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8501 Mo-Pac Blvd.
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(512) 454-4797

Barbara
Steve
Stephanie

19 February 1993

Ms. Judith Espinosa, Secretary
New Mexico Environment Department
Harold Runnels Bldg.
1190 St. Francis Dr.
Santa Fe, NM 87502 > Table 2

RE: **28 Sites Phase I RFI Work Plan, Holloman AFB, NM**
Submittal of Final Draft Work Plan

Table II

Dear Ms. Espinosa:

Enclosed for your review are two copies of the two volume final draft 28 Sites Phase I RFI Work Plan for the above referenced project. The Work Plan provides the details associated with the proposed investigations as well as the Quality Assurance Project Plan (QAPP) and the Community Relations Plan (CRP).

A draft review meeting with the U.S. Environmental Protection Agency and the New Mexico Environmental Department has been scheduled for the 8th and 9th of March, 1993 at Holloman AFB, New Mexico. We would appreciate receiving any comments you may have by 5 March in order to have them available for discussion at the meeting. Due to the limited amount of time prior to the draft reviewing meeting, please contact me or Wally Hise at (512) 454-4797 with any questions or comments. Thank you in advance for your comments.

Sincerely,

Michael W. Holder

Michael W. Holder
Project Director

MWH:jk

c: Ron Stirling--USACE, Omaha
Roger Wilkson--Holloman AFB
Wally Hise--Radian/3

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RCRA Facility Investigation Holloman Air Force Base New Mexico

28 Sites Phase I Work Plan

Volume I

March 1993

49 CES/CEV
Holloman Air Force Base,
New Mexico

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RCN 269-069-29-01

RCRA FACILITY INVESTIGATION
HOLLOMAN AIR FORCE BASE
NEW MEXICO

28 SITES PHASE I WORK PLAN

Volume I

FINAL DRAFT

Prepared for:

49 CES/CEV
Holloman Air Force Base, NM

Prepared by:

Radian Corporation
8501 North MoPac Boulevard
P.O. Box 201088
Austin, Texas 78720-1088

Under Contract No. DACW45-91-D-0018 with:

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

25 March 1993

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APPENDIX B: Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992

APPENDIX C: Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992

APPENDIX D: Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992

APPENDIX E: Walk, Haydel, and Associates, Installation Restoration Program Remedial Investigation Report for Holloman AFB, New Mexico, New Orleans, LA 1989

APPENDIX F: Radian Corporation, Project Assessment Report of the Sewage Lagoon System, March 1980--July 1990, Holloman AFB, New Mexico, August 1990

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PURPOSE OF DOCUMENT

a. This Phase I RCRA Facility Investigation (RFI) Work Plan is for use by the selected RFI Contractor and Laboratory for the conduct of the Phase I RFI at Holloman Air Force Base (AFB), New Mexico. It was prepared for, and in cooperation with, the Base Environmental Office: 49 CES/CEV, 550 Tabosa Avenue, Holloman AFB, NM 88330-8458, (505) 479-3931. The RFI Work Plan includes four of the six plans required by the Base's federal Hazardous and Solid Waste Amendment (HSWA) Permit. The four plans included are: the Sampling and Field Measurements Plan; the Data Management Plan; the Quality Assurance Project Plan (QAPP); and the Community Relations Plan (CRP). Information contained in these plans is designed to: 1) facilitate the investigation of 40 RCRA solid waste management units (SWMUs) and one Area of Concern (AOC) which may have potentially released hazardous waste or hazardous constituents to the environment; and 2) to determine if a release of hazardous waste or hazardous constituents to the environment has occurred from any of the 40 SWMUs and one AOC.

b. The Sampling and Field Measurements Plan and the Data Management Plan are contained in Volume I and are referred to as the "Phase I RFI Work Plan". The Work Plan details the procedures for investigatory methods, sample collection, waste management, data management, and reporting. It also identifies the SWMU-specific potential contaminant migration pathways and the potential receptors of the contamination. Information describing each SWMU is provided as well as SWMU specific investigation and sampling plans.

c. The QAPP is contained in Volume II and presents the procedures and information necessary for the analysis and evaluation of all samples collected during the Phase I RFI. Measurement Data Quality Objectives and acceptance criteria are provided for laboratory analytical results. Analytical methods to be used for sample analysis during the investigation are cited and described.

d. The CRP, also contained in Volume II, presents the mechanisms for public dissemination of information during the conduct of the Phase I RFI. A discussion of public involvement in the RCRA process is provided, as well as information concerning the investigation and it's role in the Base's on-going suite of environmental investigations.

1.0 SCOPE OF WORK

This Work Plan for the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) contains field and laboratory procedures, site-specific sampling plans, and data management and evaluation procedures for the investigation of solid waste management units (SWMUs) at Holloman Air Force Base (AFB), New Mexico. The purpose of the Phase I RFI Work Plan is to identify the methods, technical rationale, and evaluation criteria to document the absence or presence of hazardous waste or hazardous constituents released from SWMUs. This plan is based on the requirements of the federal Hazardous and Solid Waste Amendments (HSWA) permit for the Base and guidance contained in the U.S. Environmental Protection Agency (EPA) document *Interim Final RCRA Facility Investigation (RFI) Guidance,* May 1989.

1.1 Background

Section IV (Special Conditions) of the Base's federal HSWA permit, effective 25 September 1991, contains the specific requirements for the conduct of the RFI at Holloman AFB, New Mexico. These requirements are detailed in permit conditions H, I, J, and R of Section IV and cover the RFI Work Plan, the Work Plan implementation, and the RFI report, respectively. The Phase I RFI (covered by this Work Plan) has been designed to document the presence or absence of hazardous waste or hazardous constituents in the soils, soil vapors, and possibly groundwater owing to a release from the 41 SWMUs shown in Table 1-1. The 41 SWMUs (40 SWMUs and one Area of Concern (AOC)) covered by this Work Plan are grouped into 28 sites for investigation purposes. The site groupings are based on the physical proximity of SWMUs to one another where the investigation of individual SWMUs is not practical or feasible. However, the SWMUs will be discussed and the results reported by the SWMU number to avoid confusion with the sites being investigated under the Base's Installation Restoration Program (IRP).

Table 1-1

Solid Waste Management Units (SWMUs) for 28 Sites RFI Work Plan

SWMU No.	Unit Name
119 2 [a]	Bldg 121 Waste Oil Tank Bldg. 121 Oil/Water Separator
120 15 [a]	Bldg. 309 Waste Oil Tank Bldg. 309 Oil/Water Separator
121 17 [a]	Bldg. 316 Waste Oil Tank Bldg. 316 Oil/Water Separator
123 22 [a]	Bldg. 704 Waste Oil Tank Bldg. 704 Oil/Water Separator
126 36 [a]	Bldg. 1000 Waste Oil Tank Bldg. 1000 Oil/Water Separator
125 32 [a]	Bldg. 868 Fire Water Tank Bldg. 868 Oil/Water Separator
127 39 [a] 135	Bldg. 1092 Waste Oil Tank Bldg. 1092 Oil/Water Separator Bldg. 1092 Oil/Water Separator Drainage Pit
138 128 40 [a]	Bldg. 1166 Oil/Water Separator Drainage Pit Bldg. 1166 Waste Oil Tank Bldg. 1166 Oil/Water Separator
118	Bldg. 21 Pesticides Holding Tank
129	Bldg. 1191 Spill Tank
54 55	Bldg. 702 Waste Accumulation Area Bldg. 702A Waste Accumulation Area
56	Bldg. 807 Waste Accumulation Area
63	Bldg. 867 Waste Accumulation Area
71	Bldg. 1178A Waste Accumulation Area
78	Trim Pad 3 Waste Accumulation Area
75	DRMO Hazardous Waste Storage Area
91	Bldg. 816 Washrack
136	Bldg. 1119 Washrack Drainage Pit
141	Pad 9 Drainage Pit
164	Bldg. 1080 Pond
124	Bldg. 752 Waste Oil Tank
155	Sludge Drying Beds

Table 1-1

(Continued)

SWMU No.	Unit Name
156	Imhoff Tanks (5)
184	Wastewater Recirculating Line
177 181 179 [b]	Bldg. 1176 Sumps Bldg. 1176 Drainage Trough Bldg. 1176 Discharge Box
101	Bldg. 121 Landfill
183	Air Base Sewer System
AOC-U [c]	Lost River Basin

[a] HSWA Permit, Table 3
[b] HSWA Permit, Table 1
[c] AOC = Area of concern.

The SWMUs contained in Table 1-1 include those listed in Table 2 of the federal permit. In addition, eight SWMUs from Table 3 in the permit are included, as well as one SWMU from Table 1 in the permit. The SWMUs from Table 3 are oil/water separators for the waste oil tanks contained in Table 2. Because of their physical closeness to the tanks, they were included in the Work Plan for this investigation. The single SWMU from Table 1 in the federal permit, SWMU 179, has been previously investigated during the remedial investigation (RI) at IRP Site 39. This SWMU is adjacent to SWMUs 177 and 181 (Table 2 of the permit) and is included to maintain consistency between the IRP and the RFI programs. Figure 1-1 shows the general location of the 41 SWMUs on the Base and Plate 1 (attached) provides detailed location information for each SWMU.

A Phase II RFI to determine the nature and extent of detected releases will be conducted only at those SWMUs for which Phase I data document a release of hazardous waste or hazardous constituents to the environment. If no releases are identified in the Phase I investigation, the RFI for those SWMUs will be concluded and the appropriate requests for permit modifications will be submitted to the U.S. EPA, Region VI.

1.2 Data Quality Objectives

The data collected during the Phase I RFI are necessary to determine whether or not a release has occurred from a SWMU (the objective of the Phase I investigation). In addition, the data need to be of a quality that will ensure their support of ongoing investigations where necessary. The Phase I RFI is the first step in the RCRA corrective action process, and any subsequent investigations and remedial actions that may follow will build on the results of the Phase I investigation. For this reason, it is imperative that the activities discussed in this Work Plan fulfill not only the objectives of the Phase I RFI but also directly support any necessary future activities. To ensure that the above goals are met, Data Quality Objectives (DQOs) for the investigation were developed and are presented below.

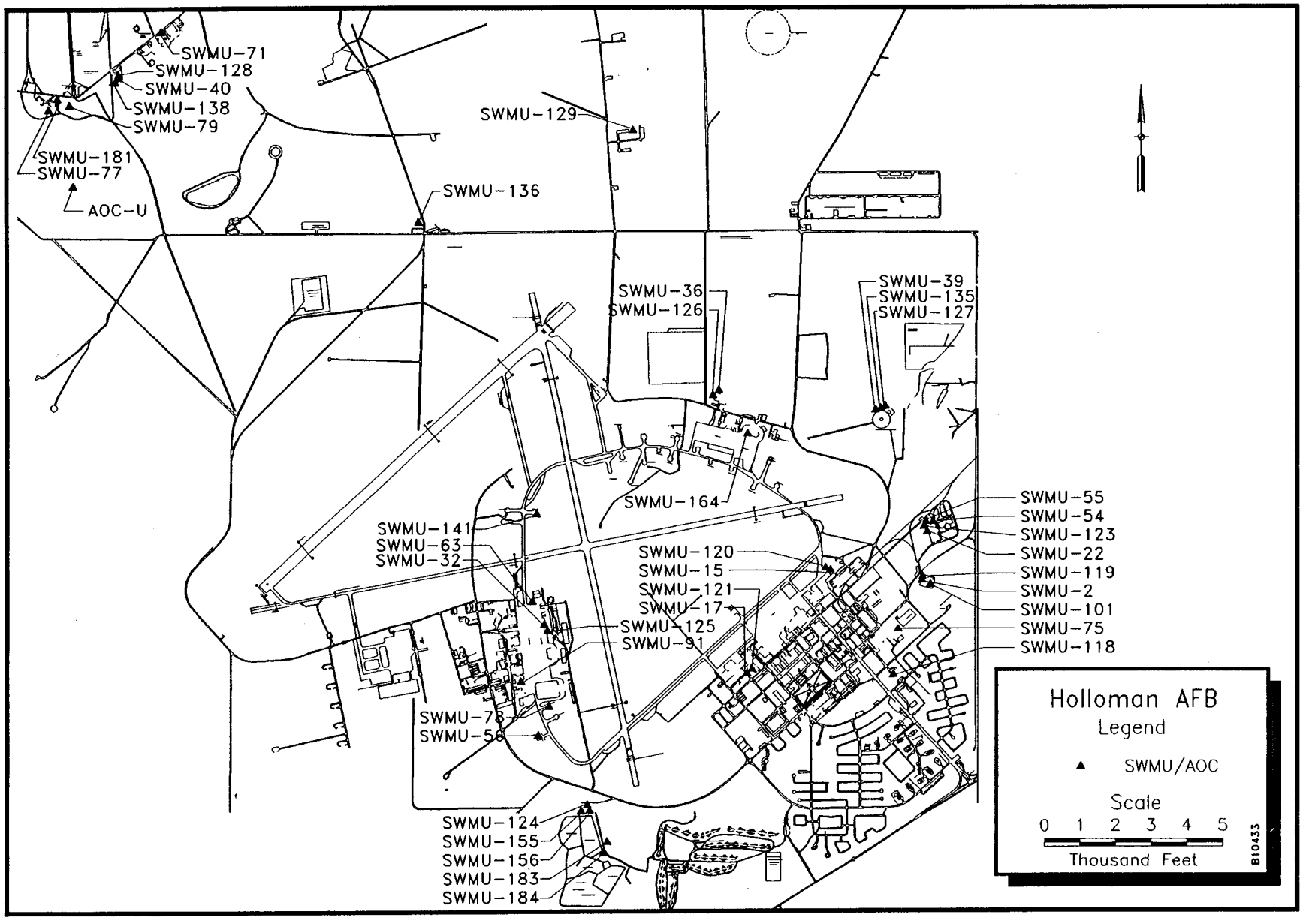


Figure 1-1. Phase I RFI SWMU Locations at Holloman AFB, New Mexico

DQOs are a statement of the "quality" of data required to enable project personnel to make decisions (e.g., a decision to remediate or not to remediate a site, a decision to pick one remediation technique over another, etc.). This statement of the quality must include a detailed specification of the following components:

- The types of data required to make a decision (e.g., chemical analysis of soils, depth to groundwater, etc.);
- The quantity of data required to make a decision (e.g., how many samples are required to achieve a given level of statistical power with specified Type I and Type II error rates); and
- The measurement objectives (e.g. precision, accuracy) for each type of measurement data to be collected.

1.2.1 DQOs for Holloman AFB -- Phase I RFI at 41 SWMUs

DQOs are established to focus data collection planning so that sufficient data are available for decision makers to resolve project objectives. This section presents the DQOs developed to complete Phase I RFI activities at 41 SWMUs on Holloman AFB. The following elements of the DQO development process are summarized:

- Decision makers;
- Decisions to be made to complete Phase I of the RFI;
- Generic definition of DQOs that must be formulated for the detailed projects during Phase I and future corrective actions phases;
- Chemical criteria that may be used to determine presence/absence of contaminants at the 41 SWMUs; and
- How the definition of potential remedial alternatives may be useful for project planning.

The DQOs presented in this section are not complete for all forthcoming phases of corrective action activities. As more information is gathered about the presence or absence

of contamination at any of the SWMUs and the project objectives are refined, DQOs must be refined iteratively for each sequential activity. The DQOs for each activity must then be a clear statement of the following items:

- The decision to be made from the results of each activity;
- The individuals and agencies with input to the decision;
- The decision rule (e.g., the rule to which data will be subjected and the resulting decision); and
- A definition of uncertainty constraints (e.g., a quantitative statement of the amount of uncertainty or risk that is acceptable, given that the probability exists that a decision will be made incorrectly).

During the course of an RFI, the primary decision maker interacts with a host of data collectors, data users, and federal and state regulatory agencies. Figure 1-2 presents the individuals and agencies that will interact to complete the RFI for the 41 SWMUs currently under investigation at Holloman AFB.

The *primary objective* of an RFI is to determine if a release has occurred from a SWMU (Phase I) and, if so, its nature and extent (Phase II). The *primary decision* is to decide if remediation is required to protect human health and the environment. There are only two options for this primary decision: to remediate, with the qualification that the level of effort for remediation may be variable based on the level of the threat; or, to take no further action. Table 1-2 presents the objectives of the Phase I RFI and summarizes the status of data collection activities. A review of historical activities (the RCRA Facility Assessment--RFA) at these SWMUs indicated past activities may have caused contamination of soil and/or groundwater.

In order to complete the objectives listed in Table 1-2 and resolve the primary decision, seven types of data must be collected during the activities recommended to complete the RFI. These six data types, the intended use of the data, and generic-level

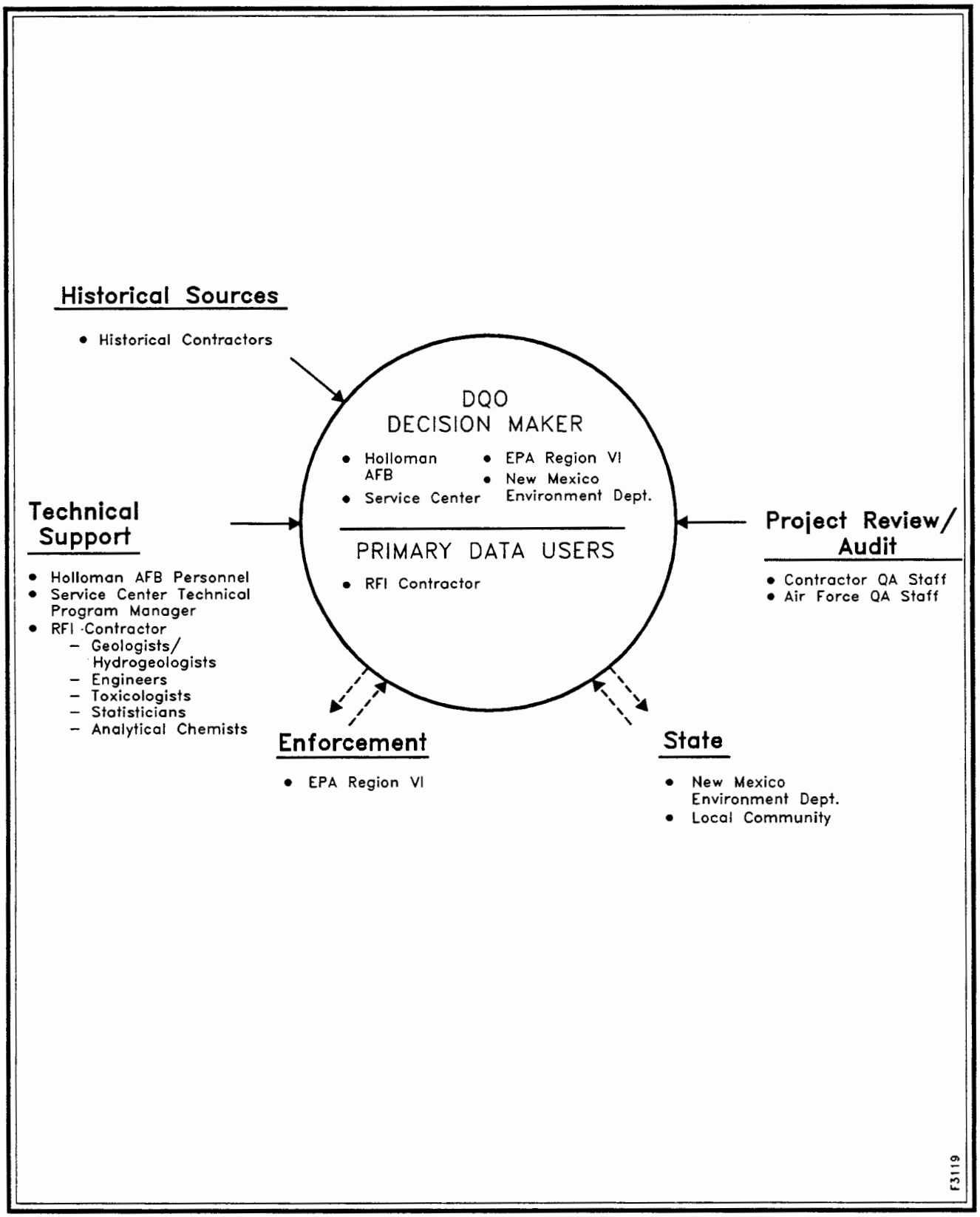


Figure 1-2. Individuals and Agencies that Interact in the Decision-Making Process of the RFI

Table 1-2

Summary of Phase I RFI Objectives and Data Needs for 41 SWMUs

Objectives	Data Needs	Completeness of Data to Meet Data Needs [a]
Objective 1:		
Determine if a release has occurred at each SWMU.	• Presence or absence of organic contaminants at concentrations greater than quantitation limits; and • Presence or absence of inorganic contaminants at concentrations greater than background.	C: SWMUs 75 and 101 P: SWMUs 22, 39, 40, 54, 55, 118, 119, 121, 123, 127, 128, 129, 135, 138, 177, 179, 181, 184 N: SWMUs 2, 15, 17, 32, 36, 56, 63, 71, 78, 91, 120, 124, 125, 126, 136, 141, 155, 156, 164, 183, AOC-U [6]
Objective 2:		
Identify potential migration pathways through which contamination may affect human health and the environment and identify potential receptors of this contamination.	• Hydrological factors; • Climate; • Population, environmental, and welfare concerns at risk; • Routes of exposure; and • Atmospheric dispersion potential and proximity of targets.	C: SWMUs 75 and 101 P: SWMUs 22, 39, 40, 54, 55, 118, 119, 121, 123, 127, 128, 129, 135, 138, 177, 179, 181, 184 N: SWMUs 2, 15, 17, 32, 36, 56, 63, 71, 78, 91, 120, 124, 125, 126, 136, 141, 155, 156, 164, 183, AOC-U [6]

[a] Data is available at some SWMUs through previous investigations.
[b] AOC = Area of concern.

Possible summaries of data collected will be:

(C) Complete = data collected resolves the data need and a decision may be made to complete the objective.
(P) Partial = data collected to date is insufficient to resolve the data need; and
(N) None = no data collected to date.

DQOs are summarized in Table 1-3. Generic-level DQOs in this case are a statement of the intended use of the data, required analytical levels, families of contaminants of concern, regulatory action levels or health-based concentrations of concern that must be considered, and a general comment about other factors that must be considered in future work plans. Analytical levels were chosen on the basis of the definitions and considerations presented in "Data Quality Objectives for Remedial Response Activities--Development Process", U.S. EPA, March 1987. Quality Assurance (QA) validation and evaluation will be performed as described in the Quality Assurance Project Plan (QAPP) section of the Work Plan. Analytical chemistry methods (both preparation and analysis) must be chosen to assure an adequate sensitivity (i.e., detection limit) and precision and accuracy to allow comparison of results to quantitation limits, background concentrations, and, ultimately, to action levels and/or risk- or health-based concentrations of concern. The DQO development process also includes statements of goodness indicators (e.g., precision, accuracy, etc.) for the RFI. Generically, these "goodness" indicators may be specified at two levels:

- Project level (DQOs); and
- Measurement data level.

For Phase I activities, project level goodness indicators will be addressed by the use of a judgmental sampling plan that conservatively designates sampling points in locations most likely to be affected by a release from the unit. Measurement-level objectives are complete and are defined in the QAPP as the necessary detection limits, precision, accuracy, representativeness, completeness, and comparability objectives for analytical measurement data. The QAPP also presents the QA program required to ensure that measurement objectives are met.

1.2.2 Concentration Levels of Concern

For the purposes of the Phase I RFI, contaminant concentrations that will trigger the need for a Phase II investigation are the quantitation limits associated with the

Table 1-3

Data Quality Objectives for Recommended Activities to Resolve Phase I RFI Data Needs

Data to be Collected	Priority/Data Use	Required Analytical Level [a]	Contaminants of Concern	Concentration Level of Concern	Comments [b]
Concentration of suspected contaminants in soil.	1) Determine presence or absence of contamination.	III	Fuels, solvents, metal-bearing wastes, pesticides, etc.	• Organic--greater than quantitation limits. Inorganic--statistically greater than background concentrations.	• SW846 analytical methods required. • 90% data completeness required for each matrix-method combination.
Concentration of suspected contaminants in soil vapor.	1) Determine presence or absence of contamination	II	Fuels, solvents	• Organic--greater than quantitation limits. Inorganic--statistically greater than background concentrations.	• 90% data completeness required for each matrix-method combination. • SOP must be provided and followed.
Site specific characteristics (e.g., hydraulic conductivity, topography, soil type, depth, aquifer parameters, etc.)	1) Transport modeling. 2) Determine potential pathways.	I	NA [c]	NA	• 100% data completeness required.
Concentration of suspected contaminants and by-products in waste.	1) Determine fate of suspected contaminants and potential impact on human health and the environment.	III	Fuels, solvents, metal-bearing wastes.	• Detectable concentrations.	• SW846 analytical methods required. • 90% data completeness required for each matrix-method combination.
Concentration of naturally occurring constituents in background soil and groundwater. [d]	1) Determine if concentrations of inorganic compounds are greater than naturally occurring concentrations.	III	Inorganic compounds.	• Detectable concentrations.	• SW846 analytical methods required. • 90% data completeness required for each matrix-method combination.

Table 1-3

(Continued)

Data to be Collected	Priority/Data Use	Required Analytical Level [a]	Contaminants of Concern	Concentration Level of Concern	Comments [b]
Concentration of suspected contaminants in groundwater. [d]	1) Determine presence or absence of contamination.	III [e]	Fuels, solvents, metal-bearing wastes.	• Organic--greater than quantitation limits. Inorganic--statistically greater than background concentrations.	• Should include filtered and unfiltered samples. • SW846 analytical methods required. • 90% data completeness required for each matrix-method combination.
Groundwater levels [d]	1) Determine depth to groundwater.	I	NA	NA	• 100% data completeness required.

[a] See "Data Quality Objectives for Remedial Response Activities--Development Process", EPA/540/G-87/003, March 1987, for definitions and considerations of analytical levels.
[b] Data requirements are suggested to improve the comparability and usability of data across all phases of the RFI.
[c] Not applicable.
[d] Although groundwater samples are not currently scoped to be collected during the Phase I RFI, they will be collectd at SWMUs 177, 179, and 181 during the expanded 29 Site RI investigation. If during the performance of the Phase I RFI groundwater sampling is deemed necessary, the above data quality objectives will be followed.
[e] All off-site analytical chemistry work will be completed at EPA Level III.

analytical methods for organic compounds and levels that are statistically greater than background concentrations for inorganic compounds. The use of statistical methods is described in Section 3.6 of the Work Plan. If a Phase II investigation is required, then action levels and/or risk- or health-based concentrations of constituents of concern, will be used as the criteria to determine if further actions are warranted.

The above sources provide information that may be used to establish decision rules for the determination of presence or absence of contamination as well as action versus no further action alternatives. These sources also provide information that may be used to determine appropriate analytical methods and quantitation limits to ensure comparability and sensitivity to such limits.

1.2.3 Comparison of Historical Data

In general, Phase I activities currently being planned will be the first investigation of most of the 41 SWMUs. Thus, historical data were not available to assist in DQO development and subsequent sampling and analysis planning for all the SWMUs. However, some sites were included in earlier RI activities and, where possible, this historical information is used to guide RFI tasks.

1.2.4 Preliminary Development of Remedial Actions

At this time, potential remedial actions will not be identified. However, data collection activities will be used to develop such a list if Phase II investigations indicate they are warranted or interim measures (Section 10.0) are found to be necessary.

1.3 Contents of the Phase I RFI Work Plan

The HSWA permit for the Base requires that the RFI Work Plan contain specific features and information. These requirements are discussed and presented in

Conditions H and R (Task II) of the permit. In addition to the activities associated with the Sampling and Field Measurements Plan to be conducted at the SWMUs listed in Table 1-1 of this document, the permit required Work Plan also includes a QAPP, a Data Management Plan, a Health and Safety Plan, a Community Relations Plan (CRP), and a Project Management Plan. Therefore, a total of six individual plans comprise the entire Phase I RFI Work Plan.

The Phase I RFI Work Plan presented in Volume I contains the Sampling and Field Measurements Plan and the Data Management Plan. Section 2.0 of the Work Plan contains a facility description that summarizes the environmental setting at the Base and provides a brief description of ongoing and historical environmental programs at Holloman AFB. The media investigation programs and Phase I sampling programs are discussed in Sections 3.0 and 4.0, respectively. In addition, descriptions of individual SWMUs and the wastes handled are provided in Section 4.0. Section 5.0 provides a summary of the quality assurance/quality control (QA/QC) measures that are to be followed during data collection and laboratory analysis. The Data Management Plan is contained in Section 6.0. The management of wastes generated during field activities is discussed in Section 7.0. The identification of potential contaminant migration pathways and of potential receptors is discussed in Section 8.0. Sections 9.0, 10.0, and 11.0, respectively, contain the Phase I RFI schedule and administrative outline, interim measures, and references. For the purposes of this document, the term "Work Plan" refers to the Sampling and Data Management Plans described above unless otherwise indicated. The remaining plans will be referred to by their specific titles (e.g., CRP).

The QAPP and the CRP presented in conjunction with this Work Plan are attached separately in Volume II. The QAPP provides a detailed discussion of the QA/QC measures to be followed during the field and laboratory programs as well as a description of all analytical methods to be performed and of the individual method requirements. The QAPP is not laboratory specific, since at this time a laboratory has not been selected for the performance of this work. At such time that a laboratory is selected, it will be provided with

a copy of the QAPP and will be required to meet all criteria contained therein. The CRP presents the objectives of the Community Relations Program and discusses the RFI process and site-specific factors to be considered in community relations.

The Health and Safety Plan and the Project Management Plan are not contained in this submittal. At this time, a contractor has not been selected for the performance of the Phase I field work. Upon selection, the contractor will prepare a site-specific Health and Safety Plan in accordance with the permit-specified requirements for submission to the Base and U.S. EPA Region VI for approval. The Project Management Plan will be prepared according to the requirements contained in the federal permit, following the selection of a laboratory and a contractor. Since the resumes of key personnel and the budgets for the performance of work are required in the Project Management Plan, it is not possible to prepare it at this time.

2.0 FACILITY DESCRIPTION

The following sections describe various aspects of the Holloman AFB facility and its surroundings.

2.1 Ownership and Operation

Holloman AFB is one of 18 Air Combat Command bases. The Base is host for the 49th Tactical Fighter Wing and the 479th Tactical Training Wing. Holloman AFB also supports some additional units of various Air Force commands, as well as U.S. Army units and the New Mexico State University Primate Research Laboratory.

Originally established as a transitional flight training facility, Holloman AFB was reactivated after World War II with emphasis on guided missile research and testing. The Base's primary mission remained guided missile and aerospace research until 1968, when the 49th Tactical Fighter Wing was assigned there. Aerospace research continues at Holloman AFB through activities at the Test Track Sled Facilities conducted by the 6585th Test Group.

2.2 Environmental Setting

The following subsections describe the environmental setting of Holloman AFB, New Mexico. Included in this section are geographic, geologic, and hydrogeologic data compiled from existing Base records, published literature, and previous reports.

2.2.1 Demographics and Land Use

Holloman AFB is situated in south-central New Mexico, in the northwest-central portion of Otero County. The Base occupies about 50,000 acres in the northeast quarter of section T.17S., R.8E. Additional land extending northward is occupied by the

White Sands Missile Range testing facilities. The Base is situated approximately seven miles west of Alamogordo, NM, the only town of appreciable size within 50 miles of the Base. The City of Alamogordo has a 1992 estimated population of approximately 31,090. There are nearly 6,600 military personnel and 3,000 civilian personnel employed at Holloman AFB. Of these, approximately 5,500 reside on the Base. Personnel housing is concentrated in the southeast corner of the Base.

The desert terrain of the area surrounding Holloman AFB has limited development in the immediate vicinity of the Base. There are no agricultural operations, residential communities, or large industrial operations located adjacent to the Base. Future land use in the area is not expected to differ significantly from current land use. Holloman AFB is an active military installation and is expected to remain active for the foreseeable future. No transfer of military property to the public domain is anticipated. Public access to the Base is restricted.

2.2.2 Physical Geography

Holloman AFB is located in the southern part of New Mexico as shown in Figure 2-1. The basin is approximately 120 miles long and 35 miles wide, extending from the southern end of Chupadera Mesa almost to the Texas border. The Tularosa Basin is part of a structural basin that is more than 200 miles long and 24 to 60 miles wide, extending from southeastern Socorro County, New Mexico, southward to Chiuahua, Mexico. In the vicinity of the Base, the Tularosa Basin is bound 8 miles to the east by the Sacramento Mountains and 20 miles to the west by the San Andres Mountains.

Elevations within the Tularosa Basin range from 4,400 feet above mean sea level (ft-msl) at the northeast corner to 4,000 ft-msl in the southwest corner, sloping downward to the southwest. Elevations at the Base range from 4,100 to 4,028 ft-msl, excluding Tularosa Peak. Elevations in the Sacramento Mountains reach 12,000 ft-msl and range from 7,000 to 9,000 ft-msl within the San Andres Mountains.

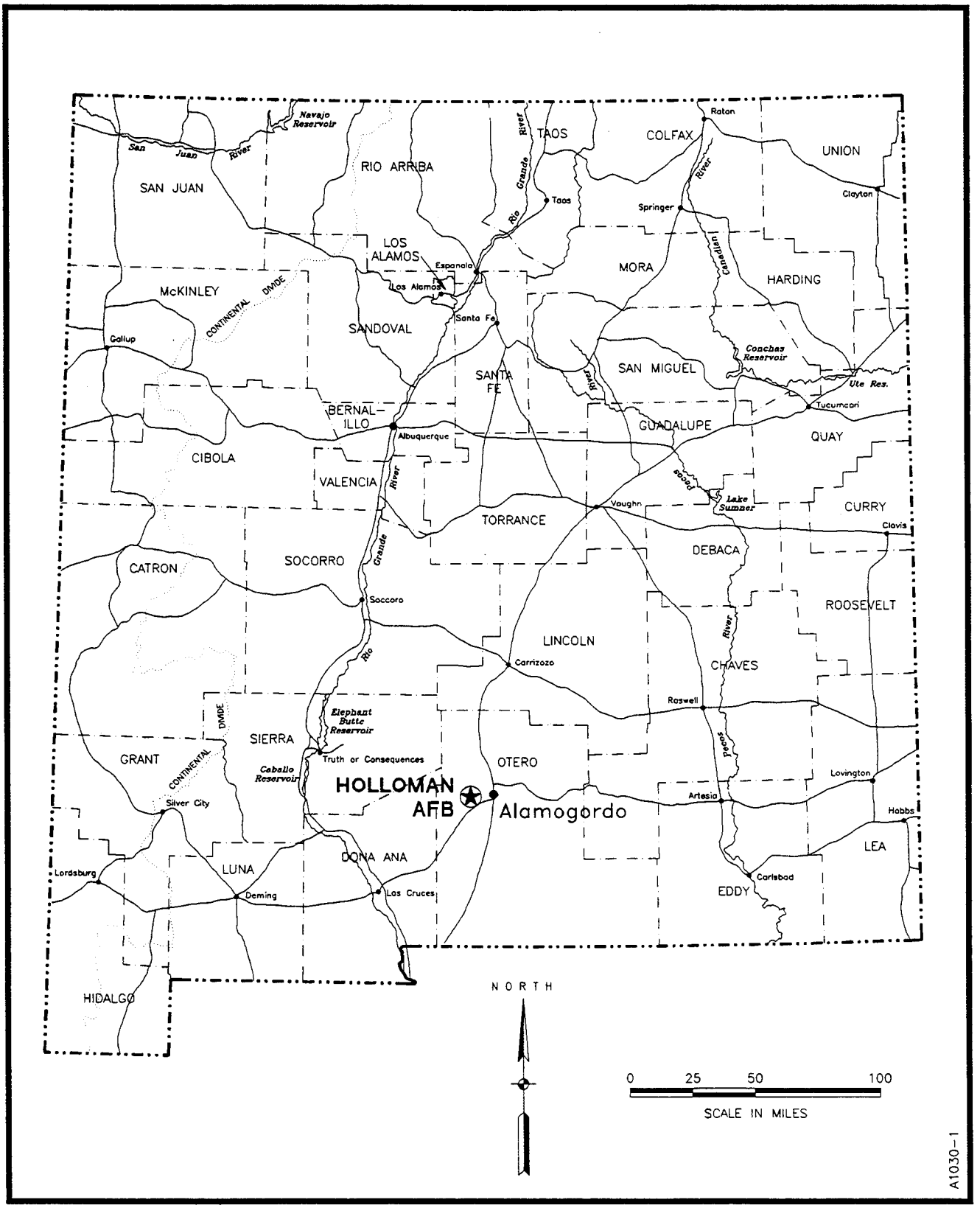


Figure 2-1. Location of Holloman AFB

The Tularosa Basin is a closed basin with regard to surface drainage. No surface water leaves the basin. Surface water is either lost to evaporation and infiltration or collects in the lowest point in the basin at or near Lake Lucero. This lake is located at the southwest edge of the gypsum dune field, known as White Sands National Monument, west of the Base. Surface water within the basin ultimately flows to Lake Lucero. Here, also a discharge point for groundwater, sulfate salts are concentrated by evaporation. The prevailing southwest winds then pick up and transport the salts, primarily gypsum, in a northeasterly direction to continue building the dune field of the White Sands National Monument.

The Base is crossed by several southwest-trending "arroyos" or intermittent stream beds, including Lost River (the largest), Dillard Draw, Malone Draw, and several smaller tributaries such as Red Arroyo and Arroyo Cavacita. Lost River is fed by groundwater seeps or springs. The river appears and disappears along its course as springs add water and evapotranspiration and infiltration recapture it.

2.2.3 Surface Water

The Tularosa Basin is a closed basin with no surface water drainage. Water is lost to evaporation, transpiration, and infiltration, or collects in Lake Lucero, the lowest point in the basin, approximately 20 miles southwest of Holloman AFB. Figure 2-2 shows surface drainage patterns in relation to the Main Base area and Base boundaries at Holloman AFB. Surface water resources within the Tularosa Basin are limited by the high evapotranspiration rate and low annual rainfall. Perennial streams occur in the mountainous regions surrounding the basin, including Rio Tularosa, Rio Bonita, and Eagle Creek. Rio Bonita, located northeast of Tularosa and approximately 60 miles from Holloman AFB, discharges to Bonita Lake, which in turn is tapped for water supply, some of which is transmitted by pipeline to the Base.

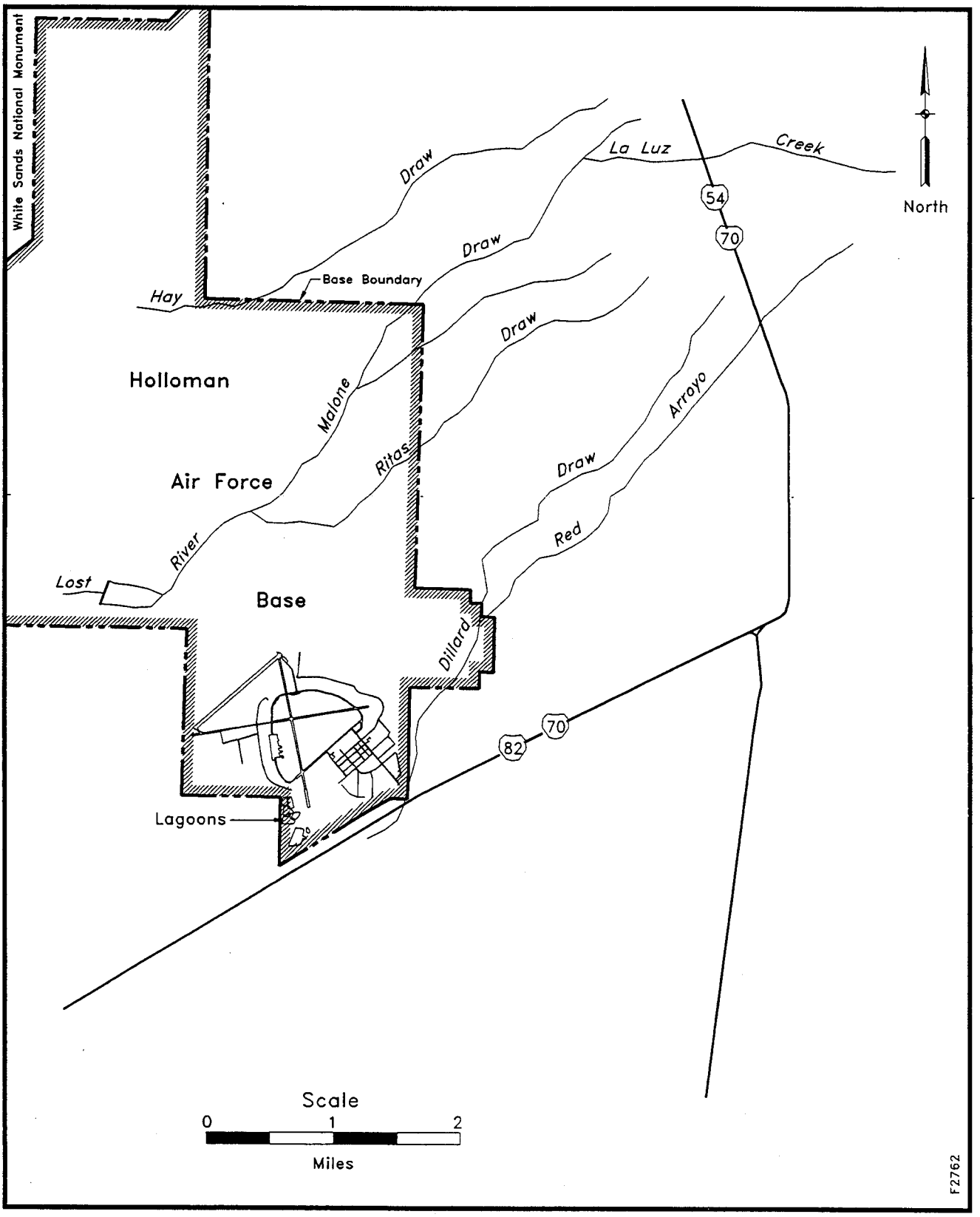


Figure 2-2. Surface Drainages at Holloman AFB

The intermittent streams and arroyos occurring within the basin are important drainage features only during the infrequent heavy rainfall, conveying surface water southwest to the basin's lowest elevation point (Lake Lucero). The Base is crossed by several southwest-trending arroyos, which control surface drainage in the undeveloped part of the Base. These arroyos are Hay Draw, in the far northern part of the Base; Malone Draw and Ritas Draw, which drain into Lost River; and Dillard Draw to the east, which runs in a southwesterly direction near the southern boundary of the Base. Arroyo locations are shown in Figure 2-2. Lost River, the largest arroyo, is dammed near the western boundary of the Base to prevent runoff from the Base from entering White Sands National - Monument. Runoff from Lost River, Malone Draw, and Ritas Draw collects in the dammed area and either evaporates or infiltrates.

Man-made and/or modified surface water features have some significance in an area otherwise devoid of lakes, rivers, and streams. The wastewater treatment system at Holloman AFB consists of seven aeration/evaporation lagoons located in the southwest corner of the Base. Just southwest of these lagoons, a natural playa occurs, which receives surface runoff from the Base as well as discharge from the sewage lagoons. The inundated portion of the playa is referred to as Lake Holloman. Surface drainage within the undeveloped parts of the Base is controlled by the major arroyos, including Lost River and Dillard Draw and their tributaries. Surface flows are directed southwesterly toward the White Sands National Monument. Drainage within the developed portion of the Base flows by way of ditches and culverts to the southwest corner of the Base, in the vicinity of the wastewater treatment lagoons.

2.2.4 Soils and Geology

Most of the Base is covered with well-drained soils (fine sandy loam) formed in gypsiferous sediments of eolian (wind blown) or alluvial (stream deposition) origin. The soils are thin and overlie discontinuous beds of gypsum. The surface soils are nearly level,

with slopes ranging from 0 to 5 percent. Permeability of the soil horizons ranges from 4 x 10^{-4} to 1 x 10^{-3} cm/sec (moderately permeable).

Geologically, the Tularosa Basin is a graben structure, bounded on the east and west by mountains that are actually tilted fault blocks. The basin had its beginning over 270 million years ago when most of southern New Mexico was covered by a shallow sea. A generalized cross-section of the Tularosa Basin geology is shown in Figure 2-3. During the succeeding years, there were periods of inundation and each cycle left behind successive layers of sediments. Then, approximately 70 million years ago, a major mountain-building episode occurred, creating the Rocky Mountains. This upheaval caused the Tularosa area to be uplifted, forming a broad, gentle arch. As the mountains formed over time, tectonic adjustments (approximately 10 million years ago) led to the collapse of the top of this arch or dome along nearly vertical fault planes. The large area, which collapsed or settled, formed what is now the Tularosa Basin.

The fault planes have produced steep scarps clearly visible on the west side of the Sacramento mountains. The basin itself is underlain mostly by unconsolidated bolson deposits more than 4,000 feet thick in the vicinity of Holloman AFB. Bolson (a basin with no surface drainage outlet) deposits refer to sediments carried by water into the closed basin or bolson. Only the uppermost bolson deposits are currently of significance to this investigation.

