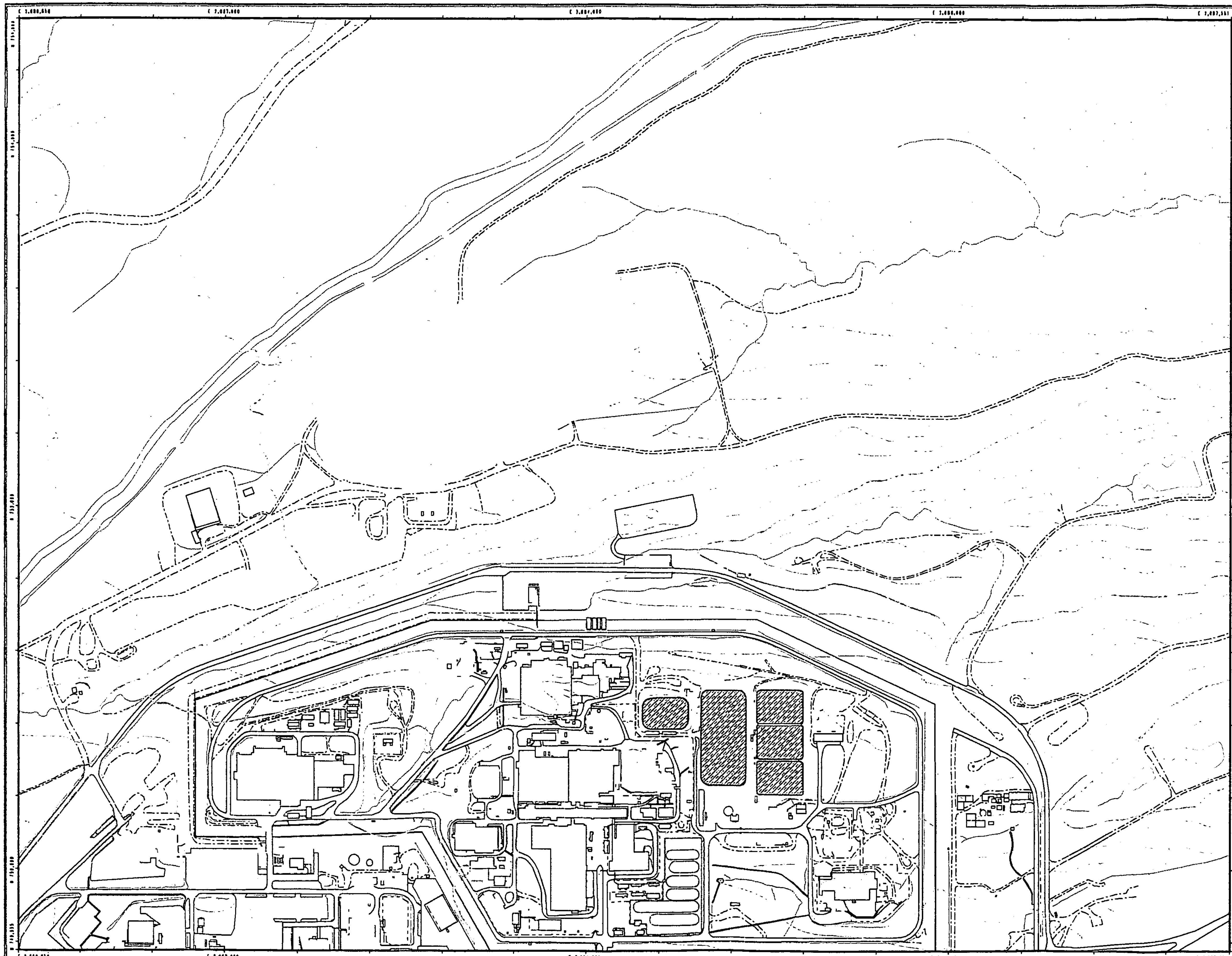

Figure 10
Individual Hazardous Substance Sites Operable Unit 7

EXPLANATION

Operable Unit 7

Standard Map Features

Buildings and other structures

Solar Evaporation Ponds (SEPs)

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Topographic Contour (20-Foot)

Rocky Flats Environmental Technology Site boundary

Paved roads

Dirt roads

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Individual Hazardous Substance Sites (IHSS)
OU1 - RFI/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by:

Prepared for:

March 16, 2004

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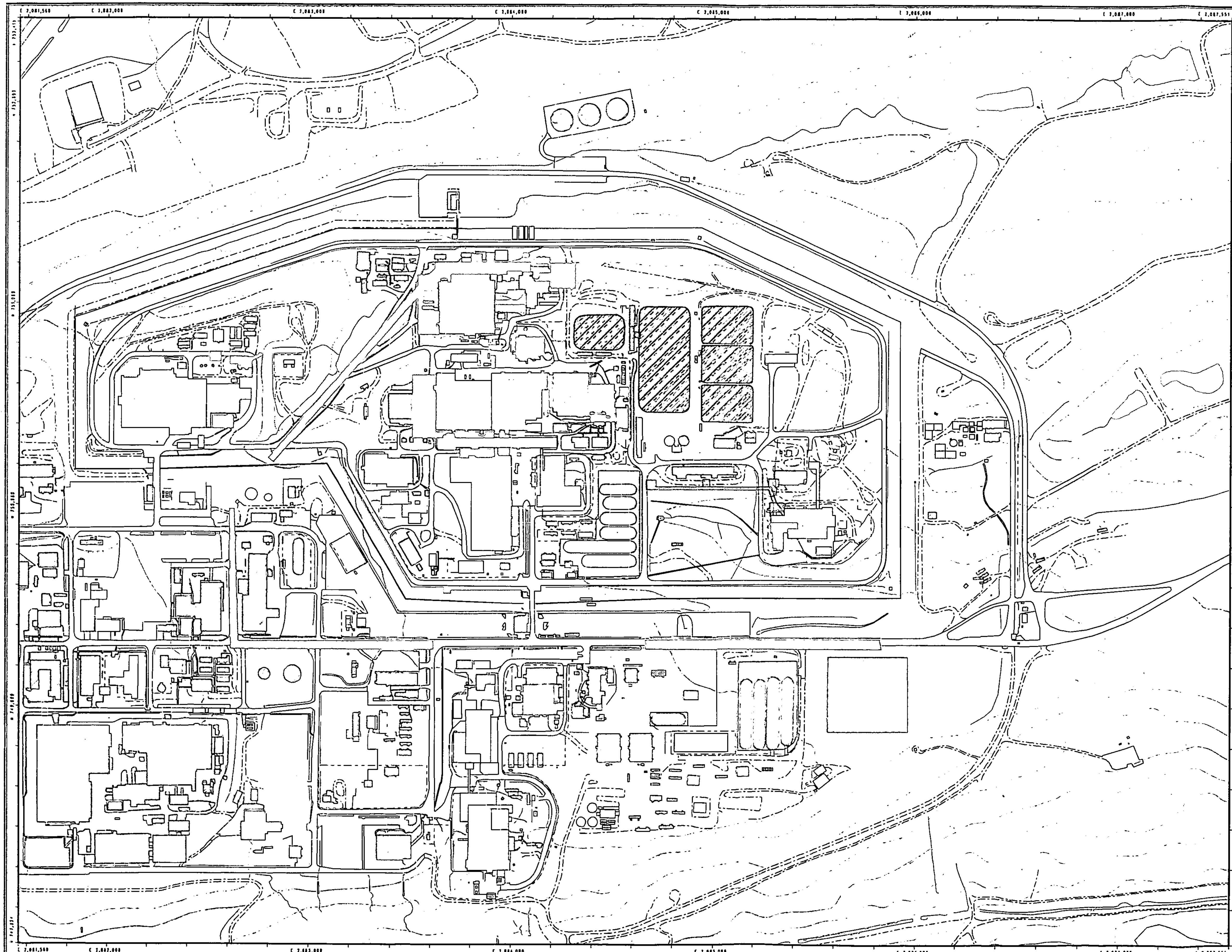
42

Figure 11
Individual Hazardous Substance Sites Operable Unit 8



EXPLANATION

Operable Unit 8

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

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

Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 5930
1 inch represents approximately 494 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by:

CH2MHILL

Prepared for:

March 16, 2004

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2.3.7 OU 9 - OPWL

OU 9 consisted of one IHSS designated IHSS 121, OPWL. The OPWL included 11 abandoned tank groups, other associated tanks, and underground pipelines used for transfer and temporary storage of aqueous process waste from previous RFETS production activities (Figures 12 and 13). The OPWL consists of approximately 35,000 ft of pipeline located beneath IA buildings and concrete or asphalt pavement areas. Documentation of the OU 9 tanks and underground pipelines is provided in the OU 9 RFI/RI Work Plan (DOE 1992a). Results of the OU 9 investigation activities for the 11 tank groups are presented in the IA Data Summary Report (DOE 2000a).

Investigation activities included:

- Visual inspections of the physical setting;
- Surface radiological surveys using a NaI instrument;
- Surface soil sampling;
- Subsurface soil sampling; and
- Tank characterization including visual inspection and tank sludge and/or liquid sampling.

Additional information on the OPWL is included in Section 4.7.

2.3.8 OU 10 -Other Outside Closures

OU 10 consists of 15 IHSSs located in the IA (Figure 14). These IHSSs include areas previously used as drum and cargo container storage areas, storage areas for surplus materials, former locations of aboveground tanks, and one underground storage tank. Descriptions of each IHSS are presented in Appendix C.

The following investigation activities were performed to assess the presence of contamination at OU 10:

- Visual inspections;
- Surface radiological surveys;
- Surface soil sampling;
- Soil gas surveys;
- Tank residue sampling;
- Vertical soil profiling; and
- Tanks and ancillary equipment testing, inspections, and investigations.

44

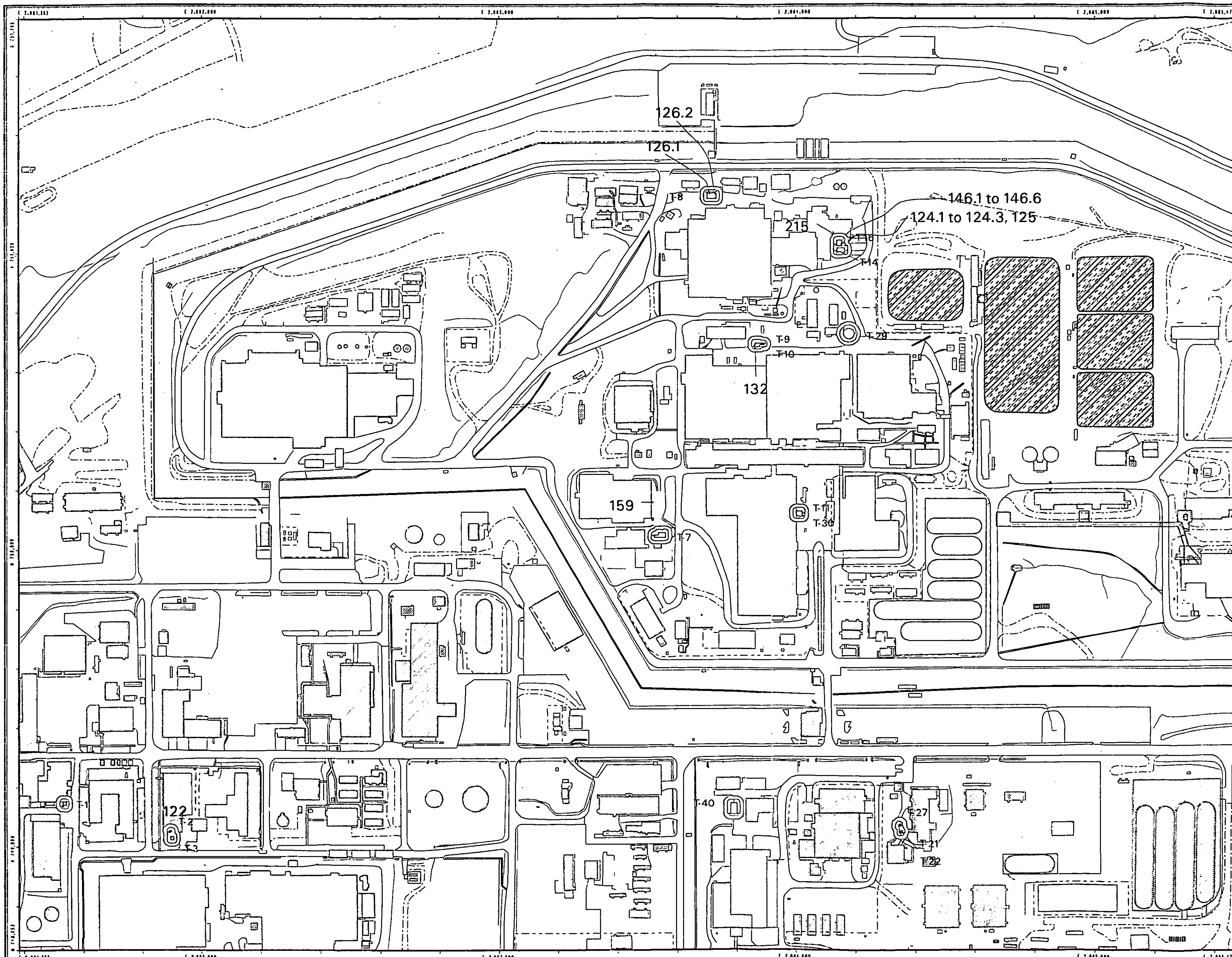

Figure 12
Operable Unit 9
Outside Tanks

EXPLANATION

- Tanks of immediate interest
- OU 9 IHSS
- 15' buffer around tanks of interest to enhance visibility

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

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

Scale = 1 : 4050
1 inch represents approximately 338 feet

100 0 200 400 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2MHILL

Prepared for:

March 16, 2004

NT_Svr w:/projects/fy2k/2k-0384/ihss_ou9_fig12.aml

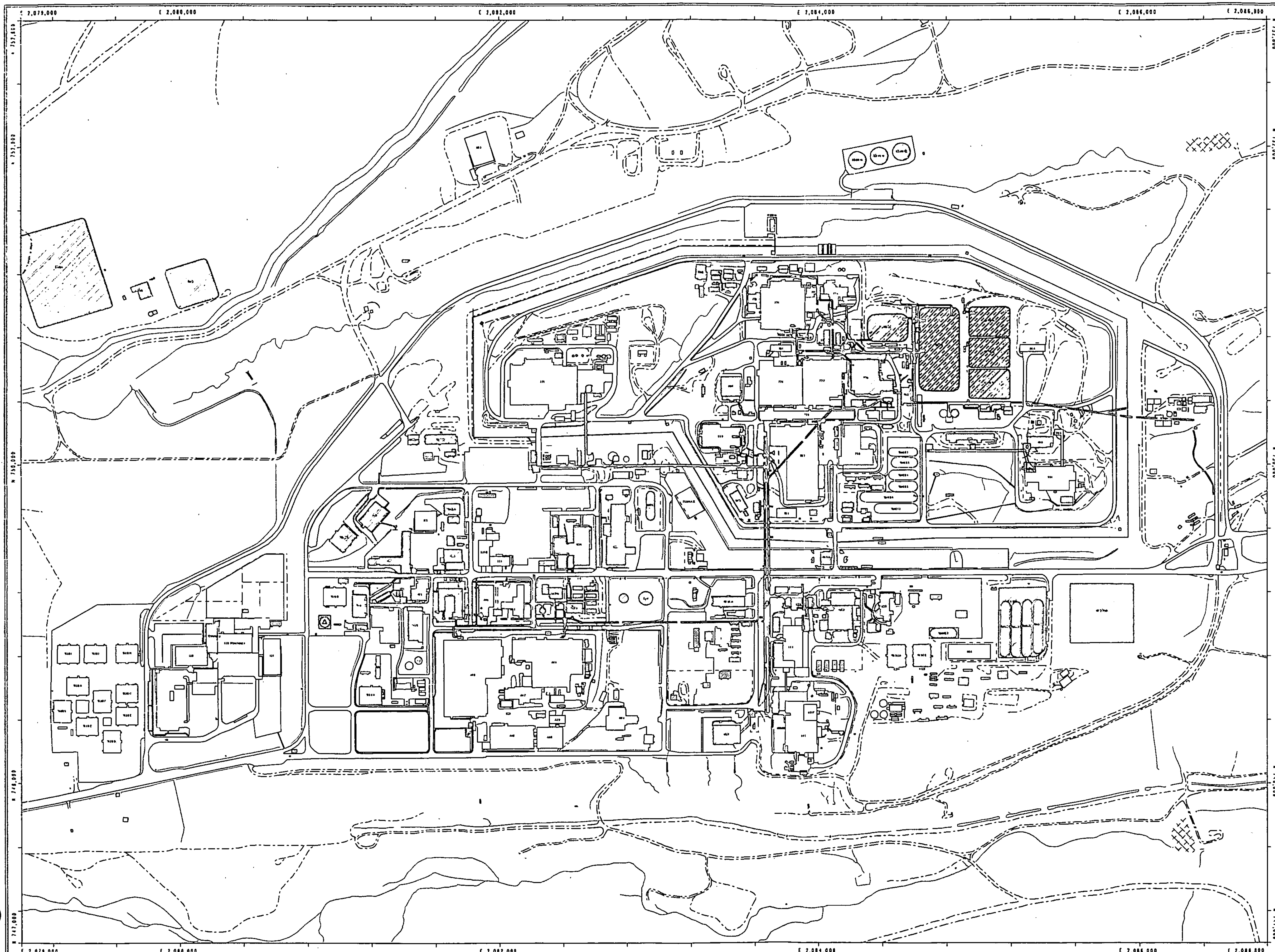

Figure 13
Operable Unit 9
Original Process Waste Lines

EXPLANATION

Original Process Waste Lines

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads
- Industrial Area Operable Unit Boundary

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

Scale = 1 : 7600
1 inch represents approximately 633 feet

250 0 500 1000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2MHILL

Prepared for:

March 16, 2004

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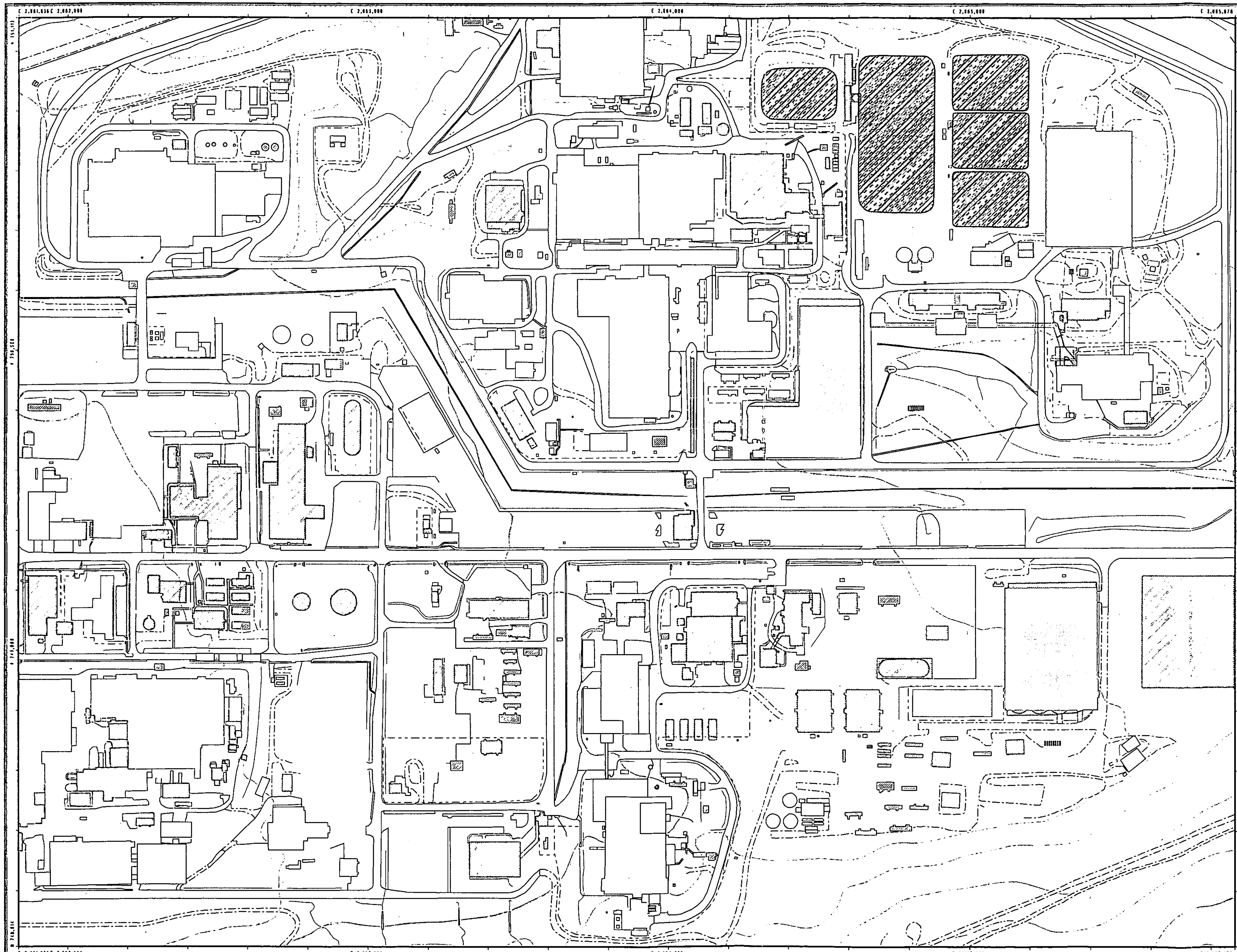

Figure 14
Individual Hazardous Substance Sites Operable Unit 10

EXPLANATION

Operable Unit 10

Standard Map Features

Buildings and other structures

Demolished buildings and Other Structures

Solar Evaporation Ponds (SEPs)

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Topographic Contour (20-Foot)

Rocky Flats Environmental Technology Site boundary

Paved roads

Dirt roads

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

Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 4000
1 inch represents approximately 333 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2MHILL

Prepared for:

March 16, 2004

NT_Svr w:/projects/fy2k/2k-0379/ou10/ihss_ou10_fig14.aml

47

The results of these investigation activities for each IHSS are documented in the IA Data Summary Report (DOE 2000a).

2.3.9 OU 12 -400/800 Areas

OU 12 consisted of 10 IHSSs: 2 small loading dock areas, 2 backfilled ponds used to impound cooling tower water, 2 former fiberglass operations areas, 2 acid spill areas, 1 storage yard, and 1 area with a varied history. Figure 15 illustrates the OU 12 IHSS locations.

Investigation activities performed at OU 12 include:

- Visual inspections;
- HPGe surface radiological surveys;
- Surface soil sampling;
- Sediment sampling;
- Soil gas surveys;
- Vertical depth profiling for the upper 6 inches of soil; and
- Asphalt sampling.

The results of these investigation activities for each IHSS are documented in the IA Data Summary Report (DOE 2000a).

2.3.10 OU 13 - 100 Area

OU 13 consisted of 15 IHSSs within the IA (Figure 16). These IHSSs are described in detail in the OU 13 RFI/RI Work Plan (DOE 1992b) and Appendix C. The following investigation activities were performed at OU 13:

- Visual inspections of the physical setting;
- Surface radiological surveys using both HPGe and NaI instruments;
- Surface soil sampling (including sampling of soil under asphalt and concrete);
- Surface water and sediment sampling;
- Soil gas surveys;
- Vertical soil profiling (6 inches); and
- Soil borings.

48

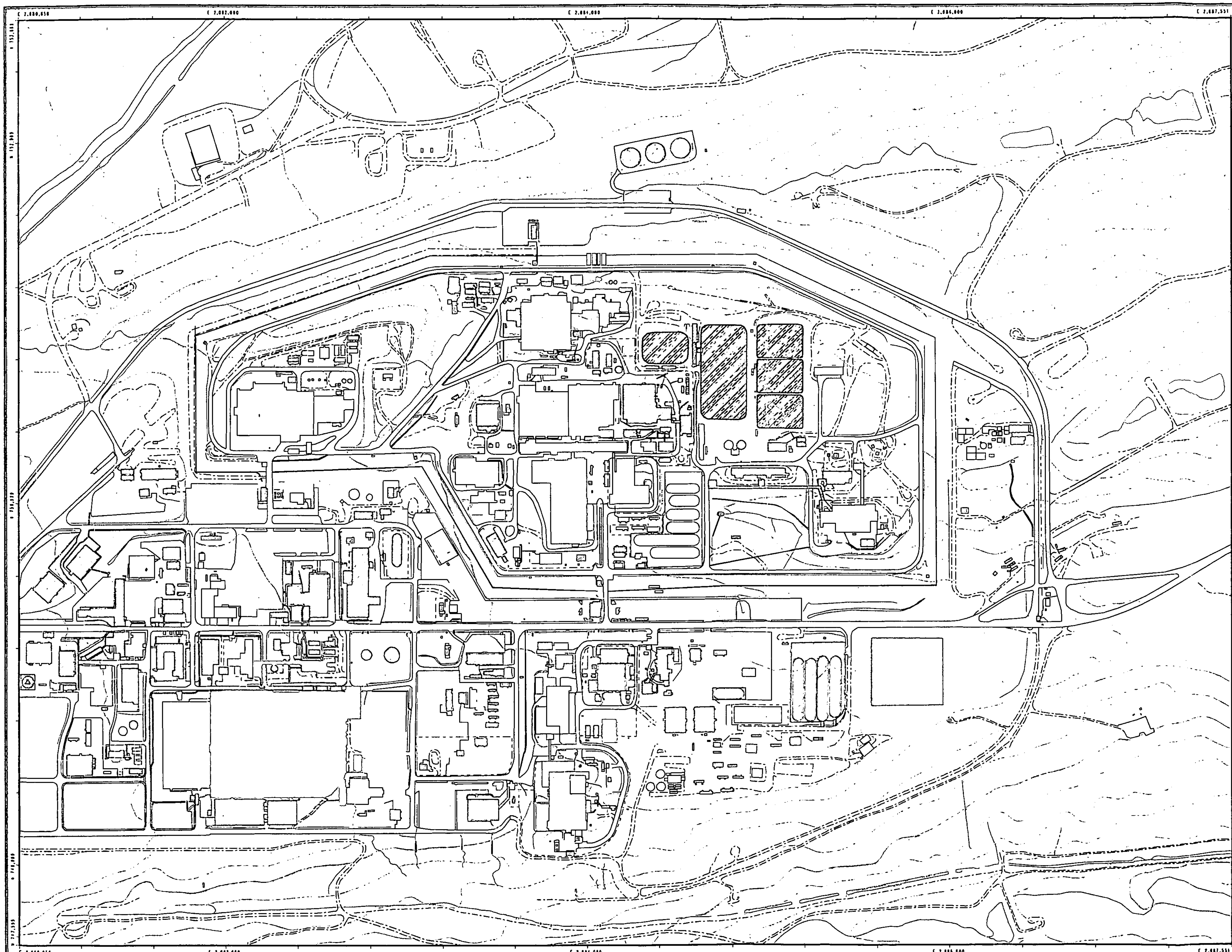

Figure 15
Individual Hazardous Substance Sites
Operable Unit 12

EXPLANATION

Operable Unit 12

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

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

Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter. resolution. DEM post-processing performed by MK, Winter 1997.

Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by:

CH2M HILL

Prepared for:

March 16, 2004

NT_Svr w:/projects/fy2k/2k-0379/ou12/ihss_ou12_fig15.aml

49

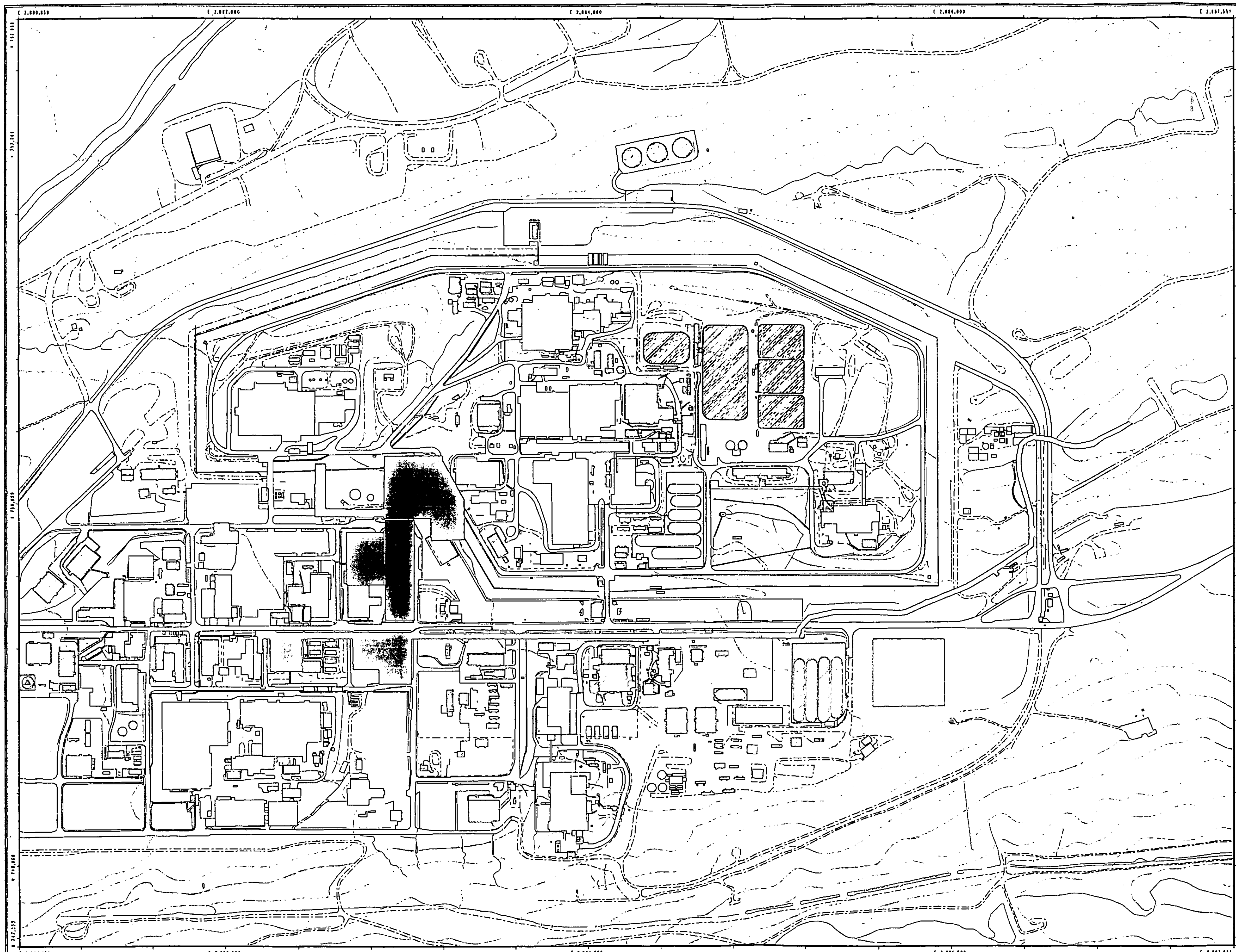

Figure 16
Individual Hazardous Substance Sites Operable Unit 13

EXPLANATION

Operable Unit 13

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

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

Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2M HILL

Prepared for:

March 16, 2004

NT_Svr w:/projects/fy2k/2k-0379/ou13/ihss_ou13_fig16.aml

The results of the above studies are presented in the IA Data Summary Report (DOE 2000a).

2.3.11 OU 14 - Radioactive Sites

OU 14 contained eight IHSSs within IA Areas 300, 400, 600, 700, and 800. The eight IHSSs include an area with radiological contamination resulting from fire fighting activities, an area of radiological contamination identified during monitoring activities, and other areas used for storage of radiologically contaminated drums, boxes, equipment, concrete, and soil (Figure 17). Specific descriptions of each IHSS are presented in the Final Phase I RFI/RI Work Plan, Operable Unit 14, Radioactive Sites (DOE 1992c) and Appendix C.

Investigation activities performed at OU 14 include:

- Visual inspections;
- Surface radiological surveys;
- Surface soil sampling; and
- Soil gas surveys.

The results of these surveys and sampling are presented in the IA Data Summary Report (DOE 2000a).

2.3.12 Other Studies

PCB Removal

A Sitewide program was initiated in 1991 to identify known, suspect, and potential PCB contaminants at RFETS. This study included record reviews, personnel interviews, and field sampling and analysis at 37 locations. The study results are documented in the Assessment of Potential Environmental Releases of PCBs, Preliminary Assessment/Site Description (EG&G 1991). The suspect locations became known as PCB Sites 1 through 37. Based on the study results presented in the assessment (EG&G 1991), PCB Sites were identified for expedited remedial action in accordance with Section I.B.10 of the IAG (DOE et al. 1991). The PCB Site locations are illustrated on Figure 18. A total of 12 PCB Sites were remediated by removing 500 cubic yards of soil and concrete. The remediation activities are documented in the Completion Report for the Source Removal of PCBs (RMRS 1997).

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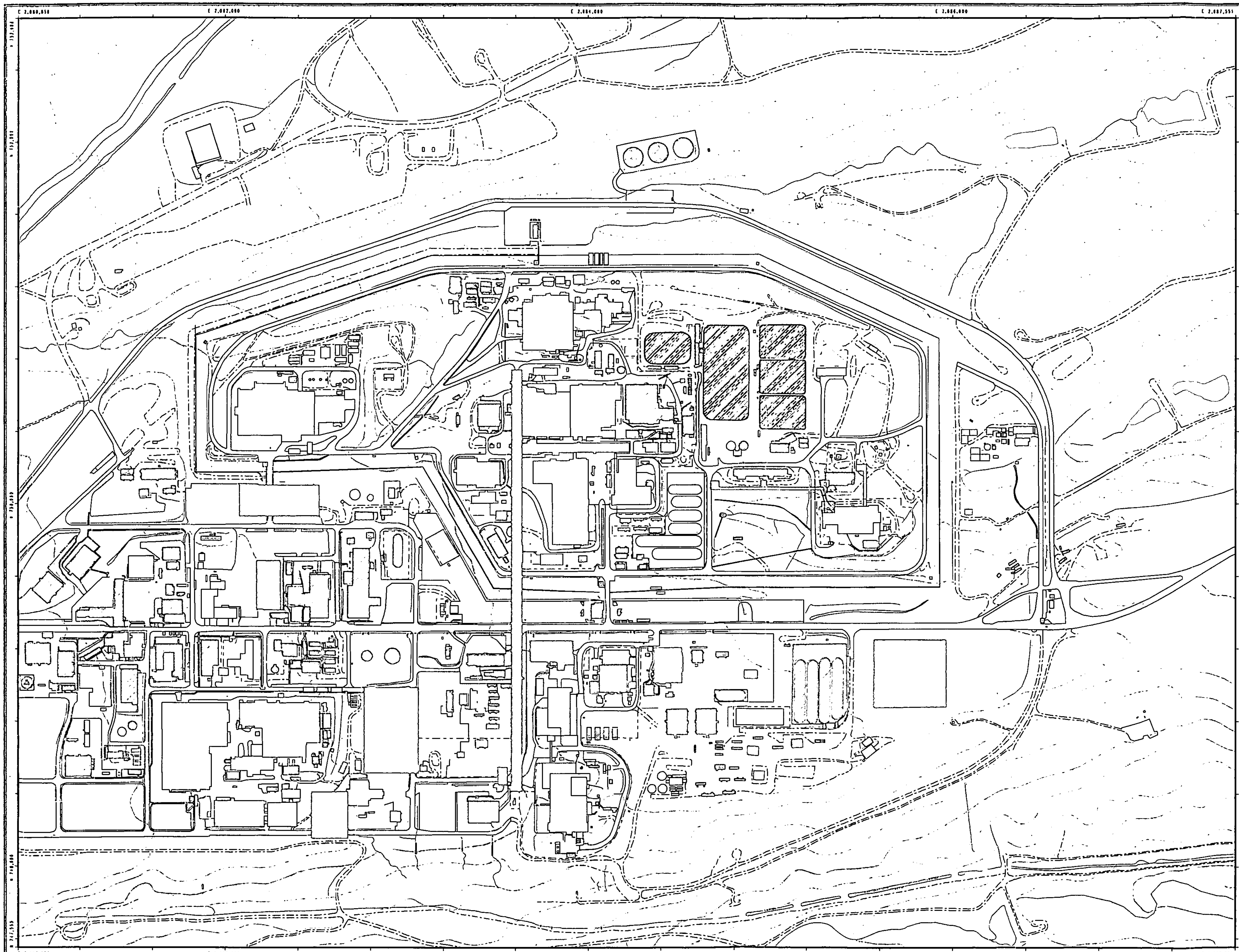

Figure 17
Individual Hazardous Substance Sites Operable Unit 14

EXPLANATION

Operable Unit 14

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95
Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.
Individual Hazardous Substance Sites (IHSS)
OU1 - RF/RI Phase III Report
OU2, 4, 7, 11, & 15 - HRR
Remaining OU's defined by their respective Workplan.

Scale = 1 : 6620
1 inch represents approximately 552 feet

150 0 300 600ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2M HILL

Prepared for:

March 16, 2004

NT_Svr w:/projects/fy2k/2k-0379/ou14/ihss_ou14_fig17.aml

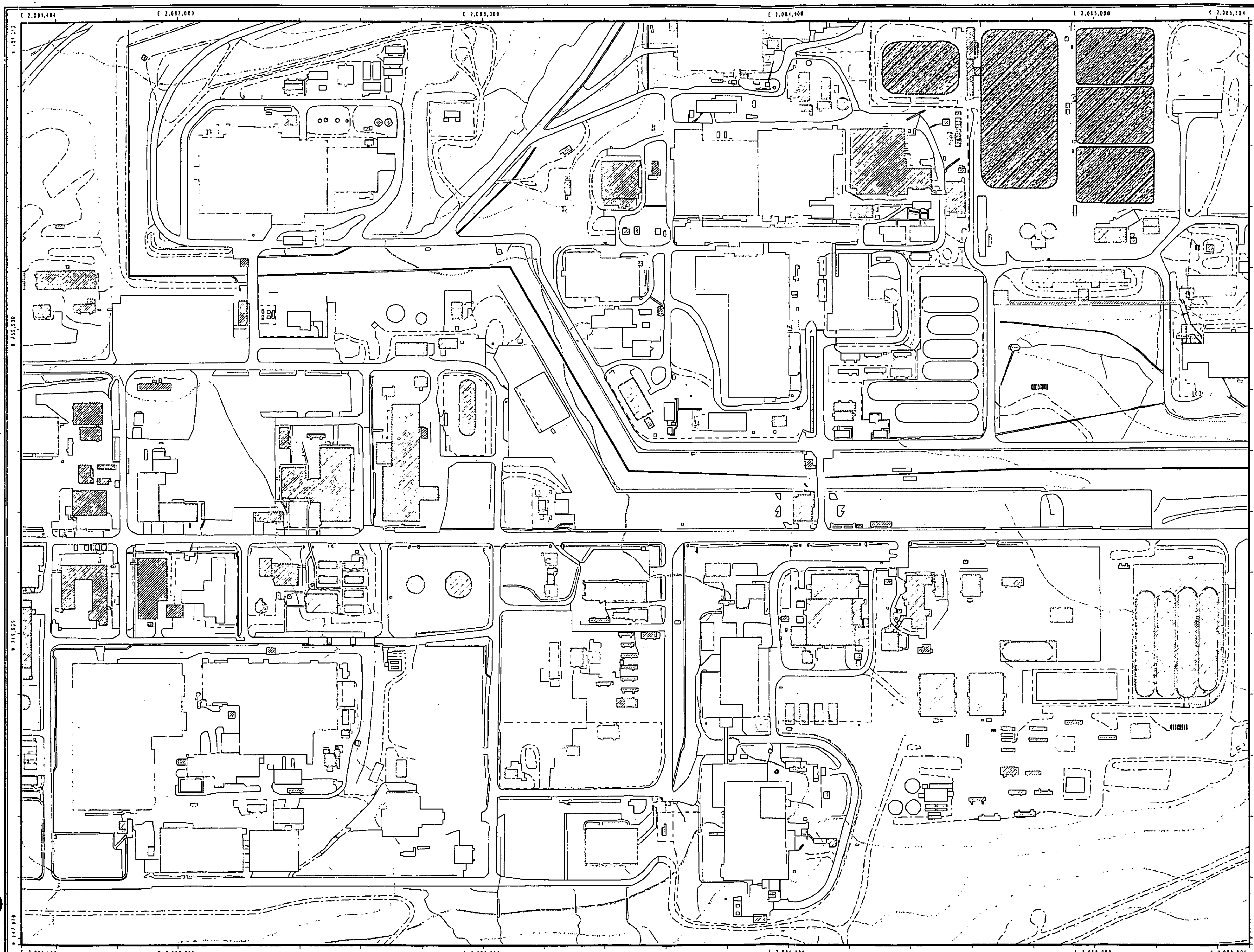

Figure 18

PCB Contamination Sites

EXPLANATION

PCB sites

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:
PCB locations from DOE Historical Report, 1992.
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G Remote Sensing Lab, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 3910
1 inch represents approximately 326 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2MHILL

Prepared for: KAISER-HILL COMPANY

March 17, 2004

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3.0 DATA QUALITY OBJECTIVES

The RFETS Quality Assurance (QA) staff and Risk Assessment Working Group developed preliminary DQOs for the IABZAP. The Working Group consisted of DOE, the Kaiser-Hill Company, L.L.C. (K-H) Team, CDPHE, and EPA representatives. This section details sampling, analytical, and data analysis DQOs for IA and BZ activities. IA and BZ Group-specific DQOs will be presented in the appropriate IABZSAP Addenda, if required.

3.1 DQO Process for the IABZSAP

The DQO process is a series of planning steps designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended purpose. EPA has issued guidelines to help data users develop site- and project-specific DQOs (EPA 1994). The DQO process is intended to:

- Clarify the study objective;
- Define the most appropriate types of data to collect;
- Determine the most appropriate conditions under which to collect the data; and
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support decisions.

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The DQO process consists of seven steps. Each step influences choices that will be made later in the process. These steps are as follows:

- Step 1 - State the Problem;
- Step 2 - Identify the Decision;
- Step 3 - Identify the Inputs to the Decision;
- Step 4 - Define the Study Boundaries;
- Step 5 - Develop a Decision Rule;
- Step 6 - Specify Tolerable Limits on Decision Errors; and
- Step 7 - Optimize the Design.

During the first six steps of the DQO process, the planning team develops decision performance criteria (that is, DQOs) for the data collection design. DQOs for the IABZSAP provide key IA and BZ characterization decision rules. All decision rules need to be considered, as appropriate. The final step of the process involves developing the data collection design based on the DQOs. The data collection design is presented in Section 4.0. These DQOs are based on EPA Guidance for the Data Quality Objective Process (EPA 1994). Data developed under these DQOs will be used to:

1. Establish the nature and extent of contamination within IHSSs, PACs, and UBC Sites, including where RFCA ALs are exceeded;

2. Support final remedy selection analysis; and

3. Confirm that remediation within IHSSs, PACs, and UBC Sites was successful.

The IABZSAP DQOs apply to surface and subsurface soil characterization (Section 3.1.1) and post-remediation confirmation sampling (Section 3.1.2). CRA DQOs are presented in the CRA Methodology ecological evaluation presented in Appendix D.

The IABZSAP DQOs complement those used in the RFETS Integrated Monitoring Plan (IMP) (DOE 1999b). The IMP and associated DQOs focus on air, surface water, groundwater, and ecology, and will be used to support remediation decisions and the CRA. Project-specific air, surface water, and groundwater performance monitoring data from stations surrounding remediation project locations will be used to identify additional areas that may require evaluation.

3.1.1 Characterization of IHSSs, PACs, and UBC Sites

The Problem

The nature and extent of contamination must be known with adequate confidence to make accelerated action decisions. Data of sufficient quality and quantity must be available to conduct an AL comparison, as specified in the RFCA Implementation Guidance Document (IGD), and assess whether an IHSS, PAC, or UBC Site requires remediation or management.

Identification of Decisions

The decisions that will be made are as follows:

1. Determine whether the nature and extent of PCOCs in an IHSS, PAC, or UBC Site are known with adequate confidence; and

2. Characterize an IHSS, PAC, or UBC Site to determine whether sampling and analysis results are greater than RFCA ALs.

Inputs to the Decisions

Information needed to make the characterization decisions specified above include the following:

1. PCOCs

   PCOCs include all analytes detected during previous studies in the IA and BZ and generally include the following analytical suites:

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- Target Compound List (Organics)

  VOCs
  SVOCs
  Pesticides
  Aroclors (PCBs)
  Herbicides

- Target Analyte List

  Metals
  Cyanide

- Radionuclides (RFETS-specific)

PCOCs will be evaluated for each IHSS Group during preparation of the IABZSAP Addenda. At that time, the PCOC list may be expanded or abbreviated depending on site-specific analytical data and process knowledge.

2. Method detection limits (MDLs)/reporting limits (RLs)

   RLs for accelerated action data and MDLs for existing data for IA and BZ PCOCs and analytical methods are presented in Appendix E. Analytical methods are organized in tables by general analytical suite. The tables present the minimum required analytes within each respective suite, as well as the required analytical sensitivity for each analyte. Sensitivities are expressed as RLs or MDLs, and are specific to the measurement systems used for IA and BZ sample analysis.

3. Background levels for each inorganic and radionuclide PCOC, included in Appendix F.

4. RFCA wildlife refuge worker (WRW) ALs for soil, as listed in ALF (Attachment 5, RFCA [DOE et al. 2003]). Comparison criteria include the following:

   a) Soil PCOC concentrations for inorganics will be compared to the background means plus two standard deviations. Soil PCOC concentrations for organics will be compared to MDLs for existing data or RLs for accelerated action data.

   b) Each soil PCOC concentration greater than background means plus two standard deviations or MDLs/RLs will be compared to the appropriate AL.

   c) RFCA radionuclide AL exceedance occurs when:

      – The ratio of each soil PCOC concentration to the RFCA AL is greater than 1; or

      – The sum of the ratios (SOR) for radionuclides is greater than 1.

   d) RFCA nonradionuclide AL exceedance is defined as:

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- The ratio of each soil PCOC concentration to the RFCA AL is greater than 1; or
- The SOR for surface soil nonradionuclides is greater than 1.

e) A PCOC concentration is considered to be below the RFCA AL when:

- The ratio of each PCOC concentration value to the AL is less than 1; or
- The SOR for radionuclides is less than 1.

f) The SOR for surface soil nonradionuclides is defined as:

- The SOR of analytes with concentrations greater than RLs or background means plus two standard deviations, and greater than 10 percent of the RFCA AL; with the exception of aluminum, arsenic, iron, manganese, and polyaromatic hydrocarbons (PAHs).

g) For sites with soil PCOC or COC concentrations exceeding RFCA ALs, the spatial extent of the AOC will be established by delineating PCOC or COC concentrations greater than the background means plus two standard deviations for inorganics and radionuclides, and PCOC concentrations greater than MDLs for existing data or RLs for accelerated action data for organics. PCOC or COC concentrations greater than RFCA ALs will be delineated. There is no lower limit on the size of an AOC; however, no single AOC will exceed 10 acres or an approved AOC size. The AOC will initially consist of an IHSS Group, which, in turn, may consist of one or more IHSS, PAC, or UBC Sites. Data will be collected within each IHSS, PAC, and UBC Site, so that each site can be individually dispositioned as an NFAA Site. However, data aggregation will be conducted over the AOC, rather than over individual IHSSs, PACs, or UBC Sites. Because the AOC only considers data results greater than background means plus two standard deviations or RLs, data aggregation over the AOC is more conservative than averaging over all locations (aggregating nondetections and results less than background). The process for determining the extent of the AOC is shown on Figure 19 and described below:

- Compare data for inorganics and radionuclides to the background means plus two standard deviations; compare data for organics to RLs.
- Establish AOCs based on the spatial distribution of data.
- Aggregate data over the AOC according to decision rules.
- Compare the 95% upper confidence limit (UCL) of the mean for each nonradionuclide PCOC or COC to the RFCA ALs.
- When evaluation of a RFCA exceedance indicates an area of very limited extent (that is, a hot spot), data aggregation may not be appropriate. The methodology for determining potential localized areas of elevated PCOC concentration (hot spots) is described in Section 5.2.

5. Process knowledge and historical data, including information and data contained in technical memoranda, RFI/RI reports, remedial action reports, IMP reports, the Historical Release Report (HRR) (DOE 1992d), and other relevant documents.

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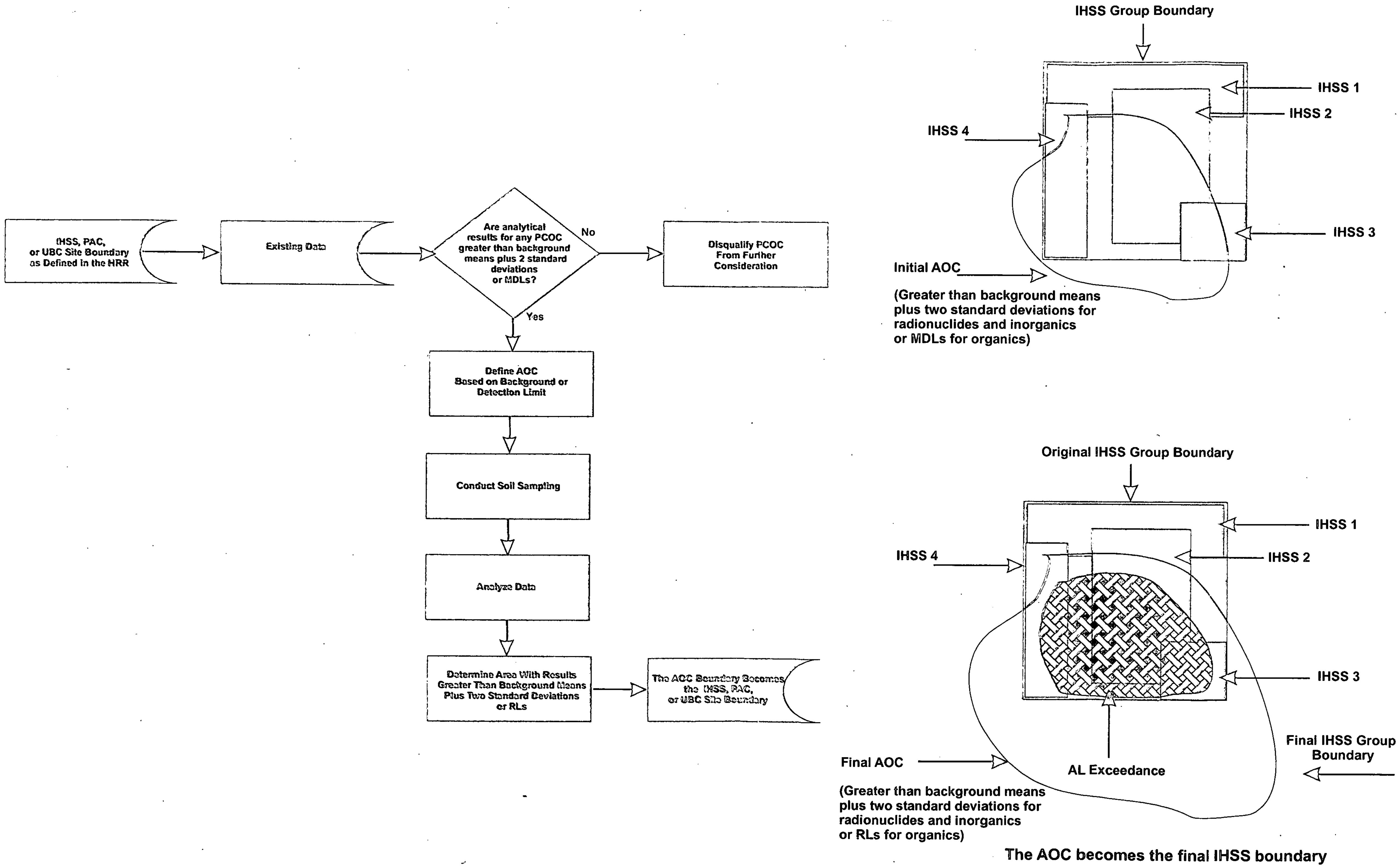
Figure 19
Initial and Final AOC Determinations



6. Existing and IABZSAP-generated characterization data, which meet usability criteria and pass the Data Quality Filter (Figure 20) (DOE 2000a). These data will be used to assess the variability of PCOC and COC concentrations.

7. Ecological information developed as part of the Accelerated Action Ecological Screening Evaluation (AAESE) (Appendix D).

Study Boundaries

Characterization decision boundaries that define when and where data will be collected are listed below. IHSSs, PACs, and UBC Sites are listed in Table 2 and shown on Figures 1 and 2. The actual boundary of an AOC will be determined from the spatial distribution of the sampling data. The study boundaries are as follows:

1. The decisions will be applied to each IHSS, PAC, and UBC Site located in the IA and BZ.

2. Soil will be considered from the land surface to the top of the saturated zone or top of bedrock, as appropriate.

3. Temporal boundaries will be consistent with project schedules. These boundaries will be refined in the IABZSAP Addenda.

4. Surface soil includes nonradionuclide- and uranium-contaminated soil from 0 to 6 inches in depth and americium-241- or plutonium-239/240-contaminated soil from 0 to 3 ft. All other soil is considered subsurface soil.

Decision Rules

The characterization decision rules that describe how the data will be aggregated and evaluated are listed below. Decision rules are complex and must be applied in a systematic way. Figure 21 illustrates the decision sequence, and Figure 22 illustrates how PCOCs become COCs. The decision rules are as follows:

1. If all analytical results for organic PCOCs or COCs are nondetections, the compounds will be disqualified from further consideration; otherwise, the compounds will be retained. AOCs will be determined based on organic PCOC or COC concentrations above MDLs for existing data or RLs for accelerated action data.

2. If all data values for inorganic and radionuclide PCOCs or COCs are less than background means plus two standard deviations, the inorganic or radionuclide PCOC or COC will be disqualified from further consideration. Some inorganic and radionuclide concentrations may be below background levels but greater than RFCA ALs. Data values less than background will not be carried over for further evaluation. AOCs will be determined based on inorganic and radionuclide PCOC concentrations detected above background.