2.2.5 Groundwater

Groundwater occurs in unconfined conditions in the unconsolidated bolson deposits beneath Holloman AFB. The primary source of recharge for groundwater in the bolson aquifer is percolation of rainfall and stream runoff through the coarse, unconsolidated alluvial fan deposits along the western flank of the Sacramento Mountains. Water migrates downward into the bolson fill aquifer and flows downgradient through progressively

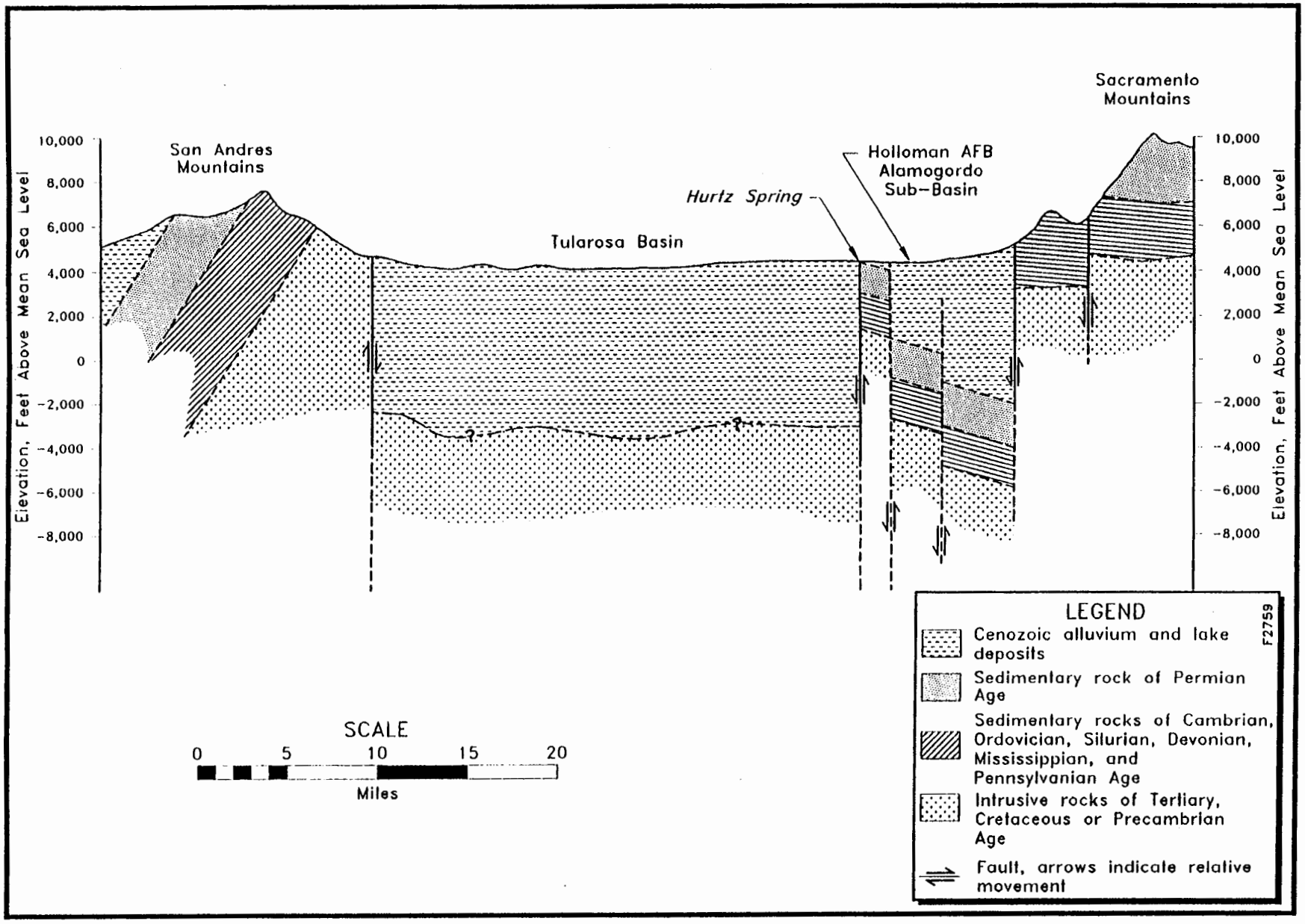


Figure 2-3. General Geologic Cross-Section of the Tularosa Basin

finer grained sediments into the basin. The hydraulic gradient is steep in the recharge zones at the base of the mountains, but then flattens out as groundwater migrates into the valley.

Groundwater occurs within the unconsolidated bolson fill at Holloman AFB. The Base obtains most of its water supply from wells installed in the fill. The Base well fields (Boles, Douglas, and San Andres) are located off Base at the foot of the Sacramento Mountains just south of Alamogordo. The bolson fill is derived from limestone, dolomite and gypsum from the surrounding mountains. Fresh water recharges the bolson fill at the base of the mountains, which contains highly soluble materials such as gypsum. Groundwater quickly dissolves these formation minerals, and groundwater quality degrades with increased contact time. The highly mineralized groundwater under Holloman AFB contains total dissolved solids (TDS) in excess of 10,000 mg/L, making the groundwater unfit for consumption (New Mexico Human Health Standard for TDS is 1,000 mg/L). The only potable groundwater in the vicinity is near the recharge area near the base of the mountains.

In the vicinity of Holloman AFB, the ground surface slopes to the west and southwest gently but at a slightly higher rate than the water table. Depth to water table at the well fields near the mountains is 270 feet or more below ground level (BGL). At Holloman AFB the water table ranges from 35 BGL to 5 to 10 ft BGL. Like surface drainage, groundwater flows predominately to the southwest, discharging by evapotranspiration. In the vicinity of Holloman AFB, groundwater generally flows toward the west and southwest. However, regional and local groundwater flow direction is controlled by the arroyos that drain the basin. In the southeastern portion of the Base, regional groundwater flows southwesterly, following the Dillard Draw surficial drainage system. In the northern portion of the Base, groundwater flows to the west, following the Ritas Draw, Malone Draw, and Lost River drainages. An apparent divide between these two drainage subsystems is seen in the northeast-central part of the Base.

2.2.6 Air

Investigation of air emissions at Holloman AFB is not an objective of this Phase I RFI and is not included in this document. However, vapor monitoring at all drilling sites will be conducted during the RFI to support health and safety considerations during the field program.

2.3 Historical and Ongoing Environmental Programs

As a result of past waste and resource management practices at Holloman AFB, some areas of the Base have become contaminated by various wastes and waste constituents. In response, a number of environmental restoration programs have been initiated at the Base. In addition, ongoing efforts to comply with applicable laws and regulations ensure that present waste and resource management practices are carried out in a manner that protects human health and the environment.

This section summarizes the current status of the Holloman AFB environmental program. The program integrates activities being performed under the IRP, the RCRA corrective action process, and the associated environmental compliance program to support full restoration of the Base.

2.3.1 Environmental Program Objectives

The objectives of the Holloman AFB environmental program are to:

- Protect human health and the environment;
- Comply with existing statutes and regulations;
- Complete RIs and RFIs as soon as practicable for each IRP site and RCRA SWMU;
- Identify all potential source areas;

- Establish areas of no suspected contamination (ANSCs);
- Initiate removal actions where necessary to control, eliminate, or reduce risks to manageable levels;
- Characterize risks associated with releases of hazardous wastes or hazardous constituents;
- Develop, screen, and select remedial actions (RAs) and corrective measures (CMs) that reduce risks consistent with statutory requirements;
- Commence RAs and CMs for areas of concern (AOCs) as soon as practicable; and
- Conduct long-term RAs and CMs for groundwater and any necessary five-year reviews for wastes present on site.

2.3.2 IRP Status

A total of 58 IRP sites have been identified at Holloman AFB. Of these 58 sites, 9 are in the preliminary assessment/site investigation (PA/SI) phase, 29 are in the RI/Feasibility Study (FS) phase, 1 is in the RA phase, and 19 have been closed. Approximately half of the sites in the RI/FS phase are not expected to need further action; those sites that do not need further action will be addressed as sites to be closed out. The site currently in the RA phase is IRP Site 17. Free-phase product floating on the groundwater is being removed at Site 17 and a soil vapor extraction system is planned. Contaminated soil has been removed from Site 47 and the site is being re-evaluated as part of a new RI.

2.3.3 Compliance Program Status

Compliance activities at Holloman AFB are being conducted in coordination with environmental restoration activities under the IRP. Compliance activities address underground storage tanks (USTs), hazardous materials management according to RCRA

and other federal and state regulations, closure of active and inactive RCRA-regulated SWMUs and polychlorinated biphenyls (PCBs).

UST Sites

A total of 43 USTs have been tested, investigated, and/or mitigated at Holloman AFB. All UST removals are scheduled to be completed by 1996. Activities are being conducted under RCRA Subpart I of the New Mexico UST Program.

RCRA, PCBs, or Other Compliance Issues

In addition to the UST Program, compliance activities at the Base include:

- Hazardous materials management in accordance with RCRA regulations;
- Proposed closure of active RCRA units through the corrective action process under the New Mexico RCRA program and the federal permit administered by U.S. EPA Region VI;
- Closure of the sewage lagoons, an active RCRA site, in accordance with provisions of the Federal Facilities Compliance Agreement (FFCA); and
- PCB disposal in accordance with the Toxic Substances Control Act (TSCA), as amended, and U.S. EPA PCB policy. There is no PCB containing equipment remaining at Holloman AFB.

Compliance Strategy

This section summarizes the strategies for compliance activities at Holloman AFB. These activities include USTs and SWMUs.

Underground Storage Tanks

Two activities are scheduled to be completed by the end of 1996. These include:

- Removal of all but three of the remaining USTs in use; and
- Monthly monitoring of USTs in use.

Solid Waste Management Units

The following compliance activities are scheduled from 1992 through 1996:

- Quarterly reports on status of the sewage lagoons are sent to U.S. EPA Region VI;
- Semiannual groundwater assessment monitoring of the sewage lagoons following determination of monitoring parameters;
- Annual groundwater report for U.S. EPA Region VI of the sewage lagoons;
- RFI Work Plan and schedule for SWMUs listed in Table 2 of the HSWA Permit;
- RFI Work Plan and schedule for SWMUs listed in Table 3 of the federal permit by September 1994; and
- Closure of the sewage lagoons by the end of 1996.

3.0 INVESTIGATION METHODS

This section contains descriptions of the field and laboratory methods and techniques that will be used during the Phase I RFI at Holloman AFB.

In accordance with the U.S. EPA guidance on the performance of RFIs (U.S. EPA, 1989), the field methods described below were reviewed with the following criteria in mind:

- Ability to yield representative samples;
- Compatibility with analytical considerations;
- Practicality;
- Simplicity and ease of operation; and
- Safety.

3.1 General Requirements

As a matter of practice, all of the following general requirements will be adhered to.

3.1.1 Record Keeping

The Contractor will maintain field records that will enable the re-creation of all sampling and measurement activities performed during the RFI. The data will meet all Installation Restoration Program Information Management System (IRPIMS) requirements for all of the investigative and sampling activities. In addition, specific data requirements for certain activities as listed in the following sections will be met. All information will be recorded with indelible ink in a permanently bound, numbered notebook with sequentially numbered pages. Information recorded on loose-leaf paper (e.g., driller logs) will be recorded in indelible ink and maintained in a three-ring notebook. These records will be

archived during and upon completion of the project in an easily accessible form and will be available on request to the United States Air Force.

All activities conducted during the RFI will be recorded including, at minimum, the location, date and time, identity of people performing the activity, and weather conditions. For all field measurements, the numerical value and units of each measurement and the identity of and calibration results for each instrument will be recorded. Notes on all sampling activity will include: sample type and sampling method used, sample identity and depth(s) of collection, sample amount, brief sample description (grain size, color, odor, etc.), identification of sampling device (e.g., type of drilling rig with split spoon sampler versus hand auger), and any uncontrollable conditions which may affect the sample integrity (weather, air quality, etc.)

3.1.2 Containerization of Wastes

All materials from soil borings will be examined to identify potential hazards using appropriate field screening techniques [photoionization detector (PID), organic vapor analyzer (OVA), etc.] as described in Section 3.1.4. Investigative waste materials will be segregated (liquid, soil, personal protective equipment) in separate drums. Materials with abnormal color, odor, or organic vapor monitor readings will be containerized in conformance to state, local, and RCRA requirements, whichever is the most stringent. The Contractor will supply the containers. The Contractor will arrange for the transport of the materials to a site designated by the Base. The Contractor will mark each container with a nonfading marker or paint, label as appropriate, and keep a log of the number, location, sample type and date(s) of when the drum was filled, when and where moved to, and final disposition of each container. The Contractor will sample the contents of the containers and analyze them for SWMU-specific Toxicity Characteristic Leaching Procedure (TCLP) parameters (see Tables 3-6, 7-1, and 7-2) based on waste known to be present or present in the past to determine the final disposition of the materials. The Contractor will also

arrange for the final disposition of the wastes once analytical results are received. Figure 3-1 is an example of the Container Log that will be used at Holloman AFB. Section 7.0 of this Work Plan (the Waste Management Plan) discusses in detail the handling and disposal of wastes generated during the Phase I RFI.

In addition to the soil borings discussed above, contaminated water generated during decontamination procedures will be containerized for disposal or allowed to evaporate after being placed in containers. Section 3.1.3 discusses the procedures to be followed based on whether the decontamination water is generated from equipment cleaning at Class 1 or Class 2 criteria sites (see Section 7.1 for criteria definitions). Section 7.0 discusses waste management in detail.

3.1.3 Equipment Decontamination

Strict procedures for equipment decontamination and avoidance with contaminated clothing will be implemented to avoid cross-contamination of subsurface strata and soils. Drill rigs and all drilling tools will be thoroughly cleaned and decontaminated before initial use and after each soil boring.

All tools and down-hole equipment, such as auger, bits, and drill rods, will be decontaminated with a high-temperature high-pressure steam wash between each borehole. This decontamination will be done in areas designated by the Base, specifically prepared to avoid the spread of contaminants. The decontamination areas may consist of a concrete base for use as a decontamination pad, or heavy gauge plastic sheeting placed on the ground surface surrounded by berms, also covered by plastic. The wastewater generated during decontamination of equipment used at Criteria 2 sites (SWMUs containing characteristically hazardous or nonhazardous wastes -- see Table 7-1) will be collected and placed in a plastic-lined basin and allowed to evaporate. The basin will be constructed as a large, above ground swimming pool with a minimum depth of four feet. The pool will be constructed at a location specified by the Base and will be large enough to accommodate rainfall without

Page _____ of _____

CONTAINERIZED MATERIALS LOG

Project _____

City _____ State _____

Drum Number	Well or Boring Number	Material Type	Date Filled First	Date Filled Last	Location Moved to	Final Disposition	Signatures of Movers

Figure 3-1. Containerized Materials Log

overflowing. Evaporation rates are high at Holloman AFB (67 in. per year), which will provide an environmentally safe method of water disposal. All decontamination wastewater (if not evaporated), plastic sheeting, pool materials, and any contaminated materials will be placed in 55-gallon drums approved by the Department of Transportation (DOT) for later disposal. Decontamination water generated during cleaning of equipment from Criteria 1 sites (SWMUs known to have managed listed hazardous wastes -- see Table 7-1) will be placed in drums at the SWMU for later disposal or placed in open containers on-site and allowed to evaporate. In addition, any water generated during performance of the HydroPunch survey will be containerized for disposal or evaporation within the SWMU boundaries.

All equipment that may directly or indirectly contact samples will be decontaminated. This includes casing, drill bits, auger flights, the portions of drill rigs that stand above boreholes, sampling devices, and instruments such as slugs, sounders, and borehole geophysical sounds. In addition, the Contractor will take care to prevent the sample from contacting potentially contaminating substances such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure will be used to decontaminate large pieces of equipment such as drill rigs, auger flights, and casing:

- Wash the external surfaces of equipment with high-pressure, high-temperature water. If necessary, using an Alconox solution, scrub until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The inside surfaces of casing, drill rod, and auger flights shall also be washed as described above; and
- Rinse with potable water.

This decontamination procedure will be performed before equipment is used and between each sampling location.

The following procedure will be used to decontaminate the HydroPunch sampler:

- Steam clean the HydroPunch rods;
- Scrub the equipment with a solution of potable water and Alconox;
- Rinse equipment in potable water; and
- Rinse equipment with reagent-grade or American Society of Testing Materials (ASTM) Type II water.

The following procedure will be used to decontaminate sampling devices such as split spoons, bailers (if required), and hand augers:

- Scrub the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent. Rinse equipment with copious quantities of potable water followed by a reagent-grade or ASTM Type II water rinse;
- Rinse equipment with reagent-grade isopropanol (at SWMUs where fuels or PCBs may be present, a reagent-grade hexane rinse must precede the isopropanol rinse);
- Rerinse equipment with ASTM Type II water or reagent-grade water; and
- Air dry equipment on a clean surface such as Teflon, stainless steel, or oil-free aluminum. If the sampling device will not be used immediately after being decontaminated, wrap it in oil-free aluminum foil.

ASTM Type II water or reagent-grade water, isopropanol, and hexane will be purchased, stored, and dispensed only in glass, stainless steel, or Teflon containers. These containers will have Teflon caps or cap liners.

3.1.4 Geologic Standards

To achieve uniformity and clarity, the Contractor will adhere to the following standards in describing and presenting geological data. Color of materials described in the field will be made using the Munsell Color System. Each sampling crew will have a chart available for reference. Unconsolidated materials will be described in a consistent format such that:

- Deposit names follow the name of the primary grain size.
- Grain size and deposit name shall be accompanied by the primary mineral content, accessory minerals, color, particle angularity, and any other defining characteristics such as:
  - -- Density or consistency.
  - -- Bedding, sorting, or grading.
  - -- Plasticity.

Grain size dimensions of the primary and secondary minerals will be recorded using the metric system. Graphic logs of soil borings and/or monitor well borings will use symbols of the Unified Soil Classification System (USCS). An example description is:

> CLAY, Clayey silt with some sand: Clay, 10% very fine to fine (.088 to .177 mm) sand with > 5% micaceous minerals, dark greenish gray (5 Y 4/1), subrounded, dry, soft, high plasticity. (MH)

All geological illustrations such as maps and cross-sections will use standard patterns for any igneous, sedimentary, or metamorphic rocks and USCS graphical symbols for soil types. The Corps of Engineers Hazardous Toxic Waste (HTW) log form will be used to log all soil borings (hollow stem and hand augered) conducted during the Phase I RFI. In addition, if conditions warrant the installation of groundwater monitoring wells,

HTW log forms will be completed. An example of the form is presented in Figure 3-2. Scales will be selected to best represent the geological and hydrogeological concept for that particular display. Cross-sections will be oriented with the northernmost and eastern most direction to the right, and all maps will be oriented with north to the top unless shape dictates otherwise. A north arrow will indicate north on all maps.

3.1.5 Field Screening Technique

At some sites at Holloman AFB, field screening techniques will be used to select samples for analysis in the laboratory. An OVA equipped with either a PID or a flame-ionization detector (FID) will be used to evaluate headspace vapor readings from all soil samples taken during the investigation. Upon retrieval of the sample material and after all volatile organic analysis (VOA) containers have been filled, a small portion of the material will be placed in a new, clean sample jar whose opening will then be sealed with a continuous sheet of aluminum foil and secured with the jar lid. The sample will then be shaken for a minimum of 15 seconds and allowed to sit for at least 10 minutes to assist in volatilization. If cold conditions exist, the samples will be warmed to near room temperature. After reshaking the jar and removing the lid, the probe of the OVA will be inserted through the aluminum foil, and the immediate reading will be recorded on the boring log and in the field log book.

Headspace jars may be lined with a new, clean plastic Ziploc® bag to facilitate reuse of the jar if OVA readings from the inside of the plastic-bag-lined jar are zero before placing the headspace sample in the jar. If necessary, the jar used for the headspace analysis could be refilled with material from the same sampling interval intended for non-volatile analyses (e.g., geotechnical or metals samples) to conserve jars. The OVA will be calibrated with an appropriate span gas of known concentration at the beginning and end of each day.

HTW DRILLING LOG

HOLE NO.	
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR
SHEET 1 OF 2 SHEETS	
3. PROJECT	4. LOCATION
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED / 11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
20. SAMPLES FOR CHEMICAL ANALYSIS			21. TOTAL CORE RECOVERY %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY) / 23. SIGNATURE OF INSPECTOR

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	ANALYTICAL SAMPLE NO. e	REMARKS f
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				

Figure 3-2. HTW Drilling Log

HTW DRILLING LOG

HOLE NO.
SHEET 2 OF 2 SHEETS

1. COMPANY NAME	2. DRILLING SUBCONTRACTOR

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	ANALYTICAL SAMPLE NO. e	REMARKS f
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				

Figure 3-2. (Continued)

3.1.6 Field Sampling

The following guidelines will apply to all sampling efforts undertaken at Holloman AFB.

Planning and Scheduling

Prior to all field sampling events, a schedule will be prepared to maximize the efficiency of the field activities. During preparation of the sampling schedule, several factors should be considered, including the condition and accessibility of the site, weather conditions, the level of contamination, and sample collection techniques to be employed.

Field quality assurance/quality control (QA/QC) is another integral aspect of schedule preparation. The number and types of QC samples to be collected (duplicates and field blanks) will be incorporated into the sampling schedule. Sample summary tables for each site are included in Section 3.3. Field QA/QC is discussed in Sections 3.5 and 5.2.

Materials and Supplies

Materials and supplies required for sampling activities will be organized prior to the start of sampling. This will encourage efficient use of time during the day. A list of typically required materials and supplies is presented in Table 3-1. In addition, safety equipment, including a first aid kit, will always accompany personnel in the field. A general safety equipment checklist is presented in Table 3-2.

3.2 Field Methods

The following field activities will be performed as part of the Phase I RFI at some or all of the units to be investigated: hollow-stem auger drilling, monitoring of organic

Table 3-1

Sampling Equipment Checklist

Quality assurance and field sampling procedures (QAPP and Work Plan)
Trip blanks
Thermometers
Sample preservatives H_2SO_4, HNO_3, HCl, NaOH, zinc acetate
Sample containers
Reagent-grade water or ASTM Type II water
Potable water
Laboratory-grade detergent (Alconox®)
Reagent-grade isopropanol
Reagent-grade hexane
OVA span gas
Calculator
Measuring tape (calibrated in hundredths of a foot)
Field notebook
Chain-of-custody forms
DQCRs and other forms
Plastic sheeting
Ballpoint pens
Sample bottles
Sample bottle labels
Duct tape
Clear plastic tape
Teflon tape
Tool kit
Scissors
Wash tubs, buckets, brushes
Drinking water container
Towelettes
Garbage bags
Coolers

Table 3-1

(Continued)

Ice
Protective mesh covering for glass sample bottles
Foam containers for volatile organic analysis vials
Aluminum foil
Ziploc bags
Custody seals
Extra-fine Sharpie® markers
Pocket knife
Federal Express forms
Strapping tape
Pipettes
Squirt bottles
Stainless steel pan or bowl
Stainless steel trowel
Stainless steel hand auger

Table 3-2

Safety Equipment Checklist

First aid kit
Fire extinguisher
Disposable coveralls
Safety glasses
Hard hats
Steel-toed boots
Disposable polyvinyl chloride gloves
Nitrile and latex gloves
Respirator and cartridges
Respirator cleaner
Safety forms
Copy of Health and Safety Plan
Portable eyewash stations
OVA
Hearing protection

Note: Additional equipment may be mandated in the Health and Safety Plan. Certain items on this list may not be required for all field activities (e.g., hard hats not required for water sampling).

vapors (if any) during drilling, collection and analysis of surface and subsurface soil samples, collection and analysis of soil gas samples, collection and analysis of groundwater samples (if warranted), and surveying sampling locations.

3.2.1 Drilling Program

For the Phase I RFI, a hollow-stem auger rig will be used to drill boreholes. This drilling method does not require the use of drilling fluids, permits collection of relatively undisturbed samples, and enables accurate identification of the position of the sample in the soil profile as well as the position of the water table. The hollow-stem auger also serves as a temporary casing to prevent borehole caving during drilling and sampling. Hollow-stem augering will be used in conjunction with split-spoon sampling techniques to collect subsurface soil samples. The split-spoon sampling technique to be used is a surface drop hammer.

The surface drop hammer system uses a 24-in. long split-spoon sampler to collect soil samples. The augers are advanced to predetermined depths and the center bit, attached to the drill rods, is pulled out of the hole. The sampler is attached to a small diameter, flush-threaded pipe and lowered to the bottom of the hole. The 140-pound surface drop hammer mounted on the drilling rig at the surface is dropped repeatedly, and the sampler is driven approximately 24-in. into the ground. The number of hammer blows required to advance the spoon 6-in. are measured every 6-in. to determine the physical characteristics of the material encountered. Fifty blow counts without significant penetration is considered formation refusal. If 50 blows are counted for a 6-in. interval, the sampler is removed and the drill stem is advanced through the material. A 140-pound drive hammer mounted above the sampler, but inside the boring (downhole hammer), may also be used for driving the sampler into the ground.

For sampling of unconsolidated and uncemented sands or gravel deposits, a split-spoon sampler equipped with a sample catcher is used to prevent sample loss. The

catcher is placed in the lower portion of the sampler. As the sampler is pulled to the surface, the catcher prevents unconsolidated or uncemented material from falling out the bottom of the sampler. The catcher will be decontaminated in the same manner used to decontaminate the split-spoon sampler.

After each borehole is completed, the drilling rig and auger fights will be decontaminated according to the procedures outlined in Section 3.1.3.

Soil samples collected during drilling activities will be monitored for volatile organic compounds (VOCs) using a portable real-time OVA. The vapor-monitoring results will be recorded in the boring logs. In some cases, monitoring results will be used to select samples for analysis. Screening methods and procedures are discussed in greater detail in Section 3.1.4.

All borings or HydroPunch holes will be backfilled with bentonite pellets or grout at the conclusion of sampling. If grout is used, it will consist of a mixture of Portland Cement, water (not more than 7 gal. per bag of cement), and sodium bentonite powder (3 percent by weight).

3.2.2 Soil Gas Survey

At certain locations on Holloman AFB, soil organic vapor (Soil Gas) surveys will be conducted to collect preliminary information on subsurface soil gas. The soil gas survey will verify the presence of organic vapors in the soil. The survey will also serve to identify any gas migration that has occurred and characterize the nature, extent, and soil gas constituents. The following section describes the minimum equipment needed to perform the soil gas survey. The Contractor performing the survey may select equipment as necessary to fulfill all contract requirements.

Soil gas samples will be collected with stainless steel drive point samplers. The rods will be pushed into the ground to the desired sampling depth, and a suction will be drawn by pumps connected to air hoses. Samples will be withdrawn and held temporarily until processing in a gas chromatograph (GC) for quantitative analysis. The GC will be calibrated at the beginning and end of each day of use. The calibration sample will be of a substance of known concentration and whose analysis is compatible with the field calibration for contaminants of interest. Blank samples of ultra zero air will be analyzed at the beginning of each day before running any standards or samples to demonstrate that the system is clean. Samples of background air will also be analyzed.

In the event that soil gas samples cannot be obtained using the technique discussed above, passive soil gas or heated headspace techniques will be used instead. Passive soil gas surveys involve the burial of individual sample collection vials. Collection units consist of resealable glass containers containing a metallic wire in an inert atmosphere, to the end of which is bonded a small amount of activated charcoal. The samplers are safeguarded from ambient air conditions by the glass container. A hole is dug to a depth of approximately 18 inches. A length of stainless steel wire is wrapped around the uncapped sampler, the sampler is lowered mouth down into the hole, and flagging material is attached to the length of wire extending above the surface to mark the location. An aluminum foil plug is placed above the collection vial, and the hole is backfilled with soil. Any volatile vapors are than adsorbed to the exposed carbon after diffusing through the uncapped vial. After an appropriate period of time, the sampler is retrieved from the borehole and resealed. Sample collectors are then sent to the laboratory for analysis by thermal desorption-mass spectrometry (TD-MS). After removal of all collectors, all boreholes will be backfilled with soil.

3.2.3 HydroPunch Program

The HydroPunch method allows for a rapid and cost-effective method to determine groundwater constituents. The HydroPunch survey is done by pushing a 1-1/2

in. diameter stainless steel and teflon rod into the ground to a minimum depth of 5 ft below the water table. Once the tool is in position, it is retracted approximately 1-1/2 ft to expose a perforated water intake screen and a sample is collected. Depending on the configuration of the particular device, the water sample is collected in an internal sampler or can be bailed out with a thin bailer. In the event the formation recharges slowly, the punch can be retracted and replaced with a temporary polyvinyl chloride (PVC) piezometer (rinsed and decontaminated) with screen to sample the location at a later time.

The HydroPunch truck contains all necessary equipment for driving the sampling rods, recording the data, and decontaminating the equipment. Once the rods are removed from the ground, they will be decontaminated as described in Section 3.1.3. Grouting of the holes will take place after the HydroPunch survey is completed at each location by a separate truck-mounted grouting unit. Samples collected during the survey must be analyzed by a laboratory according to all SW-846 requirements as specified in the QAPP.

3.3 Sampling Program for Soil, Soil Gas, and Groundwater

Table 3-3 lists the routine parameters that will be analyzed during Phase I of the RFI. These parameters were selected for analysis based on wastes known to be or have been present at the SWMUs under investigation. At two SWMUs associated with the sewage lagoons, samples will be analyzed for 40 Code of Federal Regulations (CFR) Part 264 Appendix IX parameters (Table 3-4). A summary of Phase I RFI sampling activities, by SWMU site, is shown in Table 3-5. The number of samples and their analyses, by SWMU site, are shown in Table 3-6. Table 9-1 in the QAPP provides additional information concerning QA/QC samples. The following paragraphs provide information regarding the sampling techniques proposed for the collection of soil, soil gas, and groundwater samples. All samples collected for chemical analysis will be placed in

Table 3-3

Routine Parameters to be Analyzed -- Phase I RFI

Metals	Volatiles	Semivolatiles	PCBs	Pesticides	Herbicides	General
Arsenic	Acetone	Acenaphthene	PCB-1016	**Organochlorine Pesticides:**	2,4-D	TRPH [a]
Barium	Benzene	Anthracene	PCB-1221	Aldrin	2,4-DB	Soil particle size
Cadmium	Bromodichloromethane	Benzo(a)anthracene	PCB-1232	Alpha-BHC	2,4,5-T	Soil moisture [b]
Chromium	Bromomethane	Benzo(b)fluoroanthene	PCB-1242	Beta-BHC	2,4,5-TP (Silvex)	Ignitability
Lead	Bromoform	Benzo(k)fluoranthene	PCB-1248	Delta-BHC	Dalapon	TCLP [c]
Mercury	Carbon disulfide	Benzo(a)pyrene	PCB-1254	Gamma-BHC (Lindane)	Dicamba	
Selenium	Carbon tetrachloride	Benzoic acid	PCB-1260	Chlordane-(Technical)	Dichloroprop	
Silver	Chlorobenzene	Benzyl alcohol		4,4'-DDD	Dinoseb	
	Chloroethane	bis(2-Chloroethoxy)methane		4,4'-DDE	MCPA	
	2-Chloroethyl vinyl ether	bis(2-Chloroethyl)ether		4,4'-DDT	MCPP	
	Chloroform	bis(2-Chloroisopropyl)ether		Dieldrin		
	Chloromethane	bis(2-Ethylhexyl) phthalate		Endosulfan I		
	cis-1,3-Dichloropropene	4-Bromophenyl phenyl ether		Endosulfan II		
	Dibromochloromethane	Butyl benzyl phthalate		Endosulfan sulfate		
	1,1-Dichloroethane	4-Chloro-3-methylphenol		Endrin		
	1,2-Dichloroethane	4-Chloroaniline		Endrin aldehyde		
	1,1-Dichloroethene	2-Chloronaphthalene		Heptachlor epoxide		
	1,2-Dichloropropane	2-Chlorophenol		Heptachlor		
	1,4-Dioxane	4-Chlorophenyl phenyl ether		Methoxychlor		
	Ethylene dibromide	Chrysene		Toxaphene		
	2-Hexanone	Cresols, m-, o-, p-		**Organophosphorus Pestides:**		
	4-Methyl-2-pentanone	Dibenz(a,h)anthracene		Azinphos methyl		
	Methylene chloride	Dibenzofuran		Bol star		
	Metyl ethyl ketone	Dichlorobenzene		Chlorpyrifos		
	Styrene	3,3'-Dichloroenzidine		Coumaphos		
	1,1,2,2-Tetrachloroethane	2,4-Dichlorophenol		Demeton-O		
	Tetrachloroethene	Diethyl phthalate		Demeton-S		

Table 3-3

(Continued)

Metals	Volatiles	Semivolatiles	PCBs	Pesticides	Herbicides	General
	Toluene	Dimethyl phthalate		Diazinon		
	trans-1,3-Dichloroethene	2,4-Dimethylphenol		Dichlorvos		
	trans-1,2-Dichloropropene	Di(n)butyl phthalate		Disulfoton		
	Total xylenes	Di(n)octyl phthalate		Ethoprop		
	1,1,1-Trichloroethane	4,6-Dinitro-2-methyl phenol		Fensulfothion		
	1,1,2-Trichloroethane	2,4-Dinitrophenol		Fenthion		
	Trichloroethene	2,4-Dinitrotoluene		Merphos		
	Vinyl acetate	2,6-Dinitrotoluene		Mevinphos		
	Vinyl chloride	Fluoranthene		Naled		
		Fluorene		Parathion methyl		
		Hexachlorobutadiene		Phorate		
		Hexachlorocyclopentadiene		Ronnel		
		Hexachlorobenzene		Stirophos (Tetrachlorvinphos)		
		Hexachloroethane		Tokuthion (Prothiofos)		
		Indene		Trichlornate		
		Indeno(1,2,3-cd)pyrene				
		Isophorone				
		2-Methyl naphthalene				
		Naphthalene				
		2-Nitroaniline				
		3-Nitroaniline				
		4-Nitroaniline				
		Nitrobenzene				
		2-Nitrophenol				
		4-Nitrophenol				
		N-Nitrosodiphenylamine				
		N-Nitroso-di-n-propylamine				
		Pentachlorophenol				

Table 3-3

(Continued)

Metals	Volatiles	Semivolatiles	PCBs	Pesticides	Herbicides	General
		Phenathrene				
		Phenol				
		Pyrene				
		1,2,4-Trichlorobenzene				
		2,4,5-Trichlorophenol				
		2,4,6-Trichlorophenol				

[a] TRPH = Total Recoverable Petroleum Hydrocarbons
[b] Soil moisture analyses will be performed to provide results on a dry-weight basis.
[c] TCLP = Toxicity Characteristic Leaching Procedure. Samples of investigation derived wastes from each SWMU will be analyzed for SWMU specific TCLP parameters prior to disposal. In addition, wastes possibly present in some SWMUs will also be analyzed for TCLP parameters expected to be present based on waste type.

Table 3-4

Appendix IX Parameters to be Analyzed -- Phase I RFI

Metals	Volatile Organics	Semivolatile Organics	Organochlorine Pesticides and PCBs	Organophosphorus Pesticides	Chlorinated Herbicides	Dioxins and Furans	General
Antimony	Acetone	Acenaphthene	Aldrin	Dimethoate	2,4-D	2,3,7,8-Tetrachlorodibenzo-p-dioxin	Cyanide
Arsenic	Acetonitrile	Acenaphthylene	alpha-BHC	Disulfoton	2,4,5-T	Tetrachlorodibenzo-p-dioxins	Sulfide
Barium	Acrolein	Acetophenone	beta-HC	Ethyl parathion	2,4,5-TP (Silvex)	Tetrachlorodibenzo-p-furans	Moisture[a]
Beryllium	Acrylonitrile	2-Acetylaminofluorene	delta-BHC	Famphur	Dinoseb	Pentachlorodibenzo-p-dioxins	
Cadmium	Benzene	4-Aminobiphenyl	gamma-BHC (Lindane)	Parathion methyl		Pentachlorodibenzo-p-furans	
Chromium	Bromodichloromethane	Aniline	Chlordane (technical)	Phorate		Hexachlorodibenzo-p-dioxins	
Cobalt	Bromomethane	Anthracene	4,4'-DDD	Sulfotepp		Hexachlorodibenzo-p-furans	
Copper	Carbon disulfide	Aramite	4,4'-DDE	Thionazine			
Lead	Carbon tetrachloride	Benzo(a)anthracene	4,4'-DDT	o,o,o-Triethylphosphorthioate			
Mercury	2-Chloro-1,3-butadiene	Benzo(a)pyrene	Dieldrin				
Nickel	Chlorobenzene	Benzo(b)fluoranthene	Endosulfan I				
Selenium	Chloroethane	Benzo(g,h,i)perylene	Endosulfan II				
Silver	Chloroform	Benzo(k)fluoranthene	Endosulfan sulfate				
Thallium	Chloromethane	Benzyl alcohol	Endrin				
Tin	3-Chloropropene	4-Bromophenyl phenyl ether	Endrin aldehyde				
Vanadium	Dibromochloromethane	Butylbenzylphthalate	Heptachlor				
Zinc	1,2-Dibromo-3-chloropropane	4-Chloro-3-methylphenol	Heptachlor epoxide				
	1,2-Dibromoethane	4-Chloroaniline	Isodrin				
	Dibromomethane	Chlorobenzilate	Kepone				
	trans-1,4-Dichloro-2-butene	bis(2-Chloroethoxy)methane	Methoxychlor				
	Dichlorodifluoromethane	bis(2-Chloroethyl)ether	Toxaphene				
	1,2-Dichloroethane	bis(2-Chloroisopropyl)ether	PCB-1016				
	trans-1,2-Dichloroethene	2-Chloronaphthalene	PCB-1221				
	1,1-Dichloroethane	2-Chlorophenol	PCB-1232				
	1,1-Dichloroethene	4-Chlorophenyl phenyl ether	PCB-1242				
	1,2-Dichloropropane	Chrysene	PCB-1248				
	cis-1,3-Dichloropropene	Diallate	PCB-1254				
	trans-1,3-Dichloropropene	Dibenz(a,h)anthracene	PCB-1260				
	1,4-Dioxane	Dibenzofuran					
	Ethyl benzene	1,2-Dichlorobenzene					

Table 3-4

(Continued)

Metals	Volatile Organics	Semivolatile Organics	Organochlorine Pesticides and PCBs	Organophosphorus Pesticides	Chlorinated Herbicides	Dioxins and Furans	General
	Ethyl methacrylate	1,3-Dichlorobenzene					
	2-Hexanone	1,4-Dichlorobenzene					
	Iodomethane	3,3'-Dichlorobenzidine					
	Isobutanol	2,4-Dichlorophenol					
	Methacrylonitrile	2,6-Dichlorophenol					
	Methylene chloride	Diethylphthalate					
	2-Butanone (MEK)	p-Dimethylaminoazobenzene					
	Methylmethacrylate	7,12-Dimethylbenz(a)anthracene					
	4-Methyl-2-pentanone	3,3'-Dimethylbenzidine					
	Propanenitrile	Dimethylphenethylamine					
	Styrene	2,4-Dimethylphenol					
	1,1,1,2-Tetrachloroethane	Dimethylphthalate					
	1,1,2,2-Tetrachloroethane	4,6Dinitro-2-methylphenol					
	Tetrachloroethene	Di-n-butylphthalate					
	Toluene	Di-n-octylphthalate					
	Tribromomethane	1,3-Dinitrobenzene					
	1,1,1-Trichloroethane	2,4-Dinitrophenol					
	1,1,2-Trichloroethane	2,4-Dinitrotoluene					
	Trichloroethene	2,6-Dinitrotoluene					
	Trichlorofluoromethane	Diphenylamine					
	1,2,3-Trichloropropane	bis(2-Ethylhexyl)phthalate					
	Vinyl acetate	Ethylmethane sulfonate					
	Vinyl chloride	Fluoranthene					
	Xlenes	Fluorene					
		Hexachlorobenzene					
		Hexachlorobutadiene					
		Hexachlorocyclopentadiene					
		Hexachloroethane					
		Hexachlorophene					
		Hexachloropropene					
		Indeno(1,2,3-c,d)pyrene					

Table 3-4

(Continued)

Metals	Volatile Organics	Semivolatile Organics	Organochlorine Pesticides and PCBs	Organophosphorus Pesticides	Chlorinated Herbicides	Dioxins and Furans	General
		Isophorone					
		Isosafrole					
		Methapyrilene					
		3-Methylchloanthrene					
		Methyl methanesulfonate					
		2-Methyl naphthalene					
		2-Methylphenol					
		3-Methylphenol					
		4-Methylphenol					
		Naphthalene					
		1,4-Naphthoquinone					
		1-Naphthylamine					
		2-Naphthylamine					
		2-Nitroaniline					
		3-Nitroaniline					
		4-Nitroaniline					
		Nitrobenzene					
		2-Nitrophenol					
		4-Nitrophenol					
		4-Nitroquinoline-N-oxide					
		N-Nitroso-di-n-butylamine					
		N-Nitrosodiethylamine					
		N-Nitrosodiphenylamine					
		N-Nitrosodipropylamine					
		N-Nitrosodimethylamine					
		N-Nitrosomethyethylamine					
		N-Nitrosomorpholine					
		N-Nitrosopiperidine					
		N-Nitrosopyrrolidine					
		5-Nitro-o-toluidine					
		Pentachlorobenzene					

Table 3-4

(Continued)

Metals	Volatile Organics	Semivolatile Organics	Organochlorine Pesticides and PCBs	Organophosphorus Pesticides	Chlorinated Herbicides	Dioxins and Furans	General
		Pentachloroethane					
		Pentachloronitrobenzene					
		Pentachlorophenol					
		Phenacetin					
		Phenanthrene					
		Phenol					
		p-Phenylenediamine					
		2-Picoline					
		Pronamide					
		Pyrene					
		Pyridine					
		Safrole					
		1,2,4,5-Tetrachlorobenzene					
		2,3,4,6-Tetrachlorophenol					
		o-Toluidine					
		1,2,4-Trichlorobenzene					
		2,4,5-Trichlorophenol					
		2,4,6-Trichlorophenol					

[a] Soil moisture analyses will be performed to provide results on a dry-weight basis.

Table 3-5

Summary of Sampling Activities

Location	Soil Borings	Hand Auger/ Surface Samples	HydroPunch Survey/ Soil Gas Survey/Tank and/or O/W Separator Contents	Investigation Derived Wastes[a]
SWMUs 119/2[b]	2 (1)[c]	0		1
SWMUs 120/15[b]	2 (1)	0		1
SWMUs 121/17[b]	1 (1)	0		1
SWMUs 123/22[b]	2 (1)	0		1
SWMUs 126/36[b]	2 (1)	0	Tank and O/W Separator Contents	1
SWMUs 125/32[b]	2 (1)	0	Tank and O/W Separator Contents	1
SWMUs 127/39/135[b]	0	1 (6) : 2 (1)		1
SWMUs 138/128/40[b]	2 (3)	1 (1)		1
SWMU 118	1 (3) : 4 (1)			1
SWMU 129	4 (3)	16 (1)		1
SWMUs 54/55	2 (3)	0	Soil Gas Survey	0
SWMU 56	3 (4)	0		1
SWMU 63	1 (4)	4 (1)		1
SWMU 71	4 (1) : 1 (3)	0		1
SWMU 78	4 (4)	0		1
SWMU 75[d]	0	0		0
SWMU 91	0	2 (1)		1
SWMU 136	2 (3)	0		1
SWMU 141[d]	0	0		0
SWMU 164	2 (3)	6 (1)		1
SWMU 124[d]	0	0	Tank Contents	1
SWMU 155	0	3 (1) : 3 (1)[e,f]		1
SWMU 156	3 (2)	1[e]		1
SWMU 184	6 (1) : 2 (2)	0		1
SWMUs 177/181/179[d]	0	0	HydroPunch Survey	1
SWMU 101[d]	0	0		0
SWMU 183[d]	0	0		0
AOC-U[g]	0	10 (1)		1

[a] Investigation derived wastes (e.g., soil cuttings) will be analyzed for SWMU-applicable TCLP constituents as necessary. See Section 7.
[b] Sampling activities performed if both units exhibit evidence of a release (i.e., failure of integrity testing).
[c] Number of samples per boring/hand auger-surface sample location.
[d] No samples will be collected. NOTE: SWMU 124 contents will be sampled for waste designation.
[e] Each sample location is a composite.
[f] One sample at three composite locations for Appendix IX analysis (except SW8240) and one sample at three individual locations for SW8240 analysis.
[g] AOC = Area of Concern.

Table 3-6

Summary of Samples and Analyses

Analysis	Analytical Method	SWMUs 119/2[b]	SWMUs 120/15[b]	SWMUs 121/17[b]	SWMUs 123/22[b]	SWMUs 126/36[b,c]	SWMUs 125/32[b,c]	SWMUs 39/127/135[b]	SWMUs 40/128/138[b]	SWMU 118	SWMU 129	SWMUs 54/55	SWMU 56	SWMU 63	SWMU 71	SWMU 78	SWMU 91	SWMU 136	SWMU 164	SWMU 124	SWMU 155	SWMU 156	SWMU 184	AOC-U	Total Analyses
Volatile organics	SW8240	2	2	1	2	2	2	8	7	7	28	6	12	16	7	12	2	6	6					6	134
Semivolatile organics	SW8270														7										7
TRPH	EPA 418.1	2	2	1	2	2	2	8	7	7	28	6	12		7	12	2	6	6					6	118
Total metals	SW6010	2	2	1	2	2	2	8	7			6	12	16		12	2	6	12				10	10	112
Total mercury	SW7471	2	2	1	2	2	2	8	7			6	12	16		12	2	6	12				10	10	112
Total selenium	SW7740	2	2	1	2	2	2	8	7			6	12	16		12	2	6	12				10	10	112
Total arsenic	SW7060	2	2	1	2	2	2	8	7			6	12	16		12	2	6	12				10	10	112
Total lead	SW7421	2	2	1	2	2	2	8	7		28	6	12	16		12	2	6	12				10	10	140
Organochlorine pesticides	SW8080									7															7
Organophosphorous pesticides	SW8140									7															7
Chlorinated herbicides	SW8150									7															7
UDMH, NDMA	SW8270,TIC										8														8
PCBs	SW8080			1											7	12									20
Appendix IX[d]																					3	7			10
Ignitability	SW1010					1	1													1					3
TCLP[e,f]	SW1311	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	26
Grain size analysis	ASTM D421/422	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	3	25

Table 3-6

(Continued)

Analysis	Analytical Method	Trip Blanks [g]	Field Duplicate (10%)	Equipment Blanks (10%)	Ambient Blanks (10%)	Matrix Spike (5%)	Matrix Spike Duplicate (5%)	QA [h] Duplicates (10%)
Volatile organics	SW8240	One per cooler	14	14	14	7	7	14
Semivolatile organics	SW8270		1	1	1	1	1	1
TRPH	EPA 418.1		12	12	12	6	6	12
Total metals	SW6010		11	11	11	6	6	11
Total mercury	SW7471		11	11	11	6	6	11
Total selenium	SW7740		11	11	11	6	6	11
Total arsenic	SW7060		11	11	11	6	6	11
Total lead	SW7421		14	14	14	7	7	14
Organochlorine pesticides	SW8080		1	1	1	1	1	1
Organophosphorus pesticides	SW8140		1	1	1	1	1	1
Chlorinated herbicides	SW8150		1	1	1	1	1	1
UDMH, NDMA	SW8270, TIC		1	1	1	1	1	1
PCBs	SW8080		2	2	1	1	1	2
Appendix IX		One per cooler	1	1	1	1	1	1
Ignitability	SW1010		1	1				1
TCLP	SW1311	One per cooler	3	3	3	2	2	3

[a] SWMUs 54, 55, 75, 141, 101, 27, 177, 181, and 179 have no laboratory samples scheduled to be taken during the RFI Phase I. NOTE: SWMUs 54 and 55 may require sampling based on the results of the soil gas survey.
[b] Analyses assuming samples are collected due to failure of integrity testing.
[c] Numbers include tank contents sample if necessary.
[d] See Table 3-4 for analytes. Analyses for Appendix IX constituents include: SW8240, SW8270, SW8280, SW8150, SW8140,SW8080, SW6010, SW7060, SW7421, SW7471, SW7740, SW7841, SW9030, and SW9012.
[e] TCLP analysis for SWMU applicable parameters will be performed on investigation-derived wastes (e.g., cuttings) as necessary. See Section 7.0. Cuttings from all sampling locations with an individual SWMU may be composited if applicable. Greatly separated sampling locations should be analyzed independently.
[f] TCLP analyses may include SW8240, SW8270, SW8080, SW6010, SW7060, SW7421, SW7471, SW740.
[g] Volatile organic analysis only.
[h] QA duplicate samples will be submitted to United States Army Corps of Engineers (USACE) Missouri River Division (MRD) Laboratory for analysis.

completely labeled sample containers, packed in ice, and transported with completed chain-of-custody documentation, in ice chests with custody seals affixed, as described in Section 3.5. Analytical methods for all analytes and the requirements of each method are provided in the QAPP.

3.3.1 Soil Sampling

Subsurface soil samples will be collected from both hollow-stem auger boreholes and hand-auger holes during the Phase I field program. The use of a drilling rig and hollow-stem augers is preferred for collection of soil samples when it is necessary to determine the sample's location in the soil profile. Hand-auger sampling will only be used in those instances where samples are to be collected at a predetermined depth or where access by a drilling rig is limited or presents a safety hazard. A power auger may be used at hand-auger locations to advance the borehole to a depth just above the specified sampling depth. In addition, surface soil samples will be collected at some sampling points using a clean stainless steel trowel. The methods selected for chemical analysis of soils and preservation and holding times are listed in Table 3-7.

Soil samples will be taken from the boreholes for lithologic logging (visual classification) and geotechnical testing. Samples to be used only for logging and geotechnical testing may be taken with split spoons or other sampling devices that are not stainless steel. Soil samples for lithologic logging will be taken from every 2-ft increment down to a depth of 10 ft, after which lithologic logging samples will be collected at intervals of every 5 ft from the remaining depth of the boring. If a sufficient amount of soil has been retrieved in the split spoon, samples for both chemical and geotechnical analyses may be collected from the same split spoon, provided the split spoon is stainless steel. However, if this procedure is followed, the sample taken for chemical analysis will be collected before the samples for geotechnical analysis. One sample will be taken from one borehole at each SWMU site (see Sections 4.1 through 4.28 for the grouping of SWMUs for investigation) for geotechnical testing (ASTM D421 and D422) at a depth that the geologist feels is

Table 3-7

Summary of Sample Containers, Preservation, and Holding Times for Soil Samples

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
EPA:418.1	Total Recoverable Petroleum Hydrocarbons (TRPH)	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	N/S	28 days
SW-846:6010 [c]	Ag, Ba, Be, Cd, Co, Cr, Cu, Ni, Sb, Sn, Va, Zn	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S	6 months
SW-846:7060 [c]	As	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S	6 months
SW-846:7421 [c]	Pb	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S	6 months
SW-846:7471 [c]	Hg	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S	28 days
SW-846:7740 [c]	Se	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S	6 months
SW-846:7841	Tl	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S	6 months
SW-846:8080 [c]	Organochlorine Pesticides/PCBs	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8140	Organophosphorus Pesticides	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8150 [c]	Chlorinated Herbicides	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8240 [c]	Volatile Organic Compounds	(1) 250 mL glass, Teflon-lined cap	No headspace, Refrigerated at 4°C	N/S	14 days
SW-846:8270 [c]	Semivolatile Organic Compounds	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8280	Dioxins and furans	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	30 days	45 days
SW-846:9012	Cyanide	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	N/S	14 days
SW-846:9030	Sulfide	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	N/S	7 days

[a] One 250 mL sample will provide sufficient quantity for all metals analyses.
[b] N/S = Not Specified
[c] Toxicity Characteristic Leaching Procedure (TCLP) analytical methods.

representative of all materials on site. The only exceptions to the one sample per boring at a SWMU site during the Phase I RFI are: 1) no geotechnical samples will be collected at SWMUs 75, 1010, 124, 141, 177, 179, 181, and 183 since no soil sampling will be performed at these SWMUs; and 2) three geotechnical samples will collected from sampling locations in AOC-U, the Lost River Basin. Table 3-6 shows the number of geotechnical analyses required at each SWMU site.

Hand Auger Sampling

A combination of power and hand augers will be used to collect soil samples in areas that are not accessible to a drill rig because of physical constraints or safety hazards. Soil samples will be collected from just below the land surface to a maximum depth of approximately 10 ft. A power auger will be used to advance the borehole to a depth just above the sampling point if subsurface conditions prevent hand augering. A hand auger will then be used to collect the actual soil sample. The hand auger bit will be constructed of stainless steel and approximately 3 in. in diameter. Soil samples will be described continuously, with special attention to documenting changes in lithology or evidence of contamination. Samples will be collected for chemical analysis at appropriate depth intervals specified in the sampling plans for each site. Between each sample, the augers and all other stainless steel sampling equipment (spoons, bowls, trowels) will be decontaminated according to the procedures outlined in Section 3.1.3. Analytical samples will be collected by augering to the top of the sample depth interval, decontaminating the auger, returning the auger to the sample depth and advancing downward to collect the sample, recovering the soil in the auger, and transferring the soil to a decontaminated stainless steel bowl using a decontaminated stainless steel spoon or trowel. Portions of the soil to be analyzed for volatile constituents will be quickly transferred to appropriate glass jars with as little mixing as possible. The remainder of the soil will be mixed thoroughly before being placed into jars. Sample containers will be shipped to the laboratory, as previously described in Section 3.5.

Hollow-Stem Auger Sampling

Soil samples will be collected with 5.5-ft stainless steel split-spoon sampling tubes advanced ahead of the augers. The samples recovered from each split spoon depth increment at the surface will be described in terms of lithology, texture, moisture, and any evidence of contamination. After each sampling event, the split-spoon sampler will be decontaminated, as described in Section 3.1.3. The hollow-stem auger flights and auger head will be steam cleaned between sampling locations. The selection of soil samples collected for chemical analysis will be based on several factors, as discussed in the site-specific sampling plans (Section 4.0). Samples selected for analysis will be shipped to the laboratory as previously described in Section 3.5.

Backhoe Excavation Sampling

At some SWMU locations, specifically SWMUs 119/2, 120/15, 121/17, 123/2, 126/36, 125/32, and 129, sampling with a hand auger or drilling rig may not be feasible. If this situation occurs a backhoe will be used to facilitate sample collection. The backhoe will be used to excavate soils adjacent to tanks to depths just below the tank bottom. A sample will then be collected from the soils under the tank with a stainless steel hand auger. The sample will be taken from soils at least 6 in. behind the sidewall of the excavation. At no time will sampling personnel enter the excavation.

Surface Soil Sampling

Soil samples will be collected from the surface to approximately 4 to 6 in. below the surface at some SWMUs. Soil samples collected for analysis of VOCs will be placed directly in sample containers and packed tightly. Soil for the other analytical fractions will be placed in a stainless steel bowl, mixed to ensure homogeneity of the sample, and placed in appropriate sample containers. Containers will be shipped to the laboratory, as previously described, for chemical analysis. All equipment that comes into contact with

the samples will be cleaned as described in Section 3.1.3. Only decontaminated stainless steel sampling equipment will come into contact with any sample material.

3.3.2 Soil Gas Sampling

At each site selected for soil gas analysis, a number of sampling points will be laid out on the basis of site information and areas of interest, and any physical obstacles present, and marked with identification numbers. Whenever possible, a systematic grid will be used.

At each sampling point, the probe will be driven into the ground and withdrawn 3 to 5 in. to expose a void in the soil. An air hose will be attached to the probe, and suction will be drawn on the void. A sample will be drawn using a syringe or other method deemed appropriate by the soil gas contractor. The sample will be injected into a portable GC unit for immediate analysis. All sampling equipment will be decontaminated between samples according to the methods described in Section 3.1.3.

In situations in which gas samples cannot be pulled from the underlying soil (e.g. tight clays), headspace from soil samples will be used for analysis. In these cases, a soil sampling rod will be driven to the sampling depth. The tip of the rod will be loosened with a tool used from the surface, and the hollow rod will be advanced further into the soil. When the rods are withdrawn, a portion of the soil collected will be placed in a vial with a self-sealing septum to which distilled water is added. The sample will be heated and agitated to help release any volatiles that may be present. A syringe will be used to draw a sample from the headspace in the vial, and will be injected into the portable GC unit for analysis. Passive soil gas sampling as described in Section 3.2.2 will be performed if gas samples cannot be pulled from the underlying soils using the above procedure.

3.3.3 Groundwater

Activities conducted during the Phase I RFI do not currently include the collection of groundwater samples. A HydroPunch survey will be conducted at SWMUs 177, 179, and 181 for the collection of groundwater samples for metals analysis of VOCs (SW8240); however, the survey will be conducted as part of the Base's IRP investigations. Table 3-8 presents the sampling and analysis requirements for groundwater samples in the event that changes in the Phase I RFI are warranted and groundwater samples are collected.

3.4 Surveying

3.4.1 Sampling Point Location Surveys

After the completion of any type of sampling (e.g., soil boring, soil gas, HydroPunch) stakes will be driven to mark the sampling location for subsequent surveying. Coordinates of each sampling location will be measured to the nearest foot in reference to the State Plane Coordinate System. All ground elevations will be measured in reference to mean sea level (MSL) to the nearest 0.10 ft. More specifically, elevations will be referenced to the National Geodetic Vertical Datum of 1983, if available. If the 1983 Datum is not available, references may be made to the 1929 Datum.

3.4.2 Electromagnetic Survey

For the initial investigation at SWMU 129 where the exact locations of the fuel spill tanks are unknown, geophysical techniques will be used to determine their locations. Geophysical methods are necessary because they provide an indirect nonintrusive method of collecting subsurface data to direct waste characterization activities. Electromagnetics (EM) was selected because it is commonly used to locate buried pits, trenches, and metallic objects. In addition, relative to other geophysical techniques, EM is inexpensive, quick, and easy to use and interpret. Specifically, a Geonics Limited EM31™

Table 3-8

Summary of Sample Containers, Preservation, and Holding Times for Water Samples

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
EPA:160.1	Total Dissolved Solids (TDS)	(1) 500 mL glass or polyethylene	Refrigerated at 4°C	N/S [a]	48 hours
EPA:418.1	Total Recoverable Petroleum Hydrocarbons (TRPH)	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C, pH <2 w/HCl	N/S	28 days
SW-846:6010	Sb, Ba, Be, Cd, Co, Cr, Cu, Ni, Ag, Sn, Va, Zn	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7060	As	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7421	Pb	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7470	Hg	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	28 days
SW-846:7740	Se	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7841	Tl	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:8080	Organochlorine Pesticides/PCBs	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days
SW-846:8140	Organophosphorus Pesticides	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days
SW-846:8150	Chlorinated Herbicides	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days

Table 3-8

(Continued)

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:8240	Volatile Organic Compounds	(2) 40 mL glass, Teflon-lined septa [b]	No headspace, pH <2 w/HCl, Refrigerated at 4°C	N/S	14 days
SW-846:8270	Semivolatile Organic Compounds	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days
SW-846:8280	Dioxins and furans	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	30 days	45 days
SW-846:9012	Cyanide	(1) 500 mL amber glass, Teflon-lined cap [b]	pH >12 w/NaOH Refrigerated at 4°C	N/S	14 days
SW-846:9030	Sulfide	(1) 500 mL glass, Teflon-lined cap [b]	Zinc Acetate, pH >9 w/NaOH Refrigerated at 4°C	N/S	7 days

[a] N/S = Not Specified
[b] Extra sample must be collected for matrix spike/matrix spike duplicate analyses.
[c] One 250 mL sample will provide sufficient quantity for all metals analyses.

will be used for the investigation. The EM31 provides a means of measuring the terrain conductivity and magnetic field of the shallow subsurface. In theory, the buried waste and disturbed soils will have different conductivity and magnetic values than the surrounding soil (particularly if the surrounding soil is undisturbed). These boundaries are reflected in the data values and can be determined quickly after the survey is completed. The results will be used for the site characterization activities that will follow.

Before conducting the survey, the approximate boundaries of the site will be estimated and staked. Also, a base station will be located from which initial readings will be taken. The base station will be returned to periodically and readings taken and compared to the initial readings in order to detect any instrument drift over the course of the survey. The EM survey will be conducted over the entire suspect area at intervals appropriate to the size of the site being investigated.

After the grids are established, the EM surveys will be conducted as described below unless site-specific conditions warrant changes in procedures. Prior to using the EM31, the machine's functions will be checked and any necessary calibration adjustments will be made. The EM31 consists of a small instrument box with two 5-ft long booms extending from opposite sides of the instrument box. While conducting the survey, the instrument is carried over the shoulder and placed at the hip. The mode switch will be set for the in-phase component, and the sensitivity will be set to the appropriate millimhos/meter. The quadrature phase component is best for determining terrain conductivity, and the in-phase component is best for locating buried metallic objects. The EM31 will be carried from station to station on the grid in a logical order (e.g., east-west or north-south patterns). The operator will stop for approximately 5 seconds at each station to read and log the measurements; the operator's assistant will record the measurements. At each sample station, two measurements will be collected, one with the booms of the instrument oriented to the east-west and the other with the booms oriented to the north-south. The readings on the analog meter for both measurements will be recorded in the field notebook.

After the survey is completed, the data will be reduced and interpreted. Potential locations of the buried tanks will be marked with stakes, and the grid left in place for future reference to the results.

3.4.3 Ground Penetrating Radar Survey

Prior to sampling activities at SWMU 184 (the wastewater recirculation line between Pond F and the splitter box near Pond B) the line will need to be located for the accurate placement of sampling boreholes. If probing techniques are not feasible or do not locate the line, then ground penetrating radar (GPR) will be used to accurately determine the pipeline location. GPR is a useful, easy, non-intrusive technique for determining both subsurface geological features and man-made features such as buried pipes and cables. The GPR method works by generating an electromagnetic wave through the ground and recording the energy which is reflected from the subsurface feature. A continuous vertical profile is generated by positioning the transmitter/receiver at regular intervals along a survey line. The profile represents a cross-section of the subsurface with the horizontal axis in time increments and the vertical axis in length increments. Objects such as sewers, drains, and drums exhibit a characteristic parabolic response, which is interpreted to detect their presence.

The GPR signal responds to differences in the electrical properties of the subsurface materials. For the location of buried pipes, the important factor is the materials are in the pipe. If air and/or water are in the pipe, the difference in the electrical properties of the native soil and air and/or water in the pipe will allow for a good response by the GPR tool. Where the pipe may be caved in or filled with the native soil, no response is likely.

The proper recording parameters to determine the location of the pipe will be determined after a review of the available data pertaining to the depth and approximate location of the pipe. Since the location of one end of the pipe is known,, the GPR effort

will focus on locating the unknown end and several points along the length of the pipe. It is anticipated that maximum number of twenty perpendicular lines at 20 to 30 feet each will be the maximum needed to adequately define the location of the line. Depending on the response of the line to the tool, ten perpendicular lines of 20 feet each may be sufficient. The location of the pipe along each survey line will be staked with an orange marker that will be left in place for future reference to the results. At one of the pipe locations, a hole will be augered or dug to determine the depth of the pipeline below the soil surface.

3.5 Field Quality Assurance/Quality Control (QA/QC)

In addition to the laboratory QA/QC described in Section 5 and in the QAPP, the following field QA/QC activities will be performed in the Phase I RFI to evaluate the reliability of the analytical results.

3.5.1 Sample Labeling

All samples will be clearly labeled with the following information:

- Project name/client;
- Sample location;
- Identification number;
- Analytical method;
- Media sampled;
- Preservatives used;
- Sampler's name or initials; and
- Date.

Labels will be computer generated, completed in the field using a waterproof permanent marker, and securely attached to each sample jar immediately after collection.

3.5.2 Chain-of-Custody Procedure

The Contractor will maintain chain-of-custody records for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist:

- It is in their possession;
- It is in their view, after being in their possession;
- It was in their possession, and they locked it up; or
- It is in a designated secure area.

The Contractor's personnel will complete a chain-of-custody record for each sample. Separate forms will be used for soil and water sampling so as to reduce the risk of improper laboratory analysis. The chain-of-custody form will accompany each sample shipment container from the field to the laboratory to establish the documentation needed to trace sample possession. Figure 3-3 is an example of the chain-of-custody form that the Contractor will use at Holloman AFB. The record will include:

- Sample ID number;
- Media sampled;
- Place, date, and time of collection;
- Number of containers per sample ID;
- Analyses requested;

Chain of Custody Record

Analyses

PROJECT

SITE

COLLECTOR

SAMPLE I.D.	TYPE	DATE/TIME		REMARKS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:

RECEIVED FOR LABORATORY BY:	DATE	TIME	REMARKS

10-86-25948

Figure 3-3. Chain-of-Custody Form

- Signatures of collector, sampler, or recorder, and persons involved in chain-of-custody; and
- Designation of samples for matrix spike analyses.

On arrival at the designated laboratory, the chain-of-custody form or an attached Chain-of-Custody addendum form will be completed with:

- The individual who signed for receipt and date when samples arrived or were received;
- The individual who opened the shipping container, along with date, time, temperature of shipping container, seal #, and condition of shipping container; and
- Any remarks regarding sample condition on arrival.

All sample coolers will be sealed in a manner that will prevent or detect tampering. In no case will tape be used to seal sample containers. Samples will not be packaged with activated carbon.

3.5.3 Sample Storage and Transportation

All samples will be stored at approximately 4°C from immediately after collection until analysis. In the field, samples will be stored with conventional ice or blue ice in coolers (ice chests). Protective foam, plastic mesh wraps, or styrofoam packing will be used to minimize the risk of breakage during transport and to ensure that the samples do not freeze.

When packaging samples for commercial transport, an absorbent material such as fresh vermiculite will be used to minimize sample bottle breakage. Sample containers will be separated by padded materials. Sample packaging requirements for hazardous materials requiring interstate transport are defined in the CFR 49, Chapter 1, Part 171, and are used if required during sample transport. These requirements outline in detail the

proper classification and procedures for transportation of hazardous materials and are included by reference. The samples from Holloman AFB are not expected to be classified as hazardous.

3.5.4 Additional Field QA/QC

In addition to the chain-of-custody and shipping and handling measures mentioned above, field QA/QC will be controlled by compliance with sample preservation techniques, sample hold times, and by periodic field QC samples. Tables 3-7 and 3-8 detail the holding times for the respective samples. QC samples are discussed below.

QC Samples

Several types of field QC samples will be collected during the investigative effort. The number, type, and composition of these samples will comply with the following requirements.

One trip blank will accompany every shipment or cooler, whichever is more frequent, of soil and water samples sent to the laboratory for the analysis of VOCs. This blank will be analyzed for VOCs only.

> *Definition:* A trip blank is a VOC sample bottle filled in the laboratory with ASTM Type II or reagent-grade water, transported to the site, handled like a sample, and returned to the laboratory for analysis. Trip blanks will not be opened in the field. The trip blank for soils is the same as for water samples. When volatile organics are detected in trip blanks, it indicates that sample handling, transportation, or storage conditions may have contributed to contamination of the investigative samples. Results of trip blanks should not be used for blank subtraction, but rather as a tool to assess potential contamination sources.

Ambient conditions blanks will be taken at a frequency of 10 percent and analyzed for the same parameters as the media samples being collected. Ambient

conditions blanks will be collected when samples are collected downwind of possible contaminant sources at a frequency of 10 percent.

> *Definition:* An ambient conditions blank is ASTM Type II or reagent-grade water that is poured into a sample container at a sampling site. It will be handled as a sample and transported to a laboratory for analysis.

Equipment blanks will be taken to address effectiveness of sampling equipment decontamination. This blank will be analyzed for all laboratory analyses requested for environmental samples collected at the site. Equipment blanks will be collected on a 10 percent frequency.

> *Definition:* An equipment blank is ASTM Type II or reagent-grade water that is poured into or pumped through the sampling device, transferred to a sample bottle, and transported to a laboratory for analysis. For solid sample matrices, purified sand may be used in place of Type II or reagent-grade water.

Duplicate samples will be collected to assess matrix and analytical variability. Field QC duplicates will be labeled such that they are indistinguishable from other analytical samples. Ten percent of all field samples will be collected as field QC duplicates and analyzed by the contractor laboratory for the same parameters as the media samples.

> *Definition:* Field QC duplicates are two samples collected independently at a sampling location during a single act of sampling. Soil sample duplicates will be two samples taken from a homogenized soil volume. Field duplicates will be identified so that laboratory personnel are unable to distinguish them from normal field samples.

Ten percent of all field samples will be collected as QA duplicates, also to assess matrix and analytical variability. QA duplicates will be submitted to USACE Missouri River Division (MRD) laboratory for analysis. Field QA duplicates will be labeled with the same ID number as the original field sample to facilitate easy comparison of analytical results.

Definition: Field QA duplicates are two samples collected independently at the sample location during a single act of sampling. Soil sample duplicates will be two samples taken from a homogenized soil volume.

ASTM Type II water or reagent-grade water--The Contractor will furnish analytical data or a manufacturer's certification that verifies the quality of the ASTM Type II water or reagent-grade water and shows it to be free of analytes and contaminants that may interfere with the required laboratory analyses. The water's electrical conductivity will be less than 1.0 micromho/cm (25°C). High performance liquid chromatography (HPLC) water or distilled water from sources such as supermarkets or gas stations will not be used in place of ASTM Type II water or reagent-grade water. ASTM Type II water or reagent-grade water will be purchased and stored only in glass, stainless steel, or Teflon containers. These containers will have Teflon caps or cap liners.

Field Instrument Calibration

Calibration procedures for all measuring or analysis devices will be followed on a daily basis to ensure the quality of readings or results. OVAs will be calibrated at the beginning and end of each field day with a gas of known concentration according to the manufacturer's instructions. Soil gas and HydroPunch analysis instrumentation will be calibrated daily using procedures applicable to the technologies employed.

3.6 Data Evaluation Techniques/Criteria

The objective of the Phase I RFI is to determine the presence or absence of contamination due to possible releases from SWMUs in the soils below or surrounding each SWMU. Identification of contamination will indicate that a release from the unit has occurred. A Phase II RFI would then be required to determine the nature and extent of the contamination. Statistical methods will be used during Phase I to determine if detectable concentrations of inorganic constituents at a site are significantly greater than concentrations that occur naturally (i.e., background). The characterization and use of

background data are described in this section along with the approach for determining which statistical method will be used for data analysis.

Characterization of Background

"Background" is described as conditions in sampled matrices that reflect only natural conditions and variability, that is, matrices not affected by historical activities at the Base. In general, background data for soil and groundwater matrices have already been collected during previous studies at Holloman AFB. Previous analyses of background data have suggested that these data are useful for many sites around the Base. However, if the data collected during Phase I activities indicate a change in soil type or aquifer characteristics, additional background data may be required. Existing and/or additional background concentrations will be summarized and presented in the final report, along with analytical data from the SWMUs.

Background data will also be used to determine an appropriate statistical comparison method for data analysis. Determination of the statistical method for comparisons will follow the guidance discussed in the next section.

Determination of an Appropriate Statistical Comparison Method

The RCRA guidance *Statistical Analysis of Ground-water Monitoring Data at RCRA Facilities* (U.S. EPA, 1989 and 1992) details two types of statistical comparisons that can be performed between samples collected from background and downgradient (or SWMU) locations. These two types of statistical comparisons are distributional tests and extreme-value tests. Distributional tests are statistical tests used to determine whether the central tendencies of two groups of data are similar. These tests provide a more thorough picture of the site, or SWMU, as a whole, and thus are used for site-wide decisions. Extreme value tests are statistical tests used to compare individual results (e.g., results from SWMUs) to the upper limit of a data set distribution (e.g., the upper limit of the

background distribution). These tests are useful for determining if any single sample result indicates the potential for a hot spot. Since distributional and extreme-value tests provide answers for two different questions, both types of tests may be used to determine the presence or absence of contamination and decide whether or not remediation, or further investigation, is necessary. For this project, the statistical test to be used during data analysis efforts will be chosen using the decision tree presented in Figure 3-4.

On an analyte-by-analyte basis, a number of steps will be performed to determine the statistical method to be used for comparisons of background and SWMU results. Since the decisions for determining which statistical test to use are similar for distributional and extreme-value tests, the remaining discussion will focus on the distributional tests. Figure 3-4 includes a preliminary test that will be used to determine if existing and additional background data may be pooled if collection of additional background is required.

The first step in determining an appropriate statistical procedure is to determine the percentage of detected concentrations in background and SWMU samples. To perform a statistical comparison between SWMUs and background, there must be enough detected results to characterize the statistical distribution of both background and SWMU concentrations. RCRA guidance suggests the minimum percentage of detectable concentrations is 10 percent. If between 10 and 50 percent of the results are detectable concentrations, a test of proportions is appropriate (the actual type of test of proportion is left to the judgment of the statistician performing data analyses). Tests of proportions determine whether the proportion of detected concentrations at a site, or SWMU, is statistically different from the proportion of detected concentrations in background. This type of test assumes that if average concentrations increase, there will be a higher proportion of detectable concentrations. In practice, this type of test is most useful when detection limits are constant for each analyte throughout the project. Also, the range of detected concentrations should always be evaluated to determine whether site, or SWMU,

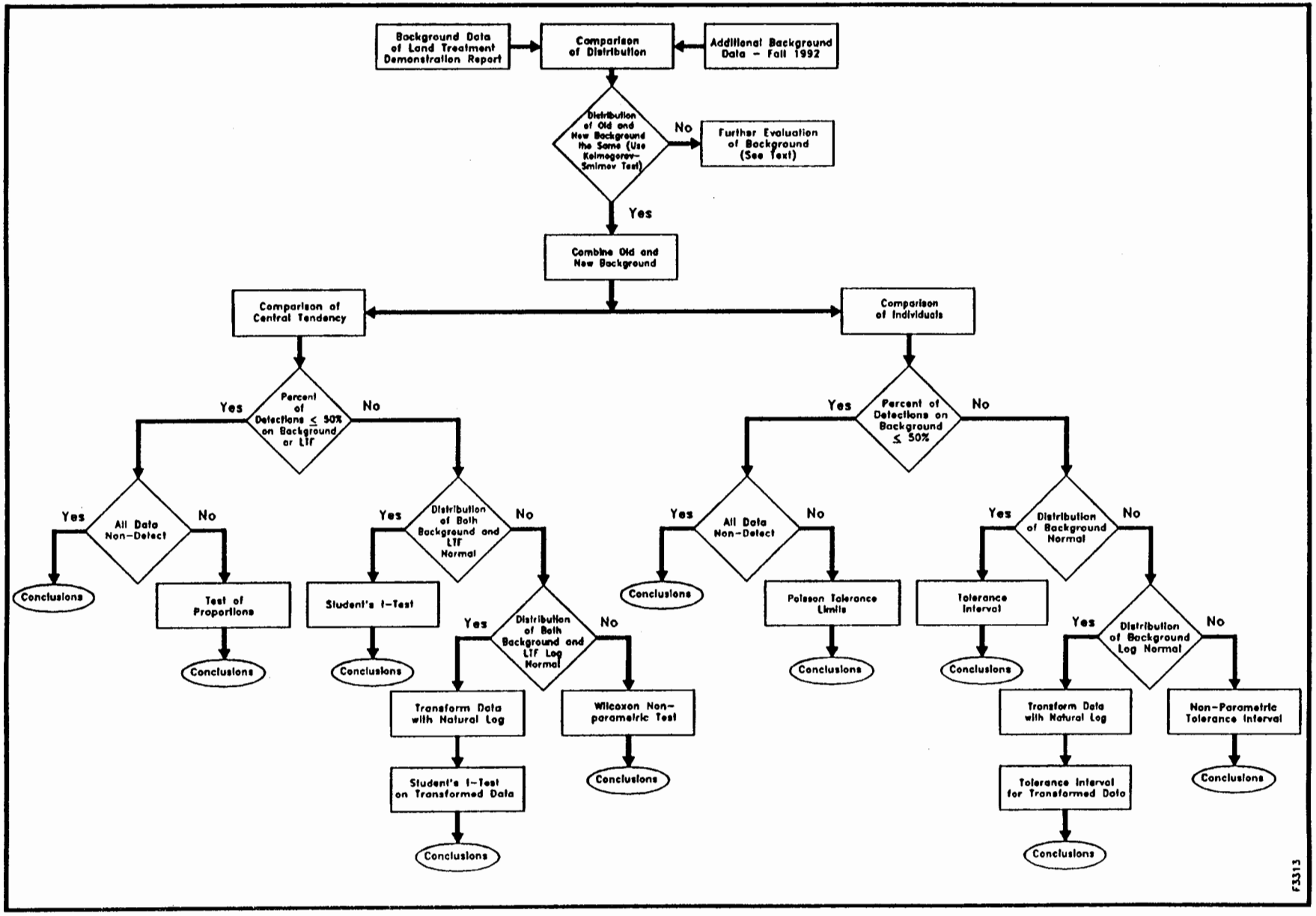


Figure 3-4. Flow Chart for Determining the Statistical Method for Comparison of Background and SWMU Analytical Results

concentrations appear to be greater than background concentrations. If there are greater than 50 percent detected concentrations, then both background and SWMU distributions are tested for "normality." To include information from "not-detected" results, a random number between zero and the detection limit will be used as the quantitative result for each sample with a not-detected result.

The Shapiro-Wilk normality test will be performed on both background and SWMU data sets (e.g., detectable measurable concentrations and random numbers replacing not-detected results) to determine if concentrations are normally distributed. This is a primary assumption of traditional statistical methods and must be performed on both background and SWMU data sets before comparisons are made. Any deviation from this assumption increases the probability of making false-positive and false-negative conclusions. If results are not normally distributed, the natural logarithms of the results will be calculated and the Shapiro-Wilk test used to determine if results are log normal. A parametric test (e.g., the Student's t-Test) will be used for comparisons of both normal and log-normally distributed results. If results are neither log normal or normal, the distribution will be undetermined and a non parametric statistical method chosen (e.g., the Wilcoxon test).

The statistical method chosen for background and SWMU comparisons, on an analyte-by-analyte basis, will be described for each matrix in the final Phase I RFI report. A justification for the use of a particular method will also be included.

4.0 SITE DESCRIPTIONS AND PHASE I SAMPLING PLANS

The 41 SWMUs being investigated in association with this Phase I RFI Work Plan are organized into 28 individual sites. In many cases, a site is composed of an individual SWMU. However, in locations where the physical proximity of the SWMUs makes separate investigation and subsequent remediation, if necessary, impractical, these SWMUs will be investigated as 1 site.

The subsections below contain a site description that presents available information for each SWMU. If previous investigations have been performed at a particular SWMU, the data collected are summarized. The objectives of the investigation for each SWMU are given and the sampling plan for each SWMU is detailed. Sampling information presented for each SWMU includes media sampled, sampling method, sample locations, number of samples, and type of analyses. Tables 3-5 and 3-6 in Section 3.3 provide summaries of sampling and analysis activities on an SWMU by SWMU basis. Procedures for lithologic logging, soil classification, and geotechnical testing are described in Section 3.3.1. In addition, procedures for backfilling and sealing boreholes are discussed in Section 3.2.1. Section 7 discusses the sampling and characterization of investigation derived wastes at each SWMU.

All activities conducted as part of the field investigations described in this section will be performed in accordance with the approved site-specific Health and Safety Plan for the Phase I RFI. If at any time during the investigation immediate threats to human health and the environment are discovered, sampling activities at the specific SWMU will cease and appropriate actions will be taken to mitigate the threat.

4.1 SWMUs 119 and 2

4.1.1 SWMU Description and History

These SWMUs consist of the Building 121 Oil/Water Separator (SWMU 2) and the Building 121 Waste Oil Tank (SWMU 119). The period of operation for these SWMUs was from approximately 1984 to the present. The site consists of an oil/water separation unit approximately 6 ft long, 2 ft wide, and 4 ft deep, with an approximate capacity of 300 gallons (gal). The top of the oil/water separator is level with the ground surface and is surrounded by native soil. Rinsate from the nearby vehicle washrack is routed to the oil/water separator for processing. The waste oil skimmed from the oil/water separator is transferred to the adjacent waste oil tank. The steel waste oil tank lies to the east of the oil/water separator and has a capacity of approximately 200 gal. The waste oil tank lies below grade and is covered by native soil. The oil level in the tank is periodically inspected, and the oil is pumped into drums on an as-needed basis for transport to the Defense Reutilization and Marketing Office (DRMO) Waste Storage Area. A halon vapor monitoring system installed to monitor the tank's integrity has shown evidence of leakage in the past. Thus, the potential for releases from the unit is high. In addition, a single fuel spill is reported to have occurred in the past at the site, although no information concerning the spill is available. Media potentially affected include the soil surrounding and beneath the area and the groundwater. Future use of the tank and separator is uncertain.

4.1.2 Evaluation of Existing Data

Vapor monitoring results were examined for any indications of leakage from the waste oil tank (SWMU 119). Evidence of leakage was determined from the records. No previous investigations have occurred at SWMUs 119 and 2.

4.1.3 Objectives

The objective of the RFI Phase I study for the Building 121 Oil/Water Separator and Waste Oil Tank is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. If at the time of the RFI the units are no longer in use, they will be removed in compliance with the New Mexico UST removal regulations (NM UST Regulations, Part 8:801(B)) and the Base-specific TPH soil cleanup standard of 1000 mg/kg established by the New Mexico Environmental Department (NMED) in agreement with the Base. Since the vapor monitoring records indicate a leak may have occurred, an integrity test will be performed on the waste oil tank in addition to the testing of the oil/water separator. If the integrity testing indicates possible leakage in either unit, soil samples adjacent to, and from a depth below, the units in question will be chemically analyzed.

4.1.4 Sampling and Analytical Plan

Integrity Testing

Since vapor monitoring data indicate possible leakage, static water level integrity tests will be performed on the waste oil tank in addition to the oil/water separator to determine whether or not either of the 2 units is possibly leaking. To perform these tests, both units will be filled with water, and the water level in the tank will be measured over an elapsed period of time. Decreases in the water level will indicate leakage. If cutoff valves do not exist for either unit, butterfly valves will be installed such that the units can be isolated and filled. If at the time of the RFI the units are still active, water from integrity testing of the separation unit will be run through the unit and into the sewer system. Water from testing of the waste oil tank will be pumped out after test completion and stored in containers as described in Section 3.1.2 or allowed to cycle through the

separation system. If the units are inactive at the time of the investigation, water from the testing of the separator unit will also be pumped out and stored in containers if the unit is no longer in line with the sewer system.

Soil Sampling

If either unit fails the integrity testing, soil sampling will occur. Boreholes will be drilled at the locations adjacent to either unit as shown in Figure 4-1. If boreholes are not feasible for any reason (i.e., accessibility), a backhoe or other method will be used to sample soil from a depth of approximately 6 in. deeper than the bottom of the unit(s). If at the time of the Phase I RFI the units are inactive and they are removed in conjunction with investigation activities, samples will be collected from the bottom of the excavation rather than from boreholes drilled adjacent to the units.

Boreholes will be advanced in 2-ft increments using hollow-stem augers. Lithologic description of each increment will be performed. Samples from the boreholes will be collected for chemical analysis from a sample interval beginning at 6 in. below the approximate bottom depth of the adjacent unit. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 8-10 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	1	SW8240, EPA 418.1, total metals
Integrity test on SWMUs 2 and 119		

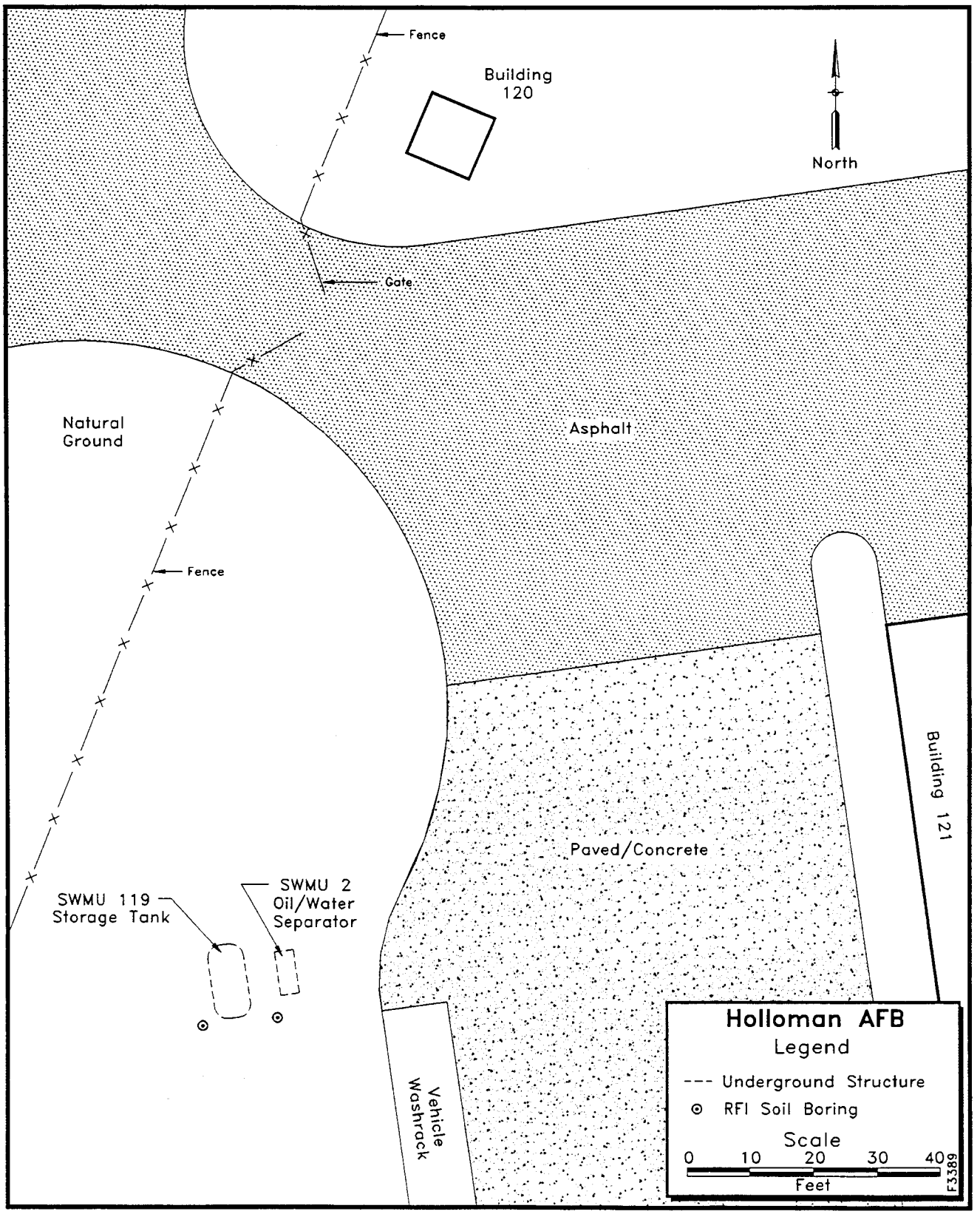


Figure 4-1. Soil Boring Locations, SWMUs 119/2

Analytical Plan

Owing to the nature of the wastes stored at this site (oil and fuel rinsates), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (as presented in Table 3-3), volatile organic compounds (SW8240), and Total Recoverable Petroleum Hydrocarbons (TRPH) (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.2 SWMUs 120 and 15

4.2.1 SWMU Description and History

These SWMUs consist of the Building 309 Oil/Water Separator (SWMU 15) and Building 309 Waste Oil Tank (SWMU 120). The period of operation for the SWMUs was from before 1975 to 1989; they are currently inactive. SWMU 15 consists of an oil/water separation unit approximately 3 ft long, 2 ft wide, and 3 ft deep. The separator is cracked and rusted and no secondary containment features are present. The top of the oil/water separator is level with the ground surface, surrounded by an asphalt pad. Oil and washwater discharged from the Building 309 vehicle washrack was routed to the separator. The separator is still connected in line with a new oil/water separator, which has its own waste oil tank. When active, the waste oil skimmed from the oil/water separator was transferred to the adjacent waste oil tank, and water was discharged to the sewer system. The steel waste oil tank lies adjacent to the oil/water separator, and has a capacity of approximately 100 gal. The waste oil tank lies below grade and is covered by an asphalt pavement pad. The oil level in the tank was visually monitored and pumped into drums for transport to the DRMO Waste Storage Area before reaching capacity. A halon vapor monitoring system is not present for the waste oil tank. Neither the age nor the integrity of the tank is known, thus the potential for releases is unknown. Future use of the tank and separator are uncertain. There have been no records of releases occurring at the site; however, because of the condition of the separator a release may have occurred. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.2.2 Evaluation of Existing Data

No previous investigations have occurred at SWMUs 120 and 15.

4.2.3 Objectives

The objective of the RFI Phase I study for the Building 309 Oil/Water Separator and Waste Oil Tank is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. Since a vapor monitoring system has not been installed at this tank, an integrity test will be performed on the waste oil tank in addition to the integrity testing of the oil/water separator. If the integrity testing indicates possible leakage in either unit, soil samples adjacent to, and from a depth below, the unit(s) will be chemically analyzed. If test results indicate that a release has occurred or that the tank is leaking, the tank(s) will be removed in compliance with New Mexico UST removal regulations as part of final closure or Phase II RFI activities.

4.2.4 Sampling and Analytical Plan

Integrity Testing

Static water level integrity tests will be performed on the waste oil tank in addition to the oil/water separator to determine whether or not either of the 2 units is possibly leaking. To perform these tests, both units will be filled with water, and the water level will be measured over an elapsed period of time. Decreases in water levels will indicate tank leakage. If cutoff valves do not exist for either unit, valves will be installed such that the units in question can be isolated and filled. After testing, water will be pumped from the unit(s) and stored in containers as described in Section 3.1.2.

Soil Sampling

If either unit fails the integrity testing, soil sampling will occur. Boreholes will be drilled adjacent to either unit at the locations shown in Figure 4-2. If boreholes are not feasible for any reason (i.e., accessibility), a backhoe or other method will be used to take a soil sample from a depth of approximately 6 in. deeper than the bottom of the unit(s). If the results of integrity testing indicate that removal of the units is necessary as part of the investigation, samples may be collected from the bottom of the excavation rather than from boreholes.

Boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from the boreholes will be collected for chemical analysis from a sample interval beginning at 6 in. below the approximate bottom depth of the adjacent unit. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	1	SW8240, EPA 418.1, total metals
Integrity test on SWMUs 15 and 120		

Analytical Plan

Owing to the nature of the wastes stored at this site (oil and fuel rinsates), all soil samples will be analyzed for typical constituents of such waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (listed in Table 3-3),

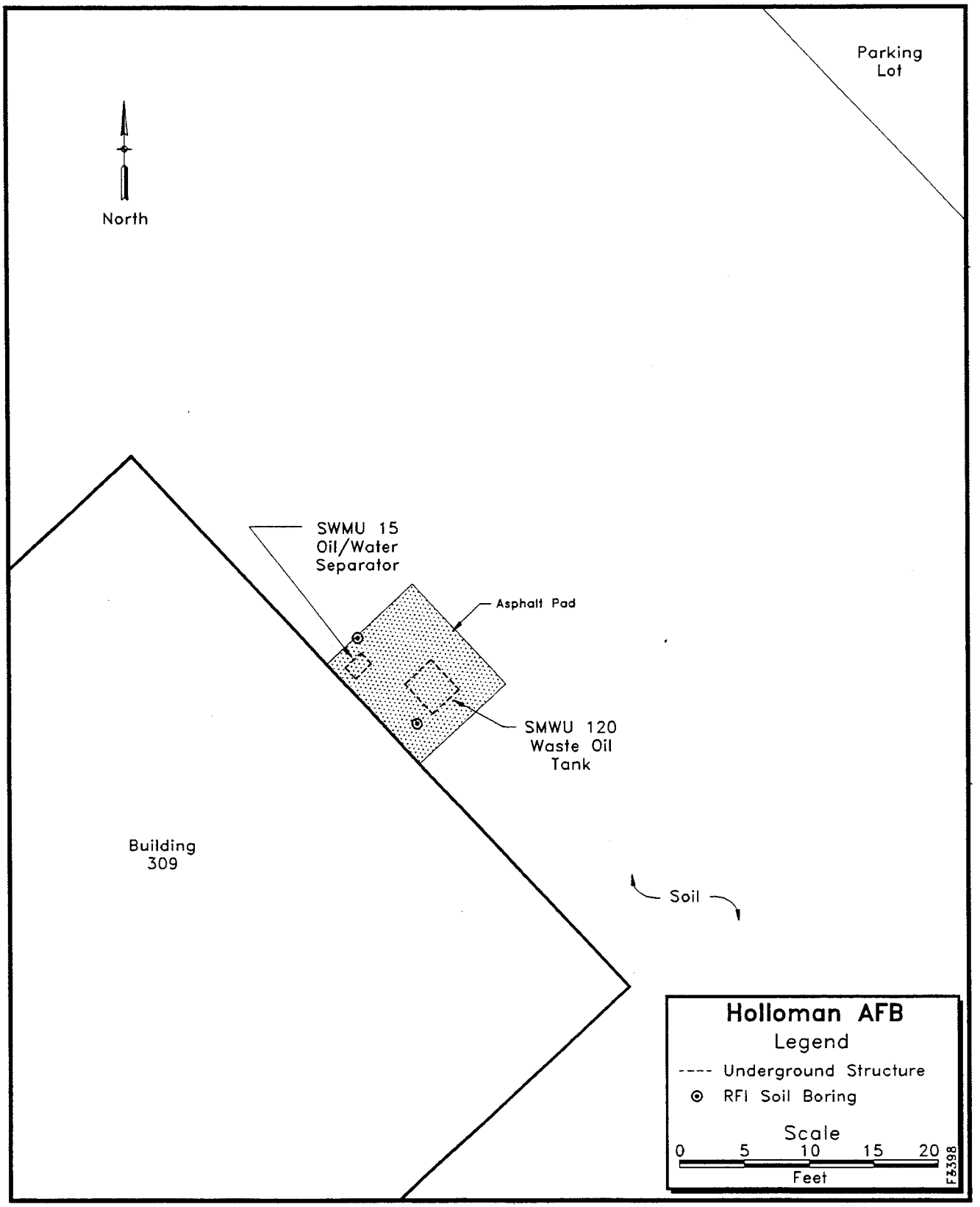


Figure 4-2. Soil Boring Locations, SWMUs 120/15

volatile organic compounds (SW8240), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.3 SWMUs 121 and 17

4.3.1 SWMU Description and History

These SWMUs consist of the Building 316 Oil/Water Separator (SWMU 17) and the Building 316 Waste Oil Tank (SWMU 121). The period of operation for these SWMUs is from an unknown date to the present. SWMU 17 consists of an oil/water separation unit approximately 5 ft long, 3 ft wide, and 4 ft deep with a total capacity of approximately 400 gal. The top of the oil/water separator is level with the ground surface, surrounded by gravel-covered soil. Washwater containing mainly hydraulic fluid from the Building 316 flight simulator is discharged from Building 316 and routed to the separator. Waste oil skimmed from the oil/water separator is transferred to the adjacent waste oil tank, and water is discharged to the sewer system. During the background search, it was reported that some of the older hydraulic oils processed through the unit may have contained polychlorinated biphenyls (PCBs).