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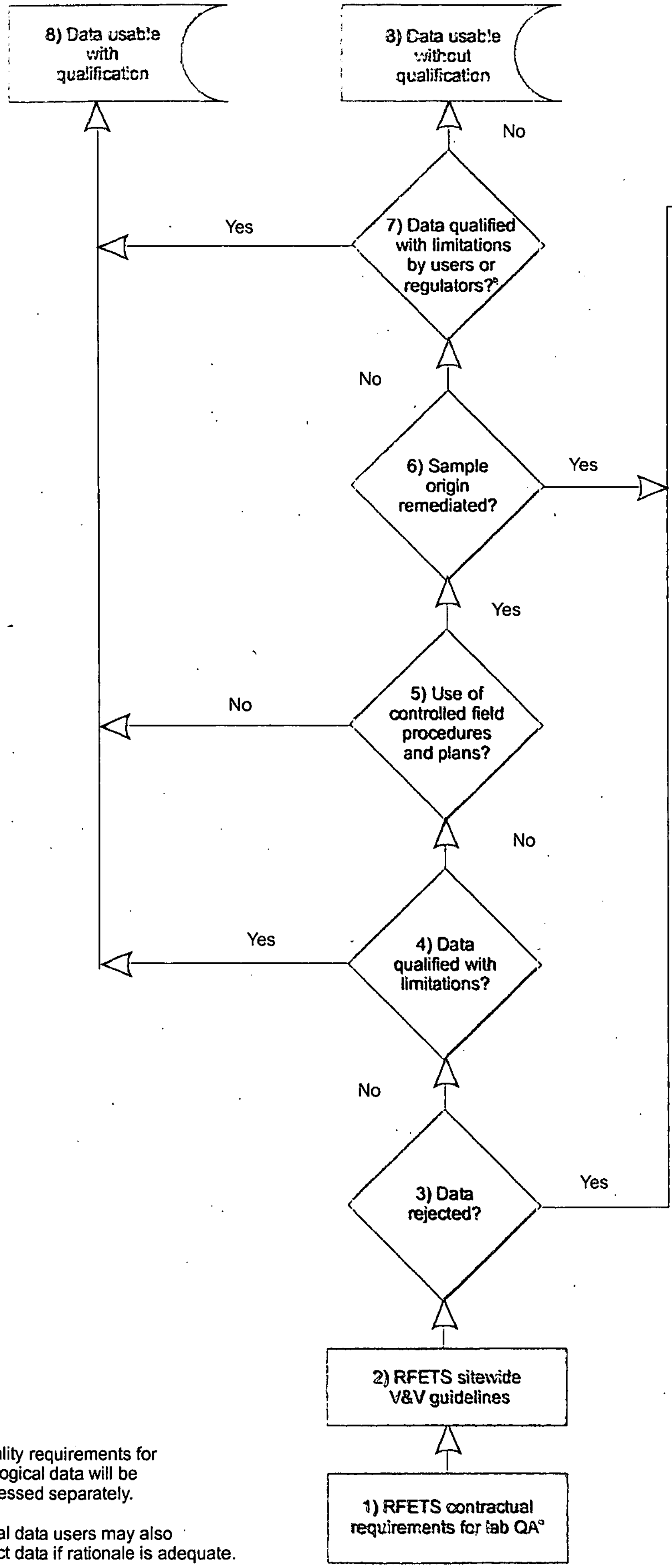
Figure 20
Data Quality Filter for the Industrial Area and Buffer Zone Sampling and Analysis Plan



8) One or more critical quality requirements have not been met.

7) This step will be documented in the IABZSAP.

6) If the source area has been remediated, the contaminated bulk material represented by the sample no longer exists.

5) Checks for intact chain-of-custody:
- Sample traceability
- Representative samples
- Programmatic control of procedures and documents
- Technical and QC reviews
- Independent assessments of work

4) If data are qualified, based on V&V criteria, they have not met all quality (V&V) requirements, but may be usable depending on how they are to be used and whether the added uncertainty is tolerable within the project's decision framework. All data will be flagged relative to the quality status, and will be discussed in the SAP.

3) Data are rejected if critical quality criteria are not met relative to sampling or analysis.

2) Checks for lab accuracy (LCS/MS/tracers)
Lab precision (MSD/replicates)
Lab cross-contamination (blanks)
Quality records intact/traceable

1) Requires documented lab procedure/use of standard methods
Documented lab QA program
Passage of annual QA/technical audits

[a] Quality requirements for ecological data will be addressed separately.

[b] Final data users may also reject data if rationale is adequate.

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Figure 21
Characterization Sampling Data Quality Assessment Logic Flow Diagram

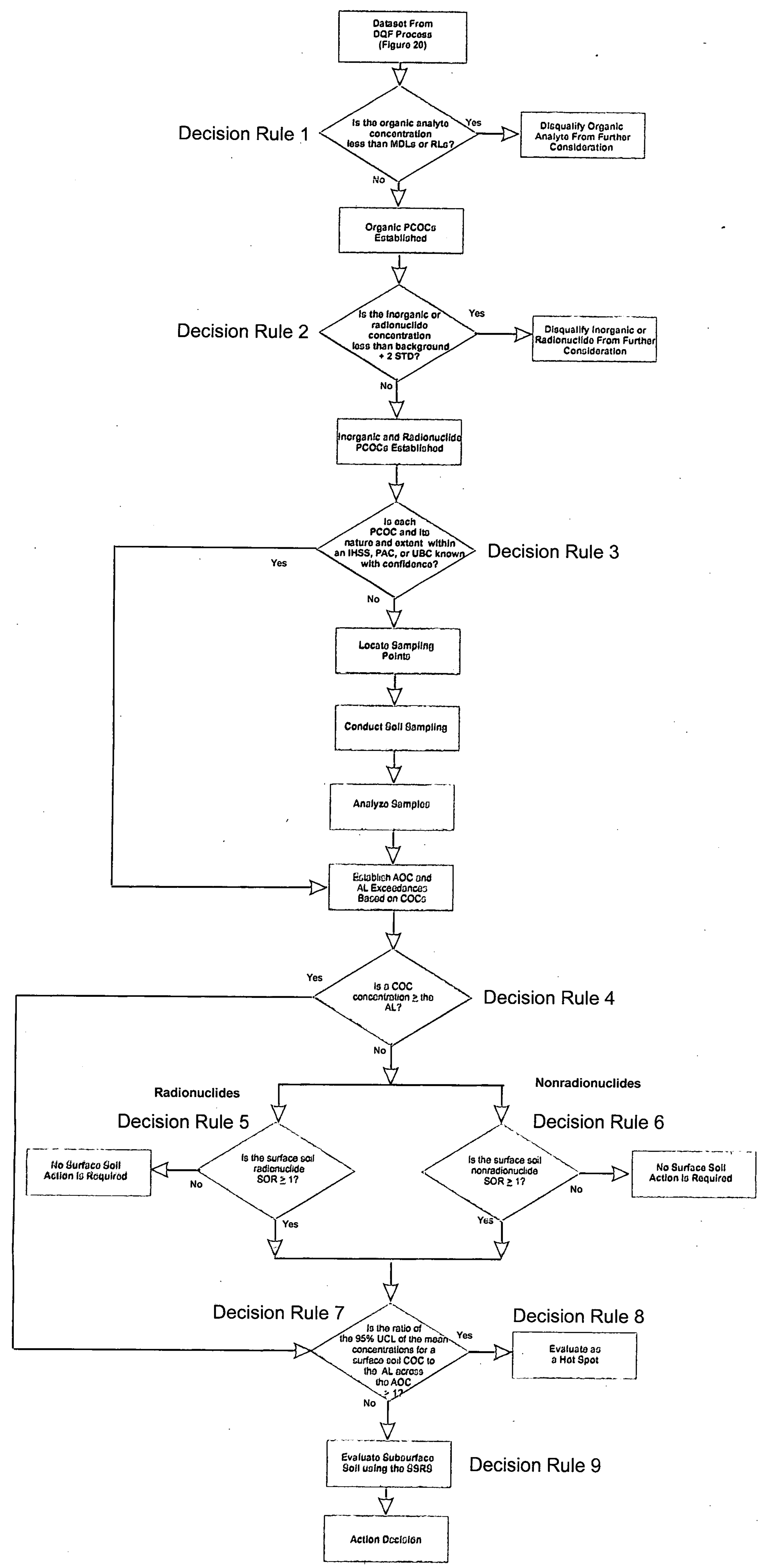
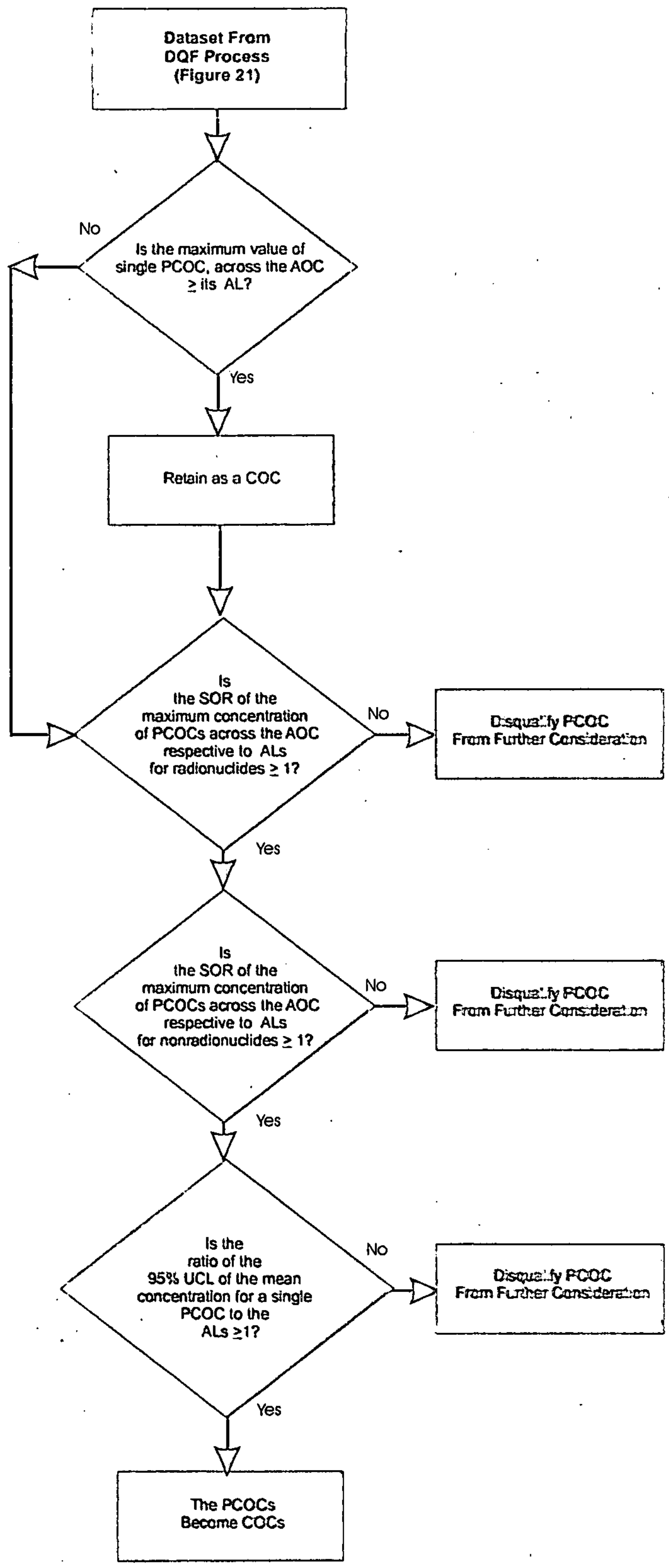


Figure 22
PCOC to COC Transition



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3. If each PCOC or COC has been documented with respect to concentrations and three-dimensional locations for IHSSs, PACs, or UBC Sites, the nature and extent are defined. Otherwise, PCOCs or COCs have not been adequately characterized, and additional sampling and analysis are necessary.

4. If a PCOC concentration is greater than or equal to its RFCA AL, the PCOC is considered a COC.

5. If a single maximum surface soil PCOC or COC concentration is equal to or greater than the RFCA AL, aggregation and evaluation as described in Decision Rules 6, 7, and 8 are necessary in accordance with RFCA requirements.

6. If the surface soil SOR at a given location for radionuclides is greater than or equal to 1, a remedial action decision will be made in accordance with RFCA requirements. Otherwise, the PCOC or COC concentrations are less than RFCA ALs and the soil does not need to be further evaluated in accordance with RFCA requirements.

7. If more than one nonradiological surface soil contaminant concentration is detected above RLs for organics or background means plus two standard deviations for inorganics and exceeds 10 percent of the respective WRW AL, then a SOR at a given location will be calculated for those contaminants that exceed 10 percent of their WRW AL. If a SOR exceeds 1, the nonradiological carcinogenic contaminants and nonradiological noncarcinogenic contaminants may each be summed separately. Data will be aggregated and evaluated as described in Decision Rule 8 in accordance with RFCA requirements. Otherwise, the soil does not need to be further evaluated or remediated in accordance with RFCA requirements. If further evaluation is necessary, the data may also be summed by target organ.

8. If the ratio of the 95% UCL of the mean concentration for a surface soil COC to its respective RFCA AL across the AOC is greater than or equal to 1, a remedial action decision will be made in accordance with RFCA requirements. Otherwise, the COC concentrations are less than RFCA ALs and the soil does not need to be further evaluated in accordance with RFCA requirements.

9. If a single maximum surface soil COC concentration is equal to or greater than the RFCA AL and the ratio of the 95% UCL of the mean concentration to its respective RFCA AL is greater than or equal to 1, additional evaluation as a potential localized area of elevated PCOC concentration (hot spot) will be necessary.

10. If a single subsurface soil COC concentration is equal to or greater than the RFCA AL, evaluation as described in the RFCA Subsurface Soil Risk Screen (SSRS) is necessary.

Tolerable Limits on Decision Errors

Sample data requirements will be based on uncertainties of 10 percent or less for alpha (false positive) errors and 20 percent or less for beta (false negative) errors. The null

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hypothesis (Ho) is that the AOC is contaminated. The Ho and alternative hypothesis (Ha) are stated as follows:

Ho = AOC concentrations greater than or equal to ALs

Ha = AOC concentrations greater than or equal to ALs

Characterization of data, including the minimum detectable relative differences and data variability, will be evaluated for each AOC.

Optimization of Plan Design

The IABZSAP sampling design will be optimized through the IABZSAP Addenda. Sampling locations, sampling depth, and PCOCs will be described in the IABZSAP Addenda for each IHSS, PAC, and UBC Site. Optimization will be conducted in consultation with CDPHE and EPA through a shared access data and mapping system (Section 6.2). This will allow RFETS and regulatory agency staffs to communicate and view data and maps concurrently so that potential sampling design issues are resolved.

Existing data and process knowledge will be reviewed and analyzed to determine:

- Type of sampling methods (geostatistical, standard statistical, biased, or a combination of methods) appropriate for each site;
- Specific PCOC lists for each IHSS, PAC, and UBC Site through comparison to background for inorganics and radionuclides, and MDLs or RLs for organics; and
- Sampling depth.

Consistent with the iterative approach of the DQO process, decisions without adequate confidence will be revisited until enough data are gathered to make a decision. Existing data sets may be checked for sampling adequacy based on comparison with the EPA QA/G-4 model (EPA 1994) or Gilbert's methods (Gilbert 1987). Sampling requirements and densities will be based on the AOC. The following documents will be used as guidance in optimizing sampling and analysis requirements:

- DOE, 1999a, Industrial Area Characterization and Remediation Strategy, September.
- EPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), EPA/540/1-89/002, December.
- EPA, 1992, Guidance for Data Usability in Risk Assessment (Parts A & B), EPA Publication 9285.7-09A & B, April/May.
- EPA, 1994, Guidance for the Data Quality Objective Process, QA/G-4, EPA/600/R-96/055, September.
- EPA, 1996, Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, May.

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- EPA, 1997, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, EPA 402-R-97-016, December.
- EPA, 1998, Guidance for the Data Quality Assessment Process: Practical Methods for Data Analysis, QA/G-9, EPA/600/R-96/084, January.
- EPA, 1999, Guidance on Environmental Data Verification and Validation, Peer Review Draft, QA/G-8, August.
- EPA, 2000, Data Quality Objectives Process for Hazardous Waste Site Investigations, EPA QA/G-4HW, EPA/600/R-00/007, January.

3.1.2 Confirmation Sampling and Analysis

The Problem

Following accelerated action at any contaminated area, the concentrations of remaining contaminants, if any, are not known with adequate confidence to conclude that remediation was complete and successful.

Due to the nature of some remediation technologies, such as soil excavation and hauling with heavy equipment, the possibility exists that limited contaminated media could be released outside the remediation boundaries during field activities.

Identification of Decisions

The confirmation sampling and analysis questions that will be resolved include the following:

1. Has contamination within an AOC been successfully remediated based on RFCA ALs and other mutually agreed-upon cleanup criteria?
2. Did any releases of contamination occur outside the remediation activity boundaries during the remediation activity (based on compliance and project-specific performance monitoring)?

Inputs to the Decisions

Information needed to resolve the confirmation sampling and analysis questions are as follows:

1. COCs as determined by the RFCA AL screen.
2. Post-remediation sampling locations based on RFCA and CRA requirements.
3. Compliance monitoring results concurrent with remediation.
4. RLs/MDLs

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RLs for accelerated action data and MDLs for existing data for IA and BZ COCs and analytical methods are presented in Appendix E. Analytical methods are organized in tables by general analytical suite. The tables present the minimum required analytes within each respective suite, as well as the required analytical sensitivity for each analyte. Sensitivities are expressed as RLs or MDLs, and are specific to the measurement systems used for IA and BZ sample analysis. RLs for off-site analytical laboratories are those established by the Analytical Services Division (ASD) and are listed in Appendix E.

5. Confirmation sample results (post-remediation concentrations).

6. RFCA WRW ALs for soil as listed in ALF (Attachment 5, RFCA). Comparison criteria include the following:

   a) Each soil COC concentration for inorganics and radionuclides will be compared to the background means plus two standard deviations. COC concentrations for organics will be compared to MDLs for existing data or RLs for accelerated action data.

   b) Each soil COC concentration greater than background means plus two standard deviations or MDLs/RLs will be compared to the appropriate RFCA AL.

   c) A RFCA radionuclide AL exceedance occurs when:

      – The ratio of each soil COC concentration to the RFCA AL is greater than to 1; or

      – The SOR for radionuclides is greater than 1.

   d) A RFCA nonradionuclide AL exceedance is defined as:

      – The ratio of each soil COC concentration to the RFCA AL is greater than 1; or

      – The SOR for surface soil nonradionuclides is greater than 1.

   e) A PCOC concentration is considered to be below the RFCA AL when:

      – The ratio of each soil COC concentration to the RFCA AL is less than 1; or

      – The SOR for radionuclides at a sampling location is less than 1.

   f) The SOR for surface soil nonradionuclides is defined as:

      – The SOR of detected analytes or those with concentrations greater than background means plus two standard deviations, and greater than 10 percent of the RFCA AL, with the exception of aluminum, arsenic, iron, manganese, and PAHs.

7. Ecological information developed as part of the AAESE (Appendix D).

8. Other mutually agreed-upon cleanup criteria.

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Data will be reviewed and evaluated against usability criteria and must pass the Data Quality Filter (DOE 2000a).

Study Boundaries

Decision boundaries that determine when and where data will be collected are listed below:

1. Identified IHSS, PAC, and UBC Sites are listed in Table 2 and shown on Figures 1 and 2. The actual boundary of an AOC will be determined from the spatial distribution of the sampling data, as specified in the IGD. The AOCs will be used as areas for confirmation sampling and analysis immediately after remediation.

2. Other areas will be sampled and addressed when monitoring data indicate contamination was spread during remediation of adjacent sites. Otherwise, they will be addressed as part of the CRA.

3. COCs determined for each AOC in accordance with Section 3.1.1 will be compared to ALs or other mutually agreed-upon cleanup criteria.

4. Confirmation sampling will cover the area remediated.

5. Surface soil includes nonradionuclide- and uranium-contaminated soil from 0 to 6 inches in depth and americium-241- or plutonium-239/240-contaminated soil from 0 to 3 ft. All other soil is considered subsurface soil.

6. Soil will be considered from the land surface to the top of the saturated zone or top of bedrock, as appropriate.

7. Temporal boundaries will be consistent with project schedules. These boundaries will be refined as remediation proceeds. Confirmation sampling will be conducted after remediation. Data from confirmation sampling will be used to support the CRA.

Decision Rules

The confirmation sampling and analysis decision rules that describe how the data will be aggregated and evaluated are illustrated on Figure 23 and listed below:

1. If all analytical results for organic COCs are less than RLs, the compounds will be disqualified from further consideration; otherwise, the compounds will be retained. AOCs will be determined based on organic COC concentrations above RLs.

2. If all analytical results for inorganic and radionuclide COCs are less than the background means plus two standard deviations, the inorganic or radionuclide COC will be disqualified from further consideration. Some inorganic and radionuclide concentrations may be below background levels but greater than RFCA ALs. Analytical results less than background will not be carried over for further evaluation. AOCs will be determined based on inorganic and radionuclide COC concentrations detected above background.

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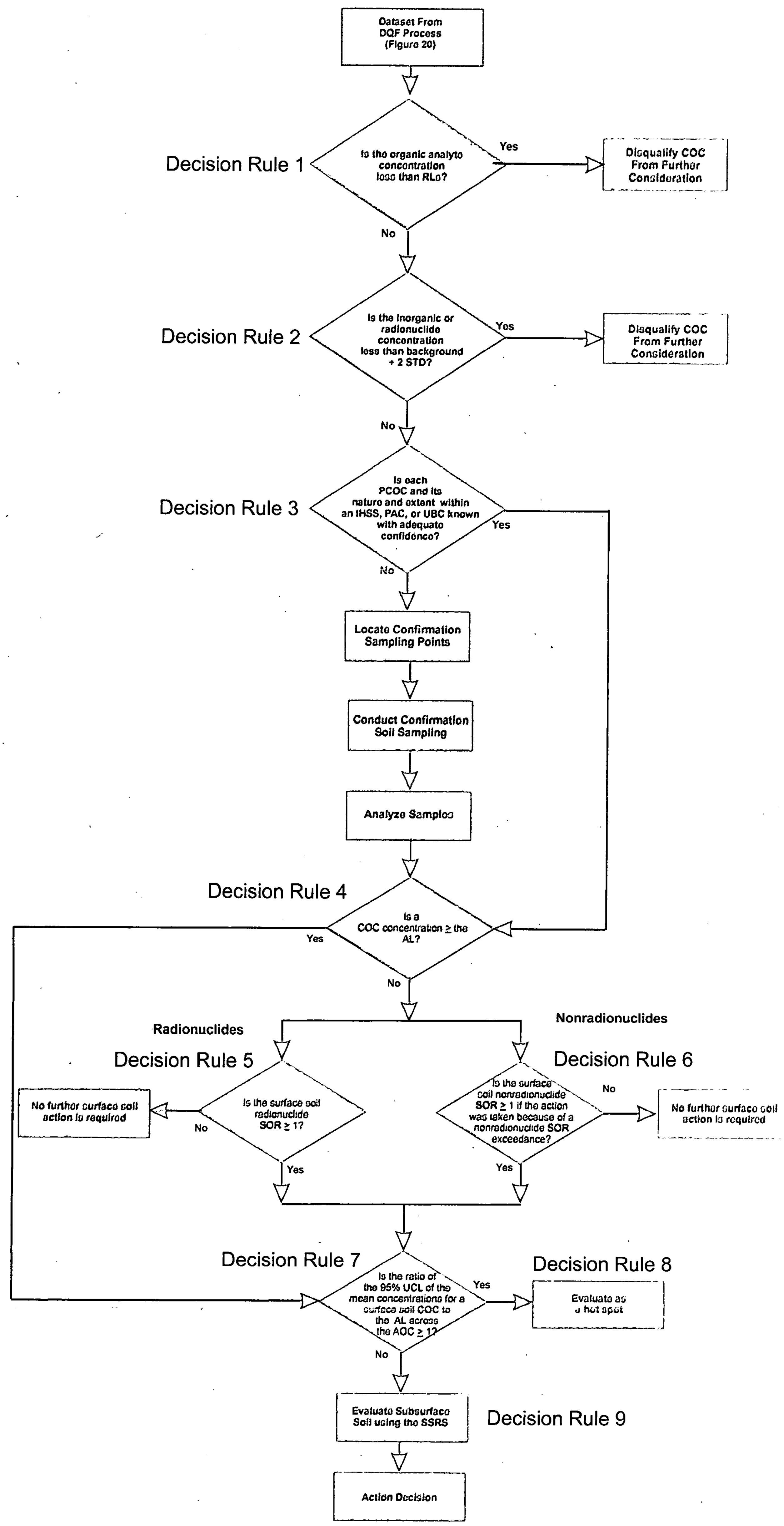
3. If each COC has been documented with respect to concentrations and three-dimensional locations for IHSSs, PACs, or UBC Sites, the nature and extent are defined. Otherwise, COCs have not been adequately characterized, and additional sampling and analysis are necessary.

Figure 23
Confirmation Sampling Data Quality Assessment Logic Flow Diagram



4. If a single maximum surface soil COC concentration is equal to or greater than the RFCA AL, aggregation and evaluation as described in Decision Rules 5, 6, and 7 are necessary in accordance with RFCA requirements. If the SOR for surface soil radionuclides at a given location is greater than or equal to 1, a remedial action decision will be made in accordance with RFCA requirements. Otherwise, the COC concentrations are less than RFCA ALs and the soil does not need to be further evaluated or managed in accordance with RFCA requirements.

5. If an action was required at a given location based on a nonradiological surface soil SOR and if more than one nonradiological contaminant concentration is detected above RLs for organics or background means plus two standard deviations for inorganics and exceeds 10 percent of the respective WRW AL, then SOR at a given location will be calculated for those contaminants that exceed 10 percent of their WRW AL. If the SOR exceeds 1, the nonradiological carcinogenic contaminants and nonradiological noncarcinogenic contaminants may each be summed separately. Data will be aggregated and evaluated as described in Decision Rule 7 in accordance with RFCA requirements. Otherwise, the soil does not need to be further evaluated or remediated in accordance with RFCA requirements. If further evaluation is necessary, the data may also be summed by target organ.

6. If the ratio of the 95% UCL of the mean concentration for a surface soil COC to its respective RFCA AL across the AOC is greater than or equal to 1, a remedial action decision will be made in accordance with RFCA requirements. Otherwise, the COC concentrations are less than RFCA ALs and the soil does not need to be further evaluated or managed in accordance with RFCA requirements.

7. If a single maximum surface soil COC concentration is equal to or greater than the RFCA AL and the ratio of the 95% UCL of the mean concentration to its respective RFCA AL is greater than or equal to 1, additional evaluation as a potential localized area of elevated COC concentration (hot spot) will be necessary.

8. If a subsurface soil COC concentration is equal to or greater than the RFCA AL, evaluation as described in the RFCA SSRS is necessary.

9. If compliance or project-specific performance monitoring (for example, air or surface water monitoring) corresponding with the remediation activity produces results that exceed ALs stated in RFCA, then the potential release of contaminants resulting from the respective remediation activity will be evaluated. Otherwise, the remediation activity was adequately controlled to prevent release of contaminants outside the immediate remediation boundaries.

Tolerable Limits on Decision Errors

Areas and associated COCs disqualified from further characterization or remediation based on process knowledge have no associated quantifiable decision error. Sample data requirements will be based on uncertainties of 10 percent or less for alpha errors and 20 percent or less for beta errors. The null hypothesis is that the AOC is contaminated.

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Characterization of data, including the minimum detectable relative differences and data variability, will be evaluated for each AOC.

Optimization of Plan Design

Optimization of the post-remediation data collection process will be based on statistical or geostatistical analysis where possible. Consistent with the iterative approach of the DQO process, decisions without adequate confidence will be revisited until enough data are gathered to make a decision. Existing data sets may be checked for sampling adequacy by comparison with the EPA QA/G-4 model (1994), Gilbert's methods (Gilbert 1987), or MARSSIM (EPA 1997A). Sampling requirements and densities will be based on the remediation area considerations.