The construction material and age of the waste oil tank and separator are unknown. However, results from the vapor monitoring system installed around the tank in October 1991 and monitored through July of 1992 indicate that the tank did not leak during that period. Since the tank exhibited integrity during this period, it is logical to assume that no previous leaks have occurred. Therefore, no further action will occur at SWMU 121 unless field investigations at SWMU 17 indicate otherwise. Accordingly, the potential for release from the tank is low but is unknown for the separator. The waste oil tank lies below grade, and is covered by gravel-topped soil. The oil level in the tank is visually monitored, and the oil is pumped into drums on an as-needed basis for transport to the DRMO Waste Storage Area. There have been no records of releases occurring at the site. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.3.2 Evaluation of Existing Data

Vapor monitoring results for SWMU 121 indicate that the tank has not experienced a loss of integrity. No previous investigations have occurred at SWMU 17.

4.3.3 Objectives

The objective of the RFI Phase I study for the Building 316 Oil/Water Separator and Waste Oil Tank is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. Vapor monitoring results reviewed for the waste oil tank indicate that leakage has not occurred. Therefore, an integrity test will only be performed on the oil/water separator. If the integrity testing indicates possible leakage from the separator, soil samples adjacent to and from a depth below the bottom of the unit will be chemically analyzed.

4.3.4 Sampling and Analytical Plan

Integrity Testing

Static water level integrity testing will be performed on the oil/water separator to determine whether or not the unit is possibly leaking. To perform the test, the unit will be filled with water, and the water level will be measured over an elapsed period of time. If cutoff valves do not exist for the unit, valves will be installed such that the unit in question can be isolated and filled. After testing the separator unit, water will be allowed to run through the unit into the sewer system.

Soil Sampling

If the separator fails the integrity testing, soil sampling will occur. A borehole will be drilled adjacent to the unit as shown in Figure 4-3. If a borehole is not feasible for any reason (i.e., accessibility), a backhoe or other method will be used to take a soil sample from a depth of approximately 6 in. deeper than the bottom of the unit.

The borehole will be advanced in 2-ft increments using hollow-stem augers. Samples from the borehole will be collected for chemical analysis from a sample interval beginning at 6 in. below the approximate bottom depth of the adjacent unit. Samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 10 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
1	1	SW8240, EPA 418.1, total metals
Integrity test on SWMU 17		

Analytical Plan

Owing to the nature of the wastes stored at this site (hydraulic oils), the soil sample will be analyzed for typical constituents of such waste types. Therefore, the soil sample submitted to the laboratory will be analyzed for total metals (as presented in Table 3-3), volatile organic compounds (SW8240), PCBs (SW8080), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

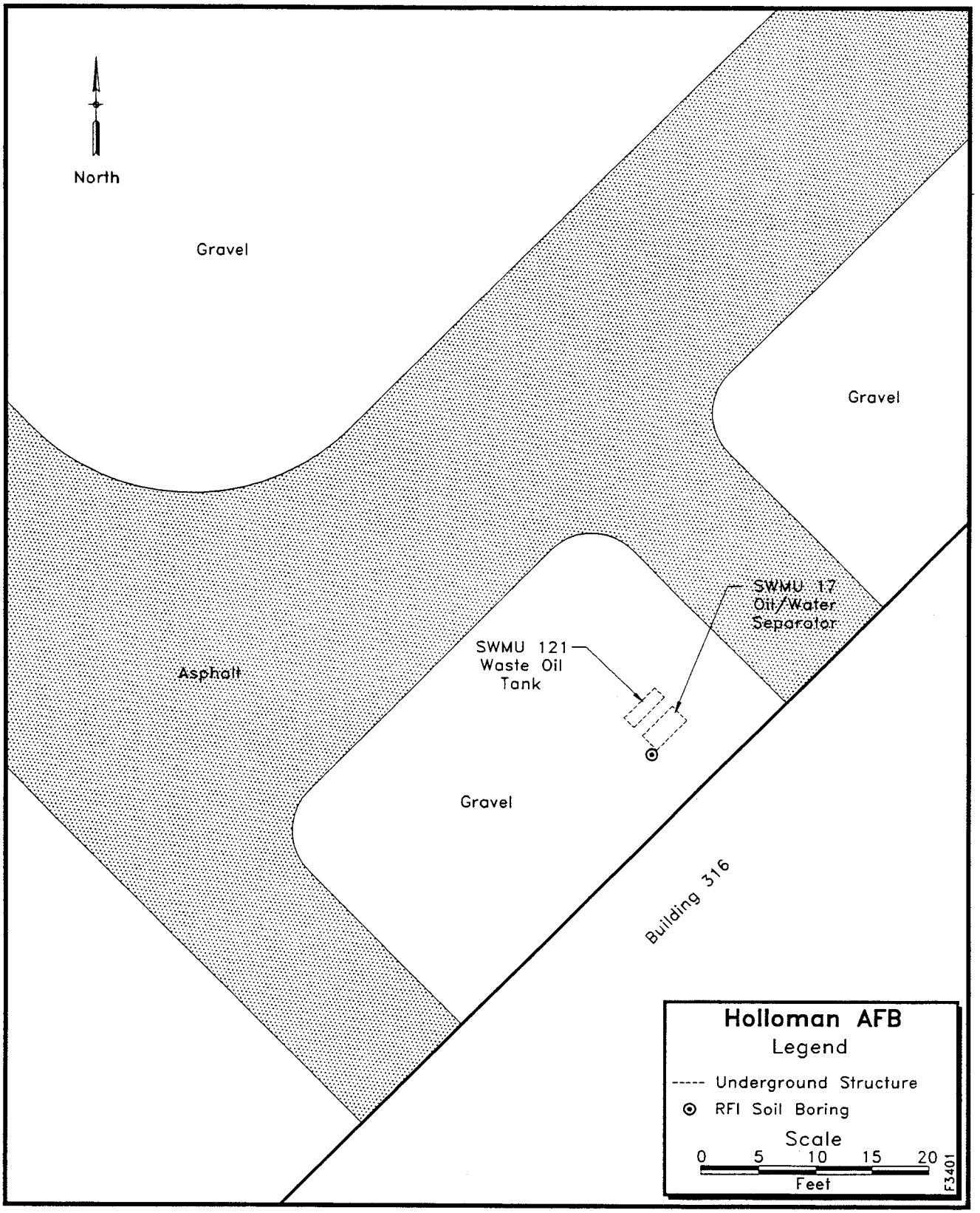


Figure 4-3. Soil Boring Locations, SWMUs 121/17

4.4 SWMUs 123 and 22

4.4.1 SWMU Description and History

These SWMUs consist of the Building 704 Oil/Water Separator (SWMU 22) and Waste Oil Tank (SWMU 123). The period of operation for the SWMUs is unknown, but the site is not currently active. SWMU 22 consists of an oil/water separation unit with unknown dimensions. The top of the oil/water separator is level with the ground surface, surrounded by soil. Washwater from the adjacent washrack containing oil and fuel was routed to the separator. Waste oil skimmed from the oil/water separator was transferred to the adjacent waste oil tank, and the water was discharged to the sewer system. A halon monitoring system is not present for this tank. The size, construction material, integrity, and age of the waste oil tank are unknown. Accordingly, the potential for release from the tank is unknown as well. The waste oil tank lies below grade, and is covered by gravel-topped soil. The oil level in the tank was visually monitored, and oil was pumped into drums on an as-needed basis for transport to the DRMO Waste Storage Area before reaching capacity. There have been no records of releases occurring at the site. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.4.2 Evaluation of Existing Data

No previous investigations have occurred at SWMUs 123 and 22. However, a remedial investigation was performed in the general area and the results are summarized in Section 4.11.2 and Appendix E of the Work Plan.

4.4.3 Objectives

The objective of the RFI Phase I study for the Building 704 Oil/Water Separator and Waste Oil Tank is to determine if previous operations have resulted in the

release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. Vapor monitoring results are not available for the waste oil tank; therefore, an integrity test will be performed on the waste oil tank in addition to the oil/water separator. If the integrity testing indicates possible leakage in either unit, soil samples adjacent to and from a depth below the bottom of the unit(s) will be chemically analyzed. If either unit fails the integrity tests, removal according to New Mexico UST regulations and the Base/NMED TPH cleanup agreement will be recommended, since the units are not active.

4.4.4 Sampling and Analytical Plan

Integrity Testing

Static water level integrity tests will be performed on the waste oil tank in addition to the oil/water separator to determine whether or not either of the 2 units is possibly leaking. To perform these tests, both units will be filled with water, and the water level will be measured over an elapsed period of time. If cutoff valves do not exist for either unit, valves will be installed such that the unit in question can be isolated and filled. After testing, water will be pumped from the unit(s) and stored in containers as described in Section 3.1.2.

Soil Sampling

If either unit fails the integrity testing, soil sampling will occur. Boreholes will be drilled adjacent to either unit as shown in Figure 4-4. If boreholes are not feasible for any reason (i.e., accessibility), a backhoe or other method will be used to take a soil sample from a depth of approximately 6 in. deeper than the bottom of the unit(s). If the units are

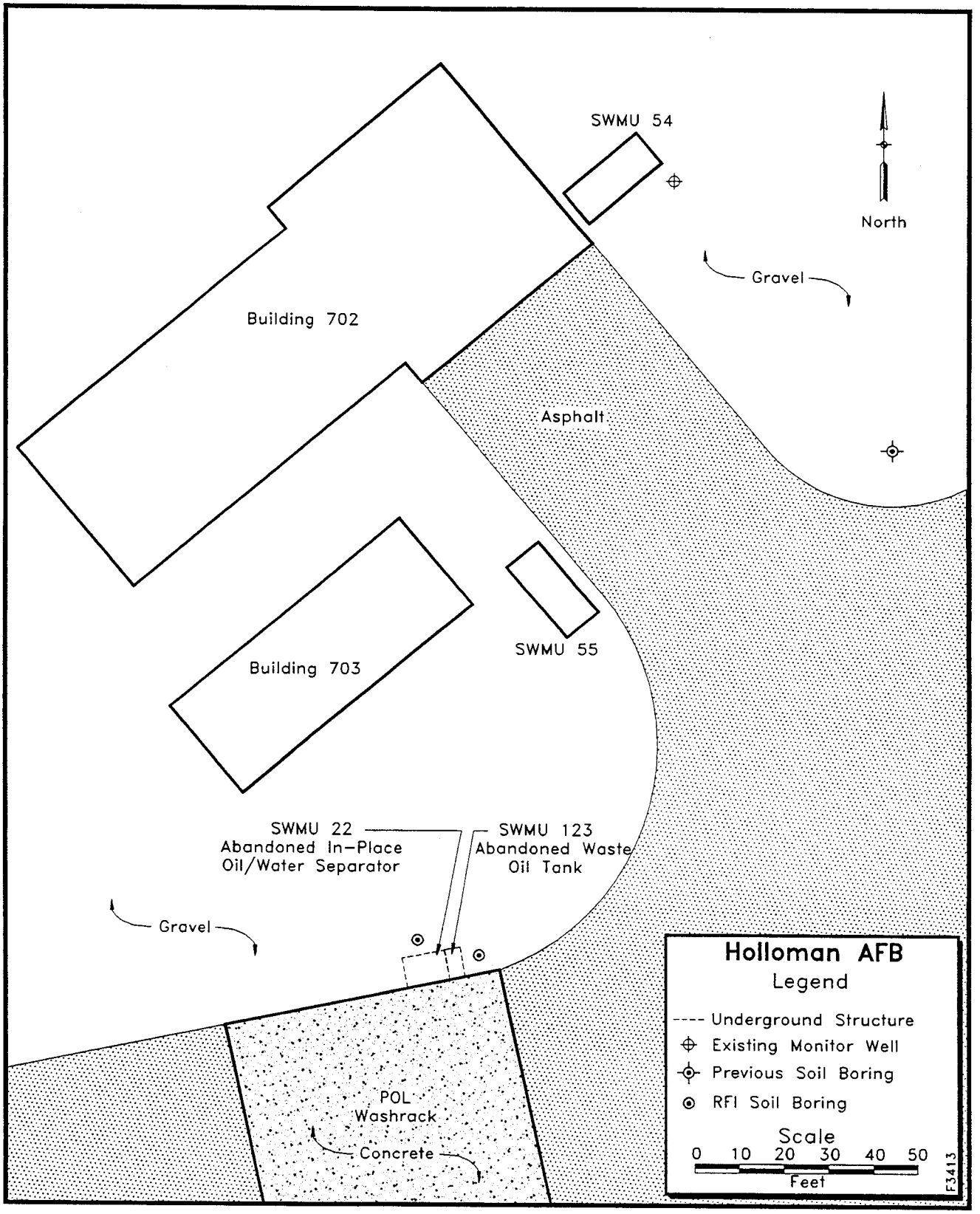


Figure 4-4. Soil Boring Locations, SWMUs 123/22

removed prior to sampling, borings will not be used and samples will be collected at the base of the excavation in an area previously below the units.

Boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from the boreholes will be collected for chemical analysis from a sample interval beginning at 6 in. below the approximate bottom depth of the adjacent unit. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	1	SW8240, EPA 418.1, total metals
Integrity test on SWMUs 22 and 123		

Analytical Plan

Owing to the nature of the wastes stored at this site (oil and fuel rinsates), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (listed in Table 3-3), volatile organic compounds (SW8240), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.5 SWMUs 126 and 36

4.5.1 SWMU Description and History

The SWMUs consist of the Building 1000 Oil/Water Separator (SWMU 36) and Building 1000 Waste Oil Tank (SWMU 126). The period of operation for the SWMUs is from approximately 1982 to the present. SWMU 36 consists of a steel oil/water separation unit with a total capacity of approximately 350 gal. The top of the oil/water separator is level with the ground surface, surrounded by gravel-covered soil. Washwater from cleaning floors in Building 1000 washes down a drain and collects in the separator. Waste oil skimmed from the oil/water separator is transferred to the adjacent waste oil tank, and water is discharged to the sewer system. A halon vapor monitoring system is not present at this tank. The size, construction material, and age of the waste oil tank are unknown. Accordingly, the potential for release from the tank is unknown as well. The waste oil tank lies below grade, and is covered by gravel-covered soil. According to interviews at the site, the waste oil tank has not been pumped out in more than 10 years. There have been no records of releases occurring at the site. There is also an above ground waste oil storage tank located on the west side of Building 1001 which is not associated with SWMUs 126 and 36. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.5.2 Evaluation of Existing Data

No previous investigations have occurred at SWMUs 126 and 36.

4.5.3 Objectives

The objective of the RFI Phase I study for the Building 1000 Oil/Water Separator and Waste Oil Tank is to determine if previous operations have resulted in the

release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. An integrity test will be performed on the waste oil tank in addition to the oil/water separator. If integrity tests indicate possible leakage in either unit, soil samples adjacent to and from a depth below the bottom of the unit(s) will be chemically analyzed. Contents of the units will also be sampled and analyzed if they cannot be characterized by other means.

4.5.4 Sampling and Analytical Plan

Integrity Testing

Static water level integrity tests will be performed on the waste oil tank in addition to the oil/water separator to determine whether or not either of the 2 units are possibly leaking. To perform these tests, both units will be filled with water, and the water level will be measured over an elapsed period of time. If cutoff valves do not exist for either unit, valves will be installed such that the unit in question can be isolated and filled. Water from testing of the separator unit will be allowed to drain into the sewer system. After testing the storage tank, water will be pumped from the unit and containers as described in Section 3.1.2 or allowed to cycle through the separator system.

Soil Sampling

If either unit fails the integrity testing, soil sampling will occur. Boreholes will be drilled adjacent to either unit as shown in Figure 4-5. If boreholes are not feasible for any reason (i.e., accessibility), a backhoe or other method will be used to take a soil sample from a depth of approximately 6 in. deeper than the bottom of the unit(s).

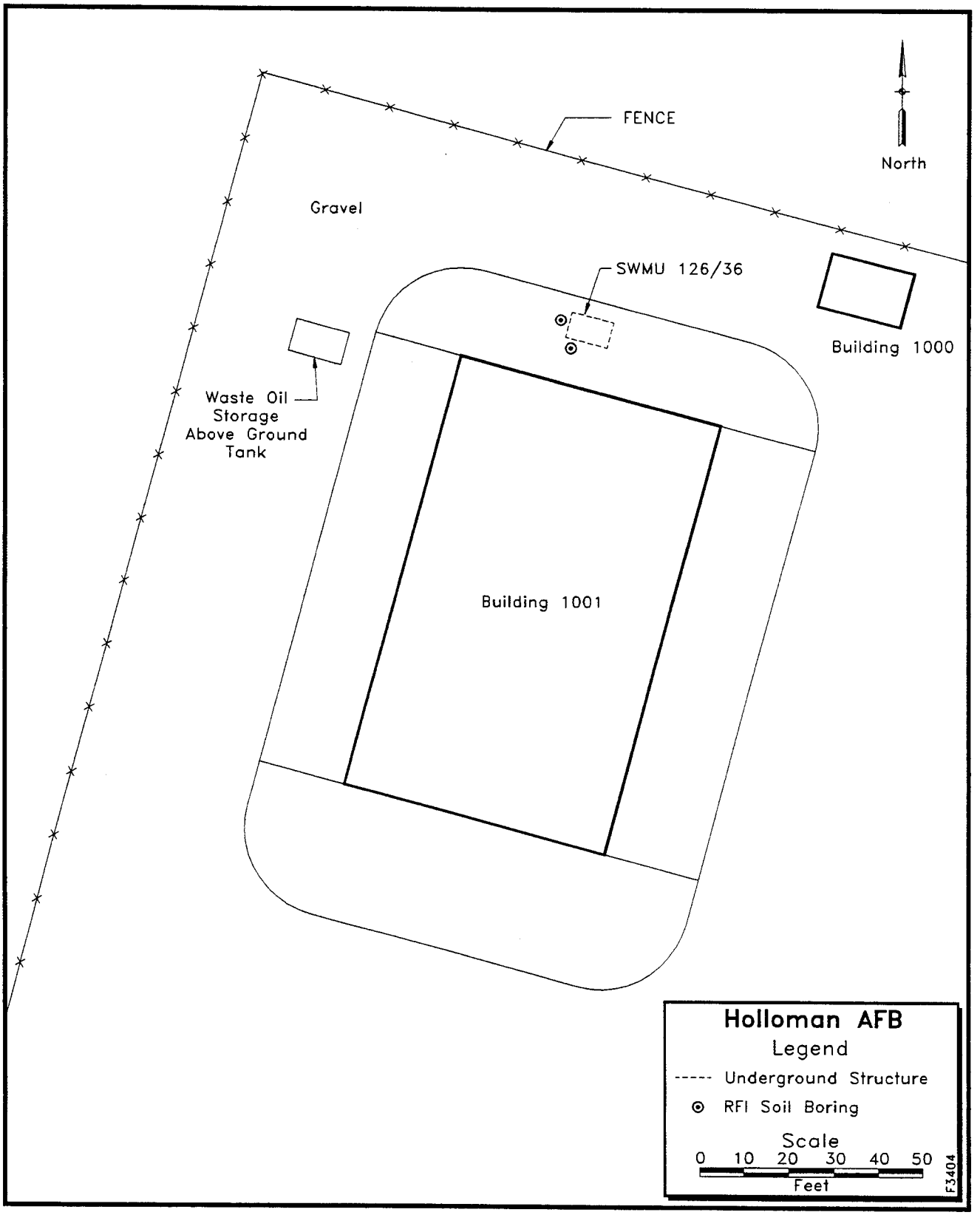


Figure 4-5. Soil Boring Locations, SWMUs 126/36

Any material contained in either the separator or tank will be sampled according to the procedures for surface soil sampling described in Section 3.3.1. If the tanks are not easily accessible, a stainless steel or teflon sampling device that can gain access to the contents will be used.

Boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from the boreholes will be collected for chemical analysis from a sample interval beginning at 6 in. below the approximate bottom depth of the adjacent unit. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Task and Oil/Water Separator Sampling

If the contents of the tank and the separator cannot be documented, they will be composited and sampled for TCLP analytes (SW1311) and ignitability (SW1010).

Estimated Groundwater Depth = 15-20 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	1	SW8240, EPA 418.1, total metals
Number of SWMUs	**Number of Composite Samples**	**Analyses Per Sample**
2	1	TCLP (SW131), ignitability (SW1010)
Integrity test on SWMUs 36 and 126, composite sampling of SWMUs contents if necessary.		

Analytical Plan

Owing to the nature of the wastes stored at this site (oil and fuel rinsates), all soil samples will be analyzed for typical constituents of such waste types. Therefore, soil or tank content samples submitted to the laboratory will be analyzed for total metals (as listed in Table 3-3), volatile organic compounds (SW8240), and TRPH (EPA 418.1). Tank and separator contents will be composited and analyzed for TCLP constituents (SW1311) and ignitability (SW1010). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.6 SWMUs 125 and 32

4.6.1 SWMU Description and History

These SWMUs consist of the Building 868 Oil/Water Separator (SWMU 32) and the Building 868 Fire Water Tank (SWMU 125). The period of operation for the SWMUs is from 1986 to the present. SWMU 32 consists of a steel oil/water separation unit located in a 3-ft by 4-ft by 5-ft deep concrete vault. The top of the oil/water separator unit is elevated a few inches above the ground surface. The ground surface inside the vault is covered with drain rock. SWMU 125 consists of a large underground concrete tank with a capacity of more than 10,000 gal. Water from the washing of floors and the application of fire suppressant are directed to the Fire Water Tank. Water from the tank is routed through the oil/water separator through which water enters the sewer system, and oil is redirected back to the Fire Water Tank. Oil levels in the tank are visually monitored and the oil is pumped out of the tank before the capacity is reached. Oil is pumped into drums that are then taken to DRMO. There is a potential for release from the separator, since water was observed to be standing in the vault surrounding the separator unit. No testing of the integrity of the Fire Water Tank has occurred to date. In addition, a halon vapor monitoring system is not in place for the tank, thus the potential for releases is unknown. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.6.2 Evaluation of Existing Data

No previous investigations have occurred at SWMUs 125 and 32.

4.6.3 Objectives

The objective of the RFI Phase I study for the Building 868 Oil/Water Separator and Fire Water Tank is to determine if previous operations have resulted in the

release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. An integrity test will be performed on both units. If integrity tests indicate possible leakage in either unit, soil samples adjacent to and from a depth below the bottom of the unit(s) will be chemically analyzed. Contents of the units will also be sampled and analyzed.

4.6.4 Sampling and Analytical Plan

Integrity Testing

Static water level integrity tests will be performed on both the oil/water separator and the waste oil tank to determine whether or not either of the 2 units are possibly leaking. To perform these tests, both units will be filled with water, and the water level will be measured over an elapsed period of time. If cutoff valves do not exist for either unit, valves will be installed such that the unit in question can be isolated and filled. After testing the oil/water separator water will be allowed to run through the system and into the sanitary sewer system. Wastewater generated from tank testing will be pumped out and allowed to cycle through the separation system.

Soil Sampling

If either unit fails the integrity testing, soil sampling will occur. Boreholes will be drilled adjacent to either unit as shown in Figure 4-6. If boreholes are not feasible for any reason (i.e., accessibility), a backhoe or other method will be used to take a soil sample from a depth of approximately 6 in. deeper than the bottom of the unit(s).

Boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from the boreholes will be collected for chemical analysis from a sample interval

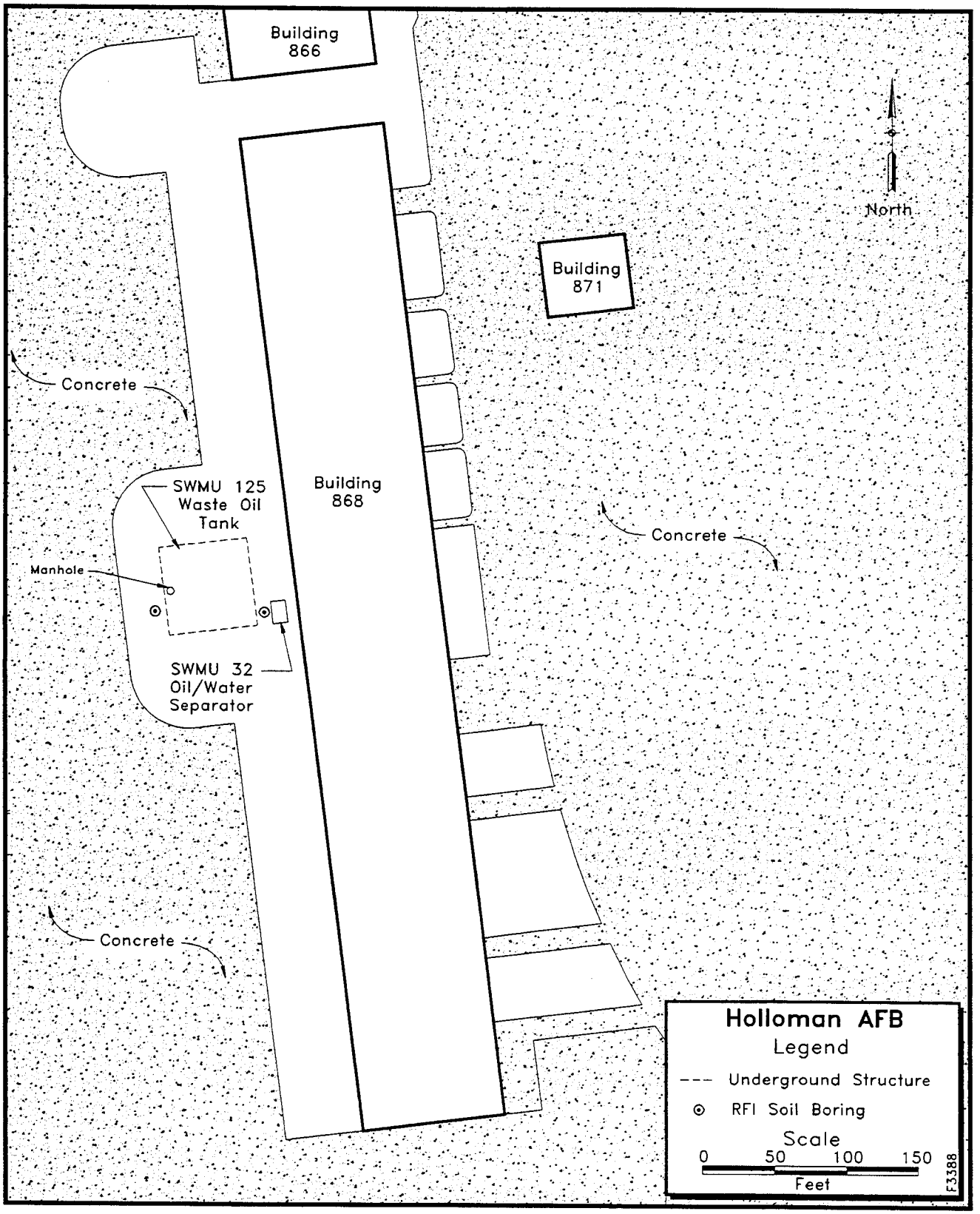


Figure 4-6. Soil Boring Locations, SWMUs 125/32

beginning at 6 in. below the approximate bottom depth of the adjacent unit. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing evenly among the sample containers.

Tank and Oil/Water Separator Sampling

The contents of the units will be composited and analyzed for TCLP constituents (SW1311) and ignitability (SW1010) if the nature of the contents cannot be determined by other means.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	1	SW8240, EPA 418.1, total metals
Number of SWMUs	**Number of Composite Samples**	**Analyses Per Sample**
2	1	TCLP (SW1311), ignitability (SW1010)
Integrity test on SWMUs 32 and 125; composite sampling of SWMUs if necessary.		

Analytical Plan

Owing to the nature of the wastes stored at this site (oil and fuel rinsates), all soil samples will be analyzed for typical constituents of such waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (listed in Table 3-3), volatile organic compounds (SW8240), and TRPH (EPA 418.1). Tank and separator contents will be composited and analyzed for TCLP constituents (SW1311) and ignitability (SW1010). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.7 SWMUs 39, 127, and 135

4.7.1 SWMU Description and History

These SWMUs consist of the Building 1092 Oil/Water Separator (SWMU 39), Waste Oil Tank (SWMU 127), and Oil/Water Separator Drainage Pit (SWMU 135). The entire site is enclosed by a fence and occupies approximately 5000 square ft, with the separator and tank contained within the drainage pit. The SWMUs were in use from their installation in 1979 until 1991. The oil/water separator received drainage of fuel and fire water from the old fire-training area [Installation Restoration Program (IRP) Site 31] located immediately adjacent to the SWMUs. The fuels and oils were then skimmed from the separator and stored in the 500 gal waste oil tank. The water remaining in the separator was then discharged into the drainage pit. Halon vapor monitoring records are not available for the waste oil tank. Since the pit is not lined and the condition of the separator and the waste oil tank is unknown, the media potentially affected include the soils in the pit and surrounding the separator and tank and the groundwater. The primary fuel used at the fire-training area was JP-4.

4.7.2 Evaluation of Existing Data

Extensive investigations have occurred at the old fire-training, area including a remedial investigation (RI) and a risk assessment (Appendix A). Five monitoring wells exist in the area adjacent to the SWMUs but no recent sampling has occurred. Several soil borings were also conducted at the site. Although surficial contamination was found in the fire pit and 1 of the monitoring wells showed slight contamination, the risk assessment indicated that no risk is present and no further action was recommended (Decision Document, 1990). However, since no actions have occurred recently at the SWMUs and past groundwater monitoring did indicate contamination, additional investigations are being performed as part of the Phase I RFI.

4.7.3 Objectives

The objective of the RFI Phase I study for the SWMUs associated with Building 1092 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soils surrounding the area.

This objective will be met by installing a borehole in the lowest portion of the pit, and by the collection and chemical analysis of soil samples. In addition, soil samples will be collected from soils under the tank and oil/water separator.

4.7.4 Sampling and Analytical Plan

Figure 4-7 illustrates the proposed location of the hand-auger borehole for the Phase I study. Also, the 5 existing monitoring wells are located on Figure 4-7. The borehole is located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater. Location of the borehole in the lowest portion of the pit will provide the greatest probability of detecting a release since ponding of released liquids would accumulate in this area prior to infiltration into the underlying soils.

Sampling Plan

The tank and separator will be removed according to New Mexico UST removal regulations [NM USTR, Part 8:801(B)] and the Base/NMED TPH cleanup agreement. Verification sampling for TRPH (EPA 418.1), total metals (as presented in Table 3-3), and volatile organic compounds (SW8240) will be performed in association with the tank and separator removal.

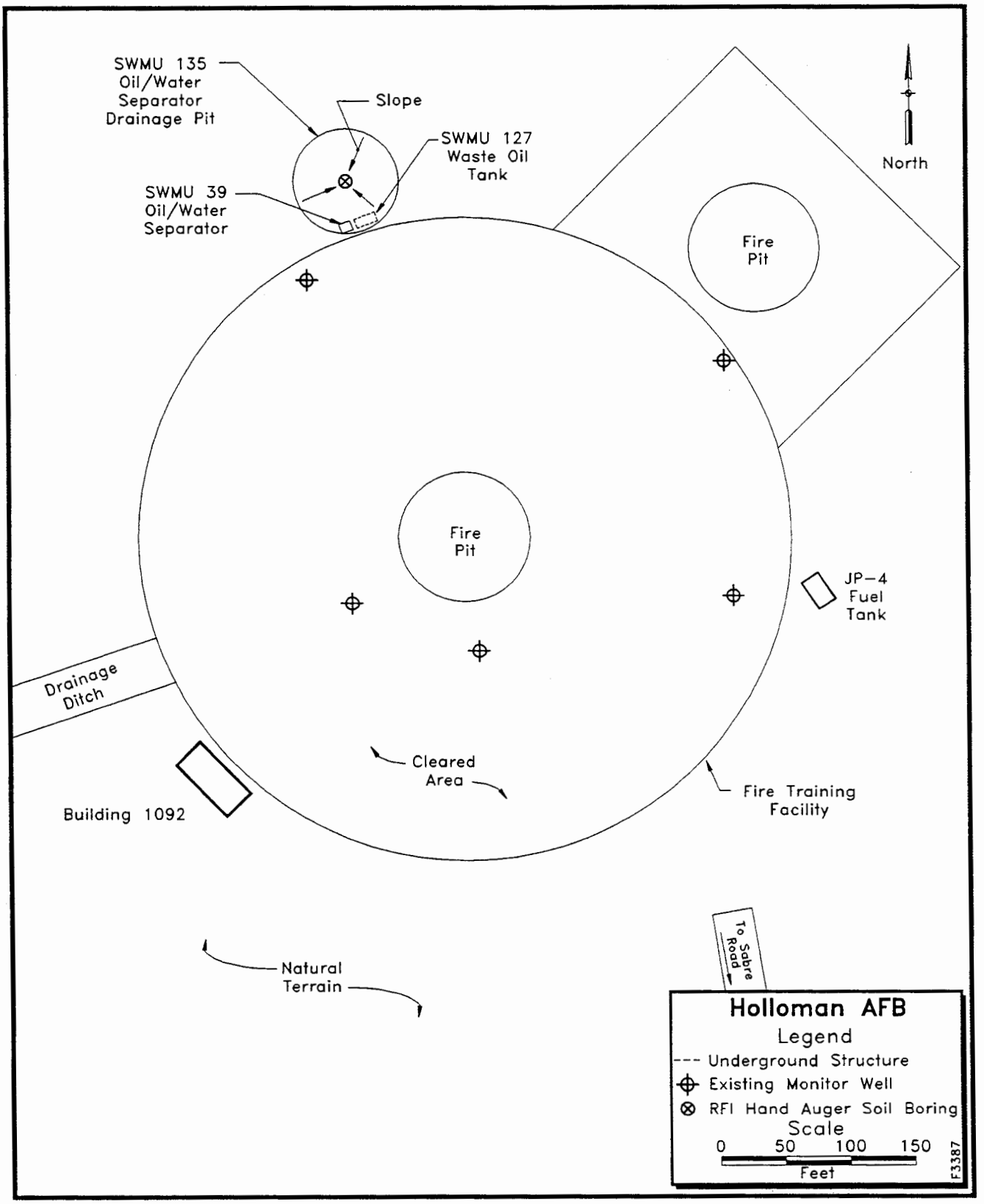


Figure 4-7. Soil Sampling Locations, SWMUs 39/127/135

A single borehole located at the lowest portion of the pit will then be advanced to the groundwater interface using a stainless steel hand auger. A power auger may be used to advance the borehole to just above the sampling depths after the 0- to 2-ft interval has been sampled. Samples will be collected for chemical analysis from the 0- to 2-ft interval, then from 1 interval every 5 ft until groundwater is reached, and also from the interval which intersects the groundwater interface. Samples will be collected with a stainless steel hand auger which has been decontaminated prior to use according to the process described in Section 3.1.3. The removed soil will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the soil will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 20-25 ft		
Number of Hand Auger Borings	**Samples Per Boring**	**Analyses Per Sample**
1	6	SW8240, EPA 418.1, total metals
Number of Verification Sample Locations	**Samples Per Verification Location**	**Analyses Per Sample**
2	1	SW8240, EPA 418.1, total metals
Removal and verification sampling of SWMUs 39 and 127.		

Analytical Plan

Owing to the nature of the wastes stored in this site (fuels and oils), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for TRPH (EPA 418.1), total metals (as presented in Table 3-3), and volatile organic compounds (SW8240). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.8 SWMUs 40, 128 and 138

4.8.1 SWMU Description and History

These SWMUs consist of the Building 1166 Oil/Water Separator (SWMU 40), Waste Oil Tank (SWMU 128), and Oil/Water Separator Drainage Pit (SWMU 138). The separator and tank are located immediately adjacent to Building 1166 vehicle washrack; the drainage pit is situated approximately 50 ft southeast of the washrack. The separator receives rinsate from the washrack that could include water, oils, detergents, and fuels. The oils and fuels are skimmed and stored in the 250 gal waste oil tank that is directly beside the separator. The water remaining in the separator is then discharged to the unlined drainage pit. It is unknown when the site operations began, but they continued until 1992. During that period of operation, there have been no reported spills or remedial actions. In addition, results from the halon vapor monitoring system installed in October 1991 and monitored through July 1992 indicate that no leakage has occurred from SWMU 128. Since no leakage occurred during the monitored period, it is logical none has occurred previously. Therefore, no further action will occur at SWMU 128 unless investigations associated with SWMU 40 indicate otherwise.

4.8.2 Evaluation of Existing Data

Extensive investigations have occurred at the sled test maintenance area (IRP Site 38) located at Building 1166 approximately 100 yds northwest of the SWMUs, including an RI and a risk assessment (Appendix B). Three monitoring wells exist at the sled test maintenance area. These wells were sampled as part of the RI performed in 1991. The nitrate-nitrite concentrations detected in these wells were slightly elevated, probably due to the fact that there is a septic tank drainfield located at the site. Also, several volatile compounds were detected. Chloroform and trichloroethene were detected in 2 wells at concentrations below the detection limit, and methylene chloride was detected in all 3 wells. However, the presence of methylene chloride in natural samples is uncertain because it was

often blank detected. Two soil borings were also drilled at the site. Petroleum hydrocarbons were present in all soil samples. Also, methylene chloride and toluene were detected. The presence of these constituents in natural samples is uncertain due to the fact that they have historically been found in blank samples. Nevertheless, the risk to human health and the environment is considered acceptable and no further action was recommended (*RI Report*, Radian Corporation, 1992). However, the previous investigations did not include SWMUs 40, 128, and 138 and their inclusion in the Phase I RFI is warranted.

4.8.3 Objectives

The objective of the RFI Phase I study for the SWMUs associated with Building 1166 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soils surrounding the area, or if the constituents have reached the groundwater.

This objective will be met by installing 2 boreholes, 1 at either end of the drainage pit, and by the collection and chemical analysis of soil samples. In addition, if the units are no longer active, they will be removed according to New Mexico UST regulations and the Base/NMED TPH cleanup agreement.

4.8.4 Sampling and Analytical Plan

Figure 4-8 illustrates the proposed location of the boreholes for the Phase I study. Also, the 3 existing monitoring wells are located on Figure 4-8. The boreholes are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater.

The boreholes are located at either end of the pit to provide for the detection of any releases from the entire pit. The boring located nearest the separator and tank is close to the separator outfall while the opposite boring will detect any releases occurring from that portion of the pit.

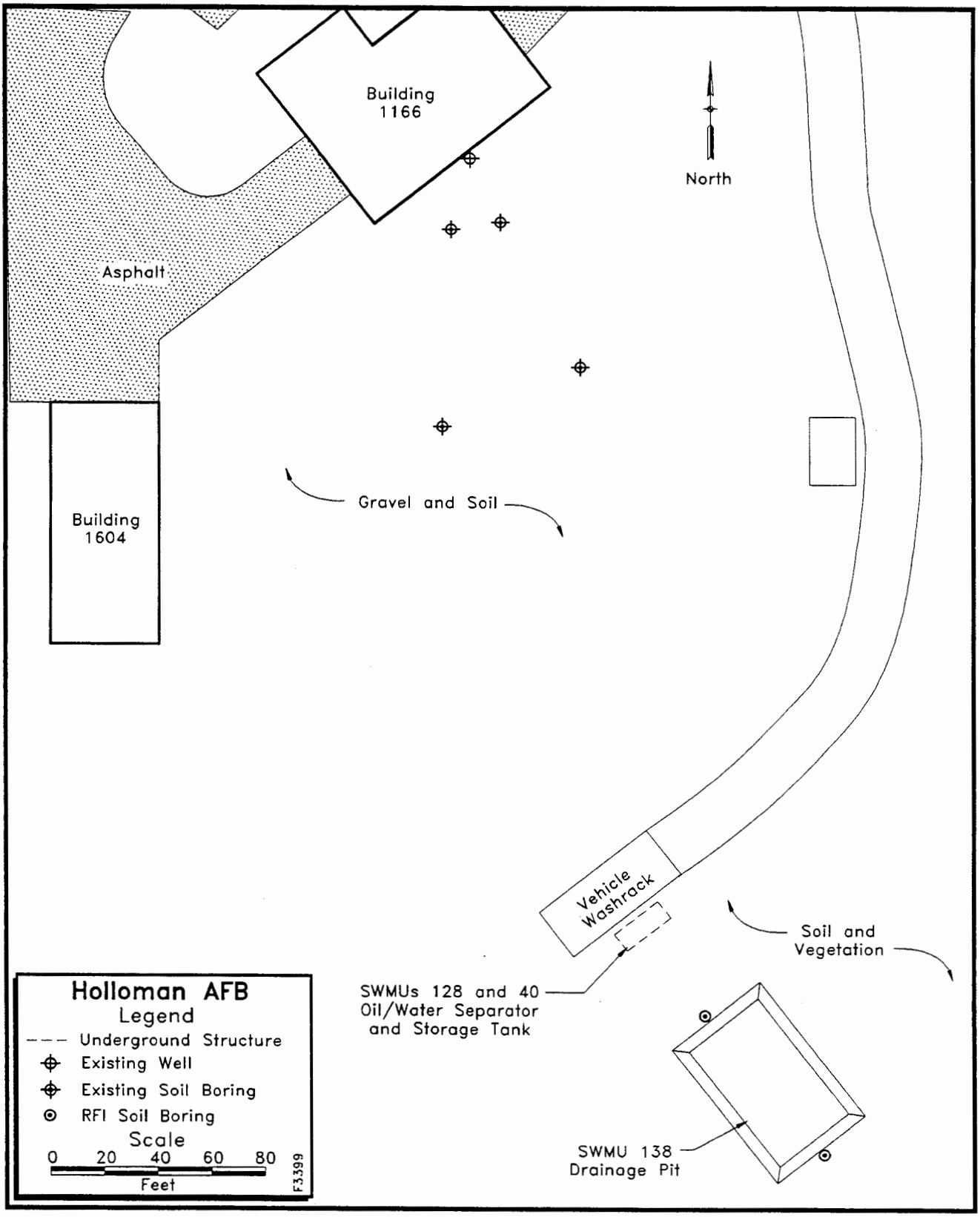


Figure 4-8. Soil Boring Locations, SWMUs 40/128/138

Sampling Plan

The tank and separator will be removed according to New Mexico UST removal regulations (NM USTR Part 8:01(B)) and the Base/NMED TPH cleanup agreement. Verification sampling for TRPH (EPA 418.1), total metals (as presented in Table 3-3), and volatile organic compounds (SW8240) will be performed in the bottom of the excavation in a location formerly below the separator. Since vapor monitoring records indicate that no leakage from the tank occurred, underlying soils will not be sampled unless visually contaminated.

The boreholes located at either end of the pit will then be advanced using hollow-stem augers in 2-ft increments from the land surface to the groundwater interface. Samples will be collected for chemical analysis from the 0- to 2-ft interval, then all intermediate 2-ft increments will be screened using an HNU (or equivalent). A sample will be taken from the interval with the highest HNU results, and also a sample will be taken from the interval that intersects the groundwater interface.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3. The 2-ft interval will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing evenly among the sample containers.

Estimated Groundwater Depth = 20-25 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	3	SW8240, EPA 418.1, total metals
Number of Verification Sample Locations	**Samples Per Verification Sampling Location**	**Analyses Per Sample**
1	1	SW8240, EPA 418.1, total metals
Removal of SWMUs 40 and 128; verification sampling of SWMU 40		

Analytical Plan

Owing to the nature of the wastes stored in this site (fuels and oils), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for TRPH (EPA 418.1), total metals (as presented in Table 3-3), and volatile organic compounds (SW8240). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.9 SWMU 118

4.9.1 SWMU Description and History

This SWMU consists of the Building 21 Pesticide Holding Tank and an open-ended concrete containment box. The holding tank was located in the concrete containment box immediately adjacent to Building 21 as illustrated in Figure 4-9. The pesticide holding tank was used from 1986 to 1991. In 1991 the existing tank was known to be leaking. That tank and the dirt in the concrete containment around the tank were removed and replaced with a new tank and fresh dirt. Then in August 1992, the contents of the building were moved to the new Entomology Shop and the tank and dirt were removed once again. At this time the cavity within the concrete containment was backfilled with fresh dirt. All that remains now is the concrete containment filled with soil. When in use the tank held rinsate from the cleaning of portable pesticide sprayers. The rinsate, which included water, soap, and pesticide residue, was eventually used as herbicide on the Base. No historical spills have been reported but according to Base personnel, while filling the tank some rinsate would spill over the side of the tank and on to the soil.

4.9.2 Evaluation of Existing Data

Extensive investigations have occurred at the pesticide rinse water spill area and the leachfield, both located at the Building 21 Entomology Shop (IRP Site 16), including an RI and a risk assessment (Appendix C). Four monitoring wells exist at the entomology shop. These wells were sampled as part of the RI performed in 1991. Several organochlorine pesticides and volatile organic compounds were detected in all of the wells. One soil boring was also drilled at the site. Organochlorine and organophosphorus pesticides were present in the surface soils (1 to 2 ft BGL), but not in the underlying 2- to 4- ft BGL samples. Ethyl benzene and methyl ethyl ketone were detected in soil samples from the 2- to 4-ft interval. Nevertheless, the risk to human health and the environment is considered acceptable; no further action for this site was recommended (*RI Report*, Radian

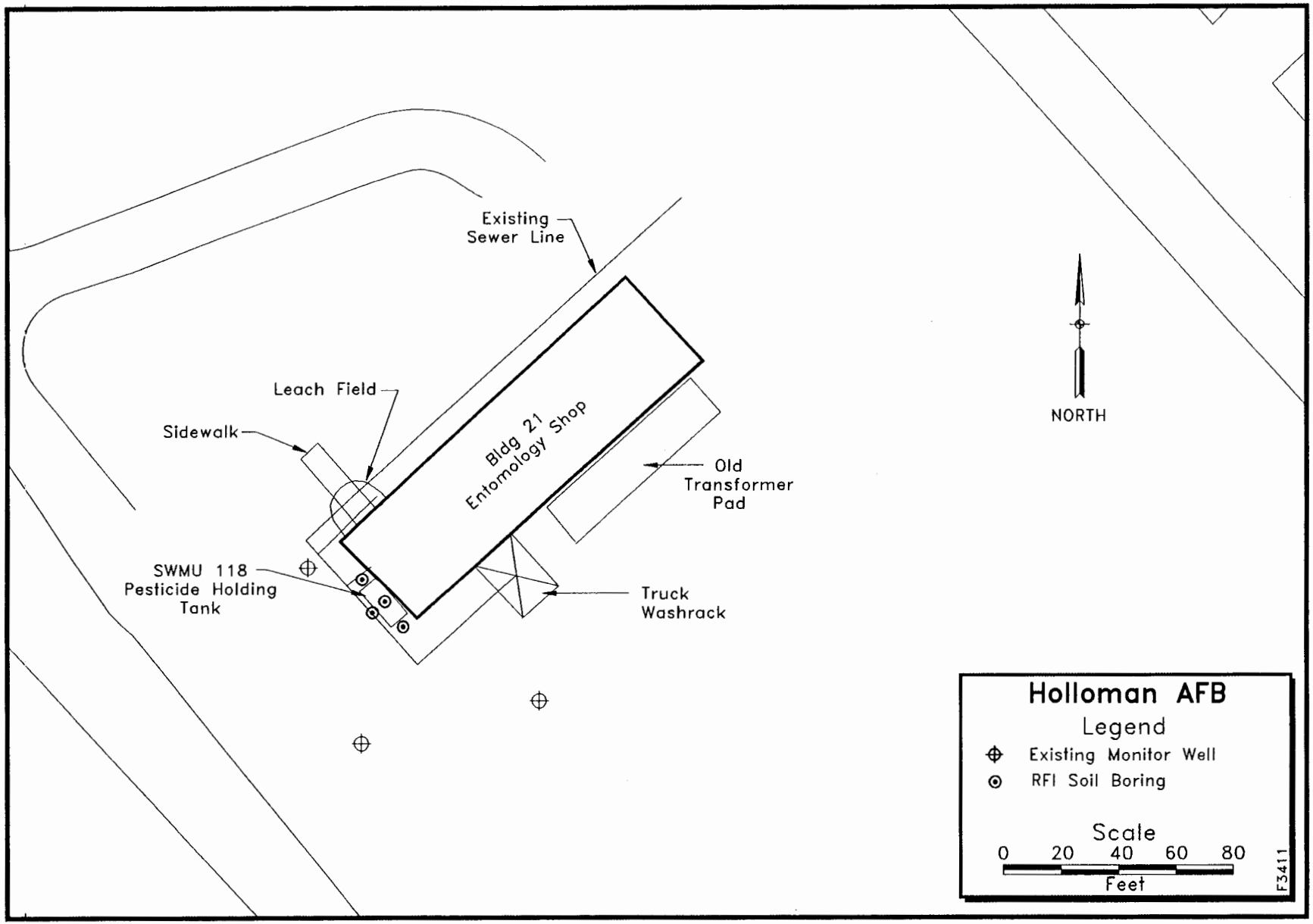


Figure 4-9. Soil Sampling Locations, SWMU 118

Corporation, October 1992). However, the source and extent of contamination at the site was never fully characterized and the EPA has recommended additional investigations at the site. To further characterize the site, additional soil sampling around the pesticide holding tank area will be conducted under the RFI Phase I study.

4.9.3 Objectives

The objective of the RFI Phase I study for the Building 21 pesticide holding tank is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to further characterize the source of contamination found in the area by determining if waste constituents have migrated into the soils surrounding the area of the pesticide holding tank, or if the constituents have reached the groundwater.

This objective will be met by drilling 4 boreholes, 1 in the center of the concrete containment box and 3 on the outer sides of the box, and by the collection and chemical analysis of soil samples. If Building 21 has been removed at the time of the RFI, (as planned) a fourth boring will be performed on the building side of the concrete containment box.

4.9.4 Sampling and Analytical Plan

Figure 4-9 illustrates the proposed location of the boreholes for the Phase I study. Also, the 4 existing monitoring wells are shown in Figure 4-9. The boreholes are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater.

Borings will be performed on three sides of the tank in order to detect waste constituents that may have leaked from any side of the containment box. One soil boring

will be performed through the center of the box in order to characterize the soil immediately underlying the containment box.

Sampling Plan

The borehole located in the center of the concrete containment will be advanced using hollow-stem augers in 2-ft increments from the land surface to the groundwater interface. Samples will be collected for chemical analysis at 2-ft intervals from the surface to the top of the groundwater table. The 3 boreholes outside the box will be advanced in the same manner to a depth of 4 ft BGL. Samples will be collected for chemical analysis at the bottom of the borehole. If Building 21 has been demolished by the time of the RFI, a fourth borehole will be advanced on the fourth side of the concrete containment box to a depth of 4 ft and sampled the same as the first 3 boreholes.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3. The 2-ft interval will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 4-5 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
1 central 4 outer[a]	3 1	SW8240, SW8080, SW8140, SW8150, EPA 418.1
[a] Assuming Building 21 has been demolished (as planned).		

Analytical Plan

Owing to the nature of the wastes stored in this site (pesticides and herbicides), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for TRPH (EPA 418.1), organochlorine pesticides (SW8080), organophosphorus pesticides (SW8140), chlorinated herbicides (SW8150) and volatile organic compounds (SW8240). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.10 SWMU 129

4.10.1 SWMU Description and History

This SWMU consists of the Building 1191 and Building 1192 Spill Tanks (SWMU 129). This site is also known as IRP Site 36. Buildings 1191 and 1192 had a total of 4 runoff pits (collection tanks) that received all spilled fuels and floor washings from the concrete pad storage and mixing areas. The fuels handled by this area included unsymmetrical dimethylhydrazine (UDMH), JP-4, inhibited red fuming nitric acid (IRFNA), inhibited white fuming nitric acid (IWFNA), and aniline. The site which is no longer used for unconventional fuels storage, is currently the Base Equestrian Facility. Buildings 1191 and 1192 are now used as horse stables. The estimated dates of operation of unconventional fuel storage at IRP Site 36 are from 1952 to 1964.

Figure 4-10 shows 1 possible configuration of the tanks with 3 collection (spill) tanks located south of Building 1192, and 1 spill tank located south of Building 1191. The exact location of the tanks was not determined during the literature search conducted in 1991 for the IRP Site 36 RI. According to that literature search the tanks were replaced in 1978 with new tanks, then filled with concrete, and left in place (letter dated 31 March 1978). At least 1 tank was reported to have begun collecting water and was removed from service. This indicates that a release may have occurred at that location.

Figure 4-11 shows an alternate configuration of the tanks with 2 spill tanks located at each building. This figure is taken from a plan of the Acid Storage Building trench details dated 1956. However, these drawings are not as-built drawings, and the detail could have changed before construction. No other sources of the trench and tank layout could be found. Trenches can be seen in some places in the building foundations. Borings can be placed with respect to the features in the building foundation.

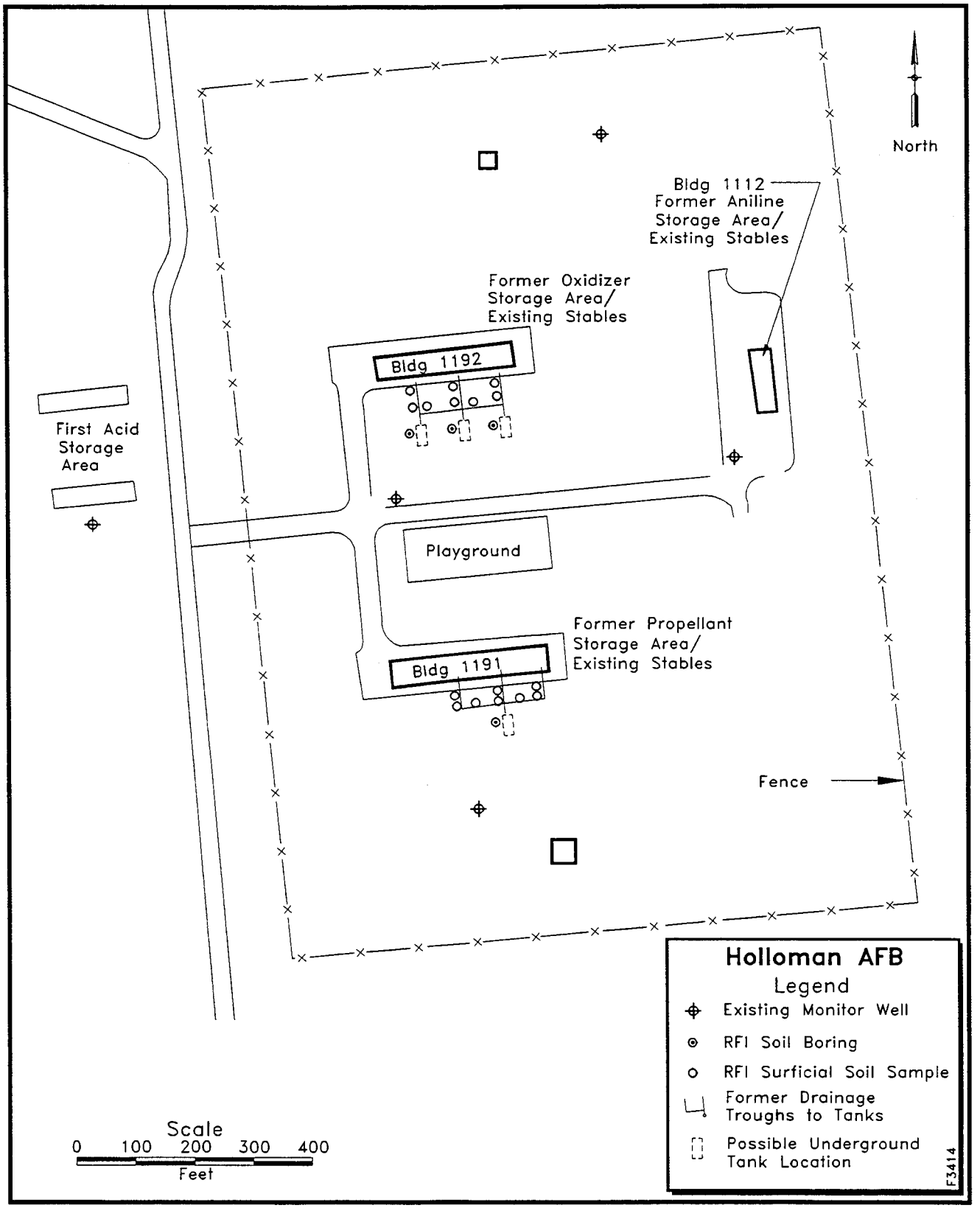


Figure 4-10. Soil Sampling Locations, Configuration 1, SWMU 129

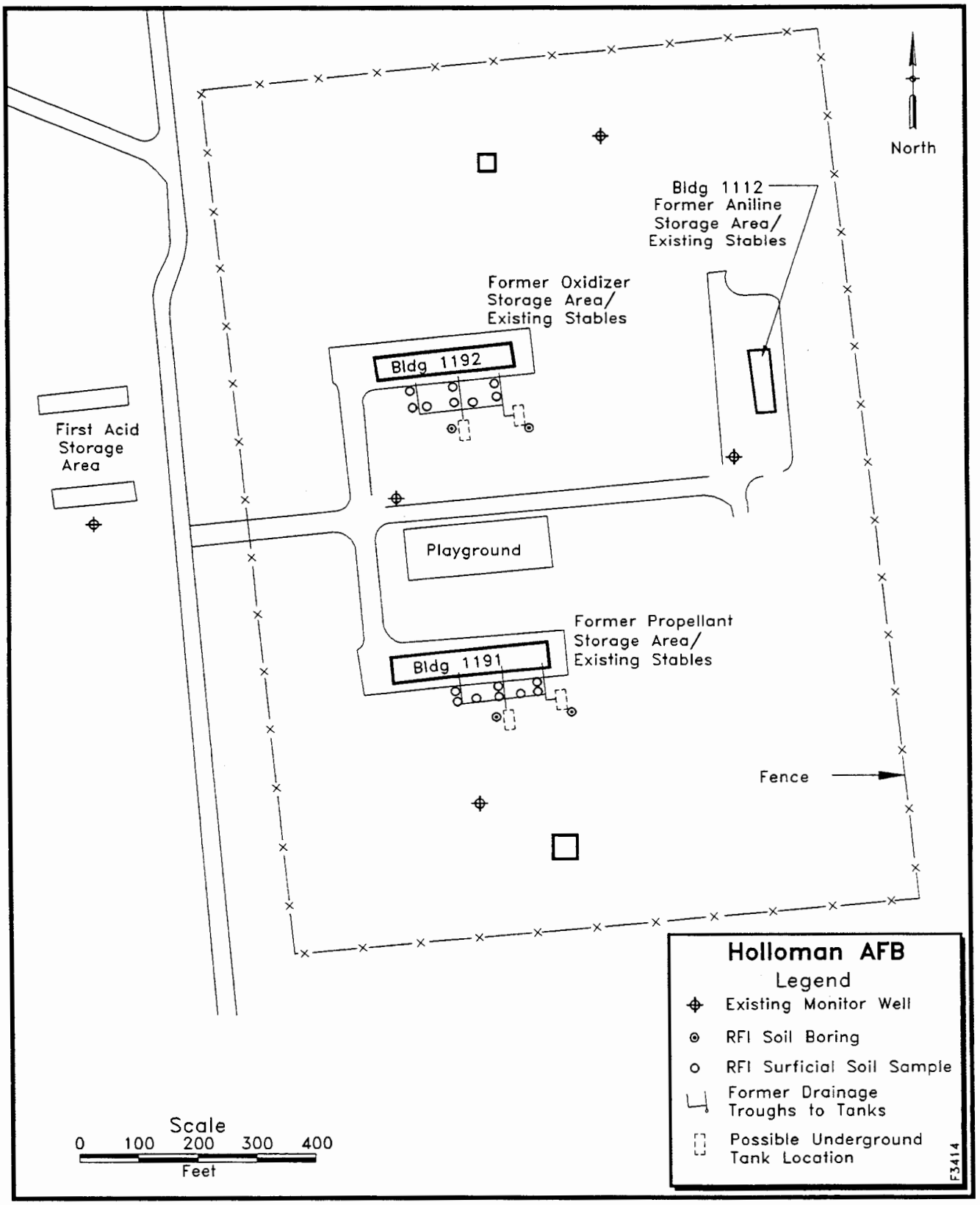


Figure 4-11. Soil Sampling Locations, Configuration 2, SWMU 129

4.10.2 Evaluation of Existing Data

Extensive investigations have occurred at IRP Site 36, including an RI and a risk assessment (Appendix D). In previous soil sampling (1978 and 1979) there was no evidence that UDMH was present in former spill sites (letter dated 28 June 1979). Soil samples taken in June 1981 indicated that no significant levels of waste fuels were present in the soils (letter dated 15 December 1981). In association with the RI, 5 monitoring wells were installed (Figure 4-10). This study indicated the presence of nitrate-nitrite and lead concentrations above background levels. Also, petroleum hydrocarbons and some VOCs were detected in all wells. The presence of trichloroethene in the well next to the former first acid storage area is the strongest evidence of a release from IRP Site 36. This evidence is enhanced by the detections of other VOCs Nevertheless, the risk assessment indicates that the risk to human health and the environment is acceptable and a no-action alternative was recommended based upon the results presented in the RI (*RI Report*, Radian Corporation, October 1992). Also recommended in the RI however, is the need for further soil borings as well as additional groundwater investigation. These investigations will be conducted as part of the Base IRP investigations and are not discussed here. In addition, the EPA has recommended further assessment to determine if a release has occurred from IRP Site 36. The results of the sampling conducted during the Phase I RFI will be incorporated into future investigations.

4.10.3 Objectives

The objective of the RFI Phase I study for SWMU 129 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soils surrounding the area or underlying the tanks.

This objective will be met by the collection of surface samples along the former drainage troughs and performing borings at the location of each tank, and by the collection and chemical analysis of soil samples.

4.10.4 Sampling and Analytical Plan

Figures 4-10 and 4-11 illustrate the proposed sampling locations depending on where the tanks are located. The samples are located to determine whether a release of waste or waste constituents has occurred to the site soils by testing the surface soil along each drainage path, and the subsurface soils (via soil borings) beneath the spill tanks.

Sampling Plan

Owing to the uncertainty of the tanks locations, an electromagnetic (EM) survey will be performed as described in Section 3.4.2 prior to any sampling. Once the tanks are located, a sampling plan can be developed that reflects either the configurations in Figures 4-10 and 4-11 or the configuration determined by the survey. If the electromagnetic survey is uneffective because of aboveground interferences, a backhoe will be used to investigate and determine the tank locations as well as for sampling purposes.

At each located tank, a borehole will be advanced in 2-ft increments immediately adjacent to the tank to the groundwater table. Samples will be collected for chemical analysis from the 0 to 2-ft interval, then all intermediate 2-ft increments will be screened using an HNU (or equivalent). A sample will be taken from the interval with the highest HNU results, and also a sample will be taken from the interval that intersects the groundwater interface.

Surface samples will also be collected along the drainage troughs that lead to the tanks. In many cases the troughs are filled with concrete or covered with soil. Following location of the troughs, samples will be collected approximately every 20 ft and

at the corners of the troughs where spills were likely to occur. Samples will be collected from the 0- to 12-inch depth increment with stainless steel hand trowels.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3. The 2-ft interval will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing evenly among the sample containers.

Estimated Groundwater Depth = 25-30 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
4	3	SW8240, SW7421, EPA 418.1
Number of Surface Samples	**Composite Interval of Sample**	**Analyses Per Sample**
16	0-1 ft	SW8240, SW7421, EPA 418.1
Eight UDMH/NDMA (SW8270, TIC) samples will be collected (four surficial and one from each boring).		

Analytical Plan

Owing to the nature of the wastes stored in this site (unconventional fuels), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore all samples submitted to the laboratory will be analyzed for TRPH (EPA 418.1), lead (SW7421), and volatile organic compounds (SW8240). Also, 1 sample from each borehole advanced next to the tanks and no more than 4 samples collected adjacent to the troughs will be analyzed for UDMH and n-nitroso dimethyl amine (NDMA - the primary breakdown product of UDMH) (SW8270, TIC). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.11 SWMUs 54 and 55

4.11.1 SWMU Description and History

These SWMUs consist of the Building 702 Waste Accumulation Area (SWMU 54) and the Building 702A Waste Accumulation Area (SWMU 55). The period of operation for SWMU 54 was from 1955 to 1987; SWMU 55 has been operated from 1987 to the present. SWMU 54 consists of a 10-ft-square area of soil topped with gravel and covered by a storage shed. When active, waste oils from the Building 702 vehicle and equipment maintenance areas and washrack were stored on pallets on SWMU 54 while awaiting transferral to the DRMO Waste Storage Area. SWMU 54 became inactive after an oily film was seen on standing water in the vicinity of the SWMU. According to interviews, the area was excavated down to a depth of 3 ft, and backfilled with new soil and gravel. The site is currently covered by a steel building. Both sites are contained within the POL washrack area which is fenced and clearance is needed for entrance into the facility. Currently, there is no current potential for a release at SWMU 54, but releases have been recorded in the past. SWMU 55 consists of a steel building approximately 20 ft long and 8 ft wide which is used to store flammable liquids. According to site inspection and interviews, some spills have occurred at the site inside the building; however, these spills were cleaned up. Some drums may have been stored outside the building in metal drip pans on wooden pallets. Stains had been observed on the wooden pallets and in the drip pans; therefore, there is some evidence of potential past releases. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.11.2 Evaluation of Existing Data

There have been 2 soil borings and 1 monitoring well installed in the vicinity of the SWMUs as shown in Figure 4-12 (Appendix E). Analytical results from the RI Report (Walk, Haydel & Associates, Inc., 1989) indicated that neither volatile organic compounds nor TRPH was detected in any soil or groundwater samples, except for 1 TRPH

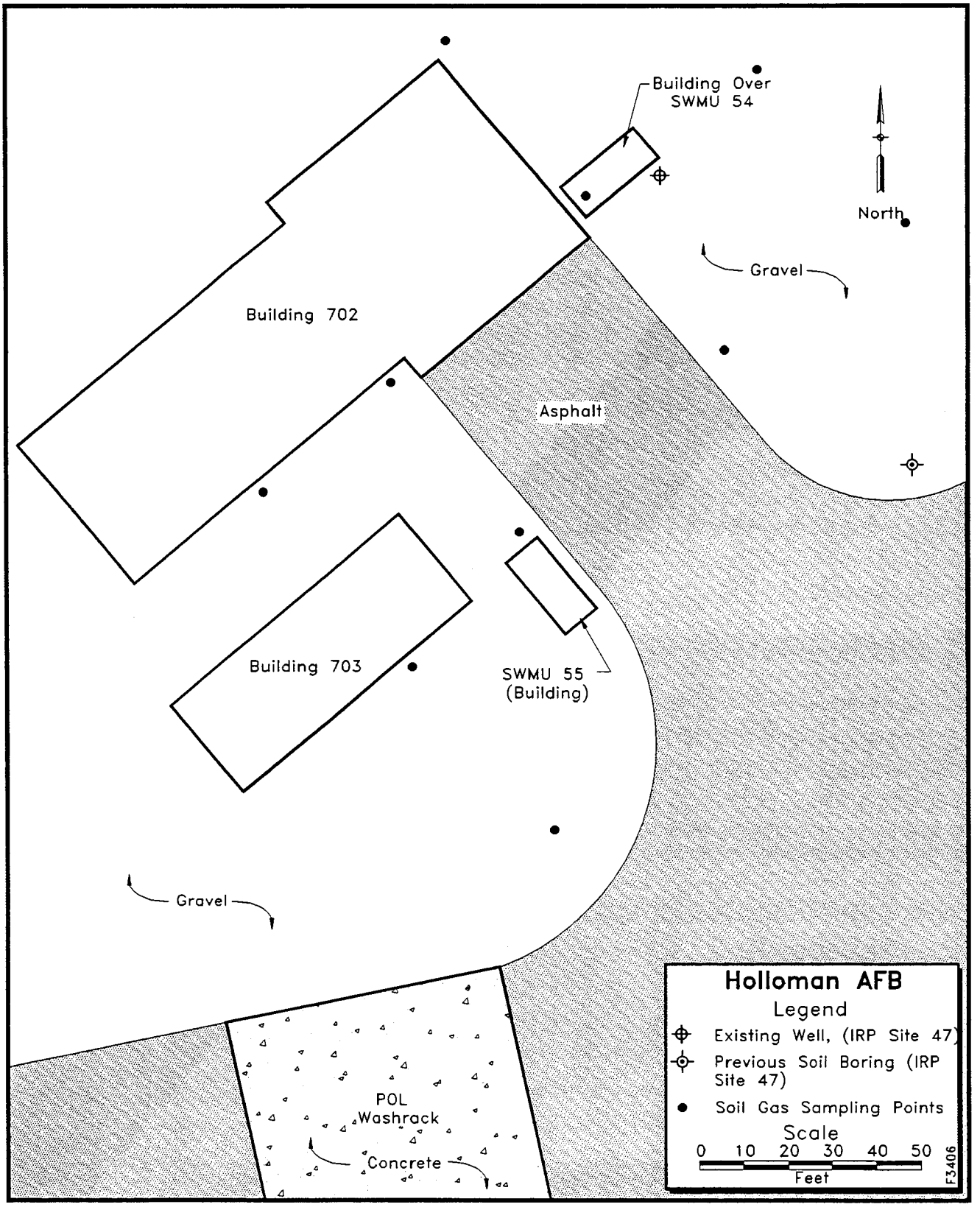


Figure 4-12. SWMUs 54/55 Previous Sampling Locations

detection of 31 mg/kg at a depth of 10 ft in the boring southeast of SWMU 54. These borings do not adequately represent the immediate area surrounding either of the 2 SWMUs, and additional information specific to the site is necessary.

4.11.3 Objectives

The objective of the RFI Phase I study for SWMUs 54 and 55 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area.

A number of steps will be taken toward meeting this objective. Preliminary soil gas surveys will be conducted at each site to characterize the presence of volatile organic vapors in the soil. Two soil borings will be placed, drilled, and logged at locations indicated by the results of the soil gas survey. Soil samples will be taken from the boreholes for chemical analysis on the basis of the results of the soil vapor study.

4.11.4 Sampling and Analytical Plan

Soil Gas Survey

Soil gas survey locations surrounding the 2 SWMUs are shown on Figure 4-12. The grid covers both SWMUs and the sample locations are placed 50 ft a part for a total of 10 sampling points (5 at each SWMU). Soil gas surveys will be conducted following the guidelines presented in Section 3.3.2. Soil gas survey points are spaced evenly over the entire area in order to effectively characterize any potential release of waste constituents from either SWMU.

Soil Sampling

Two boreholes will be drilled in locations where the soil gas survey results indicate possible areas of concern adjacent to either unit. These boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from the boreholes will be collected for chemical analysis from the 0- to 2-ft sampling interval, from the interval intercepting the groundwater interface, and from the 2-ft interval between the 0- to 2-ft interval and the groundwater interface interval which screens highest with an HNU (or the equivalent). At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	3	SW8240, EPA 418.1, total metals
Soil gas survey with a total of 10 points will be performed at SWMUs 54 and 55.		

Analytical Plan

Owing to the nature of the wastes stored at this site (oils and flammable liquids) all soil samples (if collected) will be analyzed for typical constituents of such waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (as presented in Table 3-3), volatile organic compounds (SW8240), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.12 SWMU 56

4.12.1 SWMU Description and History

This SWMU consists of the Building 807 Test Cell Waste Accumulation Area. The period of operation for the SWMU was from approximately 1978 to 1990. The SWMU consists of an area approximately 45 ft by 75 ft where drums containing waste oil and solvents were stored on runway matting. The area is now covered with gravel. The drums were stored on wooden pallets, with no form of secondary containment or berms. Surface staining is evident at the site, possibly originating from a leaky forklift but may indicate past releases. Media potentially affected include the soil surrounding and underlying the area and the groundwater. Wastes stored in the drums include waste oils, waste fuels, and product fuel.

4.12.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 56.

4.12.3 Objectives

The objective of the RFI Phase I study for the Building 807 Test Cell Waste Accumulation Area is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area, or if the constituents have reached the groundwater.

This objective will be met by the drilling and logging of 3 borings, and by the collection and chemical analysis of soil samples.

4.12.4 Sampling and Analytical Plan

Figure 4-13 illustrates the proposed locations of soil sampling points for the Phase I study. Three borings will be drilled, spaced evenly throughout the Waste Accumulation Area with one drilled in the stained area. The boreholes are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater from either the stained area or the SWMU as a whole.

Soil Sampling

The boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from all 3 boreholes will be collected for chemical analysis from the 0- to 2-ft interval, then from 1 interval every 5 ft until groundwater is reached, and also from the interval that intersects the groundwater interface. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing evenly among the sample containers.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
3	4	SW8240, EPA 418.1, total metals

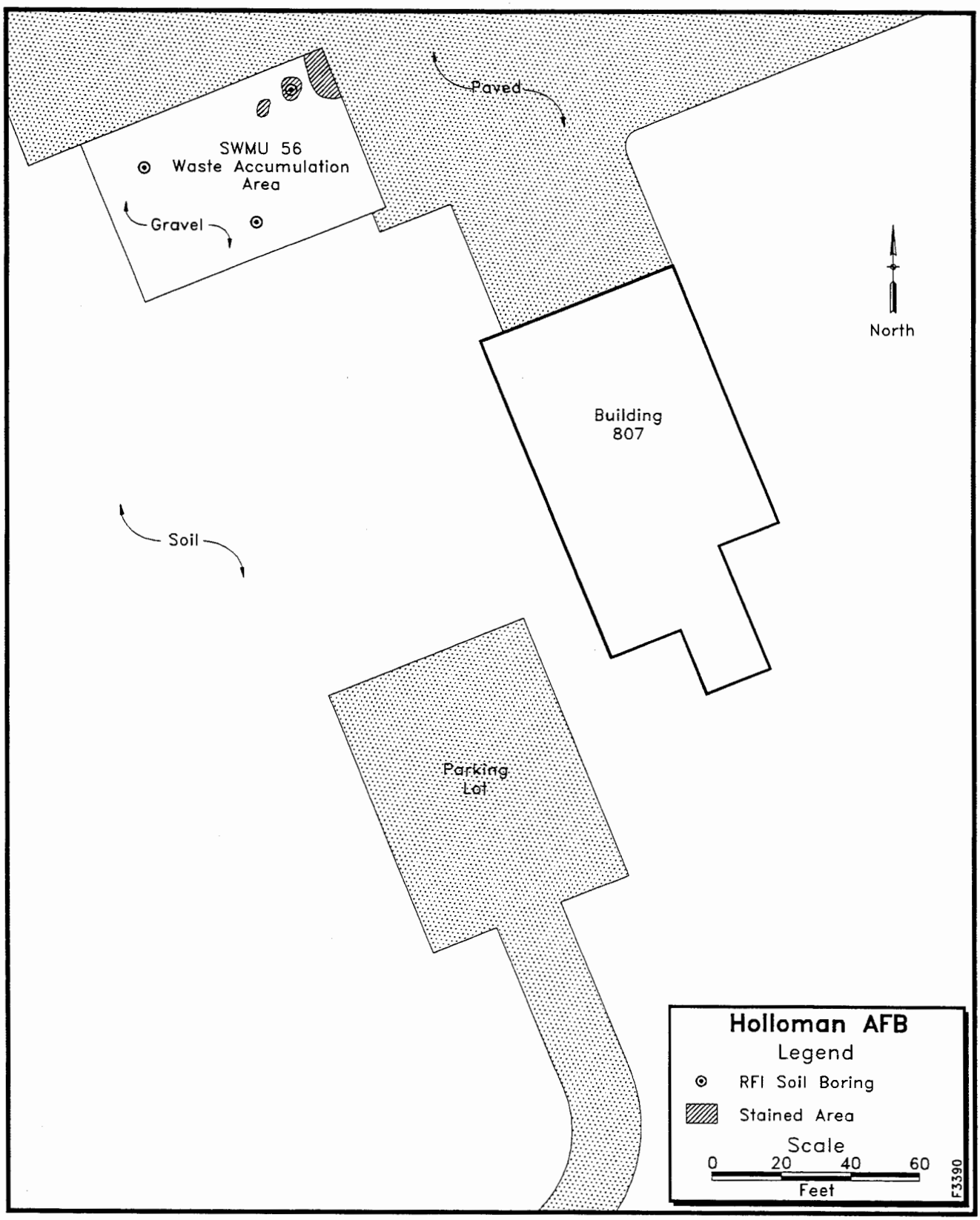


Figure 4-13. Soil Boring Locations, SWMU 56

Analytical Plan

Owing to the nature of the wastes stored in this site (fuels and oils), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (as listed in Table 3-3), volatile organic compounds (SW8240), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.13 SWMU 63

4.13.1 SWMU Description and History

Building 867 Waste Accumulation Area, SWMU 63, operated from approximately 1984 to 1987. The SWMU consists of an area of soil approximately 10 ft by 10 ft in size where excess paint and paint thinners were stored. Wastes were collected in a 55-gal drum underlain by a wooden pallet and drip pan, and transferred to the Building 809 Waste Accumulation Area for disposal. At times however, drums were placed on bare ground with no secondary containment or other release controls. Facility interviews indicated that the waste accumulation area was taken out of service because of mismanagement; however, it is not known if the mismanagement resulted in the release of any waste constituents. The area is now covered with gravel. In the past, light surface staining has been visible at the site, possibly indicating releases that have occurred. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.13.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 63.

4.13.3 Objectives

The objective of the RFI Phase I study for the Building 867 Waste Accumulation Area is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area, or if the constituents have reached the groundwater.

This objective will be met by the collection of 4 surface soil samples, the drilling and logging of 1 borehole, and by the collection and chemical analysis of soil samples.

4.13.4 Sampling and Analytical Plan

Figure 4-14 illustrates the proposed locations of soil sampling points for the Phase I study. Four surface soil samples will be collected, evenly spaced over the entire area, and 1 centrally located borehole will be drilled. The borehole and surface samples are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater from the SWMU as a whole.

Soil Sampling

Surface soil samples will be taken using a clean stainless steel hand auger after removing gravel from the soil surface. Surface samples will be taken from a sample interval of 0- to 12-in. below the ground surface following sampling procedures outlined in Section 3.2.1. Soil will be removed from the hand auger with a stainless steel spoon or trowel, and placed in a stainless steel bowl. The soil will be sampled for volatile organic compounds with as little mixing as possible. Before sampling for metals, the remainder of the soil will be thoroughly mixed. All sampling equipment will be decontaminated before sampling at another location within the site.

The borehole will be advanced in 2-ft increments using hollow-stem augers. Samples from the borehole will be collected for chemical analysis from the 0- to 2-ft interval, then from 1 interval every 5 ft until groundwater is reached, and also from the interval that intersects the groundwater interface. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder

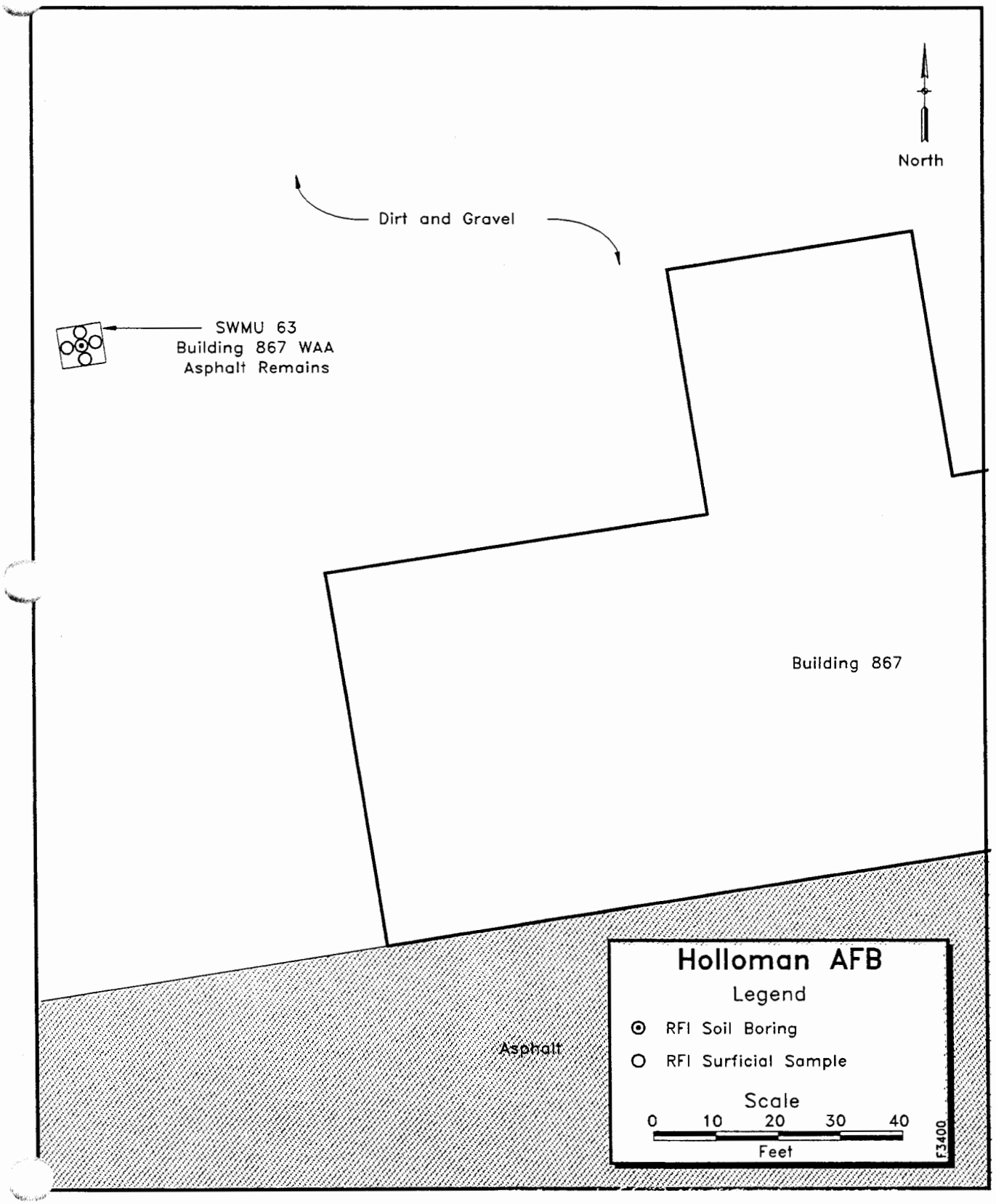


Figure 4-14. Soil Sampling Locations, SWMU 63

of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing evenly among the sample containers.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
1	4	SW8240, total metals
Number of Surface Samples	**Composite Interval of Sample**	**Analyses Per Sample**
4	0-1 ft	SW8240, total metals

Analytical Plan

Owing to the nature of the wastes stored at this site (paints and paint thinners), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (listed in Table 3-3) and volatile organic compounds (SW8240). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.14 SWMU 71

4.14.1 SWMU Description and History

SWMU 71 the Building 1178A Waste Accumulation Area, consists of 3 concrete pads approximately 25 ft southwest of Building 1178A. Two smaller pads, approximately 3 ft on each side, are adjacent to a larger pad that is 3 ft by 7 ft in size. The concrete pads are in good condition with some staining (indicating possible spills) and have no berms or secondary containment. The site is currently inactive. The area was used from 1954 to 1988 as a less than 90-day storage area for waste stored in 1 55-gal drum at a time. During the site's active period, the DRMO picking up and disposing of the drum and supplying a new, empty drum approximately once a week. Media potentially affected include the soil surrounding the pad, and the groundwater. Wastes stored in the drum included paint, lacquer thinner, paint thinners (F005), PD-680 solvent, and toluene (F005) mixed with acetone (F003).

4.14.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 71.

4.14.3 Objectives

The objective of the RFI Phase I study for the Building 1178A Waste Accumulation Area is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have impacted the soil underlying and surrounding the concrete pads, or if the constituents have reached the groundwater.

This objective will be met by the drilling and logging of 5 boreholes, and by the collection and chemical analysis of soil samples.

4.14.4 Sampling and Analytical Plan

Figure 4-15 illustrates the proposed locations of soil sampling points for the Phase I study. Five boreholes will be drilled; 1 5 ft away from each side of the pad group in order to detect waste constituents from any releases on the perimeter of the area and 1 in the center of the pads to determine if releases have occurred in this area. The boreholes are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater.

Soil Sampling

The four perimeter boreholes will be advanced in 2-ft increments using hollow-stem augers (or stainless steel hand auger). Only 1 2-ft increment from the soil surface to 2 ft below ground level will be collected at the 4 perimeter locations at which point the boreholes will be terminated. At each location, samples will be collected with stainless steel sampling equipment. Any part of the sample representing slough will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing among the sample containers.

The center borehole will be advanced in two-ft increments using hollow-stem augers. Samples will be taken in 2-ft increments down to the groundwater surface and headspace samples from each increment will be screened with an HNU (or the equivalent). Samples for chemical analysis will be taken from the 0- to 2-ft increment, from the 2-ft increment with the highest HNU reading, and from the 2-ft increment which intercepts the groundwater interface.

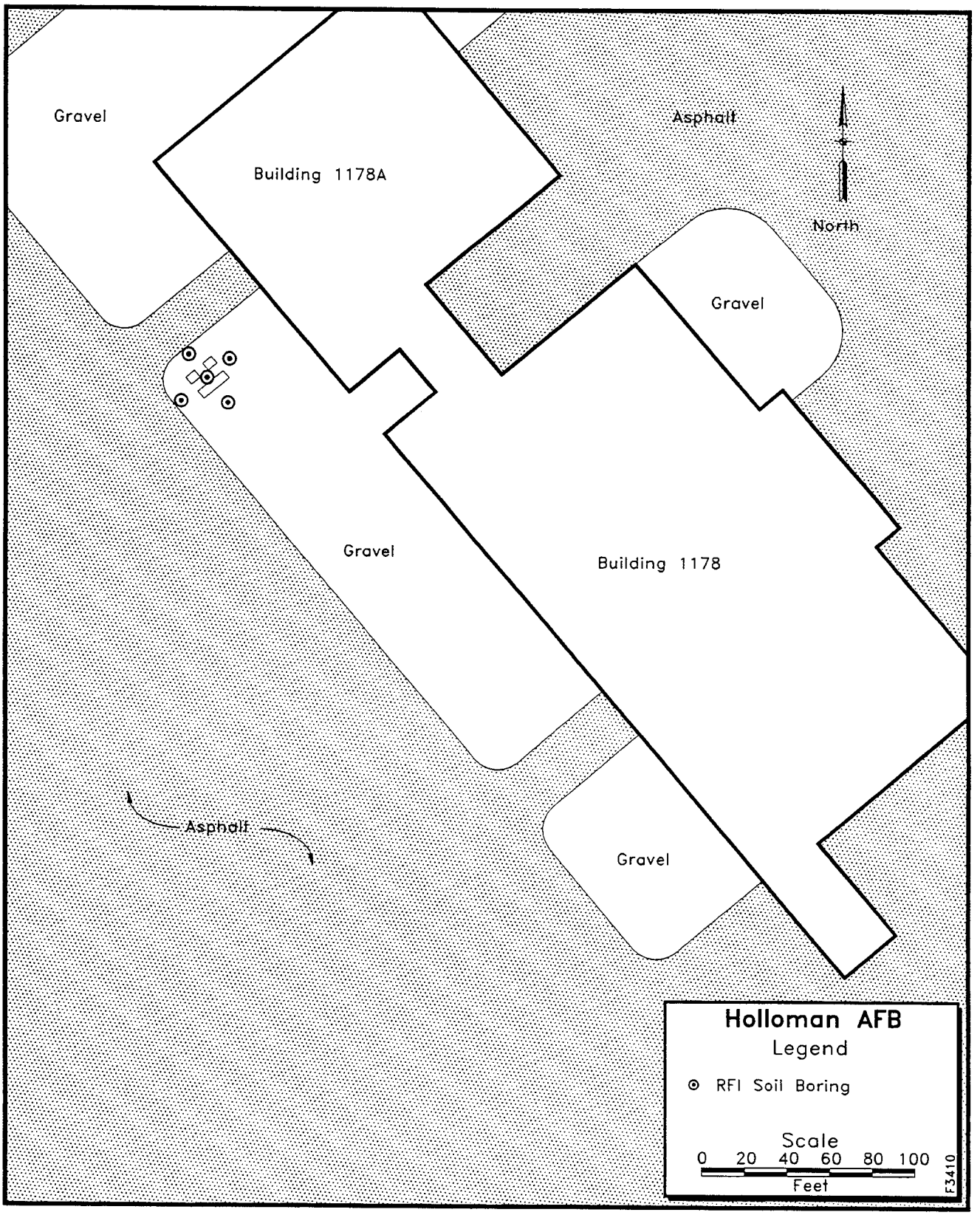


Figure 4-15. Soil Boring Locations, SWMU 71

Estimated Groundwater Depth = 20-25 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
1	3	SW8240, SW8270, SW8080, EPA 418.1
Number of Hand Auger Borings	**Samples Per Boring**	**Analyses Per Sample**
4	1	SW8240, SW8270, SW8080, EPA 418.1

Analytical Plan

Owing to the nature of the wastes stored in this site (paints, solvents, thinners, toluene, and acetone), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for volatile organic compounds (SW8240), semivolatile organic compounds (SW8270), PCBs (SW8080), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.15 SWMU 78

4.15.1 SWMU Description and History

This SWMU consists of the Trim Pad 3 Waste Accumulation Area. The period of operation for the SWMU was from approximately 1986 to 1990. The SWMU consists of a sloping circular pad approximately 50 ft in diameter upon which waste oil had been stored in 55-gal drums and 400-gal oil bowsers. The bowsers were on wheels and positioned over metal drip pans, and the drums rested on wooden pallets. In the past, a portable, fully enclosed shed with a 570-gal spill reservoir was located on the pad. The building was designed for the safe storage of flammable fluids. Waste oil and hydraulic fluids were stored in 55-gal drums within the shed. The shed is no longer present at the site. No evidence of past releases has been noted in file information, but staining has been observed on the concrete pad near the former bowser and drum locations. Any runoff from the site would generally follow the slope of the pad toward a drainage ditch approximately 50 ft from the pad. Currently, the concrete pad is weathered, cracked, and patched in some places. Media potentially affected include the soil surrounding and beneath the area, and the groundwater. A brick wall 3 ft high and on grade with the pad has been constructed surrounding a portion of the pad near the drainage ditch, and the soil within the wall excavated to a depth of 3 ft.

4.15.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 78.

4.15.3 Objectives

The objective of the RFI Phase I study for the Trim Pad 3 Waste Accumulation Area is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste

constituents have migrated into the soil underlying and surrounding the area, or if the constituents have reached the groundwater.

This objective will be met by the drilling and logging of 4 boreholes, and by the collection and chemical analysis of soil samples.

4.15.4 Sampling and Analytical Plan

Figure 4-16 illustrates the proposed locations of soil sampling points for the Phase I study. Four boreholes will be drilled spaced evenly around the perimeter of the concrete Waste Accumulation Area. The boreholes are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater from the SWMU as a whole.

Soil Sampling

The boreholes will be advanced in 2-ft increments using hollow-stem augers. Samples from the boreholes will be collected for chemical analysis from the 0- to 2-ft interval, then from 1 interval every 5 ft until groundwater is reached, and also from the interval that intersects the groundwater interface. At each location, samples will be collected with a stainless steel split spoon. Any part of the sample representing slough (sides or ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before dividing evenly among the sample containers.