The following documents will be used as guidance to optimize sampling and analysis requirements in support of remediation activities:

- DOE, 1999a, Industrial Area Characterization and Remediation Strategy, September.
- EPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), EPA/540/1-89/002, December.
- EPA, 1992, Guidance for Data Usability in Risk Assessment (Parts A & B), EPA Publication 9285.7-09A & B, April/May.
- EPA, 1994, Guidance for the Data Quality Objective Process, QA/G-4, EPA/600/R-96/055, September.
- EPA, 1996, Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, May.
- EPA, 1997, MARSSIM, NUREG-1575, EPA 402-R-97-016, December.
- EPA, 1998, Guidance for the Data Quality Assessment Process: Practical Methods for Data Analysis, QA/G-9, EPA/600/R-96/084, January.
- EPA, 1999, Guidance on Environmental Data Verification and Validation, Peer Review Draft, QA/G-8, August.
- EPA, 2000, Data Quality Objectives Process for Hazardous Waste Site Investigations, EPA QA/G-4-HW, EPA/600/R-00/007, January.

3.1.3 Final Characterization of the IA and BZ for the CRA

The IA and BZ will be assessed in the CRA to quantify and report risks posed by residual contamination at the Site to human and ecological receptors after accelerated actions are complete. The CRA will address all media with exposure pathways listed as significant in the Site conceptual model. Other media will be sampled and evaluated as part of the compliance monitoring or other RFETS programs. The nature and extent of soil contamination remaining in accelerated action areas within the IA and BZ must be determined with adequate confidence to support the CRA. Detailed DQOs for the CRA are presented in the CRA Methodology.

4.0 SAMPLING STRATEGY

The IA sampling strategy specifies soil sampling and analysis methodologies that will streamline characterization and remediation processes and maintain appropriate QA. The sampling strategy will:

- Provide a consistent process for characterizing IHSSs, PACs, and UBC Sites shown on Figures 1 and 2;
- Provide characterization focused on identifying areas that require remediation;
- Diminish reliance on off-site analytical laboratories to reduce cost and accelerate schedules; and
- Provide defensible quality data for the CRA.

The IA and BZ sampling strategy includes the following key elements:

- In-process characterization and remediation sampling at IHSSs, PACs, and UBC Sites;
- Post-remediation confirmation sampling at IHSSs, PACs, and UBC Sites;
- Sampling in other areas, as needed, for risk assessment or screening; and
- Samples, in addition to those in support of the CRA, identified for other purposes.

Areas in the IA and inner BZ outside of AOCs that are within or extend from IHSSs, PACs, and UBC Sites, as shown on Figure 24, are not expected to have contamination above ALs. To support the CRA, data sufficiency analyses will be performed to confirm that concentrations within the accelerated action AOCs have been adequately delineated against background or RLs as appropriate (DOE 2003a).

4.1 In-Process Sampling

The K-H characterization team will implement an in-process sampling approach that combines a statistical or biased approach to determine sampling locations and remediation areas with the use of field analytical equipment. Existing data and historical process information will be used to determine the statistical approach needed to determine characterization sampling locations in IHSSs, PACs, UBC Sites, and other areas. After the sampling locations have been identified, samples will be collected and analyzed using field analytical instrumentation. The data will be evaluated using a geostatistical or standard statistical approach to delineate the AOC and areas that require remediation.

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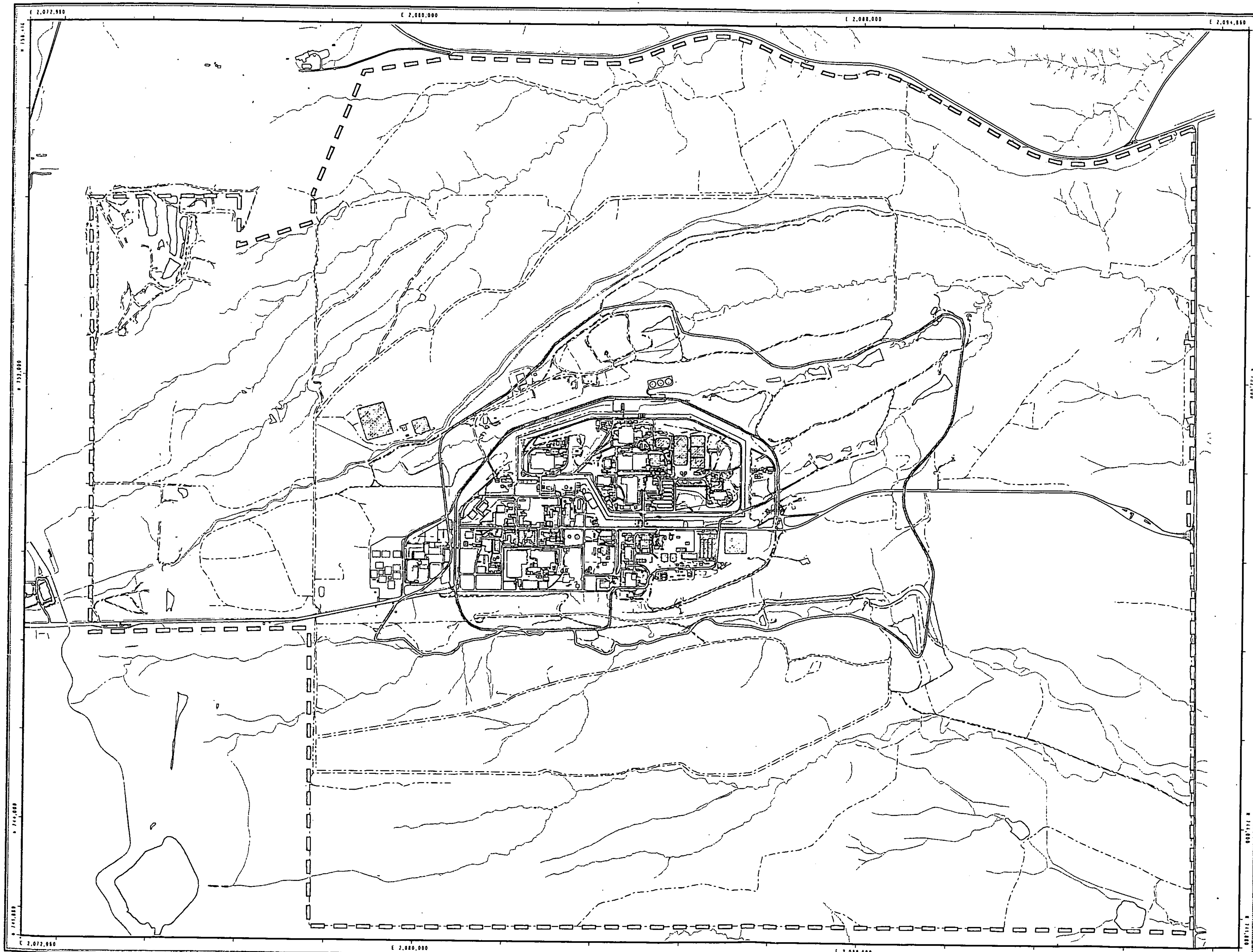

Figure 24

Industrial Area White Space and Inner Buffer Zone

EXPLANATION

Inner Buffer Zone

Industrial Area

Standard Map Features

- Buildings and other structures
- Demolished buildings and Other Structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Rocky Flats Environmental Technology Site boundary
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95
Data Source:
Boundary data source unknown, please reference RFCA Report.

N

Scale = 1 : 21330
1 inch represents approximately 1778 feet

500 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: CH2MHILL

Prepared for:

March 16, 2004

NT_Svr w:/projects/fy2k/2k-0294/inner_bz_bdy_fig24.aml

After the areas have been remediated, samples will be collected and analyzed using field analytical instrumentation to immediately determine whether remediation goals have been achieved. Soil will be removed in "lifts." After a lift is removed, the remaining soil will be analyzed with field instrumentation. This process will continue until remedial objectives have been achieved. When field analytical results indicate remediation has been achieved, post-remediation confirmation samples will be collected and analyzed on site if appropriate data quality can be demonstrated, or sent to an off-site laboratory for analysis. Off-site laboratory results will be validated according to ASD requirements.

If remediation is not required at specific IHSSs, PACs, or UBC Sites based on the results of field analysis, confirmation samples will be collected to support an NFAA recommendation and the CRA. An off-site or on-site laboratory will perform the confirmation sample analysis. Field analytical instrument data will be used for the CRA if appropriate data quality can be demonstrated. Off-site laboratory results will be validated according to DQO requirements. Figure 25 illustrates the overall in-process sampling technique for IHSSs, PACs, and UBC Sites.

4.2 Sampling Approaches

Characterization sampling locations will be determined for each IHSS, PAC, and UBC Site using geostatistical, standard statistical, or biased sample selection methods. Table 3 generally describes when each method will be used. Using existing data, a decision as to whether the data define a contaminant distribution (apply geostatistical approach) or a localized area of elevated PCOC concentration (hot spot) (apply standard or biased approach) will be made. The method for determining sampling locations will be specified in the appropriate IABZSAP Addenda. In some cases, a combination of techniques may be used. For example, if process knowledge or existing data indicate discrete spill areas in a large IHSS, both standard statistical and biased sampling may be appropriate.

Table 3
Sampling Decision Matrix for IHSSs, PACs, and UBC Sites

Method	Condition
Geostatistical	Existing analytical data Existing data indicating a contaminant distribution
Standard Statistical	No existing analytical data Limited analytical data Process knowledge
Biased	Process knowledge Limited analytical data Analytical data indicating localized contamination or point sources

In-process sampling will use a variety of statistical error management approaches to meet the decision error limits specified in the DQOs. The specific approach will be customized to meet the uncertainty, time, and health and safety (H&S) constraints of each IHSS, PAC, and UBC Site characterization.

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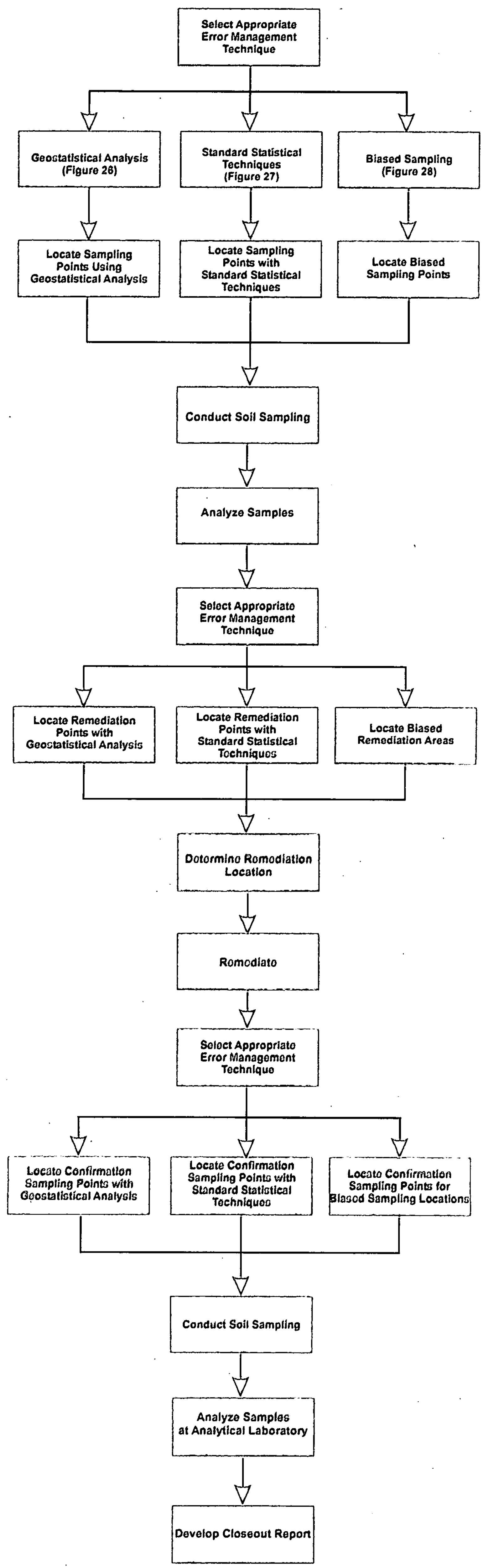
Figure 25
Sampling Process for IHSSs, PACs, and UBC Sites



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Each component of the sampling design is based on the project DQOs presented in Section 3.0. The sampling strategies described in this section are the basis for IHSS, PAC, and UBC Site characterization. However, these strategies are flexible and will be modified, as needed, to fit actual field conditions. Statistical methods are described in the following sections.

4.2.1 Geostatistical Approach

SmartSampling, a geostatistical approach developed at Sandia National Laboratories (SNL) and used at several DOE sites, is the basis for the geostatistical approach that will be used to determine the optimum number and location of samples needed to characterize IHSSs, PACs, and UBC Sites for remediation.

The geostatistical approach will be used to:

- Optimize the number and locations of characterization samples;
- Develop maps of the areas with concentrations or activities exceeding RFCA ALs at a given level of probability;
- Optimize the number and location of post-remediation confirmation samples;
- Achieve DQO-specified limits on decision errors; and
- Link on-site analysis with sampling to allow near-real-time remediation decisions.

Geostatistics uses an iterative process based on remediating a site to required ALs at a specified level of confidence. Geostatistics will be applied using existing data to generate maps showing the probability of exceeding RFCA ALs in IHSSs, PACs, UBC Sites, and other areas. Based on the probability of exceedance, two types of maps can be developed:

1. Maps showing areas requiring additional sampling; and
2. Maps showing RFCA AL exceedances at a specified level of reliability.

Existing data will be analyzed, and a decision to collect more samples will be based on an analysis of sampling locations, analytical results, and the chosen reliability level. After characterization of individual IHSSs, PACs, and UBC Sites, geostatistical or standard statistical techniques will be used to define AOCs and areas with concentrations above RFCA ALs. Sampling necessary to define the extent of contamination will be iterative: as sample data are received, they will be evaluated using geostatistics. The results will be used to determine the optimal number and locations of samples to be collected in the next iteration, if necessary. This iterative updating will be conducted in near real-time (on the order of several hours turnaround for incorporating the new sample information).

Geostatistics are not designed for developing a characterization plan around a single localized area of elevated PCOC concentration. Sampling to identify localized areas of elevated PCOC concentrations will generally be more focused on defining contaminants

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in a single location, and may not provide the necessary areal coverage to define the extent of contamination across an entire IHSS. However, depending on the size of the IHSS, the same sampling grid spacing used for finding a localized area of elevated PCOC concentration may provide the necessary information for the geostatistical approach. Figure 26 illustrates how geostatistics will be used at the IHSSs, PACs, and UBC Sites. A more detailed description of geostatistical procedures is provided in Section 5.1.4.

4.2.2 Standard Statistical Approach

The geostatistical approach is not suitable for IHSSs, PACs, or UBC Sites that have relatively few or no observations. Therefore, a separate sampling methodology is necessary to adequately characterize soil contamination in these areas. An efficient sampling strategy for delineating the spatial distribution and total amount of contamination encompassing "poorly" defined areas is a statistical grid design. This type of design is best suited for detecting potential localized areas of elevated PCOC concentration of unknown spatial distribution(s).

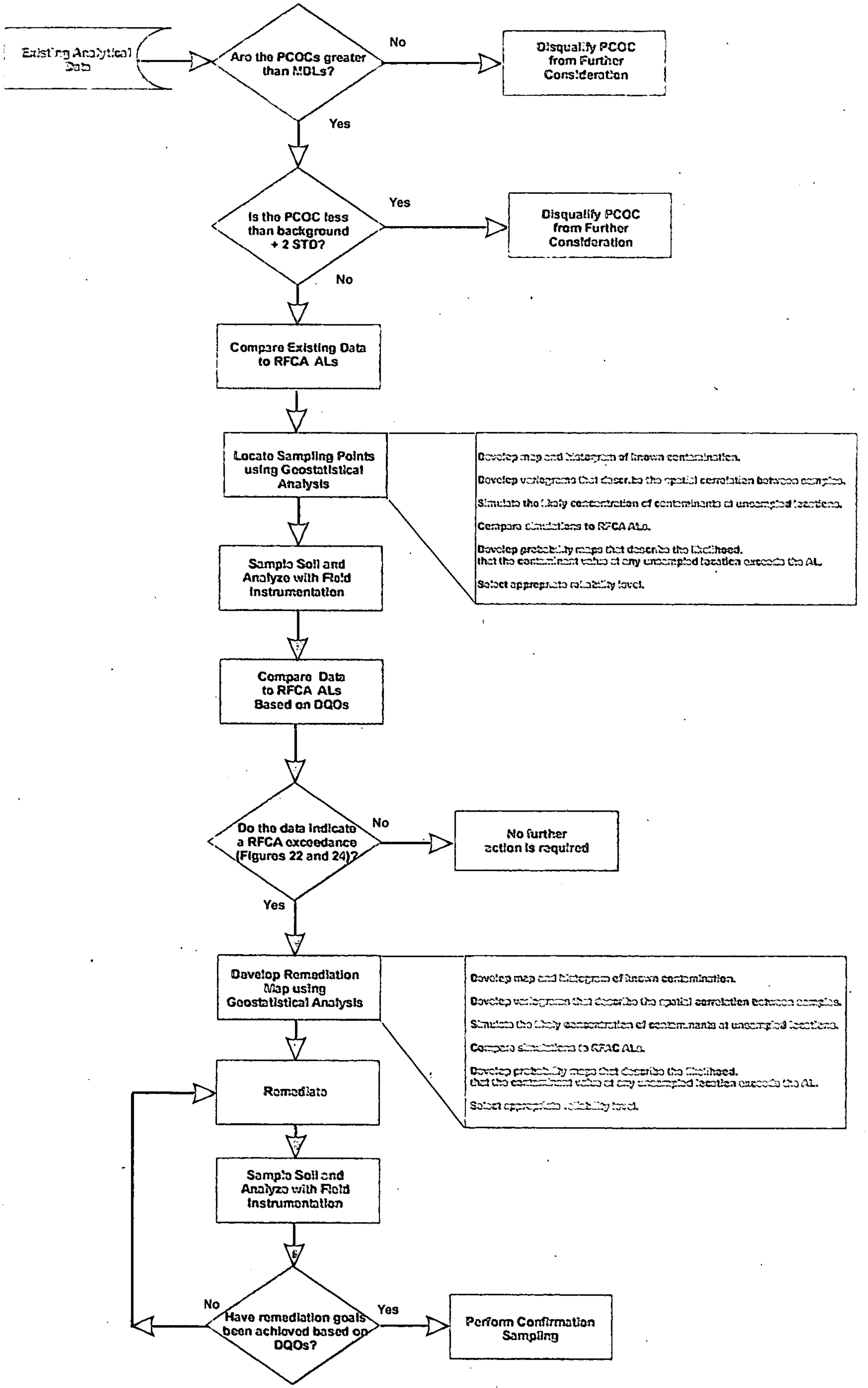
A localized area of elevated PCOC concentration is a relative term used to denote an area that has a significantly higher contaminant concentration than the surrounding area. Localized areas of elevated PCOC concentration are quantified by their size and contaminant concentration. The statistical grid design is based on the ability to determine whether these areas are present. A method for measuring localized areas of elevated PCOC concentration is needed to:

- Determine areas of limited extent that require remediation;
- Statistically evaluate the extent of contamination in localized areas; and
- Determine the size of the sampling grid.

This method is described in two steps:

1. Evaluate existing analytical data to determine whether there are data to constrain the size of a potential localized area of elevated PCOC concentration in an IHSS, PAC, or UBC Site. If data exist that provide information on potential localized areas of elevated PCOC concentration size (or sizes), these data will be used. For example, knowledge of the size of hazardous waste storage units, such as drum pallets, storage tanks, and crates, or the size of spills, will dictate the likely localized area of elevated PCOC concentration dimension(s) in a given area. If there is more than one potential localized area of elevated PCOC concentration in a given area, an average localized area of elevated PCOC concentration size will be determined. The grid size used for sampling and the number of samples required will be based on the defined localized area of elevated PCOC concentration and level of probability (90 percent) of finding a localized area of elevated PCOC concentration (Gilbert 1987). Biased sampling may also be used to augment the grid design.

Figure 26
Geostatistical Process for IHSSs, PACs, and UBC Sites



2. If there are no data available that can constrain the size of a localized area of elevated PCOC concentration in IHSSs and PACs, the statistical approach will be based on the sampling grid that was used to characterize radiologically contaminated surface soil within the 903 Pad Area. The 903 Pad Area was characterized using an HPGe detector on an 11-meter (m) (36-ft) triangular grid. Based on this grid dimension, there is a 90 percent probability of detecting a localized area of elevated PCOC concentration using Gilbert's (1987) methodology. The localized area of elevated PCOC concentration size is assumed to be circular with a diameter of 36 ft. (The field of view of the HPGe detector was 10 m [or 33 ft], which was based on the instrumentation, not a specified localized area of elevated PCOC concentration size.) The 36-ft triangular grid spacing is conservative for characterizing radionuclides and nonradionuclides, provides a consistent approach, and is small enough to detect most localized areas of elevated PCOC concentrations not targeted by biased sampling. This methodology will provide a consistent sample density for most IHSSs and PACs in the IA and BZ and provide data for subsequent geostatistical analysis, if needed.

   At UBC Sites and IHSSs or PACs that were covered by asphalt or concrete before the leaks or spills may have occurred, a larger grid size (22 m) may be used. This larger grid size is justified based on sampling at UBC Sites (UBCs 881 [DOE 2003b], 886 [DOE 2003c], and 889 [DOE 2003d]) that indicated COCs were not present beneath the slabs at concentrations greater than ALs. Biased sampling that specifically targets source terms and increases the probability of finding potential contamination will augment the larger grid size. This method provides 90 percent confidence that enough samples will be collected to adequately characterize the site.

There are IHSSs and PACs that are smaller than the proposed grid size of 11 m across. If no data are available to constrain a localized area of elevated PCOC concentration in these IHSSs and PACs, biased sampling methods will be used.

Areas with contaminant concentrations greater than RFCA ALs will be evaluated, according to IABZSAP DQOs and methods described in Section 5.0, to determine whether a localized area of elevated PCOC concentration is present. The localized area of elevated PCOC concentration, along with grid spacing and number of samples required for individual IHSSs, PACs, and UBC Sites, will be described in the IABZSAP Addenda.

Appropriate grid designs will be developed based on project DQOs and may include, but not be limited to, triangular and random stratified grids. Sampling IHSSs, PACs, and UBC Sites on a triangular grid will result in a spatial configuration of data that can be used for geostatistical analysis. This approach is conducive to determining the spatial correlation structure of the data set, which can be used in the geostatistical analysis to define areas above RFCA ALs.

A systematic sampling scheme will be used to identify and delineate the localized area of elevated PCOC concentration within the areas of interest following procedures outlined in Gilbert (1987). Sampling locations will be positioned into equilateral grids, such as triangular grids, following the methods presented in Gilbert (1987), Gilbert and Simpson (1992), and Section 4.2. Triangular grid sampling provides uniform coverage of a

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sampling area and increases the chances of identifying an elliptical or circular localized area of elevated PCOC concentration (Gilbert 1987). The following assumptions apply to the proposed sampling design:

- Samples will be collected on a statistical grid.
- The sampling area is much smaller than the grid spacing.
- Localized areas of elevated PCOC concentrations are circular or elliptical.
- Localized areas of elevated PCOC concentrations will be defined.
- After the grid interval is calculated for the specified area, a random-start grid overlay will be superimposed on a map of the IHSS, PAC, or UBC Site. In some cases, biased sampling will supplement the grid interval. This methodology provides grid coverage with a 90 percent confidence of finding a localized area of elevated radionuclide PCOC activity, as well as provides statistical confidence for other constituents consistent with DQO error rates of 10 percent (alpha) and 20 percent (beta) for both radionuclides and nonradionuclides. Confidence limits are also consistent with EPA specifications (EPA 1992).
- Soil samples will be collected at the intersection of each grid according to the sample collection methods described in Section 4.9. Additional samples will be collected, as needed, to determine the size of the AOC. Sampling methods for each IHSS, PAC, and UBC Site will be specified in the appropriate IABZSAP Addendum.

In summary, standard statistical techniques, outlined in Gilbert (1987) (and incorporated in a number of available software programs [for example, Visual Sampling Plan]), will be used to determine sampling locations in areas where:

- No existing analytical data are available;
- Limited analytical data are available;
- Process knowledge does not indicate biased sampling is appropriate; and
- Uniform contamination is indicated.

Figures 27 and 28 illustrate how standard statistical techniques and standard statistical techniques combined with a biased sampling approach, respectively, will be used at IHSSs, PACs, and UBC Sites.