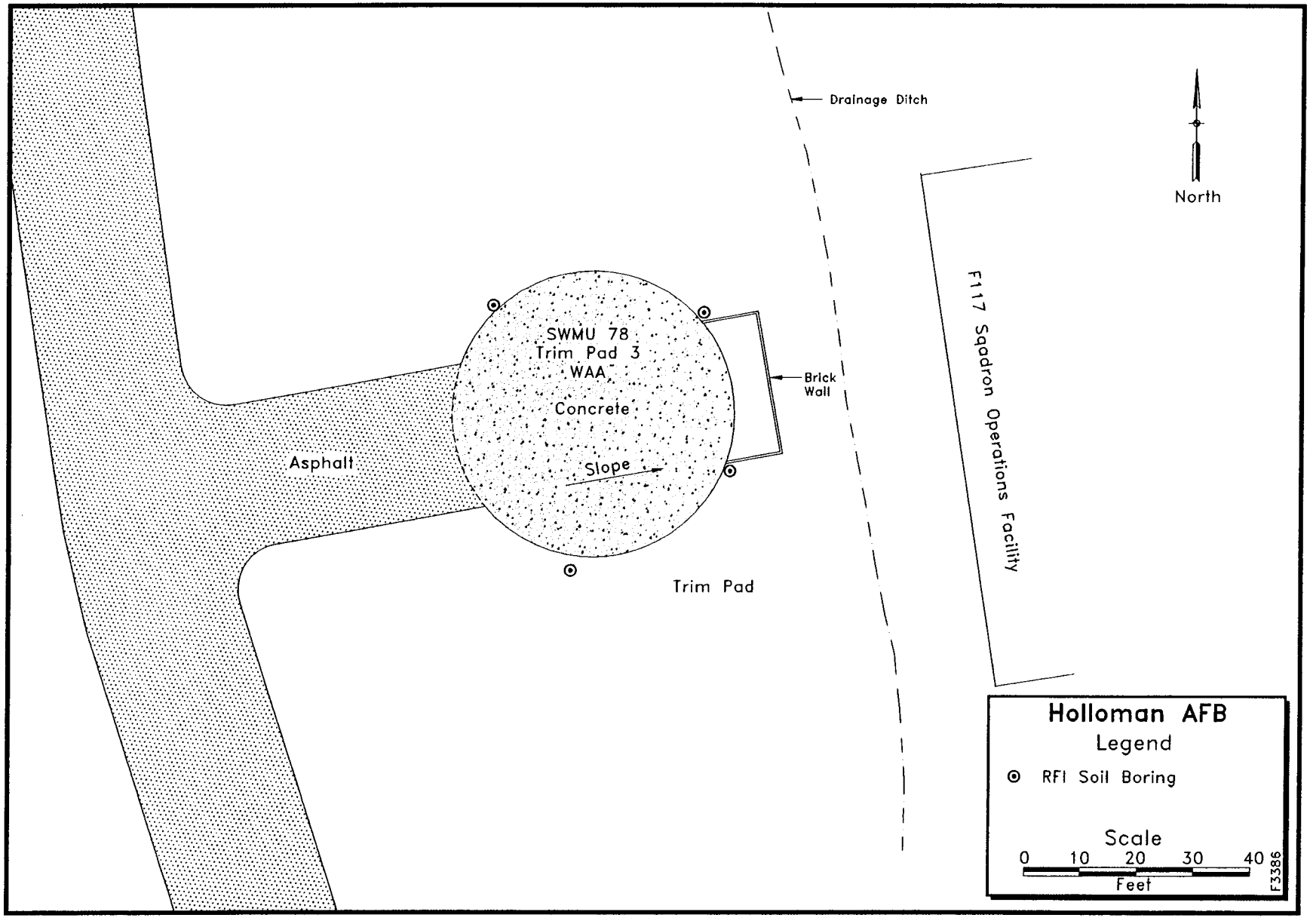


Figure 4-16. Soil Boring Locations, SWMU 78

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
4	4	SW8240, SW8080, EPA 418.1, total metals

Analytical Plan

Owing to the nature of the wastes stored at this site (waste oils, fuels, and hydraulic fluid), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for volatile organic compounds (SW8240), TRPH (EPA 418.1), total metals (listed in Table 3-3), and PCBs (SW8080). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.16 SWMU 75

4.16.1 SWMU Description and History

This SWMU consists of the DRMO Waste Storage Area. The SWMU was activated in 1980 and is presently in use.

The facility is currently permitted as a regulated unit under the Base's RCRA permit as a container storage area. The storage area is divided into 18 compartments and approximately 5000 square ft with a 1200 square ft staging area. The area, underlain by a steel-reinforced concrete pad with 6-in. concrete curbing, is well maintained. Drums are stored on pallets or shelving in the compartments comprising the unit. The unit drains through a 180 gal catch basin that empties into the sewer system.

The design capacity of the unit is 28,160 gal or 512 containers. Wastes managed in this unit include the following U.S. EPA waste designations: D001, D002, D007, D008, F001, F002, F003, F005, F007, F008, F017, U002, U003, U012, U-19, U022, U036, U044, U089, U154, U159, U167, U188, U220, U226, U228, U239, P012, P035, and P106. The wastes are generated and accumulated in various designated areas around the Base and transported to the unit. In the past, small oil spills have been reported but no releases have been observed.

4.16.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 75.

4.16.3 Objectives

The DRMO Waste Storage Area is currently operated under the Base's RCRA permit. No investigations are planned as part of the RFI since existing closure and

postclosure contingency plans are included in the permit and will be followed at the time of unit closure.

Estimated Groundwater Depth = 4-5 ft
No activities will occur at SWMU 75 during the Phase I RFI.

4.16.4 Sampling and Analytical Plan

Since no RFI investigations will be conducted at the unit, a sampling and analytical plan is not necessary at this time.

4.17 SWMU 91

4.17.1 SWMU Description and History

This SWMU consists of the Building 816 Washrack. The period of operation for the SWMU is unknown. The SWMU consists of a concrete pad sloped to a catch basin that discharged to the sewer system. The pad is approximately 15 by 25 ft, with a central drain. The sides of the pad are curbed; however, each end is open to the surrounding soils. The concrete pad is in poor condition, with cracking and evident deterioration. Although currently inactive, the pad may have managed washwater containing oil and fuel. Media potentially affected include the soil surrounding and beneath the area and the groundwater.

4.17.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 91.

4.17.3 Objectives

The objective of the RFI Phase I study for the Building 816 Washrack is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have impacted the soil underlying and surrounding the area, or if the constituents have migrated to the groundwater.

This objective will be met by the collection and chemical analysis of two surface soil samples, one at each end of the pad. The samples are located in order to detect any waste constituents carried by runoff from either end of the washrack.

4.17.4 Sampling and Analytical Plan

Soil Sampling

At each location shown on Figure 4-17, surficial soil samples will be collected from 0- to 12-in. interval as described in Section 3.3.1. The material recovered will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the material will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided evenly among the sample containers. All sampling equipment will be stainless steel and will be decontaminated according to the procedures described in Section 3.1.3 before sampling at each location.

Analytical Plan

Owing to the nature of the wastes managed at this site (oil and fuel rinsates), all soil samples will be analyzed for typical constituents of such waste types. Therefore, soil samples submitted to the laboratory will be analyzed for total metals (listed in Table 3-3), volatile organic compounds (SW8240), and TRPH (EPA 418.1). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

Estimated Groundwater Depth = 10-12 ft		
Number of Surface Samples	**Composite Interval of Sample**	**Analyses Per Sample**
2	0-1 ft	SW8240, EPA 418.1, total metals

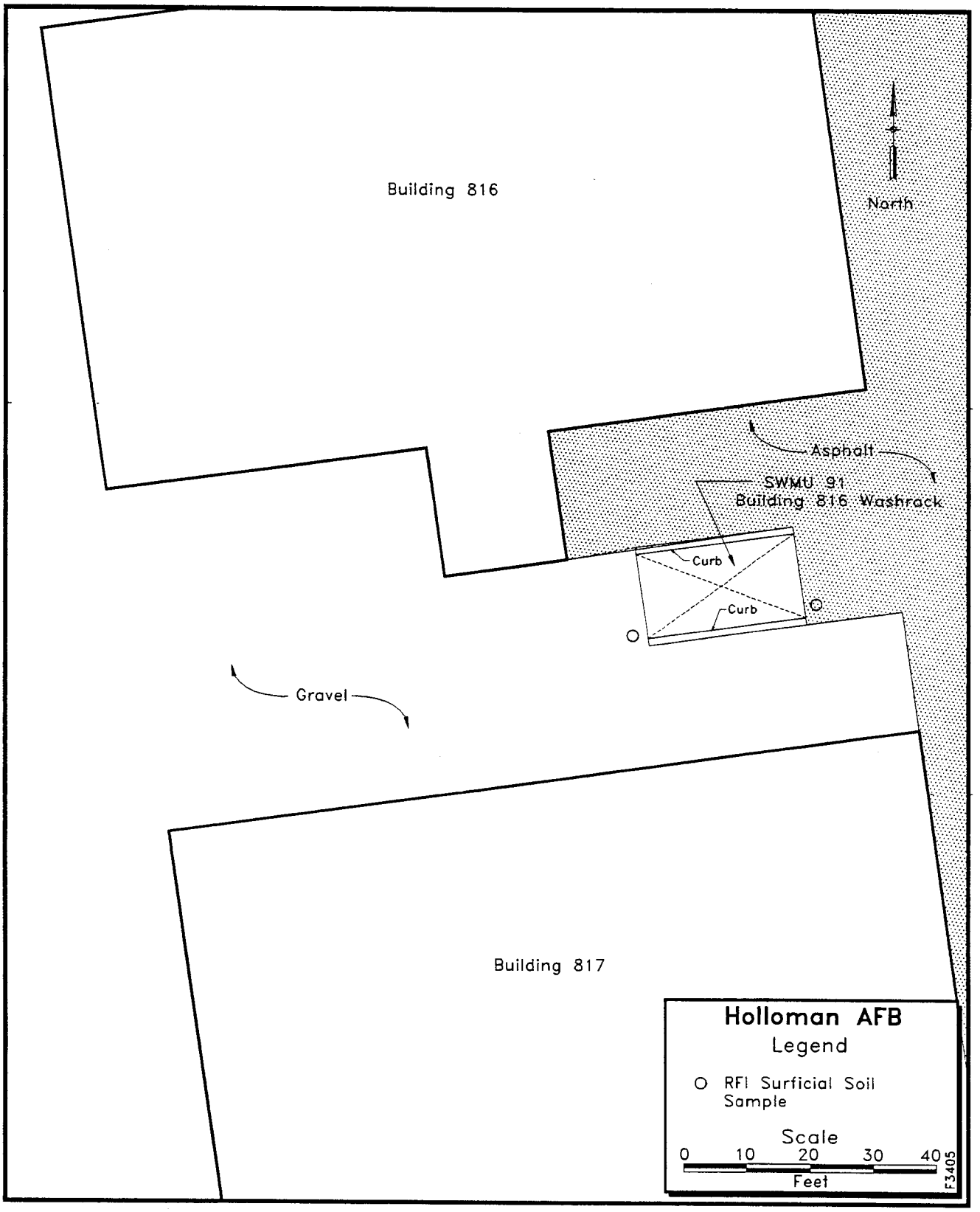


Figure 4-17. Soil Sampling Locations, SWMU 91

4.18 SWMU 136

4.18.1 SWMU Description and History

This SWMU consists of the Building 1119 Washrack Drainage Pit (SWMU 136). The Building 1119 washrack was in use from 1980 to 1990. The washrack is located approximately 75 ft west of Building 1119, and measures 12 by 21 ft. The washrack consists of a concrete pad in good condition, but which has no berms or other forms of containment. Rinsate was allowed to wash to the south down the slope of the pad, seeping directly into a gravel-covered soil area that is considered to be the Drainage Pit (SWMU 136) associated with the washrack. The Drainage Pit dimensions are approximately 7 ft by 12 ft; and has no liner or containment. Trucks and generators were washed at the washrack, resulting in the possible accumulation of rinsate containing waste fuel and oils in the Drainage Pit. When use of the washrack was discontinued, the soil surrounding the pad was excavated to a depth of 8 ft, inspected for visual contamination, and the soil was replaced in the excavation when it was visibly judged to be "clean." Wastewater has been released directly into the soil at this site, and media potentially affected include the soil surrounding the pad and the groundwater.

4.18.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 136.

4.18.3 Objectives

The objective of the RFI Phase I study for the Building 1119 Washrack Drainage Pit is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the washrack drainage area, or if the constituents have reached the groundwater.

This objective will be met by the drilling and logging of 2 boreholes, and by the collection and chemical analysis of soil samples.

4.18.4 Sampling and Analytical Plan

Figure 4-18 illustrates the proposed locations of soil sampling points for the Phase I study. Two boreholes will be drilled, 1 at each end of the washrack. The boreholes are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater via runoff from either end of the pad.

Soil Sampling

The boreholes will be advanced in 2-ft increments using hollow-stem augers. At each location, samples will be collected with stainless steel sampling equipment. Any part of the sample representing slough (sides and ends) will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided among the sample containers.

At both locations, samples will be taken in 2-ft increments down to the groundwater surface and headspace samples from each increment will be screened with an HNU (or the equivalent). Samples for chemical analysis will be taken from the first 2-ft increment (0-2 ft), from the 2-ft increment with the highest HNU reading, and from the 2-ft increment which intercepts the groundwater interface.

Estimated Groundwater Depth = 25-30 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	3	SW8240, EPA 418.1, total metals

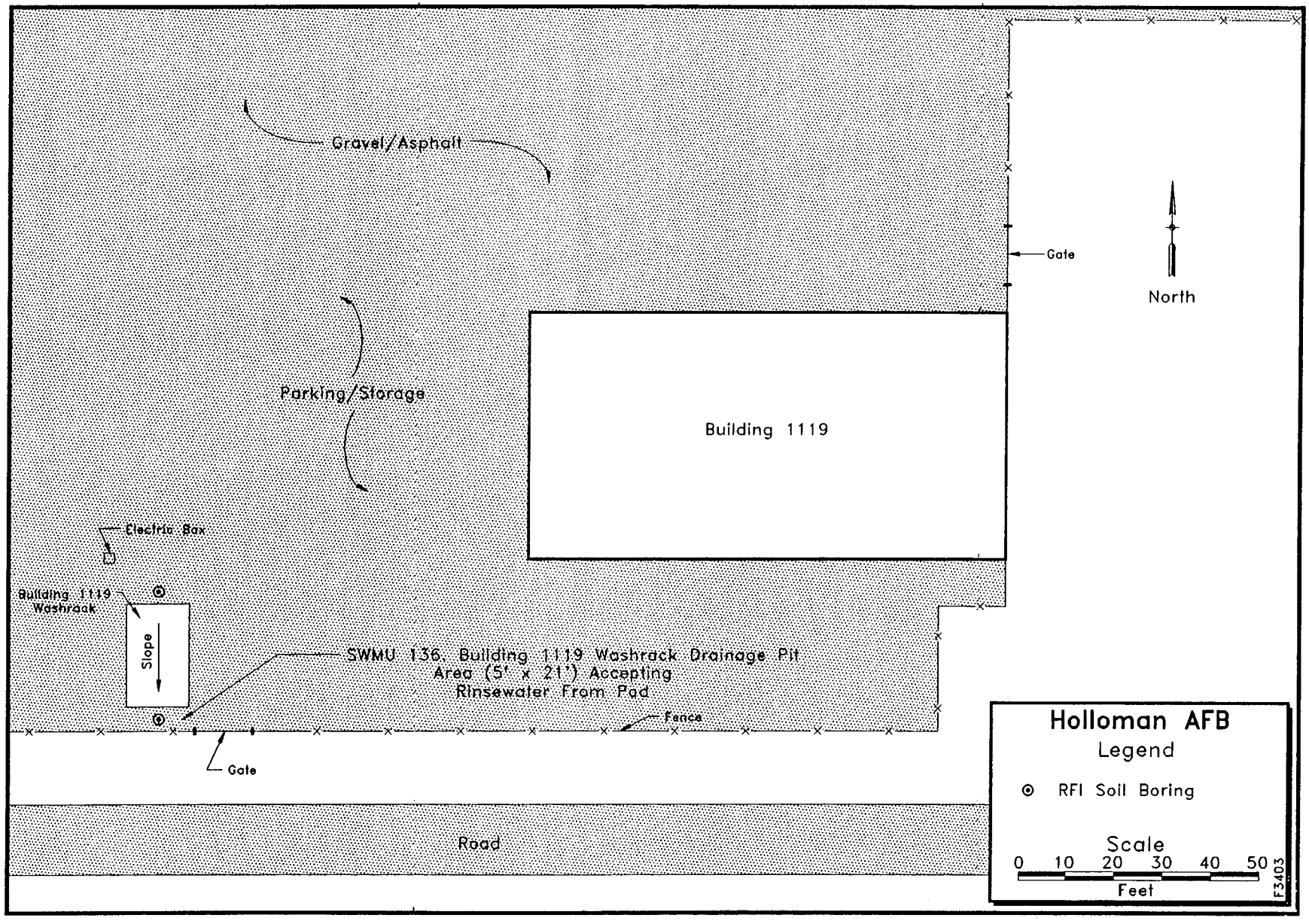


Figure 4-18. Soil Boring Locations, SWMU 136

Analytical Plan

Owing to the nature of the wastewater released at this site (rinsates containing fuels and oils), all soil samples will be analyzed for typical constituents of the aforementioned waste types. Therefore, soil samples submitted to the laboratory will be analyzed for volatile organic compounds (SW8240), TRPH (EPA 418.1), and total metals (listed in Table 3-3). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.19 SWMU 141

4.19.1 SWMU Description and History

This SWMU consists of the Pad 9 Drainage Pit, Drain, and Drainline. The Pad 9 Washrack Area is located across the taxiway to the east of Pad 8, near Building 882. The washrack was reportedly used to wash down drones and manned aircraft that had flown through clouds of nuclear blast materials in the late 1940s and early 1950s. The planes were reportedly washed only with water, and all runoff from the washrack drained into an unlined pit directly south of the pad area. The pad has not been used for aircraft maintenance since these activities. In May 1976, soil samples were collected from the bottom of the pit and submitted for analysis. The analytical results indicated no radiation above normal background levels. The pit was originally approximately 12 ft deep, but was filled in following the aforementioned sampling event.

The pad is in fair condition, exhibiting some cracks mainly along concrete seams. The sump in the middle of the pad is filled with soil and has vegetation growing in it. The drainage gallery from the sump to the southern edge of the pad is filled with soil. It is not known whether the soil in the sump and drainage gallery is underlain by concrete. The exact location of the drainage from the pad to the former pit could not be determined in the field, only inferred. It is not known whether runoff drained through a pipe or through a lined or unlined ditch. The area of the former pit is now surrounded by a slightly damaged hog wire fence and is overgrown with bushes and small trees. Likely areas of contamination include the areas directly south of the pad along the former drainage and in the vicinity of the former pit.

4.19.2 Evaluation of Existing Data

A preliminary assessment/site investigation (PA/SI) occurred at SWMU 141, known in the PA/SI as IRP Site 27, in February 1993. Activities at the site are described

in the *PA/SI Chemical Data Acquisition Plan (CDAP) for Four Waste Sites at Holloman AFB* (Radian, 1993). A summary of these activities is provided in Section 4.19.4.

4.19.3 Objectives

The objective of the PA/SI at SWMU 141 is to determine if previous operations have resulted in the release of hazardous constituents to the environment. Specifically, the objective is to determine if constituents have migrated into the soil under and around the pit, the discharge line, and the transformer, or if the constituents have reached groundwater. This objective was met by the drilling and logging of 3 boreholes, the performance of 1 hand-augered borehole, and by the collection and chemical analysis of soil samples at all locations during the PA/SI. No activities will occur at SWMU 141 during the Phase I RFI.

4.19.4 Sampling and Analytical Plan

Sampling Plan

Six soil samples were collected at the Pad 9 Washrack Area in locations where contamination was suspected. The samples were collected from the following areas: 1 surface sample from the transformer area, 1 sample from the boring just south of the pad, 3 samples from the 2 borings in the former pit area, and 1 surface sample from a background area. Soil sampling locations are shown in Figure 4-19. The surface samples from the transformer area and the background location were collected using a hand auger. The samples from the pit and adjacent to the pad were collected using a hollow-stem auger drill rig; a stainless steel split spoon sampler was used to recover samples at the bottom of the former drainage area and the former pit. Split spoon samples were collected continuously to groundwater to locate any potential zones of contamination. Samples for chemical analysis were selected on the basis of visual screening for potential contamination

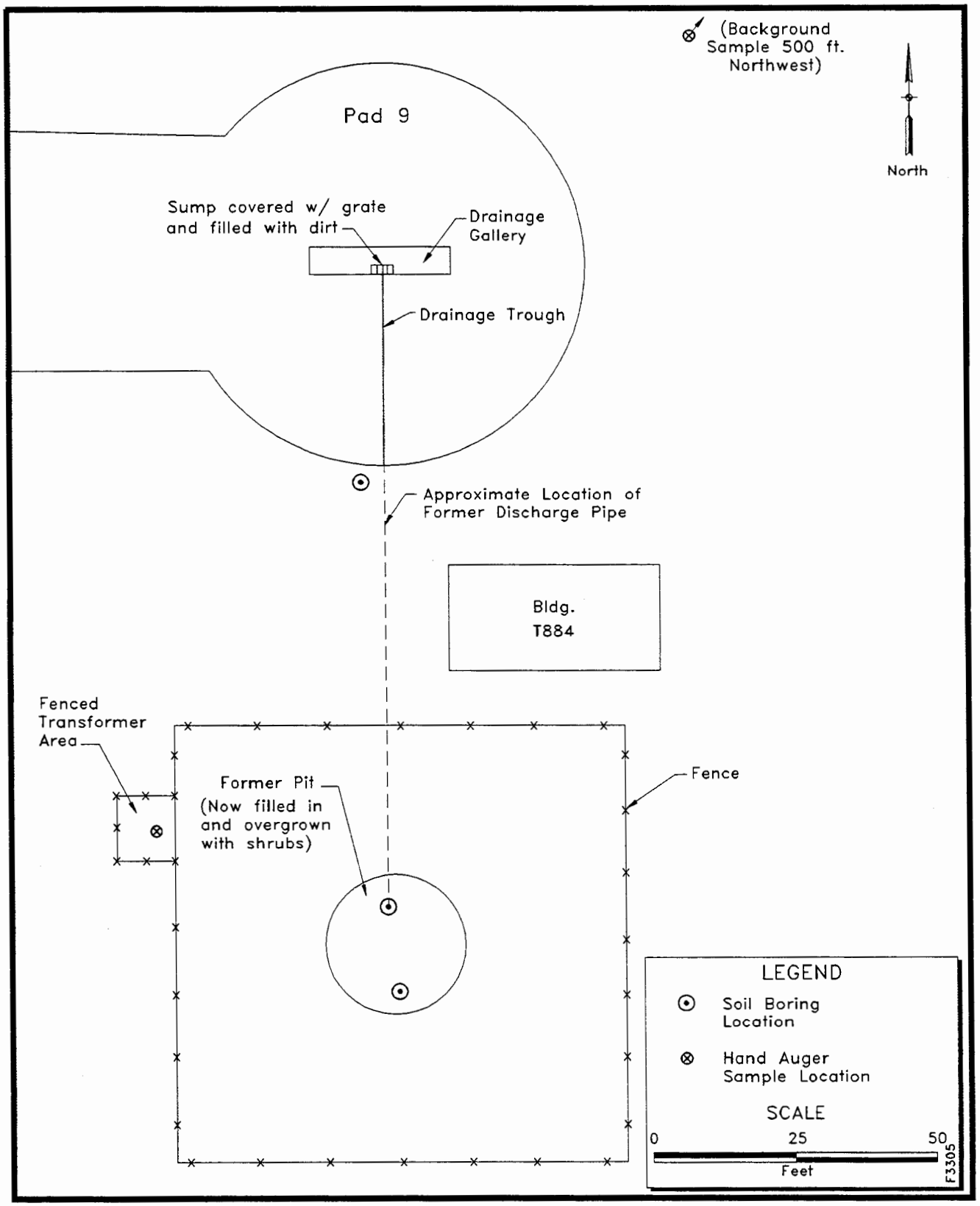


Figure 4-19. Soil Sampling Locations, SWMU 141

and to determine where native soils are encountered. The background sample was taken approximately 500 yd northeast of the site.

Estimated Groundwater Depth = 4-6 ft
No activities will occur at SWMU 141 during the Phase I RFI.

Analytical Plan

The samples were submitted for analysis of alpha and beta radiation (modified 9310, and for gamma radiation (modified 901.1). The surface sample from the transformer area was collected from a visibly contaminated area and submitted for PCB (SW8080) analysis. The CDAP for the PA/SI contains information concerning these analytical methods.

The results of sample analyses are not available at this time. Based on their outcome, appropriate recommendations for further action (if any) will be made.

4.20 SWMU 164

4.20.1 SWMU Description and History

This SWMU consists of the Building 1080 Pond. The period of operation for the SWMU was from approximately 1956 to present. The SWMU consists of a low-lying area of approximately 2 acres near Building 1080 that collects runoff from the surrounding flightline. Water ponds in this area after rainfall events and eventually evaporates or, since it is unlined, infiltrates into the underlying soil. Runoff from the asphalt-paved area near Building 1080 has previously been found to contain metals. A nearby JP-4 fuel spill in November 1992 of nearly 10,000 gal resulted in the subsequent excavation of contaminated soils, with part of the excavation extending into the pond. There have been reports of standing product immediately north of the SWMU. Any waste constituents from the fuel spill, as well as from the nearby flight line, would be found in the site surface water, possibly migrating into the underlying soil and groundwater. Potential for past releases into the air is low due to the primarily inorganic waste constituents contained in runoff from the flight line. However, the potential for recent air releases is high due to the fuel spill.

4.20.2 Evaluation of Existing Data

Surface water sampling has occurred at the Building 1080 Pond. Results of previous analyses revealed low concentrations of chromium, cadmium, lead, and silver (RCRA Facility Assessment). Due to the presence of metals in the Pond surface water, it can be expected that the metals have a high potential for migration into the soils and possibly the groundwater.

4.20.3 Objectives

The objective of the RFI Phase I study for the Building 1080 Pond Area is to determine if previous operations have resulted in the release of waste constituents to the

environment. Specifically, the objective is to determine if waste constituents have migrated into the soil underlying and surrounding the area, or if the constituents have reached the groundwater.

This objective will be met by the collection and chemical analysis of 3 surface soil samples, and 3 soil samples at a depth of 2 ft. In addition, 2 borings will be performed to groundwater and samples collected for chemical analysis to determine the subsurface extent of the fuel spill.

4.20.4 Sampling and Analytical Plan

Figure 4-20 illustrates the proposed locations of soil sampling points for the Phase I study. Three surface soil samples and 3 deeper soil samples (2 ft deep) will be collected. The 2 soil borings will be centrally located. The sample points are located to determine whether a release of waste or waste constituents has occurred to the site soils and groundwater. All sampling locations are spaced evenly throughout the Pond in order to most effectively characterize the entire area.

Soil Sampling

Surface soil samples will be taken using a clean stainless steel hand auger after removing any debris or vegetation from the soil surface. Three surface samples will be taken from a sample interval of 0- to 12-in. below the ground surface, and the 3 hand auger samples will be taken at a depth of 2 ft below the ground surface following sampling procedures outlined in Section 3.2.1. Soil will be removed from the hand auger with a stainless steel spoon or trowel, and placed in a stainless steel bowl. Before sampling for metals, the soil will be thoroughly mixed. The 2 centrally located soil borings will be advanced using a hollow stem auger and split spoon samplers to the groundwater table in 2-ft increments. A sample will be collected from the 0- to 2-ft depth interval, from the 2-ft

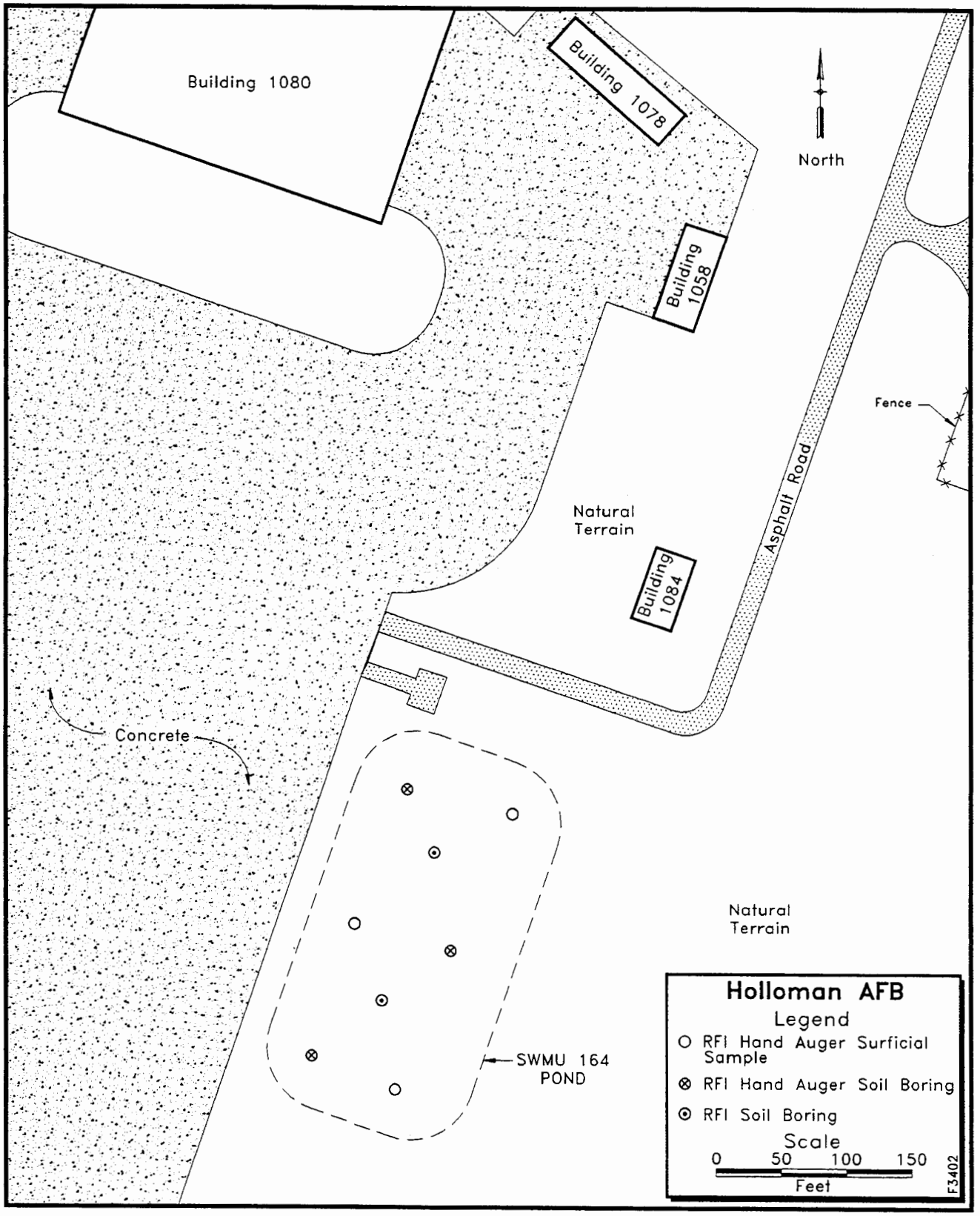


Figure 4-20. Soil Sampling Locations, SWMU 164

increment in each borehole between the initial increment and the groundwater table that shows the highest reading on an HNU (or the equivalent), and from the increment which intercepts the groundwater table.

Estimated Groundwater Depth = 10-12 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
2	3	SW8240, EPA 418.1, total metals
Number of Hand Auger Borings	**Samples Per Boring**	**Analyses Per Sample**
3	1	total metals
Number of Surface Samples	**Composite Interval of Sample**	**Analyses for Sample**
3	0-1 ft	total metals

Analytical Plan

Owing to the nature of the waste constituents detected previously at this site (metals), surficial and hand auger soil samples submitted to the laboratory will be analyzed for total metals (listed in Table 3-3). The 2 soil boring location samples will be analyzed for Table 3-3 volatile organic compounds (SW8240), TRPH (EPA 418.1), and total metals (Table 3-3), due to the November 1992 JP-4 fuel spill. Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.21 SWMU 124

4.21.1 SWMU Description and History

The Building 752 Waste Oil Tank (SWMU 124) consists of an above-ground steel tank approximately 150 ft east of Building 752 adjacent to the Base sewage lagoons as shown in Figure 4-21. The tank rests on a wooden cradle over a concrete pad. No secondary containment structure is present and a release potential exists to surrounding soils and groundwater. A small release (< 10 gal) was reported to have occurred during the attachment of the drain valve to the tank. A small area (10 ft^2) of stained soil is visible. The tank has historically been used to store waste oil from various vehicle and equipment areas near Building 752; however, it is currently labeled "contents unknown."

4.21.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 124.

4.21.3 Objectives

The objective of the RFI Phase I study for SWMU 124 is to determine the waste classification (hazardous or nonhazardous) of the waste oil contained in the tank, properly dispose of the oil.

The objective will be met by sampling the waste oil and determining its final disposition.

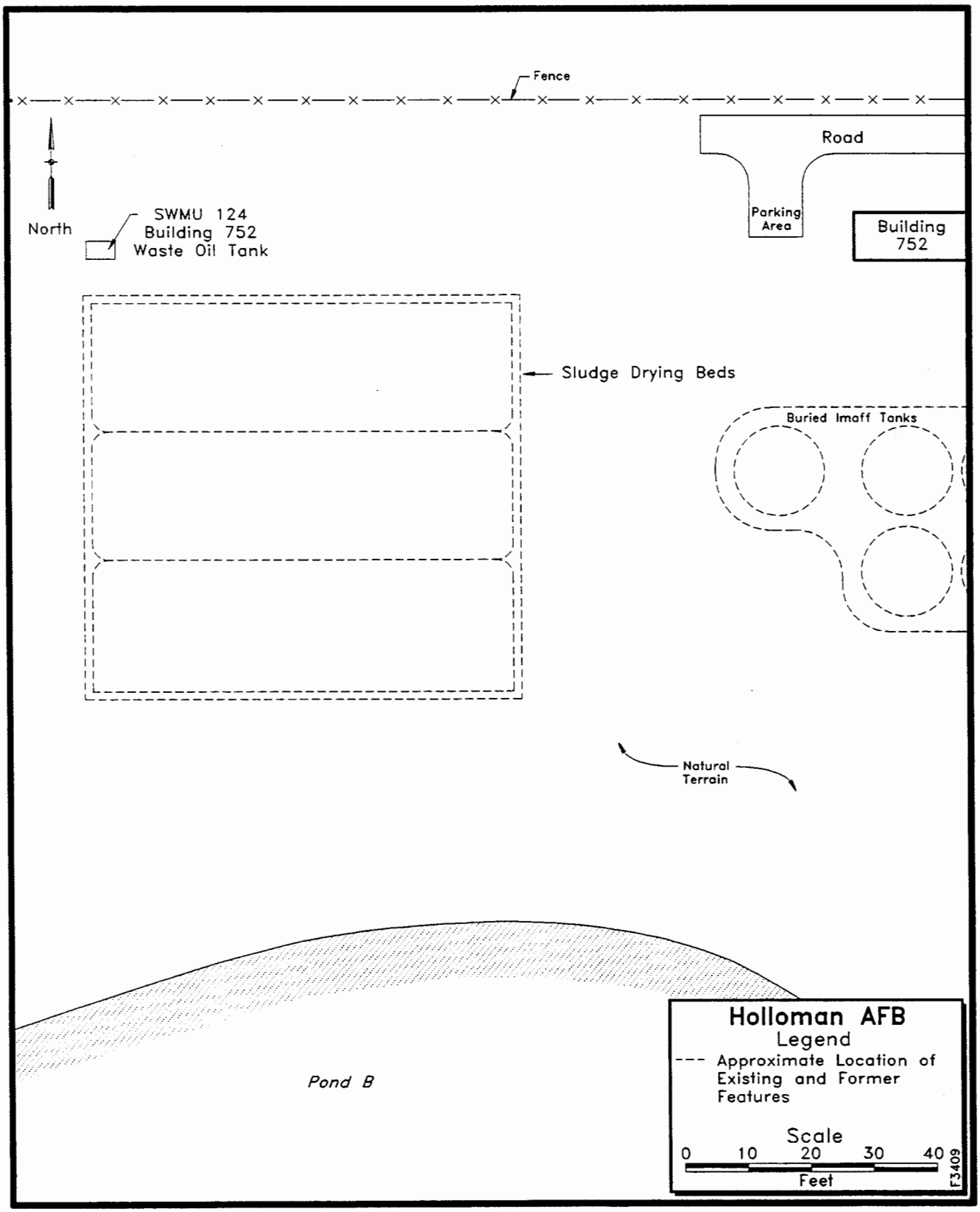


Figure 4-21. Location of SWMU 124

4.21.4 Sampling and Analytical Plan

Sampling Plan

Samples will be collected via the existing drainage valve on the tank. Sample jars will be double-bagged in Ziploc bags and shipped by themselves to the laboratory in a separate cooler from other RFI samples.

Estimated Groundwater Depth = 4-6 ft	
Number of Samples	**Analyses Per Sample**
1	TCLP (SW1311), SW1010
Only one sample of the tank's contents will be taken at SWMU 124.	

Analytical Plan

To determine the nature (hazardous or nonhazardous) of the waste oil contained in the Building 752 tank, samples will be analyzed for the TCLP (SW1311) analytes expected to be present in waste oil and ignitability (SW1010).

4.22 SWMU 155

4.22.1 SWMU Description and History

SWMU 155 consists of the Sludge Drying Beds. The sludge drying beds were an active phase in the Holloman AFB wastewater treatment system from the 1950s until 1982, at which time the sewage lagoons became the main wastewater treatment process. While in operation, sludges were pumped from the bottom of the Imhoff Tanks to the unlined beds, where they remained until dry. The dry sludge was then used as soil conditioner around the Base. Since the area where the sludge drying beds was flooded periodically, it is hard to determine the exact location of the beds. From as-built drawings the approximate location of the beds was determined as shown in Figure 4-22. When the drying beds were deactivated in 1982, all of the associated piping and concrete berms were removed.

While in operation, wastewater containing sanitary wastes, dissolved hydrocarbons, solvents, industrial cleaners, paint stripper, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, and U159 were processed by the treatment system. The present release potential to soil or groundwater is moderate though the potential for past releases is high due to the unlined nature of the unit.

4.22.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 155.

4.22.3 Objectives

The objective of the RFI Phase I study for SWMU 155 is to determine if previous operations have resulted in the release of waste constituents to the environment.

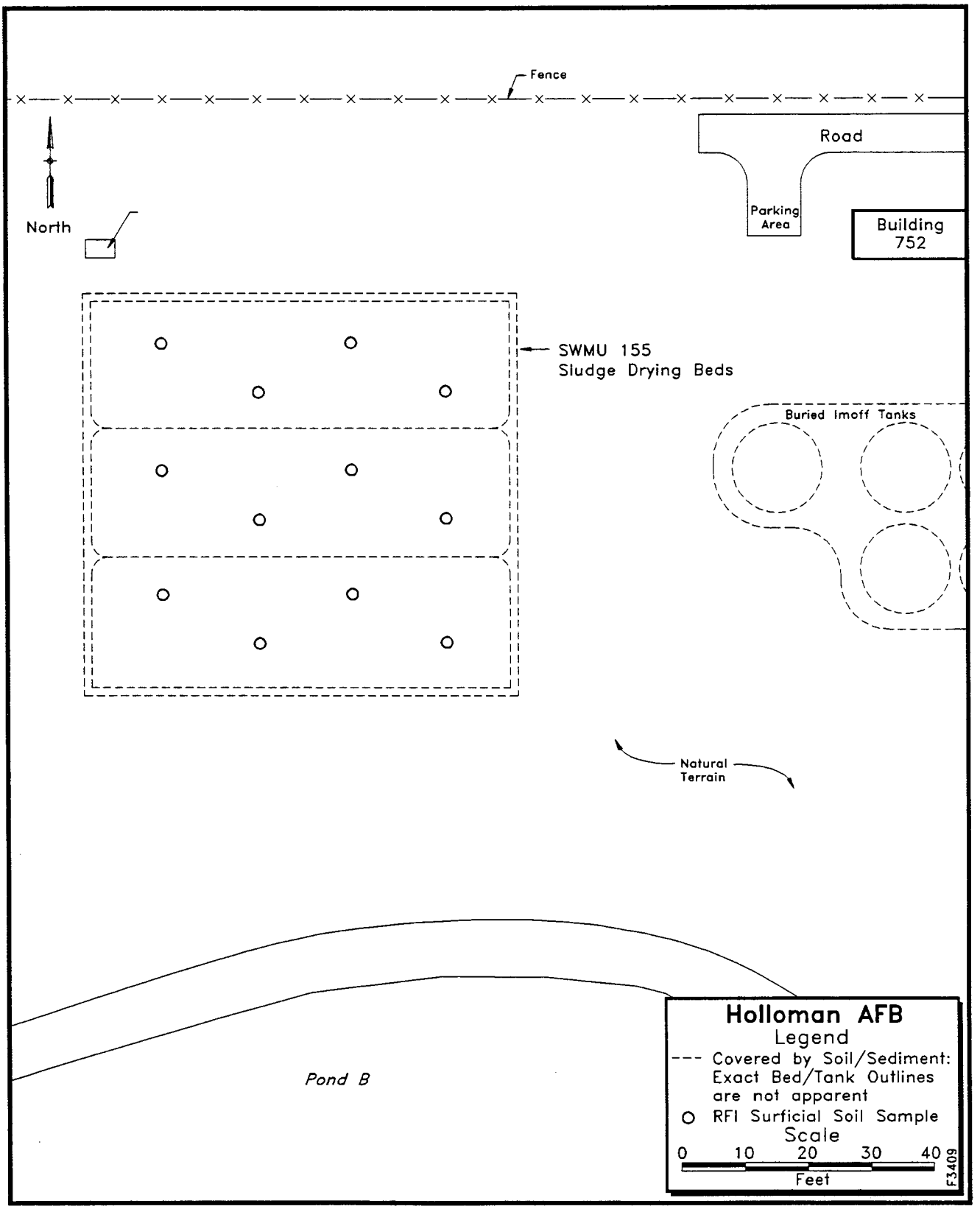


Figure 4-22. Soil Sampling Locations, SWMU 155

Specifically, the objective is to determine if waste constituents have migrated into the soils surrounding the area.

The objectives will be met by the collection and chemical analysis of soil samples from the former sludge drying beds.

4.22.4 Sampling and Analytical Plan

Figure 4-22 illustrates the proposed locations of all of the soil collection points for the Phase I study. The soil sampling points are evenly spaced throughout the beds to determine whether a release of waste or waste constituents has occurred to the site soils from any area within the SWMU.

Sampling Plan

Each bed will be delineated and sampled as shown in Figure 4-22. Within each bed 4 hand-augered samples will be collected from a depth interval of 6 in. to 1 ft. Soil collected from all 4 soil collection points in a single bed will be composited in a stainless steel bowl using a stainless steel trowel or spoon. The composite sample will then be submitted for chemical analysis. Appendix IX volatile organic samples will be collected from 1 individual sample collection point in each bed prior to compositing for the remaining Appendix IX analyses.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3.

Estimated Groundwater Depth = 4-6 ft		
Number of Surface Samples	**Composite Interval of Sample**	**Analyses Per Sample**
3 [a]	0.5-1 ft	Appendix IX Suite
[a] Each sample is a composite of four sample points.		

Analytical Plan

Owing to the nature of the wastes stored in this site, all soil samples will be analyzed for the entire Appendix IX suite of constituents (Table 3-4). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.23 SWMU 156

4.23.1 SWMU Description and History

SWMU 156 consists of the Imhoff Tanks that were an active phase in the Holloman AFB wastewater treatment system from 1950 until 1982, at which time the sewage lagoons became the main wastewater treatment process. The Imhoff Tanks were operated as in-ground units to remove sludge from the primary sewage received from throughout the Base. The sludges were pumped from the bottom of the Imhoff Tanks to the unlined sludge drying beds where they remained until dry. The water was collected by an underground piping system and discharged into the wastewater lagoons. When the concrete tanks were deactivated, they were left in place and covered with fill material. All that can be seen now is a mound of dirt, which supposedly covers the tanks. It is unknown whether sludge was left in the tanks when deactivated. The Imhoff Tanks are cylindrical with a diameter of approximately 26 ft and a depth from 28.5 to 40 ft (depending on as-built plan reviewed). From as-built drawings, the approximate location of the tanks was determined as shown in Figure 4-23.

While in operation, wastewater containing sanitary wastes, dissolved hydrocarbons, solvents, industrial cleaners, paint stripper, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, and U159 were processed by the treatment system. The present release potential to soil or groundwater is unknown though the potential for past releases is possibly high due to the concrete construction of the tanks.

4.23.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 156.

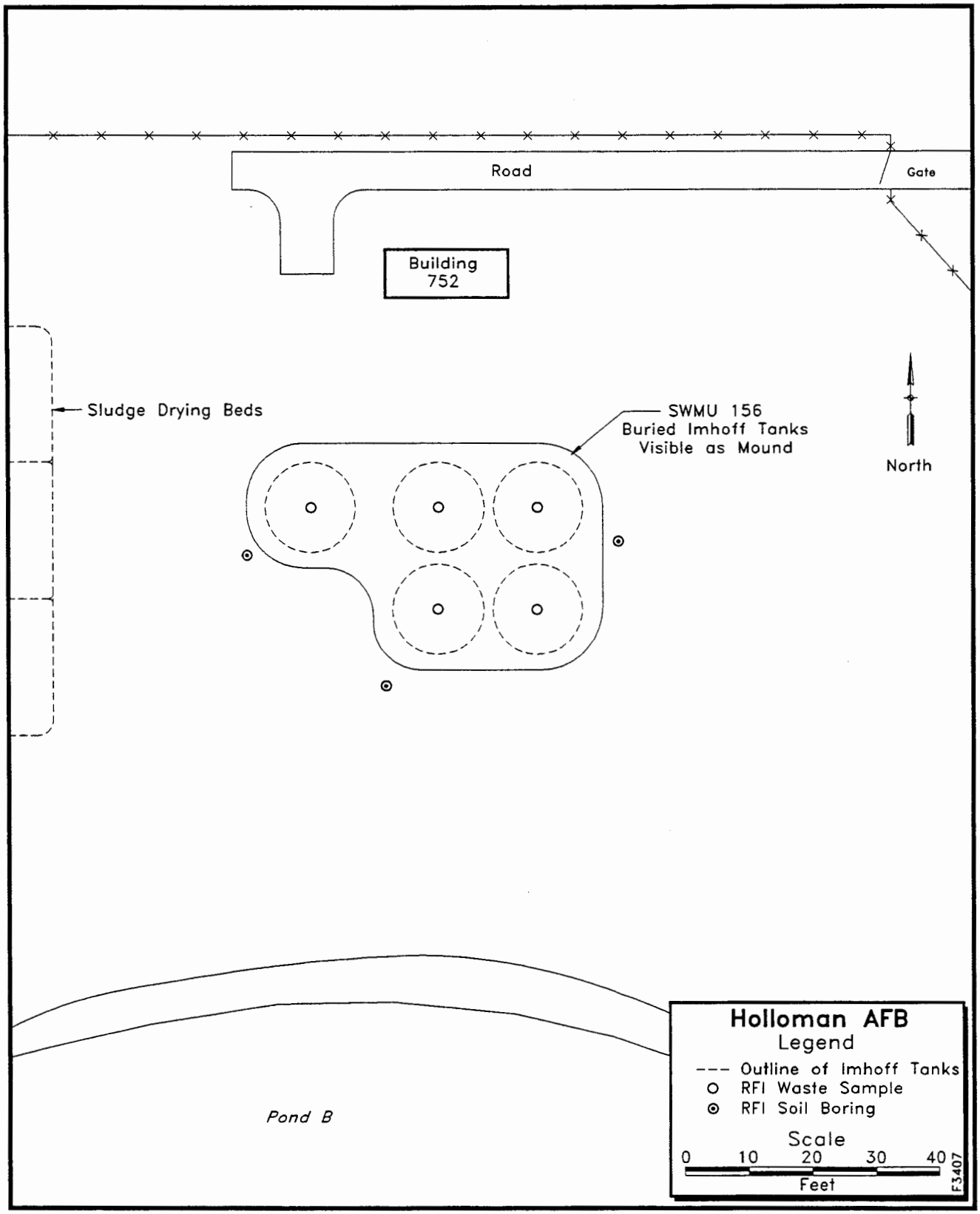


Figure 4-23. Sampling Locations, SWMU 156

4.23.3 Objectives

The objective of the RFI Phase I study for SWMU 156 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soils surrounding the area, or if the constituents have reached the groundwater.