4.2.3 Biased Approach

In addition to the systematic sampling design, some areas may require judgment or biased sampling where process knowledge or analytical data suggest there is a high probability of contamination in a limited area. This approach will provide targeted sampling of potential problem areas and result in the following:

- Additional sampling between the standard grid, if necessary; and

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Figure 27
Geostatistical Process for IHSSs, PACs, and UBC Sites

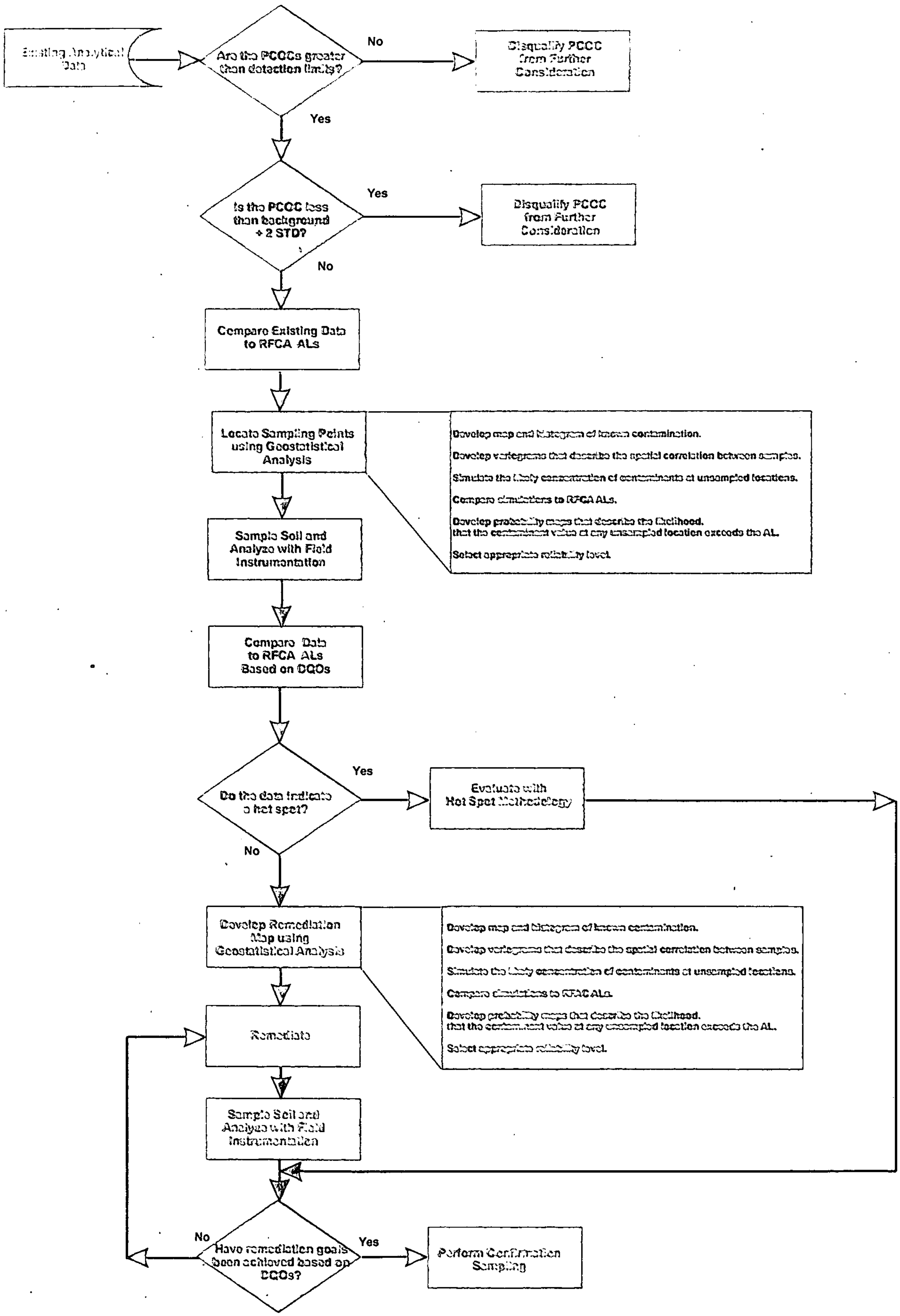
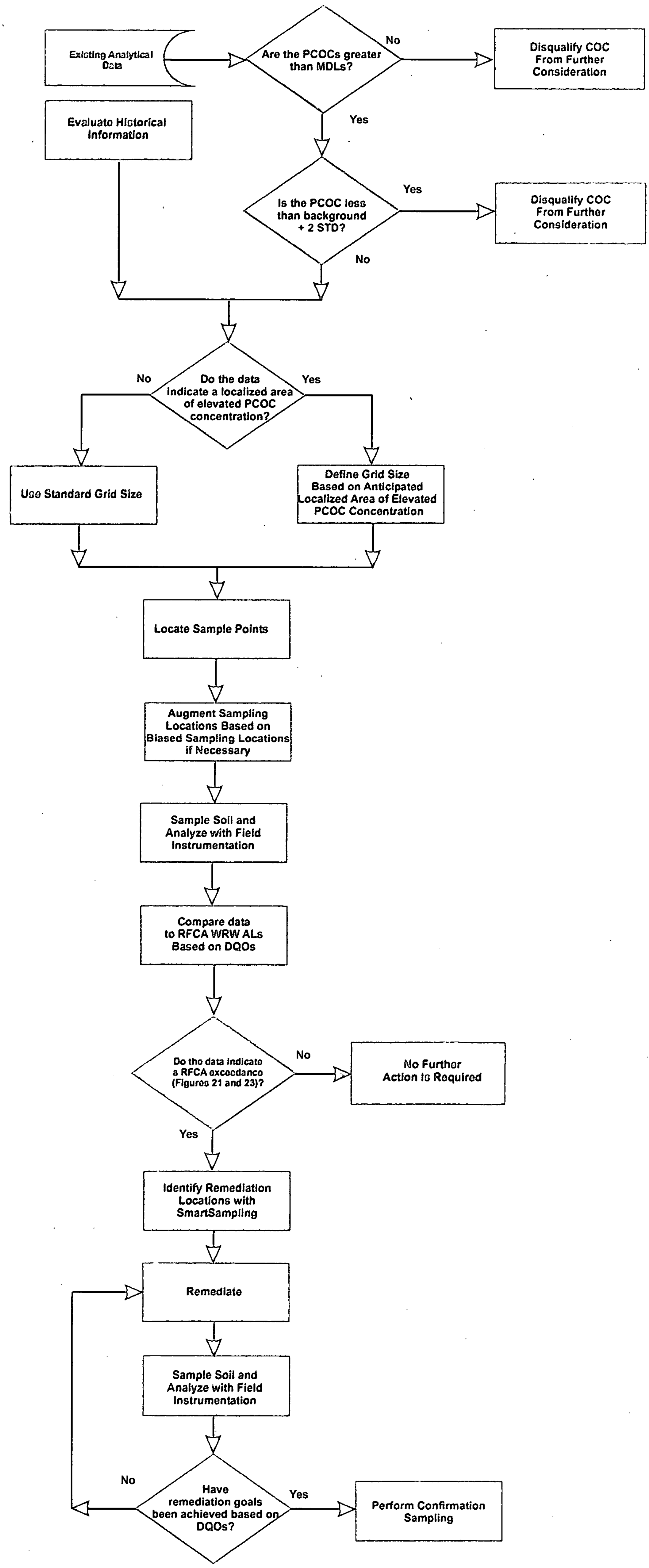


Figure 28
Standard Statistical and Biased Sampling Process for IHSSs, PACs, and UBC Sites



- Limited sampling of some IHSSs, PACs, or UBC Sites.

Biased sampling locations might include areas of deposition where contaminants have a tendency to accumulate. Other physical features that may warrant biased sampling include confluences, outfall points, and apparent discoloration of the soil, sediment, or vegetation. These features and the applicability of biased locations will be assessed during characterization planning. Figure 29 illustrates how biased sampling will be used at IHSSs, PACs, and UBC Sites.

In summary, a biased sampling approach will be used when:

- Process knowledge indicates discrete spills or releases; or
- Limited analytical data indicate hot spots or other discrete areas of interest.

4.3 Characterization Sampling Strategy for IHSSs, PACs, and UBC Sites

Existing analytical and historical information will be evaluated for each IHSS, PAC, and UBC Site to establish the appropriate statistical method (Section 4.2) for determining characterization sampling locations, PCOCs, and sampling methods for the site. A list of IHSSs, PACs, and UBC Sites, and a preliminary assessment of the statistical method that will be used, is provided in Table 4. PCOCs for the IA and BZ are listed in Section 3.0 and Appendix F. Sampling locations for IHSSs, PACs, and UBC Sites will be detailed in the appropriate IABZSAP Addendum.

4.3.1 Soil Sampling

The characterization team will sample surface soil in accordance with Standard Operating Procedure (SOP)-OPS-GT-08 and as described in Section 4.9. Surface soil samples will be analyzed with field instruments for radionuclides, metals, SVOCs, and, if existing historical or analytical data suggest, other analytes (pesticides, PCBs, and so forth). In some cases where existing data suggest a restricted PCOC list, soil samples will be analyzed for the specific PCOCs only. An example of this could be PAC 300-700, Pesticide Shed. Historical information indicates a small number of pesticides were used at RFETS and there is no evidence of any other compounds stored or used at PAC 300-700. In this case, surface soil samples will only be analyzed for pesticides. A list of PCOCs will be included in the appropriate IABZSAP Addendum.

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Figure 29
Biased Sampling Process
for IHSSs, PACs, and UBC Sites

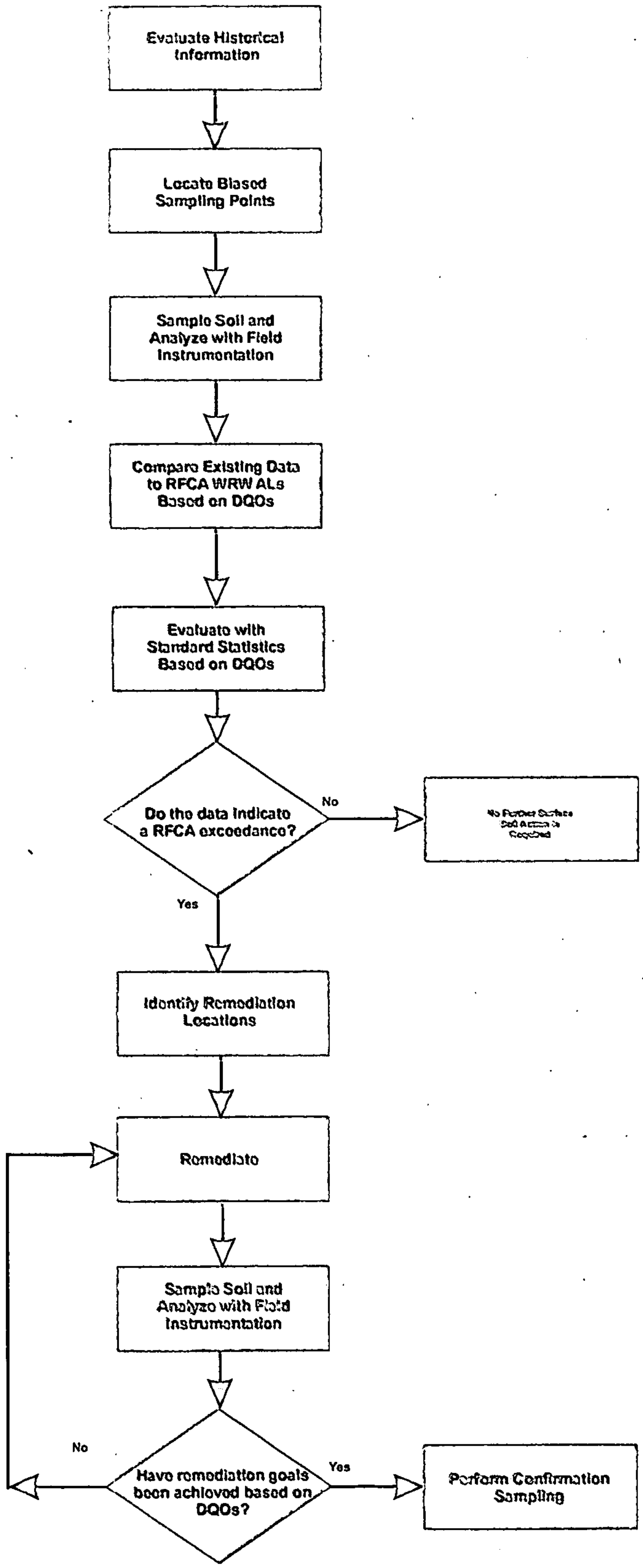

Table 4
Preliminary Sampling Location Statistical Techniques

IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
000-1	SEP	000-101	2,500	110	110	62	Waste disposal ponds	Sampling Completed
	Effluent Line	700-149.1	10,260				PVC transfer pipes w/multiple breaks; large outfall footprint	Biased Sampling
	Effluent Line	700-149.2	9,770	3	3	3	PVC transfer pipes w/ multiple breaks; large outfall footprint	Biased Sampling
	Triangle Area	900-165	242,269	23	42	34	Leaking drums, windblown contamination, plutonium soil and scrap stockpiles	Geostatistical
	S&W Contractor Yard	000-176	113,839	13	31	30	Windblown SEP spray and drum storage area	Geostatistical
	ITS Water Spill (formerly 000-502)	900-1310	4,031				ITS line separation (approx 500 gals released)	Standard Statistical
000-2	OPWL	000-121					Underground network pipes/tanks; multiple breaks and leaks	Biased Sampling
	Valve Vault West of Building 707	700-123.2	2,476				Process waste migration along containment pipe and into ditch	Biased Sampling
	Building 123 Process Waste Line Break	100-602	14,514				Line, valve vault, bedding material (conduit) between Buildings 123 and 443	Biased Sampling
	Tank 29 - OPWL	000-121		6	6	6	Aboveground waste process tank; possible leaks	Biased Sampling
	Tank 31 - OPWL	000-121					Belowgrade, open-top sewage tank	Biased Sampling
	Low-Level Radioactive Waste Leak	700-127	2,500				Multiple line breaks and leaks	Biased Sampling
	Process Waste Line Leaks	700-147.1	16,427	1			Multiple line breaks and leaks; diverse release paths	Biased Sampling
	Radioactive Site 700 Area	700-162	141,294	13	4	3	Residual hot spots along 8th Street	Biased Sampling
000-3	Sanitary Sewer System	000-500					Routine and incidental waste discharges to sinks, sumps, lines	Biased Sampling
	Storm Drains	000-505					May have received contaminated runoff	Biased Sampling
	Old Outfall - Building 771	700-143	6,167	6	6	6	Contaminated wastewater outfall area; one hot spot in nearby culvert	Biased Sampling
	Central Avenue Ditch Caustic Leak	000-190	186,016	31	8		Caustic release to Central Ave. Ditch, Walnut Creek, and Pond B-1	Biased Sampling
000-4	NPWL	000-504					Underground pipe system	Biased Sampling
000-5	Present Landfill	114	1,644,510	188	196	104	Disposal of uncontaminated solid waste	Geostatistical/Biased
100-1	UBC 122 - Medical Facility	UBC 122	9,768				Drum leaks and possible line leaks	Standard Statistical
	Tank 1 - OPWL - Underground Stainless Steel Waste Storage Tank	000-121		3	3	3	Overflows and leaks from underground tank	Biased Sampling
100-2	UBC 125 - Standards Laboratory	UBC 125	17,736				Possible spills from calibration lab (mercury)	Standard Statistical

IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
100-3	Building 111 Transformer PCB Leak	100-607	356				Transformer leak	Standard Statistical/Biased Sampling
100-4	UBC 123 - Health Physics Laboratory	UBC 123	18,885				Disposal out windows and waste line leaks	Standard Statistical
	Waste Leaks	100-148	14,143	4	4		Unlocated waste spills, OPWL leaks	Standard Statistical/Biased Sampling
	Building 123 Bioassay Waste Spill	100-603	356				OPWL leaks	Standard Statistical/Biased Sampling
	Building 123 Scrubber Solution Spill	100-611	294				Process waste leak	Standard Statistical/Biased Sampling
100-5	Building 121 Security Incinerator	100-609	599				Incinerator accepted PCB-laden paper	Standard Statistical
300-1	Oil Burn Pit #1	300-128	914				Burn and airborne contamination area	Standard Statistical
	Lithium Metal Site	300-134(N)	7,126	3	3		Burn area	Standard Statistical
	Solvent Burning Grounds	300-171	11,412	4	4		Burn area	Standard Statistical
300-2	UBC 331 - Maintenance	UBC 331	4,986				Possible spills from maintenance activities	Standard Statistical
	Lithium Metal Destruction Site	300-134(S)	23,728	9	9		Lithium burn areas (2)	Standard Statistical
300-3	UBC 371 - Plutonium Recovery	UBC 371	114,147				Known spills of wastewater and process solutions	Standard Statistical
	North Firing Range	NW-1505	117,748				Firing range currently in use	Standard Statistical/ Biased Sampling
300-4	UBC 374 - Waste Treatment Facility	UBC 374	27,131				Multiple spills and potential leaks from waste lines	Standard Statistical
300-5	Inactive D-836 HW Tank	300-206	627	8	8	8	Condensate water spill from line to tank	Biased Sampling
300-6	Pesticide Shed	300-702	4,380				Herbicide/pesticide spills/leaks in shed and surrounding area	Standard Statistical/Biased Sampling
400-1	UBC 439 - Radiological Survey	UBC 439	5,107				Possible spills from machining operations	Standard Statistical
400-2	UBC 440 - Modification Center	UBC 440	40,166				Possible spills from machining operations	Standard Statistical
400-3	UBC 444 - Fabrication Facility	UBC 444	123,113				Overflows and leaks of process solutions	Standard Statistical
	UBC 447 - Fabrication Facility	UBC 447	19,182				Possible spills and leaks from ongoing processes	Standard Statistical
	West Loading Dock Building 447	400-116.1	2,009	7	7	7	Spills and leaks impacted soil and groundwater beneath dock	Geostatistical/Biased Sampling
	Cooling Tower Pond West of Building 444	400-136.1	7,654	2	2		Evaporation holding pond	Geostatistical/Biased Sampling
	Cooling Tower Pond East of Building 444	400-136.2	7,097	10	10		Cooling tower blowdown pond	Standard Statistical/Biased Sampling
	Buildings 444/453 Drum Storage	400-182	3,465				Leaking drums and oil spills	Standard Statistical
	Inactive Building 444 Acid Dumpster	400-207	1,288				Known spills to containment berm (possible leakage)	Standard Statistical/Biased Sampling
	Inactive Buildings 444/447 Waste Storage Site	400-208	864	1			Possible leakage from drum storage	Standard Statistical

IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	Transformer, Roof of Building 447	400-801	1,597				Transformer leakage via downspouts possibly to storm drain	Standard Statistical/Biased Sampling
	Beryllium Fire - Building 444	400-810	15,073				Drainage, holding basin, and airborne contamination from fire	Standard Statistical/Biased Sampling
	Tank 4 - OPWL Process Waste Pits	000-121					Potential leaks and overflows	Biased Sampling
	Tank 5 - OPWL Process Waste Tanks	000-121					Potential leaks and overflows	Biased Sampling
	Tank 6 - OPWL Process Waste Floor Sump and Foundation Drain Floor	000-121					Potential leaks and overflows	Biased Sampling
	South Loading Dock Building 444	400-116.2	1,113	4	4	4	Windblown, drum leakage, dumping	Standard Statistical
400-4	Miscellaneous Dumping, Building 460 Storm Drain	400-803	18,932				Dumping to storm drain, extends along open ditch	Standard Statistical/Biased Sampling
	Road North of Building 460	400-804	1,393				Hot spots covered w/asphalt from falling ingots	Standard Statistical
400-5	Sump #3 Acid Site (Southeast of Building 460)	400-205	1,693				Leakage from container overflows in berm area	Biased Sampling
	RCRA Tank Leak in Building 460	400-813	356				Pipe leakage beneath building	Standard Statistical/Biased Sampling
	RCRA Tank Leak in Building 460	400-815	356				Possible leakage from spills to secondary containment	Standard Statistical/Biased Sampling
400-6	Radioactive Site South Area	400-157.2	438,409	52	52	52	Dumping, surface runoff, air releases, open surface storage	Geostatistical
400-7	UBC 442 - Filter Test Facility	UBC 442	2,583				Leaking barrels, discharges	Standard Statistical/Biased Sampling
	Radioactive Site North Area	400-157.1	51,169	7	7	7	Leaking drums, drainage to ditches	Standard Statistical
	Building 443 Oil Leak	400-129	6,434	11	11	11	Leaks and spills from underground tanks (6)	Geostatistical/Biased Sampling
	Sulfuric Acid Spill Building 443	400-187	20,206	2	2	2	Multiple leaks and sprays from storage tank	Geostatistical/Biased Sampling
400-8	UBC 441- Office Building	UBC 441						Standard Statistical
	Underground Concrete Tank	400-122					Overflows and leaking from tanks	Biased Sampling
	Tank 2 - Concrete Waste Storage Tank	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 3 - Concrete Waste and Steel Waste Storage Tanks	000-121		8	8	8	Potential leaks and overflows	Biased Sampling
400-10	Sandblasting Area	400-807	9,583				Open air sandblasting	Standard Statistical
	Fiberglass Area West of Building 664	600-120.2	5,449	12	14	3	Multiple spills around work area (resin and solvents)	Geostatistical
	Radioactive Site West of Building 664	600-161	53,346	30	10	2	Punctured and leaking drums, hydraulic leaks	Standard Statistical
500-1	Valve Vaults 11, 12, 13	300-186	48,345		8		Leaks and discharges from transfer pipes and vaults	Standard Statistical
	Scrap Metal Storage Site	500-197	89,320	5	5	5	Residual contamination from removal of process and building scrap	Standard Statistical
	North Site Chemical Storage Site	500-117.1	115,489	1	1		Surface storage of contaminated material,	Standard Statistical

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
							uranium chips	
500-2	Radioactive Site Building 551	500-158	62,166	7	7		Wastebox leakage, exterior contaminated drums transferred	Standard Statistical
500-3	UBC 559 - Service Analytical Laboratory	UBC 559	34,544				Plutonium waste line leaks and breaks	Standard Statistical/Biased Sampling
	UBC 528 - Temporary Waste Holding Building	UBC 528	432				OPWL leaks/valve vault overflows	Standard Statistical/Biased Sampling
	Radioactive Site Building 559	500-159	5,363				Broken process waste lines	Standard Statistical
	Tank 7 - OPWL - Active Process Waste Pit	000-121		3	3	3	Potential leaks and overflows	Biased Sampling
	Tank 33 - OPWL - Process Waste Tank	000-121					Potential leaks and overflows	Biased Sampling
	Tank 34 - OPWL - Process Waste Tank	000-121					Potential leaks and overflows	Biased Sampling
	Tank 35 - OPWL - Building 561 Concrete Floor Sump	000-121					Potential leaks and overflows	Biased Sampling
500-4	Middle Site Chemical Storage	500-117.2	91,616	5	5		Minor leaks and spills, partial asphalt cover	Geostatistical/Standard Statistical
500-5	Transformer Leak - 558-1	500-904	356				PCB-oil leaks to concrete pad	Standard Statistical/ Biased Sampling
500-6	Asphalt Surface Near Building 559	500-906	356				1-gal F001 spill from liquid hose transfer	Standard Statistical
500-7	Tanker Truck Release of Hazardous Waste from Tank 231B	500-907	859				Liquid and solid sludge release to soil	Standard Statistical/ Biased Sampling
600-1	Temporary Waste Storage - Building 663	600-1001	42,803				Leaking, punctured, and spilled drums (concrete pad)	Standard Statistical
600-2	Storage Shed South of Building 334	400-802	63,641				Leaking and spilled drums to concrete pad	Standard Statistical
600-3	Fiberglass Area North of Building 664	600-120.1	4,650	9	9		Multiple spills around work area	Geostatistical/Standard Statistical
600-4	Radioactive Site Building 444 Parking Lot	600-160	143,752	99	36	4	Releases from drums and boxes stored on ground	Geostatistical
600-5	Central Avenue Ditch Cleaning	600-1004	14,885				Soil spreading from ditch to area around tanks	Biased Sampling
600-6	Former Pesticide Storage Area	600-1005	356				Pesticide spills to dirt floor	Standard Statistical
700-1	Identification of Diesel Fuel in Subsurface Soil	700-1115					Subsurface fuel leak	Standard Statistical
700-2	UBC 707 - Plutonium Fabrication and Assembly	UBC 707	107,710				Process line leaks/breaks	Standard Statistical
	UBC 731 - Building 707 Process Waste	UBC 731	4,000				Process spills/OPWL leaks and breaks	Standard Statistical
	Tank 11 - OPWL - Building 731	000-121		3	3	3	Potential leaks and overflows	Biased Sampling
	Tank 30 - OPWL - Building 731	000-121		3	3	3	Potential leaks and overflows	Biased Sampling
700-3	UBC 776 - Original Plutonium Foundry	UBC 776	142,889				Airborne/tracked contamination fires and explosions/liquid waste spills	Standard Statistical/Biased Sampling
	UBC 777 - General Plutonium Research and Development	UBC 777					Process spills/OPWL leaks/fire contamination	Standard Statistical/Biased Sampling

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	UBC 778 - Plant Laundry Facility	UBC 778	26,609				Laundry water spills/OPWL leaks and breaks	Standard Statistical/Biased Sampling
	UBC 701 - Waste Treatment Research and Development	UBC 701	5,645				Possible spills from R&D lab	Standard Statistical/Biased Sampling
	Solvent Spills West of Building 730	700-118.1	246				Carbon tet overflows and line leaks	Standard Statistical/Biased Sampling
	Radioactive Site 700 Area No.1	700-131	7,072	17	17	17	Fire and explosion resulting in soil contamination	Geostatistical/Standard Statistical
	Radioactive Site West of Building 771/776	700-150.2(S)	27,113	4			Airborne and tracked contamination from fire, cleanup, and rain	Standard Statistical
	Radioactive Site South of Building 776	700-150.7	18,589	3	3		Airborne and tracked contamination from fire, cleanup, and rain	Standard Statistical
	French Drain North of Building 776/777	700-1100	1,567				Possible pathway for contamination from explosion and fire	Biased Sampling
	Tank 9 - OPWL - Two 22,500-Gallon Concrete Laundry Tanks	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 10 - OPWL - Two 4,500-Gallon Process Waste Tanks	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 18 - OPWL - Concrete Laundry Waste Lift Sump	000-121					Potential leaks and overflows	Biased Sampling
	Solvent Spills North of Building 707	700-118.2	633				Tank leaks and rupture	Standard Statistical/ Biased Sampling
	Sewer Line Overflow	700-144(N)	1,710	6	6	6	Pressurized sewer line breaks and overflows	Geostatistical/ Biased Sampling
	Sewer Line Overflow	700-144(S)	2,330	7	7	7	Pressurized sewer line breaks and overflows	Biased Sampling
	Transformer Leak South of Building 776	700-1116	356				Dielectric fluid leak to pad, gravel, and soil	Standard Statistical/ Biased Sampling
	Radioactive Site Northwest of Building 750	700-150.4	394	5	5	5	Leaks and backups of stored decon fluid	Standard Statistical
700-4	UBC 771 - Plutonium and Americium Recovery Operations	UBC 771	97,553				Fire, sewer line breaks, process waste line leaks	Standard Statistical/ Biased Sampling
	UBC 774 - Liquid Process Waste Treatment	UBC 774	15,776				Tank overflows, drain breaks	Standard Statistical/Biased Sampling
	Radioactive Site West of Buildings 771/776	700-150.2(N)	27,113	1	6	6	Fire, explosion, tank overflows	Standard Statistical
	Radioactive Site 700 North of Building 774 (Area 3) Wash Area	700-163.1	18,613	9	9	9	Contaminated equipment wash area	Geostatistical/Standard Statistical
	Radioactive Site 700 Area 3 Americium Slab	700-163.2	2,270				Buried contaminated (Am) slab 8'x8'x10"	Standard Statistical
	Abandoned Sump Near Building 774 Unit 55.13 T-40	700-215	960				Mixed waste storage tank	Biased Sampling
	Hydroxide Tank, KOH, NaOH Condensate	700-139(N)(b)	342				Overflows/spills from aboveground KOH/NaOH tanks	Standard Statistical/ Biased Sampling
	30,000-Gallon Tank (68)	700-124.1	1,133				Overflows/leaks from tank	Standard Statistical/ Biased Sampling
	14,000-Gallon Tank (66)	700-124.2					Overflows/leaks from tank	Biased Sampling

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	14,000-Gallon Tank (67)	700-124.3					Overflows/leaks from tank	Biased Sampling
	Holding Tank	700-125					Tank overflows	Biased Sampling
	Westernmost Out-of-Service Process Waste Tank	700-126.1	383				Belowgrade leaks/overflows	Biased Sampling
	Easternmost Out-of-Service Process Waste Tank	700-126.2	370				Belowgrade leaks/overflows	Biased Sampling
	Tank 8 - OPWL - East and West Process Tanks	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 12 - OPWL - Two Abandoned 20,000-Gallon Underground Concrete Tanks	000-121					Potential leaks and overflows	Biased Sampling
	Tank 13 - OPWL - Abandoned Sump - 600 Gallons	000-121					Potential leaks and overflows	Biased Sampling
	Tank 14 - OPWL - 30,000-Gallon Concrete Underground Storage Tank (68)	000-121		3	3	3	Potential leaks and overflows	Biased Sampling
	Tank 15 - OPWL - Two 7,500-Gallon Process Waste Tanks (34W, 34E)	000-121					Potential leaks and overflows	Biased Sampling
	Tank 16 - OPWL - Two 14,000-Gallon Concrete Underground Storage Tanks (66, 67)	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 17 - OPWL - Four Concrete Process Waste Tanks (30, 31, 32, 33)	000-121					Potential leaks and overflows	Biased Sampling
	Tank 36 - OPWL - Steel Carbon Tetrachloride Sump	000-121					Potential leaks and overflows	Biased Sampling
	Tank 37 - OPWL - Steel-Lined Concrete Sump	000-121					Potential leaks and overflows	Biased Sampling
	Caustic/Acid Spills Hydrofluoric Tank	700-139.2	918				Spills and leaks infiltrated surrounding soil	Standard Statistical/Biased Sampling
	Concrete Process 7,500-Gallon Waste Tank (31)	700-146.1	1,507				Frequent tank overflows and leakage	Standard Statistical/Biased Sampling
	Concrete Process 7,500-Gallon Waste Tank (32)	700-146.2					Frequent tank overflows and leakage	Standard Statistical/Biased Sampling
	Concrete Process 7,500-Gallon Waste Tank (34W)	700-146.3					Frequent tank overflows and leakage	Standard Statistical/Biased Sampling
	Concrete Process 7,500-Gallon Waste Tank (34E)	700-146.4					Frequent tank overflows and leakage	Standard Statistical/Biased Sampling
	Concrete Process 7,500-Gallon Waste Tank (30)	700-146.5					Frequent tank overflows and leakage	Standard Statistical/Biased Sampling
	Concrete Process 7,500-Gallon Waste Tank (33)	700-146.6					Frequent tank overflows and leakage	Standard Statistical/Biased Sampling
	Radioactive Site North of Building 771	700-150.1	24,779	9	9	9	Airborne, leaking drums, tracked contamination	Geostatistical/Biased Sampling
	Radioactive Site Between Buildings 771 and 774	700-150.3	5,037	3	3	3	Broken process waste line	Geostatistical/Biased Sampling
700-5	UBC 770 - Waste Storage Facility	UBC 770	3,111				Possible leakage from stored waste containers	Standard Statistical/ Biased Sampling
700-6	Buildings 712/713 Cooling Tower Blowdown	700-137	14,962	5	5	5	Ground placement of tower sludge/blowdown water leaks	Geostatistical/Standard Statistical

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	Caustic/Acid Spills Hydroxide Tank Area	700-139.1(S)	923	2	2	2	Multiple spills and leaks	Standard Statistical/ Biased Sampling
700-7	UBC 779 - Main Plutonium Components Production Facility	UBC 779	43,360				Building over original Solar Pond/water spills and leaks	Standard Statistical/ Biased Sampling
	Building 779 Cooling Tower Blowdown	700-138	14,962	9	9	9	Underground cooling tower water line break	Geostatistical/Standard Statistical
	Radioactive Site South of Building 779	700-150.6	4,435	3	3	3	Tracked contamination	Standard Statistical
	Radioactive Site Northeast of Building B779	700-150.8	13,054	2	1	1	Tracked contamination	Standard Statistical
	Transformer Leak - 779-1/779-2	700-1105	712				PCB oil released from transformer	Standard Statistical/ Biased Sampling
	Tank 19 - OPWL - Two 1,000-Gallon Concrete Sumps	000-121					Potential leaks and overflows	Biased Sampling
	Tank 20 - OPWL - Two 8,000-Gallon Concrete Sumps	000-121					Potential leaks and overflows	Biased Sampling
	Tank 38 - OPWL - 1,000-Gallon Steel Tanks	000-121					Potential leaks and overflows	Biased Sampling
700-8	750 Pad - Pondcrete/Saltcrete Storage	700-214	139,658				Pondcrete/saltcrete spills/pad runoff not contained	Standard Statistical
700-10	Laundry Tank Overflow - Building 732	700-1101	1,856				Wastewater tank overflow	Standard Statistical/ Biased Sampling
700-11	Bowman's Pond	700-1108	4,741				Tanks/process line leaks/footing drain accumulation area	Standard Statistical/ Biased Sampling
	Hydroxide Tank, KOH, NaOH Condensate	700-139.1(N) (a)	2,520	7	7	2	Multiple spills and leaks	Standard Statistical/ Biased Sampling
700-12	Process Waste Spill - Portal 1	700-1106	356				Valve vault water spilled onto street	Biased Sampling
800-1	UBC 865 - Materials Process Building	UBC 865	41,558				OPWL leaks/spills from coating ops and R&D activities	Standard Statistical
	Building 866 Spills	800-1204	2,623				Vent pipe and tank overflows	Standard Statistical/ Biased Sampling
	Building 866 Sump Spill	800-1212	364				Leak from sump pump	Standard Statistical/ Biased Sampling
	Tank 23 - OPWL	000-121					Potential leaks and overflows	Biased Sampling
800-2	UBC 881 - Laboratory and Office	UBC 881	79,222				Multiple leaks/broken waste lines	Standard Statistical
	Building 881, East Dock	800-1205	2,426				Possible unknown contamination/condensate spill	Standard Statistical
	Tank 24 - OPWL - Seven 2,700-Gallon Steel Process Waste Tanks	000-121		1	1	1	Potential leaks and overflows	Biased Sampling
	Tank 32 - OPWL - 131,160-Gallon Underground Concrete Secondary Containment Sump	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 39 - OPWL - Four 250-Gallon Steel Process Waste Tanks	000-121					Potential leaks and overflows	Biased Sampling
800-3	UBC 883 - Roll and Form Building	UBC 883	49,325				Process waste water leaks and overflows	Standard Statistical/ Biased Sampling
	Valve Vault 2	800-1200	4,541				Transfer line leak	Biased Sampling

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	Tank 25 - OPWL - 750-Gallon Steel Tanks (18, 19)	000-121					Potential leaks and overflows	Biased Sampling
	Tank 26 - OPWL - 750-Gallon Steel Tanks (24, 25, 26)	000-121					Potential leaks and overflows	Biased Sampling
	Radioactive Site South of Building 883	800-1201	1,500				Multiple areas of contamination from Plant operations	Standard Statistical
800-4	UBC 886 - Critical Mass Laboratory	UBC 886	13,517				Leaks and spills from criticality experiments	Standard Statistical/ Biased Sampling
	Tank 21 - OPWL - 250-Gallon Concrete Sump	000-121		2	2	2	Potential leaks and overflows	Biased Sampling
	Tank 22 - OPWL - Two 250-Gallon Steel Tanks	000-121		3	3	3	Potential leaks and overflows	Biased Sampling
	Tank 27 - OPWL - 500-Gallon Portable Steel Tank	000-121	31,400	2	2	2	Potential leaks and overflows	Standard Statistical/Biased Sampling
	Radioactive Site #2 800 Area, Building 886 Spill	800-164.2	31,400	57	57	57	Tank leak	Geostatistical
800-5	UBC 887 - Process and Sanitary Waste Tanks	UBC 887	378				Leaks and breaks in process waste lines	Standard Statistical/Biased Sampling
	Building 885 Drum Storage	800-177	1,064	9	9	9	Possible releases from waste storage	Geostatistical/Standard Statistical
800-6	UBC 889 - Decontamination and Waste Reduction	UBC 889	2,603				Radiological car wash area/OPWL leaks/waste tank breaches	Standard Statistical/ Biased Sampling
	Radioactive Site 800 Area Site #2 Building 889 Storage Pad	800-164.3	28,944	34			Leaks/spills/rainwater transport from storage area	Standard Statistical
	Tank 28 - Two 1,000-Gallon Concrete Sumps	000-121					Potential leaks and overflows	Biased Sampling
	Tank 40 - Two 400-Gallon Underground Concrete Tanks	000-121		4	4	4	Potential leaks and overflows	Biased Sampling
900-1	UBC 991 - Weapons Assembly and R&D	UBC 991	59,849				Potential line leaks/valve vault breaches and overflows	Standard Statistical/ Biased Sampling
	Radioactive Site Building 991	900-173	5,970	3	3	3	Small spills and equipment wash area	Standard Statistical
	Radioactive Site 991 Steam Cleaning Area	900-184	4,125				Equipment cleaning area	Standard Statistical
	Building 991 Enclosed Area	900-1301	3,939				Possible leaks from waste containers/material storage	Standard Statistical
900-2	Oil Burn Pit No. 2	153	6,403				Disposal and burning of uranium-contaminated coolant and waste oils	Biased/Stratified Statistical Grid
	Pallet Burn Site	154	3,152	4	4	12	Burning of wooden pallets	Biased/Stratified Statistical Grid
900-3	904 Pad, Pondcrete Storage	900-213	127,334	1			Spillage and rainwater runoff of stored pondcrete/saltcrete	Standard Statistical
900-4&5	S&W Building 980 Contractor Storage Facility	900-175	5,819	10	10	10	Leaks and spills from drum storage	Geostatistical/Standard Statistical
	Gasoline Spill Outside Building 980	900-1308	356				Gas overflow during filling	Standard Statistical/Biased Sampling
900-11	East Firing Range and Target Area	SE-1602	465,173				Lead bullets in Firing Range berm; armor-piercing bullet fragments made of depleted uranium in Target Area	Biased/Stratified Statistical Grid

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft²)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	903 Pad	112	146,727	52	12	73	Leaks and spills from drum storage	Geostatistical/ Biased Sampling
	Hazardous Disposal Area	140	65,498	14	12	48	Reactive metal destruction and disposal site	Biased/Stratified Statistical Grid
	903 Lip Area	155	1,009,572	1,173	16	73	Wind dispersal contamination from the 903 Pad	Geostatistical/ Biased Sampling
900-12	Trench T-6	111.3	4,089	2		2	Received sludge, asphalt planking, miscellaneous material	Biased Sampling
	Trench T-8	111.5	13,135	2	2	2	Received sludge, asphalt planking, miscellaneous material	Biased Sampling
	Trench T-9	111.6	21,061	5	5	5	Received sludge, asphalt planking, miscellaneous material	Biased Sampling
NE-1	Pond A-1	142.1	39,294	4	4	4	Received wastewater effluent from the Industrial Area; spill control	Biased/Stratified Statistical Grid
	Pond A-2	142.2	61,373	1	4	4	Received wastewater effluent from the Industrial Area; spill control	Biased/Stratified Statistical Grid
	Pond A-3	142.3	122,909	4	5	4	Received wastewater effluent from the Industrial Area	Biased/Stratified Statistical Grid
	Pond A-4	142.4	254,102	4	4	4	Received wastewater effluent from the Industrial Area	Biased/Stratified Statistical Grid
	Pond A-5	142.12	12,256	5	5	5	Received wastewater effluent from the Industrial Area	Biased/Stratified Statistical Grid
	Pond B-1	142.5	11,396	5	4	5	Flow-through retention pond; received treated sanitary effluent and process waste	Biased/Stratified Statistical Grid
	Pond B-2	142.6	33,761	5	5	5	Flow-through retention pond; received treated sanitary effluent and process waste	Biased/Stratified Statistical Grid
	Pond B-3	142.7	18,422	4	4	4	Flow-through retention pond; received treated sanitary wastewater effluent discharge	Biased/Stratified Statistical Grid
	Pond B-4	142.8	11,731	5	5	5	Flow-through retention pond; received treated sanitary wastewater effluent discharge	Biased/Stratified Statistical Grid
	Pond B-5	142.9	129,515	5	5	7	Flow-through retention pond; received treated sanitary wastewater effluent discharge	Biased/Stratified Statistical Grid
	Pond C-1	142.10	33,975	2	2	2	Retention and monitoring pond; received sanitary sewage discharge and runoff from the 903 Pad Area	Biased/Stratified Statistical Grid
	Pond C-2	142.11	168,524	3	4	4	Received discharge from the SID	Biased/Stratified Statistical Grid
NE-2	Trench T-7	111.4	15,565	9	9	27	Disposal of sanitary waste sludge and debris	Biased/Stratified Statistical Grid
	Ryan's Pit (Trench 2)	109	261	2	2	6	Disposal of VOCs and drum carcasses	Biased/Stratified Statistical Grid
NE/NW	East Spray Field-Center Area	216.2	73,458	1	1	8	Spray irrigation from Pond B-3	Biased/Stratified Statistical Grid

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IHSS Group	Description	IHSS/PAC/ UBC Site	Area (ft^2)	Number of Existing Sampling Locations			Historical Notes	Sampling Location Technique
				Rads	Metals	Organics		
	East Spray Field-South Area	216.3	651,580	10	13	27	Spray irrigation from Pond B-3	Biased/Stratified Statistical Grid
	Trench T-12 Located at OU 2 East Trenches	NE-1412	7,449				Disposal of sanitary waste sludge and flattened drums	Biased/Stratified Statistical Grid
	Trench T-13 Located at OU 2 East Trenches	NE-1413	5,090				Disposal of sanitary waste sludge and flattened drums	Biased/Stratified Statistical Grid
	PU&D Yard - Drum Storage	174a	4,342		21	93	Leaks and spills from RCRA drum storage	Geostatistical/Biased Sampling
	OU 2 Treatment Facility	NE-1407	356				Leaks and spills from process operations	Biased/Stratified Statistical Grid
SW-1	Recently Identified Ash Pit	SW-1702	5,588				Disposal of combustible waste ash, depleted uranium, and metallic debris	Biased/Stratified Statistical Grid
	Ash Pit 1	133.1	13,960	4	4		Disposal of combustible waste ash and noncombustible trash	Biased/Stratified Statistical Grid
	Ash Pit 2	133.2	26,624	7	7		Disposal of combustible waste ash and noncombustible trash	Biased/Stratified Statistical Grid
	Ash Pit 4	133.4	10,749	3	3		Disposal of combustible waste ash and noncombustible trash	Biased/Stratified Statistical Grid
	Incinerator	133.5	45,495	2	2	1	Area backfilled with ash potentially contaminated with depleted uranium	Biased/Stratified Statistical Grid
	Concrete Wash Pad	133.6	35,274	1	1	4	Deposition of potentially contaminated ash	Biased/Stratified Statistical Grid
SW-2	Original Landfill	SW-115		68	71	68	General Plant waste disposal/burning pits/depleted uranium disposal	Sampling Completed
	Water Treatment Plant Backwash	SW-196		3	3	3	Sandfilter backflushing	Sampling Completed

Subsurface soil will be sampled where historical information and analytical data suggest contamination may be present below a depth of 6 inches. The characterization team will collect subsurface soil samples with a Geoprobe® (or other appropriate method) to the top of the saturated zone or top of bedrock. The characterization team will use concrete drills (for UBC Sites, concrete slabs, and other foundation areas) where necessary. The types of Geoprobe® and other sampling methods that may be used are described in Section 4.9. The COCs for each IHSS, PAC, and UBC Site will be specified in the appropriate IABZSAP Addendum.

Soil sample analytical results will be compared to RFCA ALs. Data from each IHSS, PAC, and UBC Site will be evaluated according to DQOs (Section 3.0).

4.4 Post-Remediation Confirmation Sampling

Post-remediation confirmation sampling will be conducted at AOCs associated with IHSSs, PACs, and UBC Sites in the IA and BZ. In-process confirmation soil samples will be collected and analyzed during remediation to verify cleanup below remediation goals. In-process samples will be analyzed with field analytical instruments. Post-remediation confirmation samples will also be collected and analyzed. The combination of in-process and confirmation samples will ensure that residual contamination levels are below remediation goals.

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4.4.1 Confirmation Sampling and Analysis

Confirmation samples are defined as those samples collected following a remedial action. The characterization team will conduct confirmation sampling and analysis on remediated areas to verify that the site has met remedial objectives. The confirmation sampling and analysis will provide a representative assessment of the magnitude and spatial configuration of the COC(s) after remediation. The number and distribution of confirmation samples will be based on the probability of detecting residual contamination (90 percent) and the size and spatial variability of the remediated site. Statistical sampling strategies will ensure that the appropriate numbers of samples are collected from unbiased locations.

The characterization team will collect soil from the remediated areas before the areas are covered with clean fill. Confirmation sampling locations will be determined using geostatistical methods or the approaches described in Section 4.4.2. Soil samples will be analyzed on site if appropriate data quality is achieved, or sent to off-site analytical laboratories for analysis, and analytical data will be validated in accordance with ASD requirements. If adequate correlation is demonstrated between field analytical and laboratory analysis data, field instrumentation may also be used for confirmation analysis.

The characterization team will conduct confirmation sampling at all IA and BZ IHSS Group remediations. They will compile and evaluate confirmation sampling data generated during that time to determine whether field analytical data are of sufficient quality to be used for CRA analyses. If the regulatory agencies concur that the field analytical data are of sufficient quality, remediation confirmation samples will be analyzed with field analytical instruments rather than sent to off-site laboratories.

4.4.2 Sampling Locations

Confirmation sampling locations will be determined based on the configuration of the remediated area or as determined through the consultative process. The following sampling location methods may be used:

- Biased sampling will be used at sites with known or suspected discrete spills or leaks and to supplement statistical sampling if necessary. Exact locations of biased sampling points will be based on site-specific and physical characteristics of the soil. Some characteristics that may require biased sampling may include, but are not limited to, the following:
  - Preferential migration pathways (for example, burrows, fractures, bedding planes, and sandstone lenses);
  - Source areas (for example, outfalls, storage areas, and historical spill sites);
  - Stained soil;
  - Changes in soil characteristics (for example, sand/clay interfaces); and
  - Depressions and ditches.

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- At remediated areas smaller than 0.06 acre (2,614 ft^2), a minimum of five locations will be sampled. Locations will include the walls and floor of the remediated area.

- Confirmation sampling in trenches will consist of biased sampling. This will include sampling every 100 ft, depending on the length of the pipeline or trench, along the bottom of the pipeline or trench. If residual contamination is found along the bottom of the trench, sidewall sampling may also be necessary.

- Composite or grab samples may be used as confirmation samples within a remediation grid as determined through the consultative process.

- For remediated areas that were contaminated with radionuclides, 90 percent of the area may be scanned using in-situ HPGe techniques within a triangular grid system. Considering that an HPGe detector has an 11-m-diameter field of view with the detector placed 1 m above the soil surface, a grid interval of 11 m (36 ft) will be used to achieve 90-percent coverage. This grid spacing is consistent with the characterization sampling approach.

- For remediated areas where nonradiologically-contaminated soil was remediated, the grid density for confirmation sampling in nonradiologically-contaminated areas may be based on the size of the remediated area (Michigan DNR 1994). This approach is based on a 95% confidence level of determining any hot spot concentrations on a site. Incorporating confirmation sampling will allow for a reduction in the Type I error rate from 0.1 to 0.05, which will reduce the probability of residual contamination after remediation. This approach is designed to delineate nonuniform areas of residual contamination, and is therefore appropriate for reliable characterization of the entire remedial area. Grid density is proportional to the size of the area and can be determined using one of the following equations (Michigan DNR 1994):

Small Remediation Site (0.06 to 0.25 acre): $$GI = \frac{\sqrt{A/\pi}}{2}$$ (Equation 4-1)

Medium Remediation Site (0.25 to 3.0 acres): $$GI = \frac{\sqrt{A/\pi}}{4}$$ (Equation 4-2)

Large Remediation Site (> 3.0 acres): $$GI = \sqrt{(A * \pi)/SF}$$ (Equation 4-3)

Where:

GI = grid size (L)
A = size of area of interest (L^2)
SF = site factor, length of grid area (dimensionless)

As shown above, the grid equations apply to three different size areas. The grid densities vary according to the size of the area of interest.

Table 5 presents several examples of the calculations.

Table 5
Calculation of Confirmation Sampling Location Grids

Equation 4-1	Area (ft^2)	A/π	Sq Root	Grid Size (ft^2)
Small Site - 0.06 to 0.25 acre (2,614 to 10,890 ft^2)	2,614	832	28	14
	5,000	1,592	39	20
	10,890	3,468	58	29
Equation 4-2				
Medium Site - 0.25 to 3.0 acres (10,890 to 130,680 ft^2)	50,000	15,923	126	32
	100,000	31,847	178	45
	130,680	41,617	204	51
Equation 4-3	**Area (ft^2)**	**A*π**	**SF**	**Grid Size (ft^2)**
Large Site - >3.0 acres (>130,680 ft^2)	1,000,000	3,140,000	1,000	56

Both the sidewalls and bottom areas will be included in the determination of the confirmation samples. A minimum of five confirmation samples will be collected, including one sample for each sidewall and the floor or as determined through the consultative process. Sidewall samples will be located in biased areas, if possible.

4.5 Characterization Sampling Strategy for Surface Soil in Areas Outside of IHSSs, PACs, and UBC Sites

Surface soil in areas outside of IHSSs, PACs, and UBC Sites in the IA and BZ will be sampled and analyzed to provide data for risk assessment or screening. The SOR data for COCs from existing data and IA and BZ characterization data will be compared to RFCA ALs through geostatistical analysis, and the resulting simulation will be used to determine optimal sampling areas within these areas.

Sampling grid spacing and the number of required samples will be calculated based on Gilbert's method (1987). Specific sampling locations will be described in the appropriate CRA sampling addendum.

Soil samples will be collected at the specified locations and depths according to the sample collection methods described in Section 4.9. These samples will be analyzed in accordance with CRA requirements. Data will be evaluated according to CRA DQOs.

4.6 UBC Sites

There are 31 designated UBC Sites in the IA OU. Past and current operations in these buildings have included production and waste management activities. These buildings were designated as UBC Sites because of documented spills or releases in the buildings or routine operations that may have resulted in contamination (DOE 1992d). Issues associated with characterization of these UBC Sites include the following:

- Potentially unknown spills, releases, and contamination;
- OPWL and other utilities beneath buildings;

- More than one type of pipeline beneath buildings;
- Free-standing water beneath buildings;
- Basements or foundations below the water table or top of bedrock;
- Additional PCOCs because of associated IHSSs;
- Potentially wide range of PCOCs;
- Accessibility; and
- Structural integrity of foundations.

Because of the potential H&S issues associated with the unknown contamination at UBC Sites, initial characterization will begin during deactivation as soon as building floors and slabs are accessible, usually during the last 50 percent of deactivation. Initial characterization will support field characterization and H&S planning efforts by providing information on the approximate extent of potential contamination. The timing of initial characterization will be determined on a building-by-building basis as safety and security allow. Characterization techniques will include soil sampling by drilling or coring through building slabs or using horizontal directional drilling (HDD) beneath building slabs.

Initial UBC Site soil characterization will consist of biased sampling. Sampling locations will be selected based on process knowledge, existing data, and decommissioning sampling. Sampling and analysis methods will follow those described in Section 4.9.

4.7 OPWL, NPWL, Sanitary Sewers, and Storm Drains

The OPWL, NPWL, sanitary sewers, and storm drain systems are unique characterization challenges. The key strategy for the OPWL is consistent with RFCA Attachment 14. The key strategy for NPWL, the sanitary sewer system, and storm drains is to remediate contaminated soil and associated pipelines, and stabilize in place those segments with contaminant concentrations below RFCA ALs.

Issues that add to the complexity of characterizing and remediating the OPWL, NPWL, sanitary sewer system, and storm drains include the following:

- Extent and size of systems;
- Systems under buildings, roads, and other infrastructure;
- Conflicting information on pipeline locations and use;
- Pipelines collocated with other utilities;
- Pipelines and utility corridors as potential groundwater migration pathways;
- Varying or unknown pipeline depths;

- Various pipeline compositions (polyvinyl chloride [PVC], stainless steel, cement asbestos, cast iron, Saran-lined steel, vitrified clay, ribbed hose fiberglass, reinforced epoxy pipe, black iron, polyethylene, glass, and Schedule 40 steel);
- Documented leaks and releases from many pipelines, or pipelines listed as leaking with no supporting evidence; and
- Many potential waste streams and PCOCs.

4.7.1 OPWL

The OPWL, shown on Figure 30, is a network of tanks, underground pipelines, and aboveground pipelines used to transport and temporarily store aqueous chemical and radioactive process wastes. The OPWL potentially transported a variety of wastes including acids, bases, solvents, radionuclides, metals, oils, PCBs, biohazards, paints, and other chemicals (DOE 1992d).

The OPWL network originally consisted of approximately 35,000 ft of pipeline. Parts of the OPWL were converted to NPWL or other systems (for example, fire plenum deluge system), and will be characterized as part of those systems. The current OPWL system contains approximately 28,638 ft of pipeline. Approximately 13,317 ft of pipeline is included in IHSS Group 000-2. The remaining 15,321 ft of pipeline is included in other IHSS Groups.

4.7.2 NPWL

The NPWL, illustrated on Figure 31, consists of pipelines, tanks, and valve vaults that may overlap with the OPWL. The NPWL transports low-level aqueous waste to the liquid waste treatment facility in Building 374. Based on Site utility maps, it is estimated that approximately 6,300 ft of pipeline does not overlap and is not included with the OPWL.

4.7.3 Sanitary Sewer System

The sanitary sewer system (Figure 31) consists of approximately 36,480 ft of pipeline, and 25 valve vaults, pump vaults, and similar structures. This estimate includes only main pipelines. Remaining pipelines will be characterized with UBC Sites or other IHSSs or PACs. No previous characterization of the sanitary sewer system exists. The sanitary sewer system has been used for the transport, storage, and treatment of sanitary wastes since 1952. Historically, waste streams other than typical sanitary wastes have been discharged to the sanitary sewer system, including a variety of chemical and radioactive wastes from laboratories, process buildings, and laundries. Additionally, hazardous and radioactive liquids from spills and accidental discharges have entered the sanitary sewer system. Historic discharges to the system may have included acids, bases,

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THIS TARGET SHEET REPRESENTS AN
OVER-SIZED MAP / PLATE FOR THIS DOCUMENT:
(Ref: 04-RF-01112; KLW-034-04)

Industrial Area and Buffer Zone Sampling and Analysis Plan Modification 1

Figure 30:

Original Process Waste Lines

April 6, 2004

CERCLA Administrative Record Document, SW-A-005011

U.S. DEPARTEMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

GOLDEN, COLORADO

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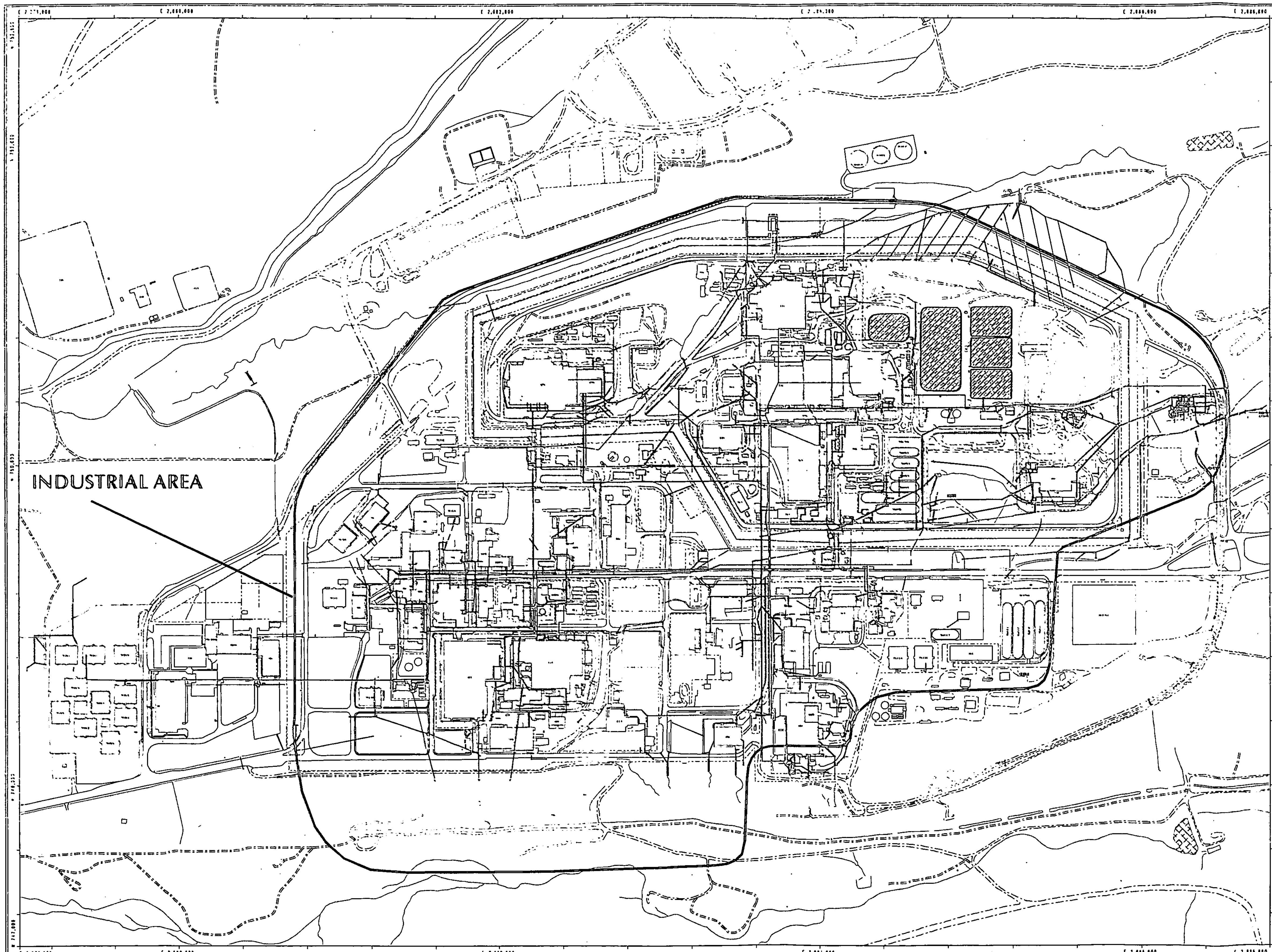
Figure 31

New Process Waste Lines, Sanitary Sewer System, and Storm Drains



IHSS Groupings

- New Process Waste Lines - 000-4
- Storm Drains - 000-3
- Sanitary Sewer System - 000-3
- PAC, IHSS, UBC site, or Tank

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads
- Industrial Area Operable Unit Boundary

DATA SOURCE BASE FEATURES:

The utilities (above-ground and underground) information was supplied by EG&G Facilities Department in DXF format, Aug 1993. The GIS Department created ARC coverages (data layers) from the DXF files and converted the data from Rocky Flats Coordinate system to State Plane Coordinate system.
NOTE: This data HAS NOT BEEN edited or coded (with attributes information).