The objectives will be met by performing 3 soil borings to the groundwater interface, and the collection and chemical analysis of soil samples. In addition, if waste material is found in the tanks, a single composite sample of material from each tank waste is found in will be collected and analyzed in order to characterize the tank contents.

4.23.4 Sampling and Analytical Plan

Figure 4-23 illustrates the proposed locations of all of the soil borings for the Phase I study. The soil borings will be drilled at either end and between the tank grouping and Pond B in order to determine whether a release of waste or waste constituents has occurred to the site soils or underlying groundwater.

Sampling Plan

The soil covering the tanks will first be removed. If sludge is present within the tanks, samples of the sludge will be taken from each tank, composited into one sample, and analyzed for the entire list of Appendix IX constituents. The total depth of the tanks is not known. If waste material is not evident at the surface of the tanks following removal of the soil mound, borings (using a drill rig if possible, a combination of a power auger and hand auger if not) will be advanced till waste material is encountered or to the bottom of the tanks (either 28.5 or 40 ft).

Three soil borings that bracket the tanks will be advanced in 2-ft increments to the groundwater interface using hollow-stem augers. Samples from each borehole will be collected at 4 ft BGL and at the groundwater interface, and analyzed for the complete list of Appendix IX constituents. The location of the 3 boreholes in relation to the buried Imhoff tanks is shown on Figure 4-23. Samples for analysis of Appendix IX volatile organic constituents will be taken prior to compositing the sample for analysis of the remaining Appendix IX constituents.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3. Any part of the sample representing slough will be cut or scraped from the sample. The volatile organic compounds sample will be taken immediately with as little mixing as possible. The remainder of the sample will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided among the sample containers. After drilling and sampling are complete, the borehole will be sealed with neat cement grout, and the horizontal and vertical location of the borehole will be surveyed.

Estimated Groundwater Depth = 4-6 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
3	2	Appendix IX Suite
Number of Composite Samples		**Analyses Per Sample**
1 [a]		Appendix IX Suite
[a] One composite sample from individual waste material samples from each tank in SWMU 156.		

Analytical Plan

Owing to the nature of the wastes stored in this SWMU, all soil samples will be analyzed for the entire Appendix IX suite of constituents (Table 3-4). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.24 SWMU 184

4.24.1 SWMU Description and History

This SWMU consists of the Wastewater Recirculation Line that runs between Pond F and the splitter box located near Pond B. The splitter box then divides the flow between Ponds A and B as shown in Figure 4-24. The purpose of the recirculation line is to increase the biochemical oxygen demand (BOD) content of the sewage in Ponds A and B. The age, integrity, and construction materials of the pipeline are unknown. However, it is suspected that the pipeline is constructed of concrete or clay materials. In addition, there were conflicting reports from Base personnel as to the current activity of the pipe. One person interviewed said the pipeline was still active (Sergeant Stueve) and another person (Dr. Fred Fisher) indicated that the recirculation line was no longer in use. During the background search, there was no evidence that water was being recirculated through the pipe.

While in operation, wastewater containing sanitary wastes, dissolved hydrocarbons, solvents, industrial cleaners, paint stripper, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, and U159 were processed by the treatment system. The present release potential to soil or groundwater is unknown though the potential for past releases is possibly high due to the concrete construction of the line.

4.24.2 Evaluation of Existing Data

In 1987 a single liquid sample was collected from Pond F for Appendix IX analysis (Appendix F). The only organic compound detected was phenol, at 0.02 mg/L. However, several inorganic compounds of concern were detected: arsenic, barium, cadmium, selenium, and zinc. However, only barium, cadmium, and selenium were above maximum contaminant levels (MCLs). Extensive investigations have occurred at the nearby

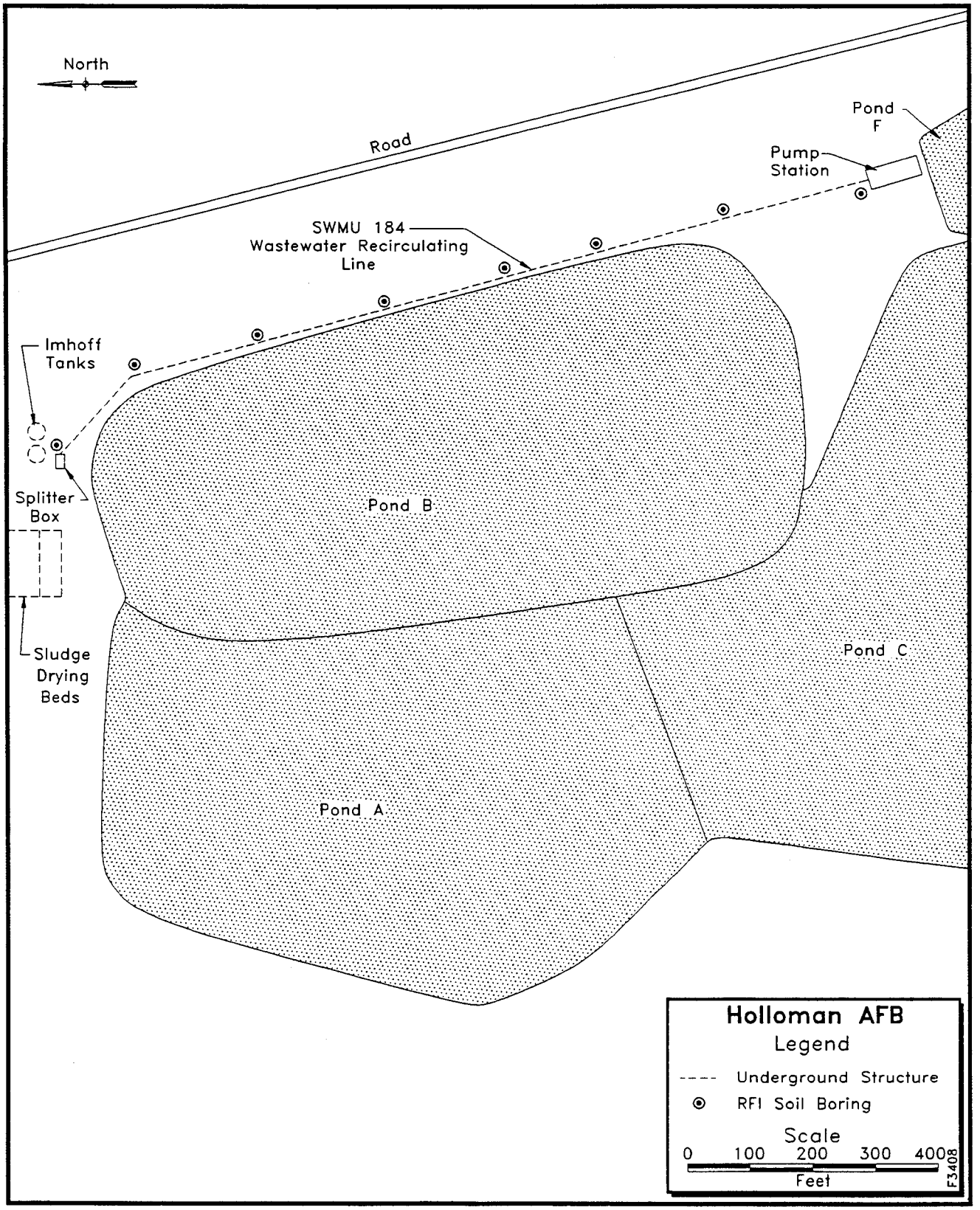


Figure 4-24. Soil Boring Locations, SWMU 184

sewage lagoons, but no soil sampling has been done in the vicinity of the wastewater recirculating line.

4.24.3 Objectives

The objective of the RFI Phase I study for SWMU 184 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if inorganic waste constituents have migrated into the soils surrounding the area, or if the constituents have reached the groundwater.

The objective will be met by performing 8 soil borings spaced evenly along the line to a depth immediately below the line, 2 of which will be advanced to the groundwater interface in order to detect possible releases from any portion of the line.

4.24.4 Sampling and Analytical Plan

Figure 4-24 illustrates the proposed locations of the soil borings for the Phase I study. The soil borings are located to determine whether a release of waste or waste constituents has occurred to site soils or the underlying groundwater.

Sampling Plan

Manual probing or a ground-penetrating radar (GRP) survey will be used to verify the location of the line prior to sampling. Initially, probing will be used to determine the location of the pipeline. A metal stake will be driven into the ground at various points to determine the location and the path of the underground line. If probing is unsuccessful GPR will be conducted as described in Section 3.4.3.

A total of 8 borings will be performed along the line. A single boring will be located at either end of the line at the splitter box and at the pump station adjacent to Pond

F. An additional 6 borings will be drilled at approximately 200-ft increments between the 2 ends and immediately adjacent to the line.

At all locations the soil borings will be advanced in 2-ft increments to a depth within 1-ft below the bottom of the line, and samples collected. At 2 of the above locations, based on visual observation, the borings will be advanced to groundwater and samples collected from the interval which intercepts the groundwater interface. If the groundwater interface exists above the line then the samples will be taken from below the line.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3. Any part of the sample representing slough will be cut or scraped from the sample. The sample will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided among the sample containers.

Estimated Groundwater Depth = 4-6 ft		
Number of Borings	**Samples Per Boring**	**Analyses Per Sample**
6	1	total metals
2	2	total metals
A probing effort or GPR survey will be performed at SWMU 184.		

Analytical Plan

On the basis of the 1987 analysis of the wastewater passed through the line, all soil samples will be analyzed for total metals (listed in Table 3-3). Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

4.25 SWMUs 177, 179, and 181

4.25.1 SWMU Description and History

These SWMUs were previously investigated as part of IRP Site 39; results are presented in the *Remedial Investigation Report -- Investigation, Study and Recommendation for 29 Waste Sites* (Radian, 1992). IRP Site 39 encompassed all SWMUs involved in the fueling and detanking of test sleds. This site contains SWMU 177 (Building 1176 Sumps), SWMU 181 (Building 1176 Drainage Troughs), and SWMU 179 (Discharge Box). The site layout, including all previous and planned sampling and well locations, is illustrated in Figure 4-25.

Fueling activities for tests at the Alpha Pad north of the SWMUs were completed on the track at the Alpha Pad before each sled launch. Before sleds were removed from the track, the fuels were emptied from the sleds into the proper storage container and the sleds were taken to Building 1176 where the remainder of the fuel was purged from the engines. Fuels used at the test track have included at least the following: unsymmetrical dimethylhydrazine (UDMH), aniline, JP-4 (jet fuel), inhibited red fuming nitric acid (IRFNA), inhibited white fuming nitric acid (IWFNA), liquid oxygen, JPX (1:1 JP-4 and UDMH), dyes, solid rocket propellants, and other compounds. The drainage systems for the Alpha Pad and Building 1176 were designed to prevent accidents in the event of a fuel spill during the fueling and/or defueling activities. The drainage systems collected and drained spilled oxidizers and propellants separately. According to the former employees, fuel spills were very uncommon because of stringent safety precautions. In addition to the aforementioned fuels, solvents such as trichloroethylene (TCE) were commonly used for sled maintenance in Building 1176. Interviews with past employees suggest that the washrack and drainage trenches could have received wastes.

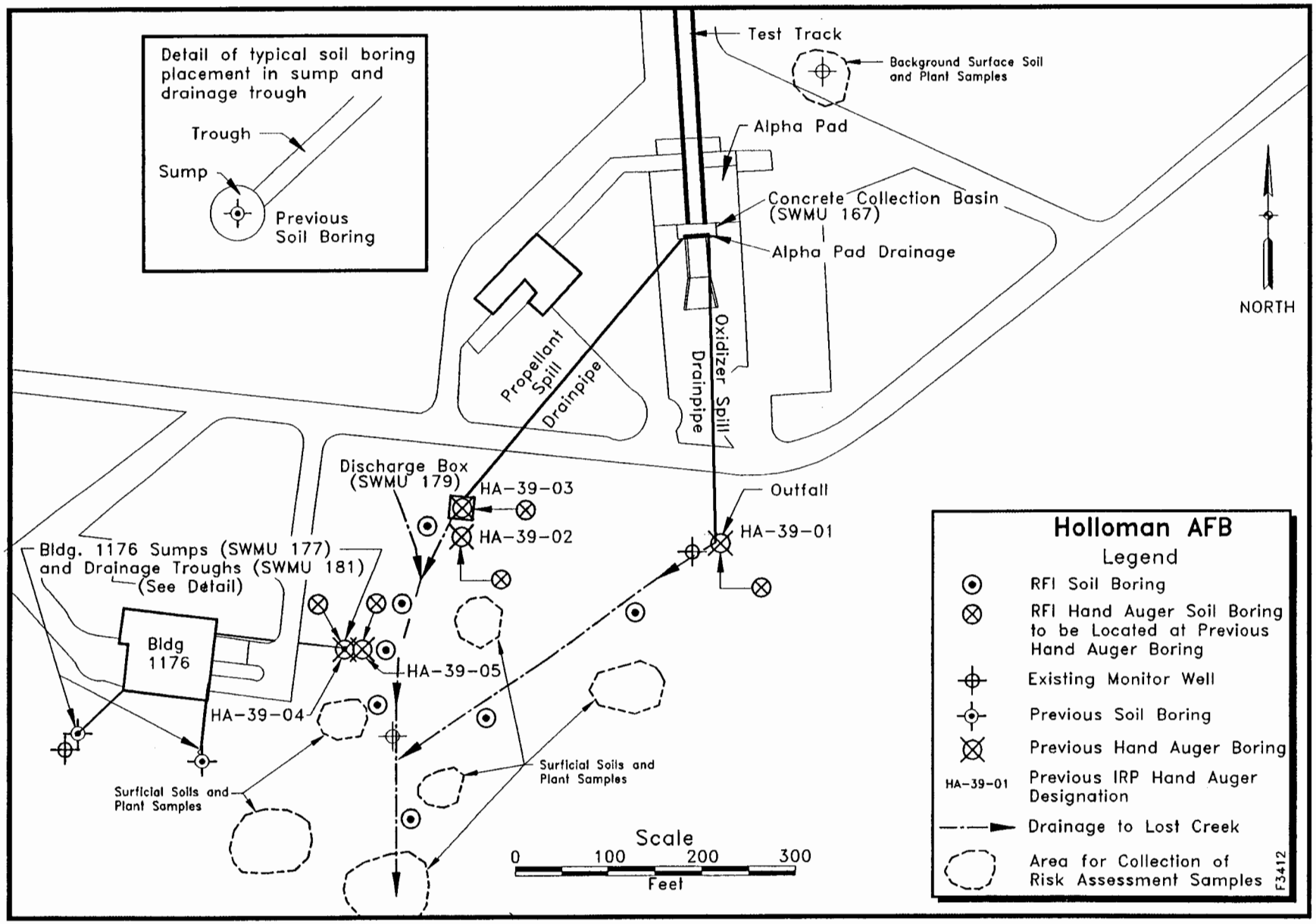


Figure 4-25. Soil Sampling Locations, SWMUs 177/179/181

4.25.2 Evaluation of Existing Data

As part of the 1991 RI, 2 surface samples were collected at the site from the 0- to 2- ft interval with a hand auger inside the Discharge Box at the Discharge Box Outfall (Appendix G) and at the outfall for the Oxidizer Spill Drainpipe. Two soil borings were drilled near the end of each drainage trenches south of Building 1176. At the end of the drainage trench east of Building 1176, a hand auger was used to collect 2 samples: 1 from within the sump at the end of the drainpipe and a second at the surface immediately west of the sump. Soil analyses included volatile organic compounds, total metals, and petroleum hydrocarbons. Four monitoring wells were installed in the area: 1 upgradient of the site and 1 well each downgradient of the outfall of the Oxidizer Spill Drainpipe, the Discharge Box, and Building 1176. One round of groundwater samples was collected and analyzed for volatile organic compounds, total dissolved solids, total metals, and anions.

Metals concentrations in soils were highest near the Discharge Box and near the sump east of Building 1176. Chlorinated VOCs found in both soil and groundwater samples in the vicinity of Building 1176 suggest that soil contaminants have migrated into groundwater from the sumps. Beryllium and cadmium detected in wells are within background ranges typical of upgradient wells at the Base, and probably do not reflect a release at the site. VOCs were mostly not detected or were present at concentrations below the detection limit in wells downgradient of the sump east of Building 1176 and below the Discharge Box. The site-specific risk assessment defined a concern for terrestrial wildlife (particularly black-tailed jackrabbits and White Sands Pupfish), but found no risk to the health of on-site human workers.

4.25.3 Objectives

The objective of the additional sampling is to define the lateral and vertical extent of metals contamination in the soil and the lateral extent of groundwater contamination. In addition, further sampling will be conducted to assess the risk to the

environment presented by the site contamination. This objective will be met by the performance of HydroPunch (or similar method) groundwater sampling downgradient of the existing monitoring wells to define the lateral contaminant migration. Soil samples will be taken in and adjacent to the Discharge Box, and to the south along the drainage ditch downstream of the Discharge Box as recommended in the RI report. In addition, further sampling at the RI hand auger locations will be performed. However, this work will be performed as part of the Base IRP investigations and not as part of Phase I RFI efforts.

4.25.4 Sampling and Analytical Plan

Soil and Groundwater Sampling

Figure 4-25 presents proposed sampling locations as well as previous sampling locations. All sampling locations are located in or along areas of suspected or known contamination. Eight boreholes will be drilled (or hand augered if locations are inaccessible to drilling rigs) downstream (to the south) of both drainpipe outfalls along the respective drainage ditches. One of the 8 boreholes will be located downstream of the confluence of the 2 ditches. In addition, 5 borings will be performed at the previous hand auger locations designated HA-39-01 through 05. A HydroPunch (or equivalent) survey will be conducted downgradient of the site toward the Lost River Basin to detect any migration of waste constituents past the 2 southernmost monitor wells.

Soil Sampling

The 8 ditch boreholes will be advanced to groundwater using a drill rig if possible (or a hand auger if not). A power auger may be used to advance the hand auger boreholes to depths immediately above the sampling depth. Samples will be collected from the 0- to 2-ft, 2- to 4-ft, and 4- to 6-ft depth intervals and from the depth interval that intersects the groundwater table. Hand auger borings at the 5 previous locations will be sampled at the 2- to 4-ft, 4- to 6-ft, and 8- to 10-ft depth intervals.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment. Any part of the sample (taken with a drill rig) representing slough will be cut or scraped from the sample. The 2-ft increment will be sampled immediately for volatile organic compounds with as little mixing as possible. The remainder of the 2-ft increment will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and mixed thoroughly before being divided among the sample containers. After drilling and sampling is complete, the borehole will be sealed with neat cement grout, and the horizontal and vertical location of the borehole will be surveyed.

HydroPunch Survey

A HydroPunch (or equivalent) survey will be conducted to determine lateral extent of any groundwater waste constituent migration toward the Lost River Basin. Samples will be taken downgradient of the 2 southernmost monitor wells; however, exact locations have not yet been determined.

Estimated Groundwater Depth = SWMU - 177-15 ft, SWMU 179 - 5-10 ft, SWMU 181 - 15 ft
No activities will occur at SWMUs 177, 179, and 181 during the Phase I RFI.

Analytical Plan

Following the recommendations from the 1992 RI Report, all soil samples collected will be analyzed for the constituents of primary concern at the site: metals (SW6010) and lead (SW7421). Soil samples will be analyzed in sequence, with the uppermost sample being analyzed first, continuing downward until no metals are detected. If metals are not detected in a certain interval, no subsequent (deeper) samples from that borehole will be analyzed. Geotechnical analyses will consist of a grain size distribution (ASTM D421 and D422).

Water samples from the HydroPunch survey will be analyzed by the laboratory in accordance with the SW-846 requirements specified in the QAPP for VOCs (SW8240) listed in Table 3-3.

Additional Risk Assessment Sampling

The contaminants driving the ecological risk at this site are cadmium and lead in the surface soil, and lead (primarily) in the surface water. Beryllium and zinc also contributed to unacceptable surface water quality. Primary uncertainties associated with the ecological risk assessment include lack of surface soil data that are representative of the site, unknown chemical uptake factor for browse plants in this soil type, and conservatively modeled concentrations of chemicals in the surface water of the Lost River.

To address these uncertainties, samples of surface soil (composited from several points in a 10- or 20-ft circle) and browse plants from the same area will be sampled and analyzed for lead and cadmium. Most of the risk to jackrabbits in the previous modeling comes from estimated intake of lead (and cadmium, to a lesser extent) by direct ingestion of soil during grooming and foraging activities, and modeled uptake by shallow rooted plants (e.g., grasses and forbs) of cadmium and lead in the surface soil. In addition, background surface soil and plant samples(s) will be collected to assess the risk presented by the site. Grasses and forbs form the bulk of jackrabbit diet, although shrubs (e.g., saltbrush and rabbit brush) may comprise up to one fifth of their diet during the winter months. Both types of forage will be collected and shrubs will be kept as separate samples from grasses and forbs. The pickleweed growing down in the salt flats at the edge of the Lost River Basin is not favored forage and will not be sampled.

Surface water samples will be collected from the Lost River both above and below the site and analyzed for lead, beryllium, and zinc to resolve uncertainties in the estimated risks to the White Sands Pupfish. The toxicity of zinc and lead is hardness dependent, therefore, water hardness will be measured as well.

Finally, jackrabbit samples (blood, urine, kidneys, and/or liver) will be collected and analyzed to verify the model. This will also entail a literature search for comparison of any values determined from the field, a statistically adequate sampling over time, and the determination of background values.

Figure 4-25 shows proposed soil and plant sampling areas near or at, and downgradient of, the previous surface sample locations.

4.26 SWMU 101

4.26.1 SWMU Description and History

This SWMU, also known as IRP Site 10, consists of the Building 121 Landfill (Old Main Base Landfill). The landfill occupies approximately 20 acres of the area around present day 4th Satellite Communication Squadron (SPACECOM). Site 26 was in operation from 1942 to 1958. During that time the landfill received domestic solid waste from the Base and possibly drums containing waste oils and solvents. Also, a Base incinerator was located in the area and the ash from its operation was buried in the landfill. The site lies north of the Main Base area and is presently inactive.

4.26.2 Evaluation of Existing Data

Extensive investigations have occurred at this SWMU, including a records search in 1983, an RI in 1987, more RI field activities in 1988, and a risk assessment in 1989 (Appendix H). The findings concluded that the landfill posed no significant risk to public health or the environment. As a result of these findings, no field investigations will occur at this site during the RFI Phase I.

4.26.3 Objectives

The objectives for this SWMU have been met under the IRP program and no further action is required.

Estimated Groundwater Depth = 8-10 ft
No activities will occur at SWMU 101 during the Phase I RFI.

4.26.4 Sampling and Analytical Plan

Since no RFI activities are necessary, a sampling and analysis plan is not required.

4.27 SWMU 183

4.27.1 SWMU Description and History

This SWMU consists of the Air Base Sewer System. SWMU 183 has been in operation since the Base was first commissioned in 1942. The sewer system for Holloman AFB receives domestic wastewaters, drains some stormwater, and in the past received some contaminated wastewater. The system transports wastewater to the sewage lagoons for treatment. The pipelines collect wastewater from approximately 12 square miles making an integrity test on the system impossible and sampling of the system economically impractical. Currently, a long-term project to replace the existing clay and concrete pipelines with PVC pipe is underway. The system replacement is part of several long-term, Base-wide upgrade activities at Holloman AFB.

4.27.2 Evaluation of Existing Data

No previous investigations have occurred at SWMU 183.

4.27.3 Objectives

The objective of the RFI Phase I study for the SWMU 183 is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine if waste constituents have migrated into the soils surrounding the sewer line.

The objective will be met during the long-term replacement of the Base sewer lines and the removal of visually contaminated material encountered while replacing the lines.

4.27.4 Sampling and Analytical Plan

No analytical samples will be taken of the Air Base Sewer System during Phase I RFI activities.

4.28 Area of Concern-U

4.28.1 SWMU Description and History

This AOC consists of a large drainage basin known as Lost River Basin which receives drainage from various SWMUs and IRP sites as shown in Figure 4-26. The basin is predominately nonvegetated. It is a known habitat for the White Sands Pupfish and blacktailed jackrabbits. Most of the time the basin remains dry, but during heavy rains runoff enters the basin from the surrounding areas. IRP Site 40 Causeway Rubble Disposal Site actually is within the Lost River Basin (Figure 4-26, point 1). At point 2 on Figure 4-26, used rocket motors and drums were stored in a flat area that drains to the basin. Also at point 2, the runoff from Buildings 1168 and 1176 (SWMUs 177/181 and IRP Site 39, respectively) enters the basin. The runoff or overflow from SWMU 179 enters the basin at point 3. Also along the drainage path at this point is debris consisting of plastics that may or may not be exhausted solid rocket fuel. The test track and similar debris deposits drain to point 4. Point 5 receives drainage from the SWMUs associated with Building 1166 (IRP Site 38 and SWMUs 40, 128, and 138).

4.28.2 Evaluation of Existing Data

No previous investigations have occurred at the Lost River Basin; however, several of the areas that drain to the basin have been investigated. The investigations that have occurred at IRP Site 40 have led to the decision that the site warrants no further action (Decision Document, August 1991, EA Engineering, Science, Technology, Inc.). The site was used for the disposal of concrete rubble. An RI has also been performed at IRP Site 39 (Appendix D). This investigation revealed possible releases of volatile organic compounds and metals. This AOC will be investigated further during the RFI Phase I field investigations of SWMUs 177 and 181. Investigations of the drainage path from SWMU 179 to the Lost River Basin have revealed concentrations of lead above action levels specified in the July 1990 proposed RCRA Subpart S corrective action regulations. The test track

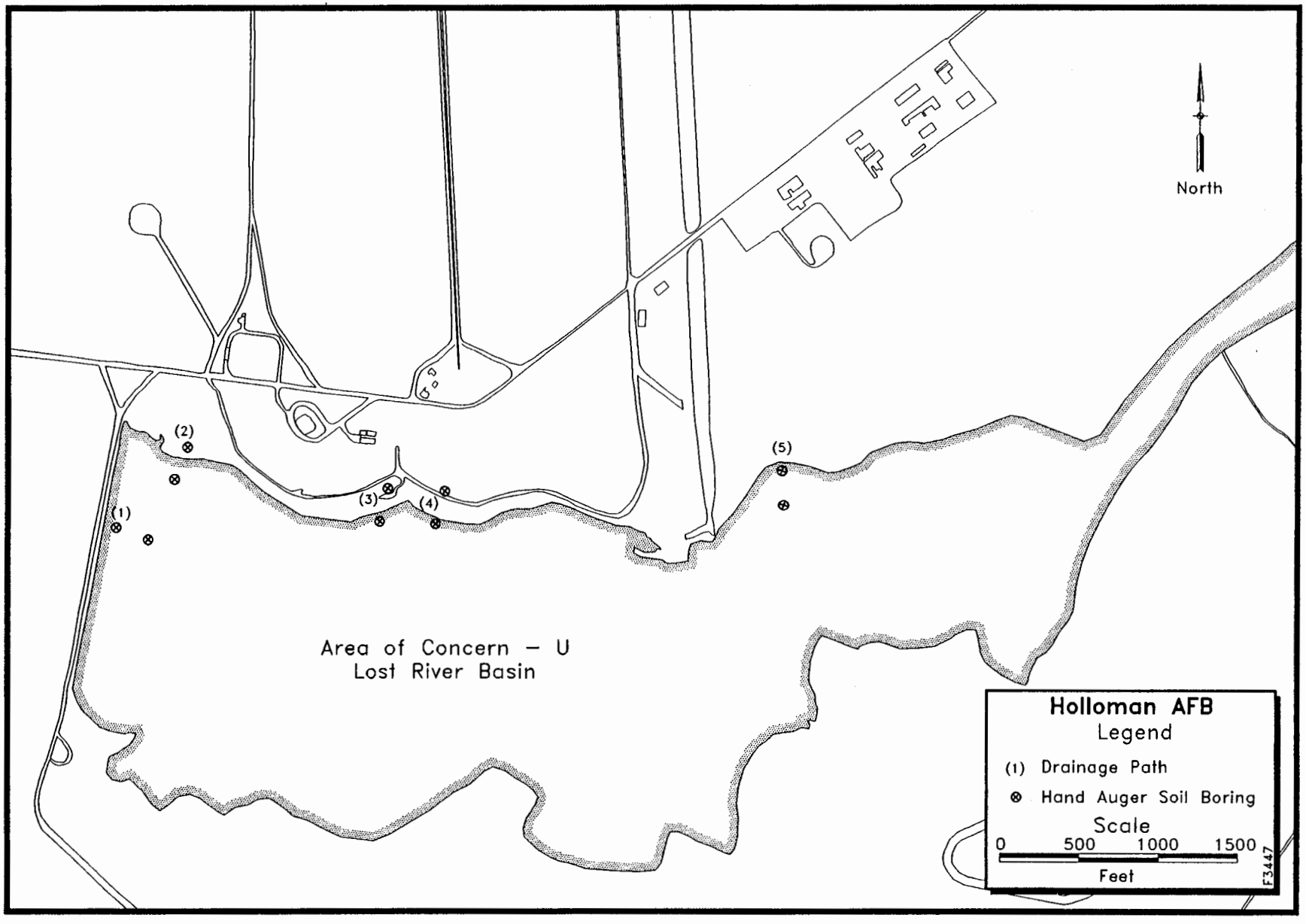


Figure 4-26. Soil Sampling Locations, Area of Concern-U

drainage path has not been investigated, but possible contaminants include volatile organic compounds, TRPH, and metals. The investigations that have occurred at IRP Site 38 (Appendix B) located at Building 1166 have shown that nitrate-nitrite concentrations detected in wells were slightly elevated, probably due to the fact that there is a septic tank drainfield located at the site; several volatile compounds such as chloroform and TCE were detected in the wells; and petroleum hydrocarbons were detected in soil samples. However, no risk from this site was determined to be present based on the risk assessment.

4.28.3 Objectives

The objective of the RFI Phase I study for the Lost River Basin is to determine if previous operations have resulted in the release of waste constituents to the environment. Specifically, the objective is to determine the source of any waste constituents that may have migrated into the soils of the Lost River Basin.

The objectives will be met by taking hand-auger samples at the discharge points of all identified drainage paths into Lost River Basin and at a point 100 ft out into the basin from those points in order to detect any possible releases of waste constituents into the basin.

4.28.4 Sampling and Analytical Plan

Figure 4-26 illustrates the approximate location of the hand-auger samples for each identified drainage path. Each of these paths drains from some possible source of contamination which will determine the analyses for the samples taken. The sample points are located to determine whether a release of waste or waste constituents has occurred into the Lost River Basin via 1 of the previously described drainage paths.

Sampling Plan

Sample points will be located at the mouth of each previously discussed drainage point and 100 ft directly out into the basin from the first sample. The boreholes will be advanced from the ground surface to 2 ft below the surface using a stainless steel hand auger. Samples will be collected for chemical analysis from the 0- to 2-ft interval.

Every sample taken for chemical analysis will be collected with stainless steel sampling equipment that has been decontaminated prior to use according to the process described in Section 3.1.3. The removed soil will be placed in a clean stainless steel bowl using a stainless steel trowel or spoon and sampled immediately for volatile organic compounds (if it is required) with as little mixing as possible. The remainder of the soil will be mixed thoroughly before being divided evenly among the sample containers. Enough sample will also be collected for soil classification at each location. Enough sample will also be collected at least 3 locations which the geologist feels are representative of all materials at the site for geotechnical testing.

Estimated Groundwater Depth = 0-2 ft		
Number of Hand Auger Borings	**Samples Per Boring**	**Analyses Per Sample**
4	1	total metals
6	1	SW8240, EPA 418.1, total metals

Analytical Plan

Owing to the nature of the variety of wastes that may have migrated into this site, individual soil samples will be analyzed for typical constituents of the possible source of contamination for that point in the basin. Therefore, soil samples submitted to the laboratory will be analyzed for different constituents based upon the drainage path immediately upstream of that point. The summary of samples and corresponding chemical

analyses to be taken from the Lost River Basin are presented in Table 4-1. Geotechnical testing will consist of grain size distribution (ASTM D421 and D422).

Table 4-1

Analysis of AOC-U Samples by Sample Location

Sample Locations [a]	Analysis	Corresponding Method
1	total metals particle size distribution	6010,7421,7740 (Table 3-3) ASTM D421 and D422
2	TRPH volatile organics total metals particle size distribution	418.1 8240 6010,7421,7740 (Table 3-3) ASTM D421 and D422
3	total metals particle size distribution	6010,7421,7740 (Table 3-3) ASTM D421 and 422
4	TRPH volatile organics total metals particle size distribution	418.1 8240 6010,7421,7740 (Table 3-3) ASTM D421 and D422
5	TRPH volatile organics total metals particle size distribution	418.1 8240 6010,7421,7740 (Table 3-3) ASTM D421 and D422

[a] Corresponds to numbered discharge locations (2 hand auger samples per location) shown on Figure 4-26.

5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

The QA/QC procedures presented in the QAPP for the Holloman AFB RFI will be implemented during the Phase I RFI work as applicable. A stand-alone copy of the QAPP is provided with the RFI Work Plan (Volume II). The QAPP addresses QA/QC procedures in depth for the collection and analysis of the soil and groundwater (if necessary) samples that will be collected during the RFI. This section will reference the QAPP and briefly discuss the QA/QC procedures.

5.1 Data Collection Strategy

The data obtained from the RFI will be evaluated to determine the absence or presence of hazardous waste or hazardous waste constituents released from the identified SWMUs at the Base. The objectives of the QA/QC efforts are to:

- Collect representative samples;
- Prevent contamination of samples during collection and analysis;
- Provide the mechanism for ongoing control and evaluation of measurement data quality on a routine basis; and
- Use QC data to define data quality for the various measurement parameters, in terms of precision and accuracy.

Data quality objectives for the analytical work performed during the Phase I RFI are presented in Table 5-1. Precision and accuracy objectives are based on QC check sample results and on QC requirements specified in SW-846, 3rd edition.

The rationale for sample representation is explained in each of the site-specific sampling plans presented in Section 4.0 of the Work Plan. Data documentation and reporting is presented in Section 6.0, Data Management, of the Work Plan.

Table 5-1

Estimated Analytical Precision and Accuracy Objectives

Parameter	Method	Precision[a]	Accuracy[b]	Completeness[c]
Metals[d]	SW6010 ICPES	20%	80-120%	90%
Arsenic	SW7060 Graphite Furnace AA	20%	75-125%	90%
Lead	SW7421 Graphite Furnace AA	20%	75-125%	90%
Mercury	SW7470/7471 Cold Vapor AA	20%	80-120%	90%
Selenium	SW7740 Graphite Furnace AA	20%	75-125%	90%
Thallium	SW7841 Graphite Furnace AA	20%	75-125%	90%
Pesticides/PCBs	SW8080 GC/ECD	See Method 8080, Table 3	See Method 8080, Table 3	90%
Organophosphorus Pesticides	SW8140 GC/FPD	50%	See Method 8140	90%
Chlorinated Herbicides	SW8150 GC/ECD	50%	See Method 8150	90%
Volatile Organic Compounds	SW8240 GC/MS	See Method 8240, Table 6	See Method 8240, Table 6	90%
Semivolatile Organic Compounds	SW8270 GC/MS	See Method 8270, Table 6	See Method 8270, Table 6	90%
Dioxins and Furans	SW8280 GC/MS	50%	40-120%	90%
Cyanide	SW9012 Colorimetric	20%	80-120%	90%
Sulfide	SW9030 Titrimetric	20%	80-120%	90%
Total Dissolved Solids (TDS)	E160.1 Gravimetric	20%	80-120%	90%
Total Recoverable Petroleum Hydrocarbons (TRPH)	E418.1 Infrared Spectroscopy	20%	80-120%	90%

Table 5-1

(Continued)

[a] Relative percent difference (RPD) for replicate QC check samples (exclusive of sample variability) will be compared to these objectives.

[b] Total error for a single measurement in a clean, laboratory-controlled matrix, including both systematic error (bias) and random error (variability due to imprecision), expressed as a percentage of the measured value. Percent recovery for QC check samples or continuing calibration samples will be compared to these objectives.

[c] Completeness will be determined by calculating the percent of valid data obtained compared to the amount of data expected under normal conditions.

[d] ICPES metals: antimony, barium, beryllium, cadmium, chromium, cobalt, copper, nickel, silver, tin, vanadium and zinc.

SW = *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods,* U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, Third Edition.

E = *Methods for Chemical Analysis of Water and Wastes,* EPA-600/4-79-020.

5.2 Sampling Procedures

Soil and groundwater (if necessary) samples will be collected for this project. Sample containers will be prepared as described in Tables 3-7 and 3-8 of this Work Plan and in Tables 5-1 and 5-2 of the QAPP. All samples collected will be labeled and stored at approximately 4°C from the time of collection until the analyses are completed, including transit to the analytical laboratory.

5.2.1 Sample Collection

Sample collection procedures include obtaining the sample, decontaminating sampling equipment, and preserving the sample, and are addressed in Section 3.0 of this Work Plan (Investigation Methods) and in Section 5.0 of the QAPP (Sampling Procedures).

5.2.2 Sample Documentation

Sample collection will be documented using bound field notebooks with consecutively numbered pages. Indelible ink will be used to record entries. Other documentation methods such as chain-of-custody forms, sample labels, and custody seals are discussed in Section 6.0 of the QAPP (Sample Custody and Sample Tracking).

5.2.3 Sampling QA/QC

QC procedures will be an integral part of each sampling methodology. The QC procedures will ensure the collection of representative samples with minimal external contamination. Although different analytical procedures will be used for the various parameters of interest, the following general sampling QC procedures are applicable to all analytical methods: splits of solid samples, duplicate liquid samples, trip blanks, equipment blanks, and ambient blanks. These procedures and frequencies of QA/QC sample collection are presented in Section 3.5 of this Work Plan (Field QA/QC).

5.3 Sample Analysis

The RFI Contractor's Project Director, or his/her designee, will oversee the work performed to ensure that the QA procedures are followed. Chemical analyses will be performed with the equipment and procedures specified in the methods listed in Table 5-1 of this Work Plan and in Table 7-1 of the QAPP. The analytical laboratory will be required to follow the approved QAPP in performing all chemical analyses. The QAPP requirements will supersede any aspects related to QC or sample analysis not mentioned or not identical to the Laboratory's QA Program Plan.

The Laboratory Director, or equivalent, has ultimate responsibility for ensuring that all contracted laboratory employees performing analyses comply with the QA/QC procedures.

5.3.1 Sample Management

Once received at the laboratory, each sample will be assigned a unique laboratory number for identification and lab-tracking purposes. The samples and extracts will be stored at approximately 4°C until the appropriate analyses are completed. The maximum turnaround time for reported analytical results is expected to be 60 days from sample receipt.

Analytical methods, sample containers, preservation, and maximum holding times are presented in Tables 3-7 (soil) and 3-8 (water) (QAPP Tables 5-1 and 5-2). Analytical techniques, preparation techniques, and detection limits are presented in Table 7-1 of the QAPP. The scope, application, and potential interferences are documented in the specified analytical method procedures. Additional sample custody and sample tracking procedures are discussed in Section 6.0 of the QAPP (Sample Custody and Sample Tracking).

5.3.2 Calibration Procedures

Documented calibration procedures are necessary to provide consistency in preparing equipment for specific analytical measurements. Established calibration procedures provide a mechanism for ensuring that measurements taken with a specific type of equipment are comparable. Calibration requirements and frequencies for each analytical method are summarized in Section 8.0 of the QAPP (Calibration Procedures).

5.3.3 Data Reduction, Validation, and Reporting

All analytical data generated within the contracted laboratory will be extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and review. Further discussion is presented in Section 10.0 of the QAPP (Data Reduction, Validation, and Reporting). For the purposes of the RFI work, generation and reduction of raw data, including the data analysis required to calculate sample concentrations, will be performed according to the protocols set forth in the methods identified in Table 5-1 and QAPP Table 7-1.

5.3.4 Internal Quality Control

The internal QC procedures, acceptance criteria, and corrective actions to be used for laboratory testing and analysis are presented in QAPP Table 9-1.

Key quality control terms are defined below.

Method Blank--A method blank is an aliquot of reagent water or clean solid matrix taken through the analytical process as though it were an actual sample. The purpose of a method blank analysis is to monitor and control laboratory sources of contamination. At a minimum, one laboratory method blank will be analyzed daily for each method of analysis.

Trip Blank--A trip blank is a sample of organic-free water that is prepared in the laboratory, transported to the field, and stored with the collected samples. The trip blank is not opened in the field, but is subjected to the same handling as the other samples. Trip blanks serve to identify contamination from sample containers or transportation and storage procedures. Trip blanks accompany samples for volatile organic analyses only. A trip blank will be included with each cooler shipped to the laboratory that contains VOC samples.

Equipment Blanks--An equipment blank is an aliquot of deionized or organic-free water poured over or through the sampling equipment. The equipment blank demonstrates that the sampling equipment has been adequately cleaned. Equipment blanks will be collected at a 10 percent frequency and analyzed for all matrices and parameters.

Ambient Blanks--Ambient condition blanks are ASTM Type II or reagent-grade water that is poured into a sample container at the sampling site. These blanks are handled the same as investigative samples. Ambient blanks will be collected and analyzed for the same parameters as media samples collected at the site at a frequency of 10 percent.

Matrix Spike--A matrix spike is a split from a field sample spiked with known concentrations of reference materials and taken through the entire preparation and analytical measurement procedures. The matrix spike allows the laboratory to assess the efficiency of extraction/digestion, accuracy of the analysis, and possible matrix effects. Matrix spike analyses will be performed on a five percent frequency for each matrix as required by SW-846.

Matrix Spike Duplicate--A matrix spike duplicate is a second aliquot of the same sample as the matrix spike that is also spiked. Method precision for the matrix can be estimated by calculating the relative percent differences between the recoveries of the spiking compounds. Matrix spike duplicate analyses will be performed on a five percent frequency for each matrix.

Duplicate Sample--Duplicate solid samples will be collected by splitting a single sample into two equal parts for the purpose of analysis. Duplicate water samples will be included in the project by collecting two samples from the same location at the same time. Unique sample numbers will be assigned to field QC duplicates so that they will be indistinguishable from other analytical samples. The purpose of collecting and analyzing duplicate samples is to provide a measure of method variability (i.e., total variability from imprecision in both sampling and analytical procedures). Field duplicate samples (QC) will be collected at a frequency of 10 percent (1 per 10 or fewer samples) and analyzed for all parameters by the Contractor Laboratory. In addition to QC duplicate samples, QA duplicate samples will be collected on a 10 percent frequency for analysis by the USACE MRD Laboratory.

Quality Control Check Sample--A quality control check sample (QCCS) is a sample having a known concentration of reference materials spiked into an aliquot of deionized water. It is taken through the sample preparation process as well as the analytical measurement process. The purpose of a QCCS analysis is to determine whether failure to meet QC acceptance criteria for a matrix spike is due to matrix interference in the sample or to out-of-control conditions associated with the analytical system.

Surrogate Compound--Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but that are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to extraction and analysis by Methods SW8240, SW8270, SW8080, SW8140, SW8150, and SW8015. Percent recoveries are calculated and reported for each surrogate. Surrogate spike recoveries can be used to assess method accuracy of individual samples.

Internal Standard--Internal standards are similar in analytical behavior to the compounds of interest and are not affected by method or matrix interferences. Internal standard calibration procedures are followed for volatile and semivolatile organic analyses.

One or more internal standard is added to all samples analyzed, including calibrations standards.

5.4 Preventive Maintenance Procedures

Preventive maintenance procedures are presented in Section 13.0 of the QAPP (Preventive Maintenance).

5.5 Corrective Action for Laboratory Problems

Corrective actions for laboratory problems are discussed in Section 12.0 of the QAPP (Corrective Action).

6.0 DATA MANAGEMENT

A Data Management Plan is included in the Phase I RFI Work Plan to facilitate the organizing and reporting of investigation data and results. The Base Environmental Coordinator (BEC) will oversee all aspects of the Phase I RFI work and will be responsible for ensuring that proper documentation procedures are followed and that tracking of the accumulated data during the investigation is performed. The Contractor will use a field notebook, soil boring logs, sample custody forms, sample labels, sample inventories, and laboratory logbooks to track and document project data. The Contractor will establish a data management plan to meet the data deliverable requirements of the Installation Restoration Program Information Management System (IRPIMS), and will collect all sample and analytical reports and submit them to the appropriate person (BEC or designee) for further evaluation.

There are six goals for the data management task:

- Archive project data and procedures to substantiate conclusions and recommendations drawn from the RFI;
- Provide timely access to an organized body of data to facilitate analysis and decision making throughout the investigation;
- Provide a useful index of project information;
- Present project information in tabular and graphic form;
- Communicate data to the U.S. Air Force electronically; and
- Report progress on the project.

This work plan will refer to the following U.S. Air Force documents:

- *RCRA Facility Investigation Guidance, Vol. I: Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations.* EPA530/SW/89/031, May 1989.

- *Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook--Version 2.2*, January 1991.

- *Handbook to Support the Installation Restoration Program (IRP) Statements of Work, Vol. I: Remedial Investigation/Feasibility Studies (RI/FS)*, May 1991.

These three documents will be referred to as the RFI Guidance, the IRPIMS Data Loading Handbook, and the IRP Handbook, respectively.

The Data Management Plan presented below addresses data and report processing procedures, project file requirements, and project-related progress reporting procedures and documents. An example format for data presentation/reduction is provided and discussed. The data management system implemented by the Contractor will be capable of accurately and quickly tracking all pertinent information associated with the Phase I RFI. In particular, once the Contractor receives the laboratory results and performs necessary data loading and data validation procedures, the Base will be notified within five working days of evidence of a potential release. The Base will then evaluate the need for possible interim measures in conjunction with U.S. EPA Region VI.