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

Scale = 1 : 7720
1 inch represents approximately 643 feet

200 0 400 800 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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

GIS Dept. 303-966-7707

Prepared by: DynCorp THE ART OF TECHNOLOGY

Prepared for: KAISER-HILL COMPANY

MAP ID: 2k-0411 June 11, 2001

NT_Svr w:/projects/fy2k/2k-0411/ia-strategy-npwl_fig .aml

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beryllium, chromic acid, chromium, film processing chemicals, laundry waste, nitrates, oils, paint, radionuclides, solvents, sulfuric acid, and tritium (DOE 1992d).

4.7.4 Storm Drains

There are 239 storm drains at RFETS as shown on Figure 31. Of these, 139 are part of IHSS Group 000-3. The remaining 100 storm drains are part of other IHSS Groups. Based on current Site maps, there are approximately 19,279 ft of storm drains. Storm drains may have been exposed to contaminated liquids because of spills, fires, contaminated surface-water runoff, and contaminated sediments. Potential wastes may include wash water from degreasing of depleted uranium parts, nitric acid (HNO_3)/nitrate waste solution, PCB runoff, silver and aluminum paint, and oil.

4.7.5 Characterization Strategy

Because of the extent and complexity of these systems, the IABZSAP characterization approach has been modified to ensure effective characterization is conducted. Two characterization approaches will be used.

1. The sections of OPWL, NPWL, sanitary sewers, and storm drain system associated with IHSSs, PACs, and UBC Sites will be characterized along with the IHSS Groups. Additionally, sections of pipeline adjacent to or close to an IHSS, PAC, or UBC Site will also be included with the IHSS Group characterizations wherever possible. This approach will reduce planning, mobilization, and field costs and schedules. Pipeline segments that will be included with other IHSS Groups will be documented in the appropriate IABZSAP Addendum.

2. Remaining sections of the OPWL, NPWL, sanitary sewers, and storm drain system will be characterized using a biased sampling approach when infrastructure constraints are eliminated or reduced. Where these systems overlap or are adjacent, characterization can be conducted concurrently.

OPWL Characterization

The sampling strategy for the OPWL (IHSS 000-121) is consistent with the recent RFCA Modification (DOE et al. 2003). In accordance with RFCA Attachment 14, the sampling methodology is described below.

Soil associated with the OPWL between 3 and 6 ft bgs in areas with reported leaks will be characterized to 8 ft bgs in accordance with this IABZSAP at the leak location. Soil associated with suspected OPWL leaks will be characterized at the suspected leak location and depth. Reported and suspected OPWL leaks between 3 and 6 ft bgs are listed in Table 6 and shown on Figure 32.

If initial characterization results indicate soil activity is greater than 3 nanocuries per gram (nCi/g), additional sampling will be conducted as follows:

- At locations perpendicular to the pipe run and 2 m from the original sampling location;

- At locations between 5 and 10 m on either side of the original sampling location; and

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- At locations to adequately characterize soil to implement the SSRS (RFCA Attachment 5 [DOE et al. 2003]) based on step-out sampling.

Soil associated with the OPWL will be characterized in accordance with Section 4.9.

Table 6
Reported or Suspected OPWL Leaks

Leak Designation	Pipe Description	Depth	Leak Description
P14-1	3-inch Saran-lined steel pipe inside a 10-inch vitrified clay pipe	Approximately 3 ft bgs	Acid leaks at intersection of P-12 and P-14
P-19-1	3-inch stainless steel	Approximately 3.5 ft bgs	Valve vault northeast of Building 707
P-20-1	3-inch stainless steel	Approximately 4 ft bgs	Reported release at intersection of P-20 and P-21
P-20-2	3-inch stainless steel	Approximately 4 ft bgs	Valve vault northeast of Building 707
P-23-1	10-inch fiberglass or stainless steel	Approximately 5 ft bgs	Reported leak at Tank T-8
P-27-1	3-inch cast iron	Approximately 6 ft bgs	Reported release at intersection of P-27 and P-28
P-27-5	3-inch cast iron	Approximately 6 ft bgs	Leak south of road on July 21, 1980. Process wastewater flowed through a 30-ft culvert along fence and around to north side of Building 774 where it ended up in Bowman's Pond. Approximately 1,000 gallons leaked. Sampling indicated 2,500 pCi/L total alpha, 4,000 pCi/L total beta, 10,000 mg/L nitrate, and a pH of 12.
P-29-1	4-inch cast iron and 4-inch stainless steel pipes	Approximately 5 ft bgs	Area around Tanks T-14 and T-16 reported as area of release.
P-34-1	4-inch stainless steel or steel	Approximately 3.5 ft bgs	Reported release at intersection of P-33 and P-34
P-34-2	4-inch stainless steel or steel	Approximately 3.5 ft bgs	Reported release at intersection of P-25 and P-34
P-34-3	4-inch stainless steel or steel	Approximately 3.5 ft bgs	Reported release in area of T-15 and T-17
P-36-1	3-inch PVC and stainless steel	Approximately 4 ft bgs	Release reported at intersection of P-36 and P-20
P-36-2	3-inch PVC and stainless steel	Approximately 4 ft bgs	Release reported at valve vault west of Pond 207-A
P-37-3	3-inch steel, PVC, and vitrified clay pipe (might be two lines)	Approximately 4.5 ft bgs	Valves north of Building 777 were found to be leaking at a rate of 25 gallons per hour at 20 psig during leak testing.
P-42-1	3-inch cast iron or stainless steel	Approximately 3.5 ft bgs	Reported release at intersection of P-42 and P-37
P-42-3	3-inch cast iron or stainless steel	Approximately 3.5 ft bgs	Valves on south side of Tank T-29 (207) reported to be leaking.
P-43-1	3-inch stainless steel	Approximately 3.5 ft bgs	Leak reported at valve vault north of Tank T-29 (207)
P-43-2	3-inch stainless steel	Approximately 3.5 ft bgs	Leak reported at valve vault southwest of Tank T-29 (207).
P-4-1	4-inch cast iron	Approximately 3.5 ft bgs	Leak at intersection of P-4 and Tank T-3.

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Leak Designation	Pipe Description	Depth	Leak Description
P-4-2	4-inch cast iron	Approximately 4 ft bgs	Leak at intersection of P-4 and P-6. There is a manhole at this location that is 8 ft deep.
P-4-8	4-inch cast iron	Approximately 3.5 ft bgs	Leak 30 ft east of driveway south of Building 441
P-4-12	4-inch cast iron	Approximately 3.5 ft bgs	Leak at check valve south of Building 441
P-4-18	4-inch cast iron	Approximately 3.5 ft bgs	Leak 31 ft east of driveway behind Building 441. This is likely in the same area as P-4-8 above and could be the same leak.
P-4-19	4-inch cast iron	Approximately 3.5 ft bgs	Leak reported 94 ft east of driveway behind Building 441.
P-5-1	4-inch cast iron	Approximately 3.5 ft bgs	Leak occurred 8 ft inside fence toward Building 444.
P-5-2	4-inch cast iron	Approximately 3.5 ft bgs	Possible leak found from leak test 8 ft out from Building 444.
P-40-2	6-inch fiberglass line	Approximately 5 ft bgs	Leak reported at settling tank near B-2 pond. This line has been removed in this area.
P-4	4-inch cast iron	Approximately 4 ft bgs	Leaks suspected along entire line.
P-14	3-inch Saran-lined steel pipe inside a 10-inch vitrified clay pipe	Approximately 3 ft bgs	Leaks suspected along entire line.
P-16	3-inch PVC	Approximately 10 ft bgs	Leaks suspected at line/tank intersection.
P-17	3- and 4-inch glass/4-inch PVC inside 6-inch glass pipe	Approximately 7 ft bgs	Leaks suspected at pipe join.
P-26	1.5-inch PVC or stainless steel and a second PVC pipe of unknown diameter	Approximately 3 ft bgs	Leaks suspected along entire line.
P-27	3-inch cast iron	Approximately 6 ft bgs	Entire line was identified as an area of a reported release.
P-28	3-inch cast iron and 3-inch stainless steel	Approximately 5 ft bgs	Leaks suspected along entire line.
P-29	4-inch cast iron and 4-inch stainless steel pipes	Approximately 5 ft bgs	A leak of 45 gallons per hour at a pressure of 20 psig detected during a 1971 leak test.
P-32	6-inch vinyl chloride pipe, 4-and 6-inch cast iron, and 4-and 6-inch steel pipe		Leak suspected at pipe join.
P-34.1	4-inch stainless steel or steel	Approximately 3.5 ft bgs	Leak suspected at line segment.
P-36/37/38	3-inch PVC and stainless steel/3-inch steel, PVC, and vitrified clay/6-inch and 10-inch vitrified clay pipe	Approximately 3 to 5 ft bgs	Leak suspected at pipe join.
P-37	3-inch steel, PVC, and vitrified clay pipe (might be two lines)	Approximately 4.5 ft bgs	Northern half of line west of Pond 207-A has been reported as an area of release.
P-38	6-inch and 10-inch vitrified clay	Approximately 3 to 5 ft bgs	Leak suspected at line segment.
P-39	6-inch vitrified clay	Approximately 10 ft bgs	Leaks suspected at east outfall.
P-40	6-inch fiberglass	Approximately 10 ft bgs	Leaks suspected at east outfall.

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Leak Designation	Pipe Description	Depth	Leak Description
P-41	2- and 3-inch vitrified clay, black-iron, and stainless steel	Approximately 5 ft bgs	Pipeline west of Building 779 identified as an area where a release occurred.
P-42	3-inch cast iron or stainless steel pipe	Approximately 3.5 ft bgs	Area around Building 779 was reported to have a pipeline release.
P-43 Tank 29	3-inch steel	Approximately 5 ft bgs	Leaks suspected at pipe join.
P-44	3-inch steel	Approximately 3.5 ft bgs	Pipeline in area east of Building 703 reported to have a leak.
P-45	3-inch steel	Approximately 3.5 ft bgs	Pipeline in area east of Building 703 reported to have a leak.
Miscellaneous 700-Area	N/A	Approximately 5 ft bgs	N/A

THIS TARGET SHEET REPRESENTS AN OVER-SIZED MAP / PLATE FOR THIS DOCUMENT:
(Ref: 04-RF-01112; KLW-034-04)

Industrial Area and Buffer Zone Sampling and Analysis Plan Modification 1

Figure 32:

Known and Suspected OPWL Leak and Sampling Locations

File: W:\Projects\Fy2003\rfca_project_2-03.apr

April 6, 2004

CERCLA Administrative Record Document, SW-A-005011

U.S. DEPARTEMENT OF ENERGY
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Biased Sampling

Characterization of the NPWL, sanitary sewers, and storm drains will focus on areas of known or suspected contamination. Existing HPGe data, if applicable, will be used to identify other areas that may warrant investigation. Additionally, pipeline structural features, where releases are most likely to have occurred, will be investigated. Pipeline structural features include the following:

- Valves, valve vaults, cleanouts, and manholes;
- Elbows, tees, and reducers;
- Pipe and tank connections; and
- Transitions in pipeline materials.

Using the in-process characterization approach, samples will be collected around the pipelines at locations where contamination is suspected. An HPGe detector will be used to detect radionuclides, and results above RFCA ALs will trigger additional characterization. This in-process approach will allow tracking of contamination along a pipeline, rather than evaluating potential contamination using a random grid method. Soil samples will be collected and analyzed in accordance with the procedures described in Section 4.9. Sampling locations and depths will be described in the appropriate IABZSAP Addendum.

4.8 Field Analytical Approach

The characterization team will use field analytical instruments to detect COCs greater than RFCA ALs in soil samples. All analytical instruments will have detection limits below RFCA ALs. Field analytical instruments will be coupled with computer software so that analytical results can be uploaded into statistical and geostatistical programs and the Site database. Field analytical instruments will be field-portable where possible or available in an on-site mobile laboratory. For compounds that cannot be analyzed for using field analytical instruments, samples may be sent to off-site laboratories.

All field analytical instruments will be calibrated to determine their relationship with standard laboratory procedures. The sample size (support) investigated with field analytical techniques will be made as close as possible to the support investigated by the laboratory analytical techniques. This calibration and consistency in sample supports will ensure a valid relationship between the concentration/activity values determined by the field analytical techniques and the concentration/activity values determined in the final confirmation sample analyses (Myers 1997, Pitard 1993).

Field analytical instruments, either portable or located in a mobile laboratory, may include, but are not limited to, the following:

- Multielement x-ray fluorescence (XRF) spectrum analyzer, laser-induced breakdown spectroscopy (LIBS) instrument, and inductively coupled plasma (ICP) spectrometer for metals;

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- HPGe for radionuclides; and
- Gas chromatography/mass spectrometry (GC/MS) instrument for VOCs, SVOCs, pesticides, herbicides, and PCBs.

Other field screening analytical instruments, including organic vapor analyzers, FIDLERs, flame ionization detectors (FIDs), or photoionization detectors (PIDs), may be chosen based on analytical requirements. Additionally, off-site analytical laboratories will be used as necessary for specific analytes or groups of analytes.

4.8.1 Radionuclides

Gamma spectroscopy using an HPGe detector is the primary means by which the type and quantity of radionuclides in soil will be determined. In general, gamma spectroscopy will be used in lieu of alpha spectroscopy because gamma spectroscopy provides data of comparable quality and sensitivity in a shorter time. Limited alpha spectroscopy analyses may be performed for verification and validation of gamma spectroscopy methods.

Soil samples will be screened with an HPGe instrument to detect areas with radionuclide activities greater than RFCA ALs. Gamma spectroscopy methods may be used in at least two ways: in situ and field laboratory. In-situ methods provide field data for two-dimensional measurements (areal), or three-dimensional measurements with very limited depth. Field-of-view depths are typically limited to several centimeters within the soil. Use of in-situ gamma spectrometry to investigate "soils at depth" for confirmation sampling will be based on remediation lifts (that is, exposed soil surfaces as the lift moves downward or laterally). The exposed soil surfaces will have relatively flat surface geometries that can be accommodated by the gamma-spectrometry measurement system. Where counting times for radionuclides are long and for subsurface samples, samples may be analyzed in the field laboratory. Quality control (QC) specifications for both techniques are presented in the Quality Assurance Project Plan (QAPjP), which is included as Appendix G. These controls will be contractually required of the gamma spectrometry vendor. Detection limits and counting times for radionuclides are specified in the DQOs and Appendices E and G.

4.8.2 Metals

Soil samples will be analyzed to detect the presence of metals using EPA Method 6200, *Field Portable XRF Spectrometry,* or SW-7090 or 7091 or equivalent. Quality controls required for this method are summarized in the QAPjP. Field analytical equipment may include field-portable XRF or LIBS instruments. Specific manufacturers and models will be chosen by the analytical subcontractor, but will be approved by K-H QA personnel. The selected instruments will have detection limits below RFCA ALs as specified in the DQOs. Mobile laboratory and off-site laboratory analyses will use standard fixed-laboratory methods (for example, SW-846).

4.8.3 Organic Compounds

Concentrations of VOCs, SVOCs, pesticides, herbicides, PCBs, and other organics will be measured using a mobile GC or GC/MS in a field or off-site analytical laboratory. Organic analyses will be preceded by an appropriate extraction/digestion method.

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Preparation and analysis will consist of SW-846 methodologies, and will be consistent with existing ASD contractual requirements, with variances listed in the QAPjP. Examples of variances might include abbreviated analytical suites based on the final PCOC list, as well as abbreviated reporting requirements, where data packages and Electronic Data Deliverables (EDDs) will be streamlined to accelerate decision making in the field. Instrumentation will have detection limits below RFCA ALs as specified in the DQOs.

4.9 Sample Collection

Sample collection requirements and procedures are described in this section. If conditions are encountered during sampling activities that may result in unsafe or inappropriate use of the sampling technique, procedures may be modified or replaced. Modifications or replacements will be justified and detailed in the sampling records, and the resulting data will be comparable and adequate to meet the project DQOs.

4.9.1 Presampling Activities

In preparation for sampling and associated field activities, contamination area (CA), radiological buffer area (RBA), and exclusion zone (EZ) support zones, and all related radiological and H&S postings, will be established and identified at each work site in accordance with project-specific H&S protocols and Radiological Safety Procedures (RSPs), as required.

All H&S protocols will be followed in accordance with the requirements specified in the Health and Safety Plan (HASP) for each IHSS Group. Drilling and sampling subcontractors will provide a HASP specific to their scope. Each HASP will be developed under the guidance of, and in accordance with, applicable federal, state, local, and Site policies and procedures. Each HASP will identify all personal protective equipment (PPE), training, and air monitoring requirements, as well as all other hazard assessments and controls specific to the work scope and the Site.

Nonintrusive Surveys

Nonintrusive surveys will be conducted to detect structures and debris beneath the soil and building surfaces. These surveys may include ground-penetrating radar (GPR). RFETS excavation specialists routinely use GPR and other survey instruments to locate subsurface utilities and structures prior to drilling and in preparation for an Activity Hazards Analysis (AHA).

4.9.2 Surface Soil Sampling

The characterization team will collect surface soil samples in accordance with DQOs and at locations specified in the IABZSAP Addenda. Modifications to sampling procedures will be made as field conditions warrant. All modifications will be documented and justified in the final report.

Where required, prework radiological surveys will be conducted. Sampling locations will be marked in accordance with OPS-PRO.947, *Location/Surveying*. Location numbers will correspond with sample numbers assigned by ASD (Section 6.0).

The characterization team will collect soil samples from the 0- to 6-inch horizon using grab or hand-auger methods. Each sample will be collected using a clean, stainless-steel or disposable scoop/trowel or hand auger depending on the sampling location and soil types present. If surface vegetation is present, it will be removed from the sampling location with a decontaminated, stainless-steel shovel or appropriate hand tool prior to soil collection. All sample material recovered will be placed into individual sample jars according to OPS-PRO.069, *Containerizing, Preserving, Handling and Shipping of Soil and Water Samples*. Other sampling equipment and materials will include standard items such as chain-of-custody seals, forms, and logbooks. Soil descriptions will be recorded in the field, as appropriate.

The samples will be analyzed in the field using field analytical instruments for characterization or in-process post-remediation sampling, or sent to an off-site laboratory for confirmation sampling. Duplicate and equipment rinsate QC samples will represent 5 percent of the samples to provide adequate information on sample variability, as defined in EPA's Guidance for Data Quality Objective Process (1994).

All reusable sampling equipment will be decontaminated prior to and between each sampling location with a Liquinox (or Alconox) solution, and rinsed with deionized or distilled water in accordance with 4-S01-ENV-OPS-FO.03, *Field Decontamination Operations,* and the project-specific HASP.

In areas where the ground surface is covered with pavement or concrete, the characterization team will collect soil samples using grab sampling or hand auguring methods. The characterization team will access the soil by removing surface obstructions using a concrete corer, rotary hammer, or other appropriate equipment. Samples will be collected from the soil substrate underlying whatever base materials are beneath the pavement. Samples will then be collected to a depth of 6 inches from the top of the collection zone.

Asphalt and concrete samples will also be collected. These samples will consist of one or more small-diameter (approximately 1- to 2-inch) core plugs. The cores will be collected in sufficient quantities with respect to the required field and/or laboratory analyses. The characterization team will collect core plugs using a rotary-type, concrete coring drill. Wet coring techniques will be used where radiological contamination is suspected to prevent airborne contamination. Residual concrete and drilling water will be handled in accordance with 1-PRO-079-WGI-001, *Waste Characterization, Generation, and Packaging*. Wastes will be managed in accordance with the RFCA Standard Operating Protocol (RSOP) for Asphalt and Soil Management (DOE 2001) or Site procedure 4-F99-ENV-OPS-FO.23, *Management of Soil and Sediment Investigative Derived Materials,* whichever is current.

4.9.3 Subsurface Soil Sampling

The characterization team may use several types of Geoprobes® (Table 7) to collect vertical profile soil samples in areas of interest. Geoprobes® will be used in accordance with Site procedure OPS-PRO.124, *Push Subsurface Soil Sampling*. Soil cores will be recovered continuously to the desired depth in 2-ft increments using a core barrel as specified in this procedure. If the characterization team encounters probe refusal before reaching the target borehole depth, they will abandon the boring using procedure

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OPS-PRO.117, *Plugging and Abandonment of Boreholes*, and attempt an offset boring within 3 ft of the original boring. If probe refusal occurs repeatedly, or a much greater depth is required, a truck-mounted, hollow-stem auger drill may be used to complete the boring. Detailed hollow-stem auger drilling and sampling procedures are presented in OPS-PRO.114, *Drilling and Sampling Using Hollow-Stem Auger and Rotary Drilling and Rock Coring Techniques*.

Table 7
Potential Geoprobe® Models for Characterization

5400
- Standard Geoprobe® unit
- Attaches to the back of most vehicles (vans, pickup trucks, and so forth)
- Hydraulics powered by hooking up to vehicle engine

54LT
- Track-mounted, compact, and designed to maneuver within building structures
- 34.5 inches wide, fits through standard 3-ft doorway
- Slightly more powerful than the 5400 model: 20,000 lb down-force, 27,000 lb up-force
- Diesel engine

54DT
- Track-mounted
- Designed to maneuver over rough terrain; mud; and tight, congested areas; 48 inches wide
- Can maneuver through 10 to 12 inches of standing water
- Angle probing capabilities
- Diesel engine

66DT
- Track-mounted, most powerful model: 34,000 lb down-force, 46,000 lb up-force
- 48 inches wide
- Sufficiently powered to probe to deeper depths or through denser materials
- Can also be used to concrete drill and soil auger
- Able to use larger downhole tooling for increased sample volume recoveries
- Diesel engine

All units can collect groundwater samples and use Geoprobe® instrumentation if desired (for example, soil conductivity and membrane interface probes for logging VOCs in subsurface).

Before advancing boreholes, all locations will be cleared in accordance with OPS-PRO.102, *Borehole Clearing*, and marked in accordance with OPS-PRO.124, *Push Subsurface Soil Sampling*. A prework radiological survey will be conducted.

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Soil cores will be recovered continuously (when possible) in 2-ft increments using a 2-inch-diameter (or 2.125-inch-diameter for the dual-wall system) by 24- to 48-inch-long stainless-steel or lexon-lined core barrel. Cores will be monitored following recovery for H&S purposes with a FID or PID, as appropriate, in accordance with OPS-PRO.121, *Soil Gas Sampling and Field Analysis*, and with a FIDLER in accordance with 3-PRO-112-RSP-02.01 *Radiological Instrumentation.* All other sampling equipment will include standard items such as chain-of-custody seals, forms, and logbooks.

Samples will be collected from the core in 2-ft increments. The characterization team will analyze the lowest 6 inches of a 2-ft increment using field instrumentation. VOC grab samples from the same interval will be containerized to minimize the amount of headspace within the sample container as actual field and sample recovery conditions permit. Due to the unconsolidated nature of the local soil, gravel recovered with the core may be removed prior to sampling.

For sampling locations beneath building slabs, a rotary-type, wet coring system will be used to initiate boreholes through the slabs. This type of system is useful in containing contamination that may be present within the paint and/or concrete. The corer is held to the floor surface by vacuum pressure supplied by a vacuum pump. The slurry produced by coring will be contained by a slurry collection system used in conjunction with a wet/dry vacuum. Little or no airborne emissions will be produced during coring activities.

Upon the completion of each boring, the characterization team will abandon the borehole in accordance with OPS-PRO.117, *Plugging and Abandonment of Boreholes.*

Equipment will be monitored for radiological contamination during and after sampling activities. All sampling equipment will be decontaminated with a Liquinox (or Alconox) solution, and rinsed with deionized or distilled water, in accordance with 4-S01-ENV-OPS-FO.03, *Field Decontamination Operations.* Field duplicates will represent 5 percent of the samples to provide adequate information on sample variability, as defined in EPA's Guidance for Data Quality Objective Process (1994) and in accordance with Appendix G.

4.9.4 Horizontal Drilling

The characterization team may elect to use HDD and environmental-measurement-while-drilling (EMWD) for characterization of soil beneath buildings. They may use HDD instead of, or with, Geoprobe® drilling to sample soil beneath buildings and building slabs. Drilling and sampling will be conducted in accordance with operating procedures if the techniques are successfully demonstrated at UBC 123 and Building 886.

HDD sample intervals will be reached using an appropriately sized and equipped horizontal drilling rig in accordance with the subcontractor drilling procedure. The characterization team will collect soil samples at the depths and intervals specified in the appropriate IABZSAP Addendum. Every effort will be made to collect an undisturbed sample from the borehole to obtain accurate and representative data from each sampling event.

If EMWD is successfully demonstrated at Building 886 and UBC 123, the levels of gamma-emitting radionuclides within subsurface soil will be continuously monitored and

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recorded every 20 seconds with a gamma ray spectrometer (GRS), providing real-time data to operations at the surface. Additional samples may be collected if the downhole GRS indicates elevated radiological conditions, or if visible evidence (staining, odors, and so forth) of contamination is present in drill cuttings.

4.9.5 Surveying

The locations of all surface soil sampling and boreholes will be surveyed using a Global Positioning System (GPS) or other surveying instruments. Sampling locations will be surveyed for northing and easting in state planar coordinates and elevation, and will be entered into the project database as well as the Site Soil Water Database (SWD). Using GPS is not possible inside buildings; manual measurements will be collected instead. Sampling location surveying will be conducted in accordance with OPS-PRO.947, *Location/Surveying.*

4.9.6 Equipment Decontamination and Waste Handling

Reusable sampling equipment will be decontaminated in accordance with 4-S01-ENV-OPS-FO.03, *Field Decontamination Operations.* Decontamination water generated during sampling will be managed according to OPS-PRO.112, *Handling of Field Decontamination Water*. Horizontal drilling and Geoprobe® rigs and equipment will be decontaminated between locations and following project completion at the Decontamination Pad in accordance with OPS-PRO.070, *Equipment Decontamination at Decontamination Facilities.*

PPE will be disposed of in accordance with 1-PRO-573-SWODP, *Sanitary Waste Offsite Disposal Procedure.* Residual soil will be handled in accordance with 1-PRO-079-WGI-001, *Waste Characterization, Generation, and Packaging.* Returned sample media will also be managed in accordance with 1-PRO-079-WGI-001, *Waste Characterization, Generation, and Packaging.* In the event that hazardous, low-level, or mixed wastes are generated, project waste generators will package and manage the waste containers in accordance with 1-PRO-079-WGI-001, *Waste Characterization, Generation, and Packaging.*

4.10 Groundwater and Incidental Water Sampling

Groundwater or incidental water may be encountered during soil sampling and, if found, may be sampled.

4.10.1 Groundwater

Several groundwater contaminant plumes were identified during previous RFI/RIs and Sitewide programs. Groundwater wells, installed to monitor plume extent, are being sampled as part of the compliance monitoring program. When active groundwater wells are located in IHSSs, PACs, UBC Sites, or areas being characterized, compliance staff may direct or perform groundwater sampling.

4.10.2 Incidental Water

Incidental water is defined in the IMP as "precipitation, surface water, groundwater, utility water, process water, or wastewater collected in one or more of the following areas:

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- Excavation sites, pits, or trenches;
- Secondary containments or berms;
- Valve vaults;
- Electrical vaults;
- Steam pits and other utility pits;
- Utility manholes;
- Other natural or manmade depressions that must be dewatered; or
- Discharges from a fire suppression system that has been breached within a radiological buffer area or a contamination area" (DOE 1999b).

If incidental water is encountered during characterization, dewatering of the area may be necessary to maintain a safe working environment. If dewatering of the area is necessary, a temporary sump will be installed to transfer the water into a temporary storage container(s). The water will then be sampled and managed in accordance with the Site's Incidental Water Program, 1-C91-EPR-SW.01, *Control and Disposition of Incidental Water.*

Incidental water is sampled to determine whether it may be discharged to the environment or treatment is required. Process knowledge, field pH, appearance, field nitrate, and field conductivity are the initial screening criteria. Compliance staff may direct or perform additional sampling and analysis when known or suspected contamination is present.

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5.0 DATA ANALYSIS PROCEDURES

The characterization team will aggregate and evaluate data generated as part of IABZSAP activities in accordance with the IABZSAP DQOs. This will include the following:

- Aggregation according to IABZSAP DQOs for comparison to RFCA ALs;
- Use of geostatistical or standard statistical techniques to determine whether additional sampling is required to reach specified confidence levels that an IHSS, PAC, or UBC Site has been adequately characterized;
- Use of verification sampling techniques to ensure the accuracy of data generated from field instrumentation;
- Use of geostatistical or standard statistical techniques to determine whether RFCA ALs have been exceeded;
- Aggregation of remediation confirmation data according to IABZSAP DQOs for comparison to RFCA ALs to determine whether remediation was successful; and
- Aggregation and evaluation according to IABZSAP DQOs for use in the CRA.

5.1 RFCA ALs and Data Evaluation

In accordance with the IABZSAP DQOs, the extent of contamination must be delineated by comparison to RFCA ALs. Designation of hot spots and subsequent remediation and/or closure decisions will be based on comparisons to RFCA ALs. A phased statistical evaluation will be conducted that consists of the following steps:

1. Data aggregation;
2. Comparison of data to RFCA ALs;
3. Geostatistical analyses if appropriate data are available; and
4. Elevated Measurement Comparison (EMC) (hot spot methodology) if necessary.

The flow chart presented on Figure 33 displays the steps and decision points used for this phased statistical evaluation. The null (Ho) and alternative (Ha) hypotheses used during the statistical analyses are as follows:

> Ho: Analyte concentrations/activities within the AOC are significantly greater than the RFCA ALs.
>
> Ha: Analyte concentrations/activities within the AOC are not significantly greater than the RFCA ALs.

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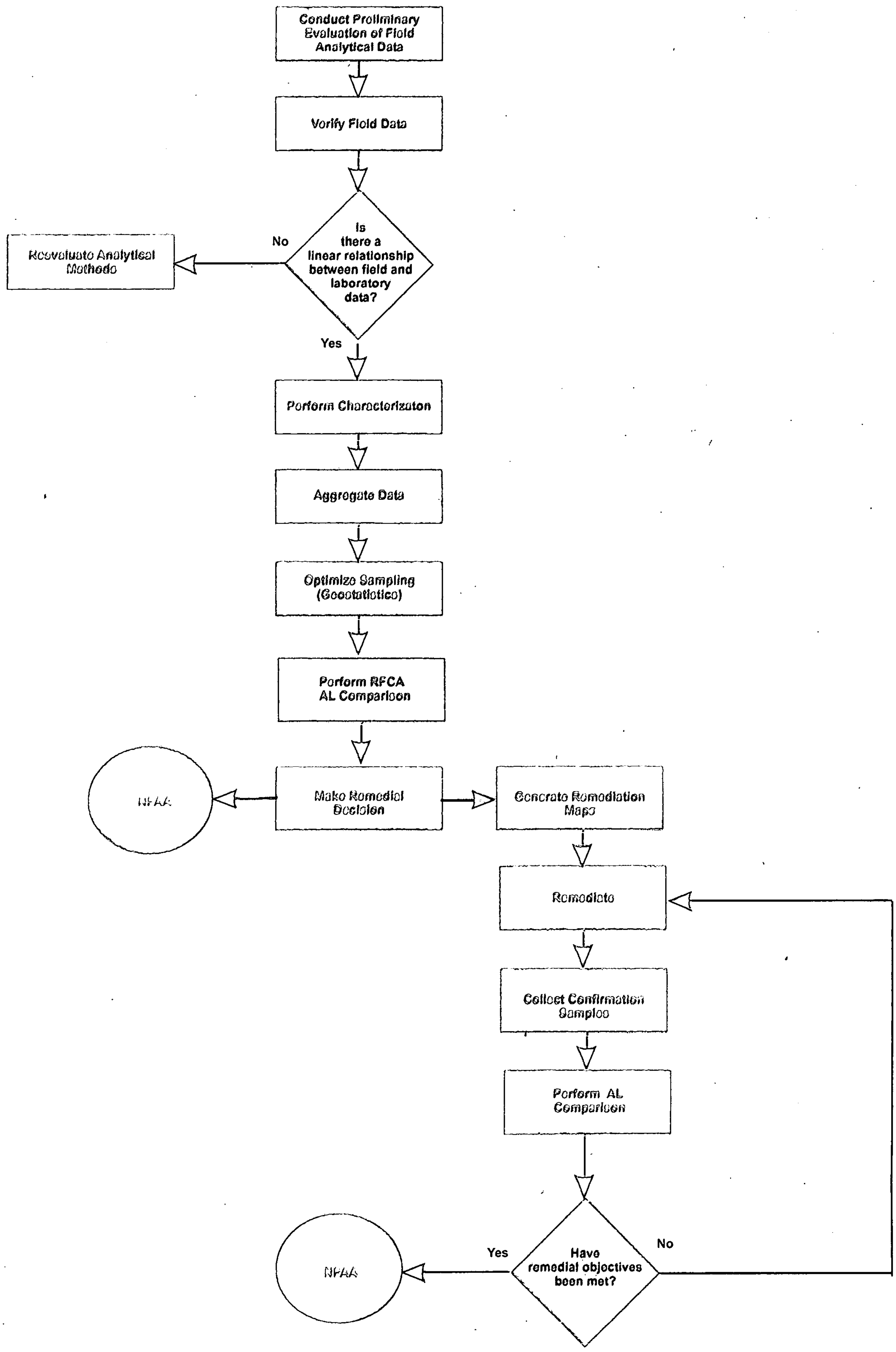
Figure 33
Data Evaluation Flow Chart



5.1.1 Data Aggregation

Data aggregation will be based on media type (for example, surface or subsurface soil), AOC, and purpose of evaluation (for example, characterization, confirmation, or CRA). To perform a valid statistical evaluation, data must meet the criteria that all observations are independent but comparable (that is, collected and analyzed using similar methods). Furthermore, data from various soil horizons need to be aggregated by subgroups before conducting statistical comparisons. These aggregated subgroups must represent a single population characterized by a fixed population mean and variance. Table 8 summarizes the data aggregation and appropriate subdivisions of each group.

Table 8
Data Aggregation Framework

Soil Horizon	Depth Interval (ft)[1]	Subgroups		
		Characterization[2]	Confirmation (Excavation Remedy)	CRA
Surface Soil	0.0 to 0.5	AOC	Floor and Sidewalls	Exposure Unit
Subsurface Soil	0.5 to 2.5	AOC		
	2.5 to 4.5	AOC		
	4.5 to 6.5	AOC		
	6.5 to 8.5	AOC		
	8.5 to Bedrock	AOC		

[1] Actual depth intervals will be based on the depth to bedrock contact or depth to water.
[2] The AOC is initially based on IHSS, PAC, and UBC Site boundaries as defined by the project team.

The first step in the data evaluation process is to group the data by soil horizons. For example, surface soil samples collected from 0 to 6 inches bgs will be grouped as a single soil horizon, and subsurface soil samples from 6 to 30 and 30 to 54 inches bgs will be grouped into second and third horizons, respectively, so that each depth interval is grouped as a unique sample population. Although different subsurface soil horizons may have similar geologic and physical properties, the aggregation of distinct soil horizons will conform to remediation excavation techniques.

Data aggregation for remediation confirmation will be based on samples collected within the excavated or remediated area. For excavations, samples from the floor and sidewalls of the excavation will be consolidated into a single subgroup.

5.1.2 Comparison of Data to RFCA ALs

Characterization results will be compared to RFCA ALs in accordance with IABZSAP DQOs using the following steps:

1. Results will be compared on a point-by-point basis to RFCA ALs.
2. The surface soil radionuclide SOR will be determined.
3. The surface soil nonradionuclide SOR will be determined.

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4. If the point-by-point comparison indicates that a surface soil radionuclide analyte exceeds its RFCA AL or the radionuclide SOR exceeds 1, then the 95% UCL for that analyte will be calculated across the AOC.

5. If the point-by-point comparison indicates that a surface soil nonradionuclide analyte exceeds its RFCA AL or the nonradionuclide SOR exceeds 1, then the SOR will be calculated for carcinogenic and noncarcinogenic nonradionuclide analytes.

6. If the surface soil carcinogenic or noncarcinogenic nonradionuclide SOR exceeds 1, then the 95% UCL for that analyte will be calculated across the AOC.

7. If the 95% UCL divided by the RFCA AL exceedance is greater than 1 in surface soil, the EMC (Section 5.2, hot spot analysis) may be used to determine whether a hot spot is present.

8. Subsurface soil will be evaluated using the SSRS.

5.1.3 Confirmation Samples

The characterization team will evaluate confirmation sampling measurements to determine whether residual soil is clean with respect to remediation goals. Measurements of a given analyte that exceed remediation goals may require additional evaluation. Flexibility in the decision process includes statistically comparing means of populations to the corresponding ALs.

5.1.4 Spatial Evaluation - Geostatistics

In addition to defining optimal sampling locations for characterization purposes, the characterization team will also use geostatistical analysis to define areas with concentrations above RFCA ALs. The geostatistical approach incorporates probabilistic and risk-based outcomes relative to the AL thresholds and decision error rates. The geostatistical methodology is an unbiased geostatistical tool that will be used to optimize characterization and remediation within the IA. Specifically, geostatistical analysis will be used to:

- Optimize the number and locations of characterization samples;
- Develop maps of the areas with concentrations above RFCA ALs at a given level of probability;
- Optimize the number and locations of confirmation samples; and
- Link on-site analysis with sampling to allow near-real-time remedial decisions.

Geostatistical Procedures

Geostatistical analysis is a spatial correlation modeling approach that uses several evaluative steps. Descriptions and applications of the SmartSampling geostatistical technique are presented in reports published by SNL (1998), Rautman (1996), and McKenna (1997). The following steps describe the ordered process of the geostatistical approach:

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1. Exploratory Analysis - The first step in the geostatistical evaluation is to determine the distribution of the data set by evaluating descriptive statistics and plotting the data on a histogram. Data found to depart from the normal distribution function should be normalized prior to performing the geostatistical evaluation.

2. Structural Analysis - Variograms (Myers 1997), which describe the geostatistical spatial correlation between samples, are generated. This procedure defines the spatial variance between data points. Three important parameters defined by the variogram include (1) the range (distance at which samples are spatially correlated), (2) sill (similar to the variance of the data set), and (3) nugget effect (departure from the origin, which indicates microscale sampling variability or imprecision of the data set).

3. Kriging - The spatial correlation model derived from the variogram analysis is used in the kriging simulation. Kriging is the process of simulating predicted values in unsampled areas by calculating a weighted least-squares mean of the surrounding data points. The weighted values account for not only the distance between known observations and points of predicted values, but also the correlation of clustered observations. For example, clustered data may provide redundancy and are weighted less than a single observation at an equal distance in a different direction. The kriging simulations are processed to produce maps defining the spatial distribution of the contaminants and uncertainty in the spatial distribution.

4. Probability Kriging - Probability maps that describe the likelihood a contaminant value at any unsampled location exceeds the AL are generated. Probability kriging is based on multiple simulations of the contaminant concentration. The outcome of each simulation reflects the actual observations within the area. The multiple simulations of the concentrations provide the basis for determining the relative uncertainty so that the probability of exceeding a specified threshold value (for example, RFCA ALs) at any point within the area can be estimated. The simulations are processed to produce maps defining the spatial distribution of the contaminants and the inherent uncertainty in spatial distribution.

5. Probability Calculation - The probabilities are calculated from the estimated value for each realization and a cumulative distribution function at each point of estimation is developed. For example, assume 100 realizations are performed for the area of interest. If the threshold value is 10 pCi/g and 20 of the 100 realizations exceed the threshold value at a given point, the probability of exceedance is 20 percent at that point.

6. Uncertainty Mapping - A map with optimal locations for additional sampling is developed. These locations are optimized to produce the greatest decrease in the spatial uncertainty of the contaminant distribution with respect to ALs. That is, areas with the greatest uncertainty of exceeding the ALs are identified and targeted for additional sampling and analysis.

7. Sample Optimization - Data are collected and added to the geostatistical program.

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8. Steps 2 through 5 are repeated as necessary.

9. Excavation Mapping - Excavation maps are developed from the probability kriging. These maps are based on the probability of exceeding a specified AL as described in Step 4. An excavation map requires that an acceptable reliability of remediation is determined. This is similar to the process of specifying an acceptable level of false positive errors in the traditional DQO procedure. For example, if the Type I error rate is specified at 10 percent, then all remediation units exceeding 10 percent would be targeted for remediation.

5.2 Elevated Measurement Comparison

The EMC (MYAPC 1999) comparison, illustrated on Figure 34, includes an equation that depends on several variables: AL, measured value, size of the hot spot, and size of the AOC. The EMC is consistent with MARSSIM (EPA 1997A), and is applicable to all sample results or hot spots with concentrations above RFCA ALs. In AOCs where all sample results are less than ALs, the EMC is not required. The EMC for nonradionuclides is shown in Equation 5-1. If the EMC is greater than or equal to 1, action is indicated.

(Equation 5-1)

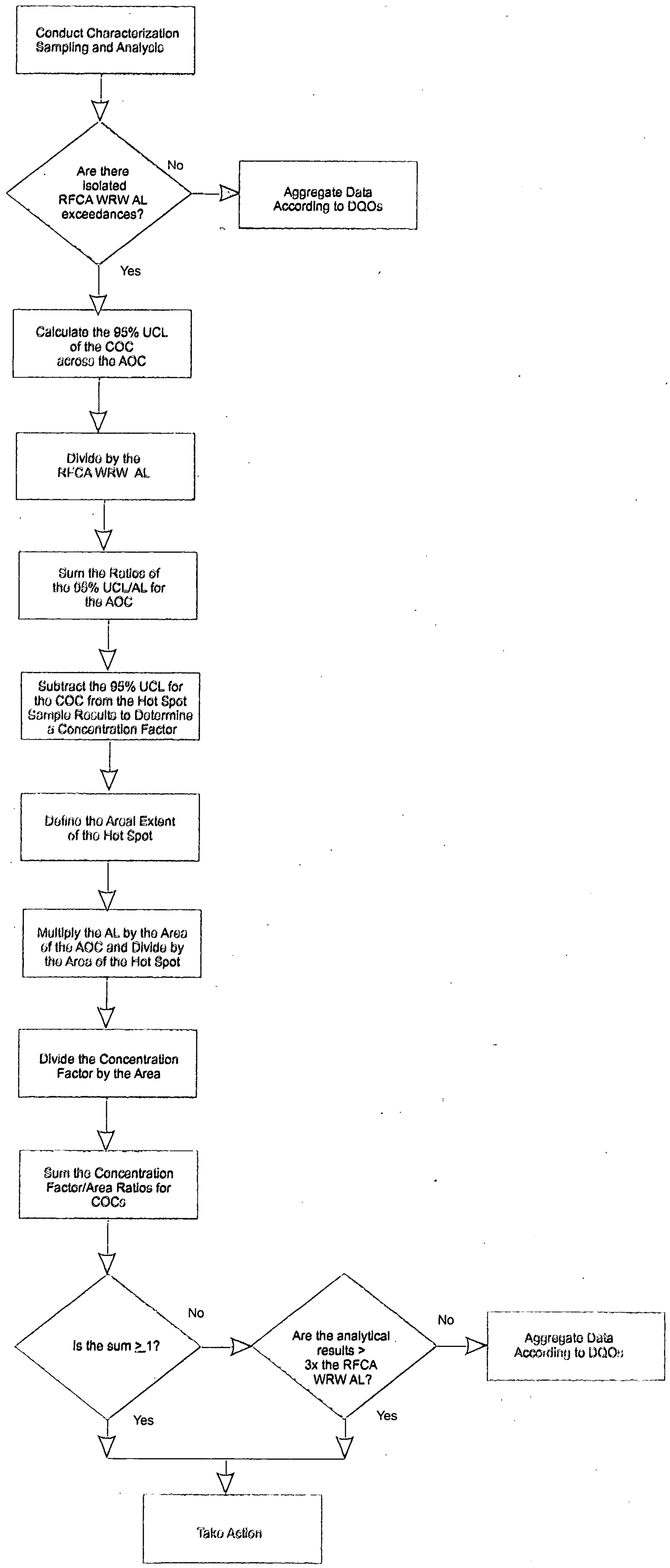
$$If: \sum_{i=1}^{n}\left[\frac{95\%UCL_{AOC}}{AL}\right]_i + \sum_{j=1}^{n}\left[\frac{\left(SampleResult_{hs} - 95\%UCL_{AOC}\right)}{\left(\frac{AL * Area_{AOC}}{Area_{hs}}\right)}\right]_j \geq 1,\ Then: Action\ is\ Indicated$$

Where:

$(95\%UCL)_{AOC}$	=	95% UCL of the mean concentration in the AOC
AL	=	RFCA soil AL
$(Sample\ Result)_{hs}$	=	hot spot sample result
$(Area)_{AOC}$	=	area of the AOC
$(Area)_{hs}$	=	hot spot area (based on the area surrounding the elevated sample result)
i	=	number of COCs
j	=	number of hot spots for a particular COC

The first term "i" of Equation 5-1 will be applied to each COC separately. This term will be used for all observations less than RFCA ALs within the AOC. As shown in Equation 5-1, the first term is defined as the ratio of the 95% UCL of the mean to the RFCA AL for the AOC. Observations greater than the ALs will be excluded from the 95% UCL calculations, because this type of censorship will ensure the data set complies with normality assumptions required for calculating the 95% UCL.

Figure 34
Elevated Measurement Flow Chart



The second term "j" of Equation 5-1 will be applied to each sample result that exceeds the RFCA AL separately, so that these results can be evaluated as a function of the hot spot size relative to the AOC and magnitude of the AL. Because human health risks are based on an individual's exposure across an area, the incremental risk due to a small, elevated COC sample result (hot spot) needs to be determined. The second term of Equation 5-1 is defined as the difference between the 95% UCL of the mean concentration and the sample result divided by the RFCA AL for a given COC. The AL is area-weighted, which is appropriate because exposure to contamination is random across an area.

For radionuclides, an area factor consistent with MARSSIM (EPA 1997A) guidance is applied to the AL as shown in Equation 5-2. Radionuclide-specific area factors are based on exposure pathway models, which can be estimated from Residual Radioactivity Computer Code (RESRAD) simulations.

(Equation 5-2)

$$If: \sum_{i=1}^{n}\left[\frac{95\%UCL_{AOC}}{AL}\right]_i + \sum_{j=1}^{n}\left[\frac{(SampleResult_{hs} - 95\%UCL_{AOC})}{(AL * AF)}\right]_j \geq 1, Then: action\ is\ indicated$$

Where:

$(95\%UCL)_{AOC}$	=	95% UCL of the mean concentration in the AOC
AL	=	RFCA soil AL
$(Sample\ Result)_{hs}$	=	hot spot sample result
AF	=	area factor (for radionuclides)
i	=	number of COCs
j	=	number of hot spots for a particular COC

The product of Equations 5-1 and 5-2 is the summation of EMCs for all COCs and each hot spot within a given AOC. Results of the equation greater than 1 indicate action may be necessary and results less than 1 indicate action is not necessary. Because the EMC includes an area-weighting component, results for very small hot spots may indicate action is not necessary for very high contaminant concentrations. To reduce this effect, when the concentration of the contaminant at a hot spot is three times the RFCA AL, action is indicated. If the hot spot is remediated, the confirmation sample values will be used in the equation. Using a value of three times the AL as an upper limit for re-evaluation is consistent with RESRAD's release criteria. The "three times the AL" concept will not apply to ALs that are based on acute toxicity. An example data set (Appendix H) shows how the EMC is applied.

5.3 Verification of Field Analytical Data

Data generated from field instrumentation will be correlated with analytical laboratory data. The following techniques will verify the accuracy of field analytical data:

- Evaluation of linear regression based on data developed during the 903 Pad characterization for HPGe correlation (Appendix I);

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- Initial verification study to compare new field analytical instruments to laboratory analytical data;
- Ongoing verification sampling of field analytical results at a rate of 5 to 10 percent (that is, 5 to 10 laboratory analytical samples for every 100 field analytical samples); and
- Confirmation sampling.

5.3.1 Linear Regression Analysis

The QA staff will evaluate the accuracy of HPGe and other field instrument methods, not only through standard, periodic QC specifications (such as daily source checks and annual full-scale calibrations), but also by regressing field measurements against associated laboratory measurements. Regression analysis provides a means of "normalizing," or standardizing, field measurements to laboratory measurements. The general linear model that relates a response to a set of indefinite variables will be used.

Successful regression analyses of HPGe data have been performed at RFETS and other DOE sites (DOE 2000b). Regression analysis has also been successfully used in the quantification of metals (Sackett and Martin 1998), and is recommended by EPA to correct for low biases inherent in the field methods.

Optimization of sample homogeneity is a key factor in producing usable field/laboratory correlations (Sackett and Martin 1998), where relatively large and variable grain sizes are thought to cause a low bias (in field methods). Samples will be homogenized and sieved, and each sample will be split for field and laboratory analysis.

A general linear model (Equation 5-3) that relates a response to a set of indefinite variables may be used as follows:

$$y = B_0 + B_1x_1 + B_2x_2 + ...B_kx_k + E \qquad \text{(Equation 5-3)}$$

Where:

$x_1, x_2...x_k$	=	independent variables
$B_1, B_2...B_k$	=	unknown parameters
E	=	random error term

Consistent with calibration curves constructed for laboratory analytical methodologies (EPA SW-846), where full-range curves are constituted by four (for example, metals, SW-6010) to five (for example, VOCs, SW-8260) sequentially increasing values, regression analyses will be initiated with a minimum of five values through the measurement range of interest. Additional values will be added to the curves as the project progresses.

Based on previous experience and related publications (Sackett and Martin 1998), a linear relationship is expected between field and laboratory results. Acceptability of a linear regression will be based on a correlation coefficient (R2) of greater than 0.90, and

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use of an Analysis of Variance (ANOVA) and corresponding F Test to determine both "goodness-of-fit" and appropriateness of the model. The regression will be rejected if the measurements are too variable or the model is incorrect. If a linear model is inappropriate, a curvilinear regression may be evaluated (including confidence intervals or limits), and if used, will be evaluated using an ANOVA to determine the significance of adding terms to the regression. Polynomial expansion beyond a quadratic is not anticipated for correlating field results with laboratory results.

5.3.2 Initial Verification Study

An initial verification study will be conducted to confirm the accuracy of field analytical equipment. Soil samples will be collocated with field analytical readings and sent to an off-site analytical laboratory for analysis.

The underlying assumption for the verification study is that a linear relationship exists between the laboratory analytical data and field analytical data. The field analytical data may be standardized using the following equation (Gilbert 1987):

$$\bar{x}_{lr} = \bar{x}_A + b(\bar{x}_{n'} - \bar{x}_F) \qquad \text{(Equation 5-4)}$$

Where:

$\bar{x}_{lr}$ = standardized estimate of μ

$\bar{x}_A$ = mean of the n laboratory measurements

b = slope of the estimated linear regression

$\bar{x}_{n'}$ = mean of the n' field measurements

$\bar{x}_F$ = mean of the n field measurements

5.3.3 Ongoing Verification

As stated previously, accuracy of several field methods will be evaluated, not only through standard, periodic QC specifications (such as daily source checks and annual full-scale calibrations), but also by regressing field measurements against associated laboratory measurements. Regression analysis provides a means of normalizing, or standardizing, field measurements to laboratory measurements.

Verification of field analytical methods will continue throughout IA and BZ characterization and remediation activities. The frequency of split samples for the ongoing field analytical equipment verification sampling will be based on the following:

- Initial verification study;
- Results of previous verification; and
- Field duplicate frequency (5 to 10 percent), as discussed in Section 5.3.4.

5.3.4 Confirmation Sampling

Environmental projects may use a variety of QC samples, depending on the needs and goals of the project. The QC samples could include blanks (for example, preparation

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blanks and trip blanks), duplicates, splits, blind performance evaluation (PE) samples, and so forth. Typically, each type of QC sample has only one use; for example, field duplicates are used to evaluate sampling precision. The QC samples required for the IA and BZ sampling and analysis efforts are presented in Appendix G.

To increase the efficiency and reliability of the project, one type of QC sample, the duplicate, will serve several purposes:

- To evaluate sampling precision (its typical use);
- To confirm that methods are sufficiently comparable with laboratory methods; and
- As "confirmation samples," to confirm the results in the AOC.

This approach will eliminate the time and cost of performing a separate phase of verification sampling and will be performed in parallel with field sampling and analysis. This approach will be implemented by sending a duplicate sample, after it is analyzed for its first purpose, to the laboratory for verification analysis. The duplicate sample, initially used for field precision purposes, effectively becomes a replicate when used for verification purposes. Acceptable verification will be determined through use of a percent difference value; specifically, this is the laboratory value compared with the normalized field value (that is, field value based on the regression analysis).

In certain cases where field analytical methods (or on-site laboratories) do not provide adequate quality, such as unacceptable detection limits or field/laboratory correlations, verification sampling must be more aggressive than described above. More rigor could include the original grid spacing and number of samples used for characterization purposes, which considers hot spot size and contaminant boundaries. The term "verification sample," in the context of the IABZSAP, is reserved for those specific samples whose sole purpose is to confirm (or contradict) results of samples already collected. Because of this narrow purpose, the number of samples needed is much less than the previous number of samples required to characterize the site of interest. If an aggressive design for verification sampling is required, it indicates that characterization sampling (and field analysis), relative to a specific COC and applicable ALs, was inadequate for cleanup decisions.

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