6.1 Data Quality and Use

The data collected during the Phase I RFI process will be used to determine if a release of hazardous waste or hazardous constituents has occurred from a SWMU and, if so, to determine if interim measures are necessary. Therefore, the data must be of sufficient quality to support these decisions.

Data quality objectives outlining the decision-making process and specifying the quality and quantity of data required to support decisions are discussed in detail in Section 1.2.

6.2 Data Record

A bound, numbered field notebook will be used to permanently record all field procedures, sample locations, types, unique identification numbers, and general observations. The specific parameters for which each sample is to be analyzed will also be recorded. A unique sample field identification number will be assigned at the time of sample collection to track each sample throughout the Phase I RFI. A corresponding laboratory ID number will be assigned by the laboratory and will be used to track each sample through the analytical process.

For soil borings and hand-auguring locations, descriptions of lithologies encountered and the soil classification will be recorded in the field notebook. This information will subsequently be used to prepare tabular and graphical logs for the Phase I RFI report.

For soil sampling, at a minimum the following information describing each sample will be recorded in the field notebook:

- SWMU/borehole identification;
- Background (ambient) organic vapor concentration;
- Time of beginning/end of sample collection;
- Method of sample collection (hand auger, trowel);
- Unique field ID number and depth interval of sample;
- Number of sample containers and types of analyses required;
- Sample description (lithology, color, texture/structure, moisture, any visual evidence of contamination, organic vapor analyzer reading, etc.); and
- Field QC samples taken at appropriate frequency.

All pages of the field notebook will be signed and dated by the supervising geologist who is entering the data. Also, the names and affiliations of all visitors on site will be entered in the notebook, as well as general notes on project progress, problems encountered, deviations from plans (with rationale), and so forth.

Field sample ID number, along with sample collection point, sample collection date/time, sampler, required analysis, and preservation will be entered on the sample label for each container. Chain-of-custody documentation will also be completed and will accompany all samples to document the chain of possession and track the samples throughout shipping, handling, and analysis.

The BEC will maintain a project file at Holloman AFB, New Mexico, containing all information reports and data regarding the Phase I RFI. The Contractor will provide the Base with copies of all files and documents discussed below. A subject file index will be maintained to easily find documents in the file. The project file will be maintained for a minimum of five years after the completion of the Phase I RFI.

6.3 Field Data

The Contractor will maintain field records sufficient to re-create all sampling and measurement activities and to meet all IRPIMS data submittal requirements. The requirements apply to all measuring and sampling data. The information will be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. At a minimum, the Contractor will keep information for the field program as specified in the IRPIMS Data Loading Handbook in all of the following tables that are applicable to the project:

- Table 6--BCHLDI--the Location Definition file;
- Table 7--BCHSLI--the Site Information Location file;
- Table 8--BCHWCI--the Well Completion Information file;

- Table 9--BCHGWD--the Groundwater Level Data file;
- Table 10--BCHSAMP--the Environmental Sampling Information file; and
- Table 12--BCHLTD--the Lithologic Description file.

The Contractor will record all information indicated in the above-listed files in accordance with the valid value list found in the Appendix to the IRPIMS Data Loading Handbook. In addition, the Contractor will prepare the analytical data Informal Technical Information Reports as described in Section 4.2.2 of the IRP Handbook.

6.4 Laboratory Data

The laboratory will maintain notebooks (hardcopy and electronic) that will be used to permanently record all laboratory data, including sample IDs, analytical results, detection limits, analytical methods, and other related data. Both electronic and hardcopy notebooks will be made available to the Contractor as part of routine data transfer. At a minimum, the Contractor will record the following information, which is specified in the IRPIMS Data Loading Handbook:

- Table 13--BCHTEST--Sample Preparation file; and
- Table 14--BCHRES--Analytical Results file.

6.5 Project File

The Contractor will maintain a project file at a single location in which copies of all basic project data and written communications are stored. Contents of the project file will include progress reports, field data, laboratory data, copies of maps, and all other facility description data.

6.6 Progress Reports

The Contractor will submit monthly progress reports and a final report on Phase I RFI activities and results to the Base. The monthly progress report will contain:

- An estimate of the percentage of the investigation completed;
- Summaries of actual or proposed changes to the Phase I RFI Work Plan or its implementation;
- Summaries of problems encountered during the reporting period and actions being taken to rectify problems;
- A summary of work accomplished during the reporting period;
- Projected work for the next reporting period;
- A data management summary listing all IRPIMS files submitted during the reporting period;
- Any preliminary or final results obtained during Phase I RFI activities; and
- Any changes in key project personnel.

The Base will continue to submit quarterly progress reports to the U.S. EPA, Region VI, of all activities, including, at a minimum:

- A description and estimate of the percentage of the Phase I RFI completed;
- A summary of contacts pertaining to corrective action or environmental matters with representatives of the local community, public interest groups, or state government during the reporting period;
- Summaries of all findings, including summaries of laboratory data;
- Changes in key project personnel during the reporting period;

- Summaries of all problems or potential problems encountered during the reporting period and actions taken to rectify problems;
- Summaries of all changes made in the RFI during the reporting period; and
- Projected work for the next reporting period.

The progress reports will include a narrative description of sampling and analytical activities. The description will include any deviations from the Work Plan, explanations of deviations, estimates of data quality, and any other significant problems encountered during the sampling and analysis. Figure 6-1 presents a proposed outline for the monthly progress reports prepared by the Contractor. Any deviations from the approved Phase I RFI Work Plan that are necessary during the Phase I RFI must be approved by the U.S. EPA, Region VI, and fully documented and described in the progress reports (both by the Contractor and the Base) and in the Phase I RFI report.

6.7 Informal Technical Information Reports

The Contractor will prepare the analytical data Informal Technical Information Reports as described in Section 4.2.2 of the IRP Handbook. The guidance given in the Handbook includes recommended table formats for reporting analytical results, extraction and analysis dates and hold times, and QC data and for cross-referencing sample identification data.

6.8 IRPIMS Reporting

The Contractor will submit data to IRPIMS in accordance with the instructions in the latest version of the IRPIMS Data Loading Handbook, which is available at the beginning of the investigation. To perform this task, the Contractor will establish a data management system plan to meet the requirements of IRPIMS and will have available the following minimum hardware and software configuration:

HOLLOMAN AIR FORCE BASE, NEW MEXICO
PHASE I RFI
MONTHLY PROGRESS REPORT NO. xxx

PERIOD COVERED: [dates]

WORK PERFORMED:

1. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

2. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

3. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

PROBLEMS ENCOUNTERED: [will include any proposed changes to the Work Plan]

1. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

2. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

ACTIVITIES PLANNED FOR THE NEXT MONTH:

1. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

2. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

3. xxxxxxxxxxxxxxxxxxxxxxxxxxxx

% INVESTIGATION COMPLETED:

% of the Phase I RFI work has been completed at the end of this reporting period.

SIGNATURE: _____

DATE: _____

Figure 6-1. Proposed Format for Phase I RFI Contractor Monthly Progress Report

- IBM PC AT (80286 based, 8 Mhz minimum) microcomputer or functional equivalent configured with a hard disk of at least 30MB capacity that is dedicated to IRPIMS data loading tasks, one floppy disk drive (minimum of 360MB), 640KB of RAM, and MS-DOS Version 3.3 or higher;

- No memory-resident software should be loaded in order that the maximum amount of memory is available on the system;

- A color monitor with an adaptor capable of a resolution of 640 x 480 pixels (minimum of EGA standard) will be useful (but is not required); and

- A 30286 math coprocessor is advised but is not required.

The ASCII data files specified in the IRPIMS Data Loading Handbook will be submitted on one of the following disk formats: 5.25 in./360 KB (Double Density), 5.25 in./1.2 MB (High Density), 3.5 in./720 KB (Double Density), or 3.5 in./1.44 MB (High Density). The Contractor will deliver the IRPIMS data files to the U.S. Air Force Center for Environmental Excellence (AFCEE-ESO) in sequence according to a controlled time schedule identified in the IRPIMS Data Loading Handbook.

All Contractor data deliverables will be sent to:

Environmental Restoration Division
ATTN: IRPIMS Data Management
AFCEE-ESO/ERD
Brooks AFB, TX 78235-5000

A transmittal letter must accompany data file submissions and state what contract and delivery order the submission is fulfilling, and identify which submission group and file names are included. Any files not required by the scope of work (SOW) will be noted in the transmittal letter and references given to the sections of the SOW that excuse the omitted files. The Contractor will obtain a current list of existing IRPIMS site and sampling location identifiers from the Technical Project Manager (TPM). Data submitted in the IRPIMS data files will be in accordance with the appropriate valid value lists found in the Appendix to the IRPIMS Data Loading Handbook.

All data submitted by the Contractor will correspond exactly with the data contained in the original laboratory reports and other documents associated with sampling and laboratory contractual tasks. All files delivered by the Contractor are to be error free and in compliance with the IRPIMS Data Loading Handbook. Any errors identified by AFCEE-ESO in the submission(s) will be corrected by the Contractor.

The contractor may use the current version of the IRPIMS Contractor Data Loading Tool (CDLT) to construct the IRPIMS data files. The data files will be checked with the IRPIMS Quality Control Tool (QC Tool) and for compliance with requirements in the IRPIMS Data Loading Handbook.

6.9 Phase I RFI Report

Figure 6-2 presents a proposed outline for the final report for Phase I activities and results. The report will include a narrative description of sampling and analytical activities. The description will include any deviations from the Work Plan and QAPP, explanations of deviations, estimates of data quality, and any other significant problems encountered during sampling and analysis.

Condition R, Tasks III and IV, of Section IV of the Base's federal permit contains the requirements for the conduct of the RFI (Task III) and the final RFI report (Task IV). Many of the requirements contained in these tasks relate to the determination of the nature and extent of any releases found to be associated with the SWMUs under investigation. The purpose of the Phase I RFI is to determine if a release has occurred from a SWMU. If a release is detected from a SWMU, a Phase II RFI will be conducted according to all applicable permit conditions to determine its nature and extent and if there is any potential threat to human health and the environment exists. The final RFI report will include information gathered during the Phase I RFI and the results of the Phase II RFI.

1.0 INTRODUCTION

--Purpose,
--Objective.

2.0 SAMPLE COLLECTION

--Date samples were collected,
--Type of samples collected (e.g., soil, groundwater, HydroPunch, soil gas),
--Amount of samples collected,
--Location and sample I.D. numbers of samples collected,
--Who collected samples,
--How samples were collected,
--Any problems encountered and corrective measures taken.

3.0 ANALYTICAL RESULTS

--Laboratory used,
--Dates samples analyzed,
--Parameters analyzed and methods used,
--Data validation results,
--Any problems encountered and corrective measures taken,
--Presentation of analytical results by SWMUs investigated.

4.0 SIGNIFICANCE OF ANALYTICAL RESULTS

--Statistical procedures,
--Presentation of significant analytical results.

5.0 CONCLUSIONS

--RFI sites requiring no further action,
--RFI sites requiring further investigations (if any),
--Additional investigations warranted.

Figure 6-2. Proposed Outline for the Final RFI Phase I Report

Information gathered during Phase I RFI activities as to the nature and extent of any potential releases from the SWMUs under investigation will be included in the Phase I final report. However, the permit requirements discussed above that relate to the Phase II RFI are not expected to be met during Phase I, since the objective of this investigation is to determine if a release has or has not occurred from a SWMU.

6.10 Data Analysis and Reporting

Analysis of data collected during Phase I activities will follow three basic approaches:

- Tabular summarization;
- Graphical analysis; and
- Statistical analysis.

Tabular summarization will be used to present the results of all data collection efforts. Graphical and statistical analyses will be used to further determine the presence or absence of potential contaminants at each SWMU. Graphical methods are particularly useful for comparing detectable concentrations and detection limits to federal or state regulatory limits. Statistical methods are useful for determining whether detectable concentrations of naturally occurring constituents are significantly greater than "natural", or "background", concentrations.

The Contractor will compile and report the data generated during the project in a timely fashion so that the data can be used for decision making throughout the project. Detections of target compounds will be flagged and reported so that the data can be reviewed immediately by Base personnel and the Contractor to determine whether a release has occurred and interim measures are required.

The Contractor will prepare all graphical, tabular, and statistical data presentations during this RFI according to the guidelines in Section 5.2 of the RFI Guidance document. The approach for each of these data analysis methods is described in this section.

6.10.1 Tabular Summarization

Tables summarizing field and/or laboratory data will be generated from the project database in a format approved for the Phase I Final Report. Tables may present both results for each independent sample collected and a site, or SWMU, summary using descriptive statistics (e.g., average, standard deviation, etc.). For laboratory data, both natural sample and QC sample results will be reported.

Tables will be used in the Phase I RFI report as a convenient means of presenting a summary of the analytical results. Tables 6-1 and 6-2 are examples of the format proposed for use for both soil and groundwater results. Table 6-1 will provide a history of a sample's collection and analysis, whereas Table 6-2 will provide the analytical result (including "J" values) and a comparison with evaluation criteria. The laboratory summary data reports will be appended to the final Phase I RFI report. Analytical raw data will be stored at the site for a minimum of five years and will be made available to agency reviewers upon request. Surveyed sample locations will also be presented on tables as well as on figures.

6.10.2 Graphical Analysis

Graphs of data may be generated to pictorially present analytical data. Types of graphs developed may include:

- Scatter plots of sample concentrations with threshold lines indicating regulatory or health-based limits;

Table 6-1

Collection/Analysis Dates for [Type of Sample] Samples Collected During Phase I RFI, Holloman AFB, New Mexico

SWMU	Sample ID	Date Collected	Prepared		Analyzed	
			Date	Method	Date	Method

Table 6-2

Analytical Results for [Type of Sample] Phase I RFI Samples Collected from [Location], Holloman AFB, New Mexico

SWMU	Sample ID	Analytical Method	Compound	Result (D.L.)	Threshold	Conclusion
					xx[p]	
					xx[b]	

[p] Practical quantitation limit.
[b] Background for naturally occurring metals.

D.L. = Detection Limit.

- Vertical bar charts; and
- Contour plots.

6.10.3 Statistical Analysis

Statistical methods will be used to determine if detectable concentrations of inorganic constituents at a site are significantly greater than concentrations that occur naturally. Procedures for determining the statistical methods to be used for data analysis, and the information that will be reported, are described in Section 3.6.

7.0 WASTE MANAGEMENT PLAN

The waste management plan describes the management and disposal of wastes generated during the investigation of the SWMUs as described in this Work Plan.

7.1 Investigation-Generated Wastes

As described in Section 4.0, the only wastes that are expected to be generated during the Phase I RFI are soils obtained from borings, contaminated clothing and equipment, water used to test the integrity of tanks, and groundwater from hydropunch sampling efforts (if performed during the Phase I RFI and not as part of IRP investigations at IRP Site 39). Wastes generated at SWMUs which are known to have handled listed hazardous wastes will be treated as hazardous waste unless and until a determination that the material does not meet the definition of a listed waste is made. In addition, until they are classified, all generated wastes will be treated as hazardous waste. The wastes from SWMUs which did not handle listed wastes will be classified by first reviewing existing data showing contaminant concentration levels to determine if TCLP sampling of SWMU applicable parameters is necessary. If after reviewing the existing sample analysis data the Contractor feels TCLP sampling of the wastes is not necessary, the wastes will be classified as nonhazardous. The remaining wastes will be analyzed for TCLP SWMU applicable parameters to determine if they are characteristically hazardous. This approach is conservative; however, it will ensure the proper management of all wastes and the Base's compliance with all applicable waste management regulations.

For the purpose of managing wastes generated during the RFI, the SWMUs being investigated have been divided into two criteria: 1) sites that are known to have managed listed hazardous waste, and 2) sites that managed characteristically hazardous waste or nonhazardous waste. The purpose of the division is to reduce the amount of potentially hazardous waste generated by the Phase I RFI. Table 7-1 lists the SWMUs being investigated under each of these criteria.

Table 7-1

Solid Waste Management Units (SWMUs) for 28 Sites RFI Work Plan

SWMU No.	Unit Name	Contents
Criteria 1 Sites: Known to Have Managed Listed RCRA Hazardous Wastes		
63	Building 867 Waste Accumulation Area	Paint and paint thinners
71	Building 1178A Waste Accumulation Area	Paint, lacquer thinner, paint thinners (F005), PD-680 solvent, toluene (F005) mixed with acetone (F003)
75	DRMO Waste Storage Area	D001, D002, D007, D008, F001, F002, F003, F005, F007, F008, F017, U002, U003, U012, U019, U022, U036, U044, U089, U154, U159, U167, U188, U220, U226, U228, U239, P012, P035, P106
155	Sludge Drying Beds	Hydrocarbons, solvents, industrial cleaner, paint strippers, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, U159
156	Imhoff Tanks	Hydrocarbons, solvents, industrial cleaner, paint strippers, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, U159
183	Air Base Sewer System	Hydrocarbons, solvents, industrial cleaner, paint strippers, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, U159
129	Building 1191 and 1192 Spill Tanks	Unsymmetrical dimethylhydrazine, JP-4, inhibiting red fuming nitric acid, inhibiting white fuming nitric acid, and aniline
184	Wastewater Recirculation Line	Hydrocarbons, solvents, industrial cleaner, paint strippers, methanol, acetone, formaldehyde, F001, F003, F005, P012, P035, P106, U002, U012, U036, U044, U167, U188, U220, U159
177, 181, 179 [a]	Building 1176 Sumps, Drainage Trough, and Discharge Box	Unsymmetrical dimethyl hydrazine, JP-4, inhibiting red fuming nitric acid, inhibiting white fuming nitric acid, aniline, liquid oxygen, dyes, and rocket propellants.
101	Bldg. 121 Landfill	Waste oils and solvents
AOC-U [b]	Lost River Basin	Stormwater runoff
Criteria 2 Sites: Managed Characteristic Wastes or Nonhazardous Waste Only		
119 2[c]	Bldg 121 Waste Oil Tank Bldg. 121 Oil/Water Separator	Waste oil
120 15[c]	Bldg. 309 Waste Oil Tank Bldg. 309 Oil/Water Separator	Waste oil

Table 7-1

(Continued)

SWMU No.	Unit Name	Contents
121 17[c]	Bldg. 316 Waste Oil Tank Bldg. 316 Oil/Water Separator	Waste oil
123 22[c]	Bldg. 704 Waste Oil Tank Bldg. 704 Oil/Water Separator	Waste oil
126 36[c]	Bldg. 1000 Waste Oil Tank Bldg. 1000 Oil/Water Separator	Waste oil
125 32[c]	Bldg. 868 Fire Water Tank Bldg. 868 Oil/Water Separator	Washwater containing fire suppressant
127 39[c] 135	Bldg. 1092 Waste Oil Tank Bldg. 1092 Oil/Water Separator Bldg. 1092 Oil/Water Separator Drainage Pit	Drainage of fuel and fire water
138 128 40[c]	Bldg. 1166 Oil/Water Separator Drainage Pit Bldg. 1166 Waste Oil Tank Bldg. 1166 Oil/Water Separator	Water, oils, detergents, and fuels
118	Bldg. 21 Pesticides Holding Tank	Pesticides, soap, water rinsate
54 55	Bldg. 702 Waste Accumulation Area Bldg. 702A Waste Accumulation Area	Waste oil, flammable liquids
56	Bldg. 807 Waste Accumulation Area	Waste oil and waste fuels
78	Trim Pad 3 Waste Accumulation Area	Waste oil
91	Bldg. 816 Washrack	Washwater containing oil and fuel
136	Bldg. 1119 Washrack Drainage Pit	Rinsate containing waste fuels and oils
141	Pad 9 Drainage Pit	Aircraft washdown [d]
164	Bldg. 1080 Pond	Stormwater runoff
124	Bldg. 752 Waste Oil Tank	Waste oil

[a] HSWA Permit, Table 1.
[b] AOC = Area of concern.
[c] HSWA Permit, Table 3
[d] Wastes from this SWMU may contain radioactive constituents. All requirements for the handling of mixed wastes will be followed until a determination has been made.

7.1.1 Soils, Clothing, and Equipment Waste

Solid wastes such as soil, clothing, and disposable equipment will be collected in DOT-approved drums. All drums will be labeled with a hazardous waste label as shown in Figure 7-1. The label will be placed on the drum immediately after the first waste has been placed in the drum and will be dated at that point. From the date of first accumulation, the drum must be removed for disposal within 90 days if it is determined to be hazardous, or stored in the Base's RCRA-permitted container storage area at Holloman AFB. Prior to storage in the permitted container storage area, a determination will be required to identity if the storage area is permitted to receive the waste(s). If it is determined to be nonhazardous the waste may be stored longer than 90 days. Containerization of these wastes is also discussed in Sections 3.1.2 and 3.1.3.

Waste of identical media (i.e., soil or clothing and equipment) collected from the SWMUs that have managed only characteristically hazardous waste and nonhazardous waste (Criteria 2 SWMUs) can be collected and stored in the same drum(s). Wastes collected from SWMUs that are known to have managed listed hazardous wastes (Criteria 1 SWMUs) should be put in separate drums, but can be stored in the same location with the other drums. For example, soils collected from the SWMUs listed under Criteria 2 in Table 7-1 can be placed in the same drum until it is full, regardless of which SWMU it was obtained from. Soils collected from the SWMUs listed in Table 7-1 under Criteria 1 should be collected in separate drums until it is known whether or not the waste has been contaminated by a listed waste that would make the contents hazardous.

Samples of the generated wastes will be collected from each drum of wastes and analyzed for SWMU-specific TCLP parameters. Should any of the parameters exceed the concentrations reported in Table 7-2, the contents of that drum will be considered hazardous. If the waste in the drums is identified as nonhazardous, the hazardous waste label may then be removed from the drum. However, the drum should be labeled in such

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE, OR
PUBLIC SAFETY AUTHORITY, OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY

PROPER D.O.T.
SHIPPING NAME _____ UN or NA# _____

GENERATOR INFORMATION:

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

EPA
ID NO. _____

EPA
WASTE NO. _____

ACCUMULATION
START DATE _____

MANIFEST
DOCUMENT NO. _____

HANDLE WITH CARE!

CONTAINS HAZARDOUS OR TOXIC WASTES

STYLE WM-6-P

Printed by LABELMASTER, Div. of AMERICAN LABELMARK CO., INC., CHICAGO, IL 60646

Figure 7-1. Hazardous Waste Container Label

Table 7-2

TCLP Hazardous Criteria

EPA Hazardous Waste No.	Contaminant	Regulatory Level (mg/L)
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol	200.0
D024	m-Cresol	200.0
D025	p-Cresol	200.0
D026	Cresol	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0

Table 7-2

(Continued)

EPA Hazardous Waste No.	Contaminant	Regulatory Level (mg/L)
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

a way to identify the contents of the drum (e.g., nonhazardous soil collected from SWMU 123).

In addition to the TCLP requirements, wastes collected from the SWMUs known to have managed hazardous waste (SWMUs listed under Criteria 1 in Table 7-1) will be hazardous, regardless of TCLP analytical results, if it is determined that the listed hazardous wastes have contaminated the collected wastes (i.e., samples of actual waste are collected, or samples collected are from an area within a waste plume). This can be determined either through visual observation and/or analysis of constituents in the listed waste as shown in Table 7-1.

All hazardous waste must be accompanied with a hazardous waste manifest during transportation to an off-site permitted treatment or disposal facility. A waste manifest is presented in Figure 7-2. Nonhazardous waste may be disposed of in any legitimate disposal facility (e.g., municipal landfill, if it will accept the waste, or one of the Base municipal landfills).

Currently, there are no land disposal restrictions for TCLP hazardous waste. However, since restrictions may be applied in the near future, regulations (40 CFR Part 268) should be reviewed prior to sending this type of hazardous waste to a landfill or other land-based unit for treatment, storage, or disposal. Other possible listed hazardous wastes that could be generated are F003 and F005 wastes. Land disposal restrictions for these and other listed wastes are presented in 40 CFR Part 268, Subpart D. For example, incineration is the best demonstrated available technology (BDAT) for F003 and F005 wastes. However, the maximum concentrations of the listed constituents contained in 40 CFR Part 268, Subpart D, if they are achieved through either BDAT or other pre-approved alternate technologies, would allow for land disposal.

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039. Expires 9-30-91

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law

3. Generator's Name and Mailing Address | A. State Manifest Document Number

4. Generator's Phone ( ) | B. State Generator's ID

5. Transporter 1 Company Name | 6. US EPA ID Number | C. State Transporter's ID | D. Transporter's Phone

7. Transporter 2 Company Name | 8. US EPA ID Number | E. State Transporter's ID | F. Transporter's Phone

9. Designated Facility Name and Site Address | 10. US EPA ID Number | G. State Facility's ID | H. Facility's Phone

GENERATOR

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above | K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name | Signature | Month Day Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name | Signature | Month Day Year

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete

Figure 7-2. Hazardous Waste Manifest

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved OMB No. 2050-0039 Expires 9-30-91

UNIFORM HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

21. Generator's US EPA ID No. | Manifest Document No.

22. Page | Information in the shaded areas is not required by Federal law

23. Generator's Name

L. State Manifest Document Number

M. State Generator's ID

24. Transporter ____ Company Name | 25. US EPA ID Number

N. State Transporter's ID

O. Transporter's Phone

26. Transporter ____ Company Name | 27. US EPA ID Number

P. State Transporter's ID

Q. Transporter's Phone

28. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	29. Containers No.	Type	30. Total Quantity	31. Unit Wt/Vol.	R. Waste No.
a.					
b.					
c.					
d.					
e.					
f.					
g.					
h.					
i.					

GENERATOR

S. Additional Descriptions for Materials Listed Above

T. Handling Codes for Wastes Listed Above

32. Special Handling Instructions and Additional Information

TRANSPORTER

33. Transporter ____ Acknowledgement of Receipt of Materials | Date

Printed/Typed Name | Signature | Month Day Year

34. Transporter ____ Acknowledgement of Receipt of Materials | Date

Printed/Typed Name | Signature | Month Day Year

FACILITY

35. Discrepancy Indication Space

EPA Form 8700-22A (Rev. 9-88) Previous edition is obsolete

Figure 7-2. (Continued)

7.1.2 Wastewater

Water used to test the integrity of waste oil and spill tanks may be generated during the RFI. Water from the tanks is not expected to be hazardous and will be treated in the Base's wastewater treatment facility.

Groundwater generated from hydropunch survey (when performed) will be collected in drums for disposal or collected in open containers and allowed to evaporate. The water will be treated as hazardous since listed wastes have been managed at the SWMU. If it is determined that the water is not a listed waste, then it may be combined and evaporated with other TCLP or nonhazardous wastewaters.

Water generated during the decontamination of equipment will be segregated if it is generated during cleaning of equipment at Criteria 1 SWMUs. This water will be drummed for later disposal or containerized and allowed to evaporate at the SWMU or other approved staging area. If the water from a particular Criteria 1 SWMU is determined to not be a listed waste, it may be combined and stored/evaporated with decontamination water from Criteria 2 SWMUs. Containerization and decontamination procedures are also discussed in Sections 3.1.2 and 3.1.3.

7.2 New Mexico UST Regulations

In accordance with New Mexico UST regulations (EIB/USTR Part 8, Section 801), to permanently close a tank, it must be empty and cleaned by removing all liquids and accumulated sludges. All tanks taken out of service permanently must be either removed from the ground or filled with an inert solid material. In addition, all soil with TPH concentrations greater than 1,000 mg/kg will be removed per the Base's agreement with NMED.

The following cleaning and closure procedures are approved methods in New Mexico:

- American Petroleum Institute Recommended Practice 1604, "Removal and Disposal of Used Underground Petroleum Storage Tanks";
- American Petroleum Institute Publication 2015, "Cleaning Petroleum Storage Tanks";
- American Petroleum Institute Recommended Practice 1631, "Interior Lining of Underground Storage Tanks," may be used as guidance for compliance with New Mexico UST rules; and
- The National Institute for Occupational Safety and Health "Criteria for a Recommended Standard...Working in Confined Space," may be used as guidance for conducting safe closure procedures at some hazardous substance tanks.

All tanks removed as part of Phase I RFI activities will be removed in accordance with New Mexico UST regulations. The tanks which may possibly be removed during the Phase I RFI include waste oil tanks at several SWMUs, as well as the spill tank(s) at SWMU 129. However, SWMU 129 is a Criteria 1 SWMU and if the tank(s) are removed, then special precautions will be required to avoid the generation of additional listed wastes as well as for the disposal of the tanks if listed wastes are determined to be present.

7.3 Contractor Responsibilities

The Contractor will be responsible for the management of investigation-derived wastes during the RFI. Following the generation of the waste at a SWMU or decontamination station, the Contractor is responsible for the proper containerization, sampling, and storage of the waste. Following the receipt of analytical results and the determination of the waste classification, the Contractor is responsible for selecting a disposal method for the waste. Following the Base's final approval of the selected disposal option, the Contractor will request bids for the transport and disposal of the wastes from

qualified firms. After the selection of the transport/disposal subcontractor, the Contractor will ensure that appropriate manifests are prepared and the waste properly disposed of, either on or off base. Essentially, the Contractor will serve to manage the wastes from cradle to grave. All appropriate local, state, and federal regulations will be observed during the process. The Contractor will report regularly to the BEC (or designee), as to the status of wastes being managed. The Contractor will inform the Base of all decisions made relative to waste management and disposal. At such time that the Base implements a base-wide waste management plan, the Contractor will obtain a copy and ensure that Base waste management procedures are followed. The Base will have the final authority for all decisions and the Contractor will not act until final approval by the Base has been granted.

7.4 Holloman AFB Responsibilities

Although the Contractor will manage the wastes from their generation to their final disposal, Holloman AFB, as the generator, will have ultimate responsibility for the wastes and for compliance with all local, state, and federal regulations. In accordance with that responsibility, the Base will have final authority on all decisions made in relation to the management and final disposal of the wastes. The Base will review proposals and decisions made by the Contractor and is responsible for final approval on all decisions. If the Base determines that the Contractor is in violation of any local, state, or federal regulation, or is not managing the wastes in a responsible manner, the Base will notify the Contractor and the appropriate authorities. The Base will then take corrective action, as appropriate, to rectify the situation. To ensure proper management of the investigation-derived waste, the BEC (or designee), will review all reports and information regarding waste management supplied by the Contractor. At such time that Holloman AFB implements a base-wide waste management plan, the Contractor will be provided with a copy of the plan, as well as instructions for its use.

8.0 IDENTIFICATION OF EXPOSURE PATHWAYS AND RECEPTORS

This section identifies and describes potential contaminant migration pathways and potential receptors of the contamination from possible releases of hazardous waste and hazardous constituents from the 41 SWMUs under investigation in the Phase I RFI. The section is not a risk assessment and does not attempt to quantify any risks associated with the SWMUs. The information presented will be used to assess the need for interim measures, if necessary, at SWMUs where releases are documented during the Phase I RFI. The information will also serve as the starting point for any risk assessment that is deemed necessary to quantify the risk at a SWMU and support decisions of no further action or the initiation of a corrective measures study. The exposure pathways and receptors outlined in this report are preliminary and may be tailored to address realistic exposures as the investigation progresses. Since little is known about each site, this assessment is necessarily conservative.

An exposure pathway describes the course a chemical or physical agent takes from the source of contamination to the exposed individual. A complete exposure pathway generally consists of the following: 1) a source and mechanism of chemical release, 2) a retention or transport medium (or media in cases involving intermedia transfer of chemicals), 3) a point of potential human or environmental receptor contact with the contaminated medium, and 4) an exposure route (e.g., ingestion).

The potential receptors (exposed populations) at Holloman AFB include Base personnel and on-Base residents. Sensitive members of these populations, including the ill, elderly, and the very young, are considered in selecting pathways. These individuals will most likely be in neighborhood areas, daycares, hospitals, and schools.

Many of the SWMUs are very small and consist of USTs. If the tanks have not leaked, the potential for contamination from these SWMUs is very small. In most cases, the integrity of the tanks is unknown; therefore, it was assumed that the tanks may have

leaked and appropriate pathways were included to cover this occurrence. As the investigation progresses, these assumptions will be revised to reflect new data on the sites.

8.1 Background Information on Holloman AFB

8.1.1 Human Population

The city of Alamogordo is the only town of appreciable size within 50 miles of the Base. Alamogordo is located approximately seven miles east of the Base boundary and has a 1992 estimated population of approximately 31,090. Holloman AFB has a labor force of approximately 6600 military personnel and 3000 civilian personnel. Of these, 5500 individuals reside in the southeast corner of the Base, referred to as the Main Base area. The term "Main Base" area will be used to refer to the area containing schools, a hospital, a daycare center, and a park, along with the residential area at Holloman AFB. Many people also work in and around the Main Base area. The West and North Base areas are other main locations for workers. The West Base area is near the runways and northwest of the sewage lagoons, while the North Base area is the location of the test tract.

Throughout this report, recreational pathways are discussed. A jogging track and a golf course exist in the West Base area north of the sewage lagoons. The frequency with which these facilities are used is variable. It is possible that avid joggers may use the track several times a week, if not every day. The Base golf course appears to be upgradient from the West Base SWMUs and is too far away from the other SWMU to be affected by potential groundwater contamination. The only potential pathway of concern at the golf course is inhalation of volatiles from SWMUs 183 and 184. These potential exposure scenarios are discussed; however, exposure is expected to be very low. Realistic assumptions (e.g., time spent at the facilities) will be incorporated into the pathways as the investigation progresses.

Another potential recreational area mentioned throughout the report is at the arroyos west of the Main Base area. These pathways were included in a previous risk assessment performed by Radian (1992). It is possible that exposure currently exists in these areas (e.g., through hiking and wading), but children and adults have not been observed in these areas during the course of our investigation. This pathway was more important in the previous risk assessment because future pathways were considered at length. Again, these exposures are expected to be very low and realistic exposure assumptions will be incorporated into the assessment as it progresses.

8.1.2 Groundwater

Currently, there are no groundwater supply wells located on Holloman AFB. The groundwater beneath the Base is considered unfit for human consumption, on the basis of New Mexico Water Quality Control Commission Regulations (NM WQCC 82-1, as amended through August 18, 1991, Parts 3-100 through 3-103), because it exceeds New Mexico Health Standards for total dissolved solids (TDS) and sulfate. The nearest production well downgradient of the Base is a livestock well 3.5 miles west of the Base. No other downgradient or near-Base potable or irrigation wells exist. Groundwater discharge occurs either through evapotranspiration, springs, or seeps along steep-sided arroyos or into closed playa lakes such as Lake Lucero, the regional groundwater discharge area. The primary source of fresh water is Lake Bonita, located 60 miles northeast of the Tularosa Basin.

Groundwater does not discharge into the sewage lagoons and lakes. These surface water bodies have a higher hydraulic head than the adjacent groundwater, making it impossible for the groundwater to discharge into the sewage lagoons and lakes. It has been documented that groundwater discharges to surface water in the banks of the arroyos through seeps or springs. However, this pathway has not been confirmed or observed during previous investigations conducted at the Base (Radian, 1992). This pathway is considered

for SWMUs near the arroyos; however, prior to assessing this pathway, additional study will be necessary to determine if it exists.

Groundwater modeling was performed at Holloman AFB for a previous risk assessment (Radian, 1992). Where appropriate, results from this modeling were used to estimate groundwater directions and travel times for sites near the previously modeled sites.

8.1.3 Surface Water

Surface water located within 10 miles of the Main Base area includes Dillard Draw, just east of the Main Base area; Lakes Holloman and Stinky, southwest of the Main Base area; the Lost River Basin, in the northwest sector of the Base; and Rita's Draw, in the northern sector of the Base. Surface water is not used as a potable water source, for agricultural purposes, or for residential use. The lakes are too highly eutrophic for game fish to survive, but they could potentially be used for recreational purposes (e.g., wading or hunting around the perimeters). The sewage lagoons drain directly into Lake Holloman, which overflows to Lake Stinky during periods of high precipitation; and are believed to supply water to Lake Holloman; therefore, sites impacting the sewage lagoons also potentially impact Lakes Stinky and Holloman.

Surface drainage ditches do not discharge into the sewage lagoons and lakes. the ditches in the Main and West Base move the surface water to the south and southwest toward low lying areas off of the Base where the water then evaporates or percolates into the soil. Given the size of many of the SWMUs, it is very unlikely that they have impacted the drainage ditch system. If constituents have migrated away from the SWMU, these pathways may be further examined based on the results of the Phase I investigation.

The sewage lagoons may be impacted by surface water or soil deposition from other SWMUs. Since the lagoons will be investigated as an RCRA site to support closure activities, and all potential human and environmental impacts arising from potential

contamination at the lagoons will be considered at that time. Therefore, it is extraneous to examine sewage lagoon-related pathways and receptors with every SWMU that potentially contaminates the sewage lagoons.

Biota

Several federal endangered species are potentially affected by contamination from the Base, including the peregrine falcon and the least tern. The state endangered species that have been identified are the common ground dove and the elegant trogon. A New Mexico Group 2 Endangered Species, the White Sands Pupfish, inhabits Lost River. The snowy plover, mountain plover, long-billed curlew, ferruginous hawk, willow flycatcher, and white-faced ibis have been classified as Federal Candidate Category 2 by the U.S. Fish and Wildlife Service and may be present in the area. The Category 2 list is a classification of species that are considered potentially threatened or endangered. In the previous risk assessment performed by Radian (1992), the black-tailed jackrabbit was used as the indicator terrestrial species. The jackrabbit is extremely common in the area and was considered a good representative for assessing exposure to other species in the area.

The area is a grass flats community dominated by alkali sacaton and salt brush. Rabbit brush is also common. Pickleweed is dominant in the more alkaline soils located around Dillard Draw and Lake Holloman. Nonmilitary use in the area surrounding the Base includes some commercial agriculture. The principal crops grown in Otero County are cotton, small grains, and alfalfa, the majority of which are produced under irrigation. Food crops, including commercial agricultural crops and produce from backyard gardens, are subject to accumulation of contaminants via root uptake of any contaminants present in the water used for watering or irrigation, or through subirrigation from the shallow groundwater.

Groundwater and surface water beneath and surrounding the Base are unsuitable for agricultural use; therefore, there is little potential for use of contaminated

water to irrigate commercially grown crops or backyard gardens. Agricultural activities that do use irrigation are located at great distances from the Base and are not expected to be impacted by groundwater migrating from the Base. Some plants have evolved long tap roots that can reach the water table (e.g., alfalfa). Most plants grown in backyard vegetable gardens are not expected to have root systems that extend to the water table and are, therefore, not expected to be contaminated.

Land adjacent to the lakes is owned by the Bureau of Land Management (BLM) or is privately owned. Livestock are allowed on lands south and west of the Base. Currently, no livestock is on the adjacent land; therefore, this exposure scenario is not discussed.

8.2 Regional Pathways and Receptors Located Off-Base

The city of Alamogordo is located too far away from Holloman AFB to be impacted by these sites. The groundwater under Holloman AFB travels very slowly and is unlikely to impact any residents or agricultural activities in the near future (more than 500 years, at least). This report does not discuss potential future pathways and there are currently no residents or agricultural wells close enough to the Base to be affected by groundwater, air, or soil migrating from the Base. The nearest production well downgradient of the Base is a livestock well located 3.5 miles west of the Base (Computrac, Inc., 1986). Wildlife inhabiting areas near the Base boundaries (and on-Base) may be exposed to SWMU contaminants via:

- Inhalation of ambient air and fugitive dust;
- Ingestion of water from seeps, springs, or surface water recharged by groundwater;
- Incidental ingestion of soil; and
- Ingestion of potentially contaminated plants.

Ecological pathways are discussed on a site-by-site basis in the following section.

8.3 SWMU-Specific Pathways and Receptors

This section contains a preliminary outline of the on-Base pathways and receptors associated with each SWMU.

8.3.1 SWMUs 119 and 2--Building 121 Waste Oil Tank and Oil/Water Separator SWMUs 123 and 22--Building 704 Waste Oil Tank and Oil/Water Separator

These two SWMU sites are located near each other, north of the Main Base area, and are USTs with their associated oil/water separators. SWMU 119 is located adjacent to the Building 121 Oil/Water Separator (SWMU 2) and is considered a single site. The tank stores oil and fuel removed from wastewater in the oil/water separator which has been in operation since 1984. SWMU 123 is located adjacent to the Building 704 Oil/Water Separator (SWMU 22) and is considered a single site. The tank collected waste oil removed from wastewater in the Building 702 Oil/Water Separator and is now inactive. As these tanks filled, oil was pumped into drums which were moved to the DRMO Waste Storage Area. Both sites are fenced and access is controlled. Fuel could be smelled and a large fuel spill was reported to have occurred in the past at SWMU 119.

Depending on the season, groundwater flow ranges from southwest to east. During higher water table conditions, groundwater flows with the regional gradient to the southwest, but during lower water table conditions, groundwater flows east toward Dillard Draw. Surface water runoff from these sites may potentially reach Dillard Draw. The Main Base area is located about one-half mile to the south of SWMU 119 and about one mile to the south of SWMU 123. There are on-site employees at both sites. The land surrounding the sites is paved or graveled. SWMU 119 is located underneath and around the SPACECOM facility. There are no secondary containment systems for either site.

The potential for release to soil and groundwater from SWMU 123 is unknown since the integrity and age of the tank is unknown. However, at SWMU 119, the halon vapor monitoring system around the tank has indicated the potential for leakage in the past. It is assumed that releases to media may have occurred for the purpose of risk identification. Potential for release to surface water from runoff is low unless a spill has occurred. Groundwater potentially may release contaminants to Dillard Draw; however, no seeps or springs have been identified in Dillard Draw. Since waste oil was pumped from the tanks to drums, some leakage may have occurred, though a large amount of oil is not expected to have been spilled. In addition to the potential releases indicated by the halon vapor monitoring system, a fuel spill was reported at SWMUs 119 and 2; therefore, the potential for a release to groundwater and surface water is higher at the SWMUs. Subsurface gas may be generated as a result of spills or leaks, potentially releasing volatiles to the air. Since the condition of the tank at Site 123 is unknown and potential leaks have been indicated at Site 119, the same pathways will be assumed for both sites.

On the basis of these release mechanisms, on-site workers, individuals using the nearby Dillard Draw for recreational purposes, and on-Base residents may be exposed to contaminants through various pathways if a release has occurred. On-site workers would be exposed through inhalation of VOCs, particularly in the SPACECOM facility. The sites are paved or covered with gravel, so fugitive dust generation and dermal contact with soil is expected to be insignificant if any releases have occurred. Exposure to on-site workers from SWMU 123 is expected to be insignificant, since the unit is small and spills have not been reported.

Main Base area residents are probably not exposed to volatiles because of the small size of the sites. Recreational receptors at Dillard Draw may be exposed through:

1) Inhalation of volatiles from the site and from the water;

2) Incidental ingestion of water; and

3) Dermal contact with water.

Dillard Draw is not commonly used for recreational purposes and exposure is expected to be very low. Ambient air concentrations of particulates originating at ground level tend to decrease rapidly with increasing distances. Therefore, particulate deposition onto Dillard Draw is not expected to impact water quality significantly.

Wildlife may be affected by potential contamination reaching Dillard Draw. This is a conservative assumption since seeps and springs potentially releasing groundwater to surface water have not been confirmed in the area. Pathways of concern for wildlife may include:

- Ingestion of water from Dillard Draw; and
- Ingestion of potentially contaminated plants.

8.3.2 SWMUs 120 and 15--Building 309 Waste Oil Tank and Oil/Water Separator

SWMU 120, a UST, is located adjacent to the Building 309 Oil/Water Separator (SWMU 15), northwest of the Main Base area. These two SWMUs are considered a single site. The tank, now inactive, stored oil removed from wastewater collected in the oil/water separator. The site was in operation since before 1975 and was closed in 1989. As the tank filled, waste oil was pumped to drums and moved to the DRMO Waste Storage Area. The site is not fenced and is easily accessible.

The site is surrounded on three sides by paved parking lots and on one side by gravel and dirt which is not used as part of routine activities at the site. The oil/water separator was cracked and rusted, and there are no containment structures. Surface water runoff flows to paved areas and is probably caught in ditches and low lying areas. The Main Base area is about 1 mile south and southeast of the site. There are on-site employees, and heavy pedestrian traffic was noted near the site.

Owing to the condition of the separator, it is assumed that the soil may have been contaminated by releases of oil. In addition, rinsate water passes through this separator to the new waste oil tank. Since the separator is cracked, leakage to soil may still be occurring. Release of contaminants to groundwater may have also occurred. The site is located directly next to Building 309 and is partially covered with gravel, which helps to keep fugitive dust generation down. Because the site covers a very small area, there is probably no pedestrian traffic directly on the site. Subsurface gas generation may occur in the tank and from any contaminated soil around the tank if a release has occurred.

Groundwater flows southwest away from Dillard Draw and probably does not reach any other surface water body. Rainfall runoff drains onto paved surfaces and is unlikely to reach surface water. There are no complete pathways involving these media. On-site workers may be exposed through inhalation of volatiles migrating from the unit if a release has occurred. This pathway should be assessed, however it is expected to be insignificant because of the size of the site. Main Base area residents may also be exposed through the inhalation of volatiles.

The site is not covered by vegetation and is too small to serve as a habitat to animals. Volatiles from the site may migrate into areas where animals live; however, this pathway is probably insignificant and extremely difficult to quantify in animals. Groundwater in the area may be taken up by certain plants, therefore ingestion of plants should be considered for wildlife.

8.3.3 SWMUs 121 and 17--Building 316 Waste Oil Tank Oil/Water Separator

SWMU 121, an UST, is located adjacent to the Building 316 Oil/Water Separator (SWMU 17), west of the Main Base area. SWMUs 17 and 121 are considered a single site. The tank is used to store oil removed from wastewater collected in the oil/water separator. As the tank fills, oil is pumped into drums that are taken to the

DRMO Waste Storage Area (SWMU 75). Hydraulic fluids and, possibly, PCBs (in older hydraulic oils) are the only materials known to have been handled at the site.

Groundwater beneath the site flows to the southwest. Runoff from the site may drain toward the sewage lagoons (over 1 mile to the southwest) if it is not caught in ditches or absorbed. The land surrounding the site is composed of parking lots and roads. The Main Base area is approximately one-half mile southeast from the site. The employee population around the site is heavy and the site is accessible.

Results from the halon vapor monitoring system in place around the tank indicate that releases have not occurred. However, for the purposes of risk identification, it is assumed that releases to soil and groundwater may have occurred in the past. Surface water runoff would probably not be heavily contaminated and PCBs generally adhere strongly to the soil as opposed to migrating in the runoff. Based on this, on-site workers may be exposed through: 1) inhalation of volatiles generated below the surface, and 2) inhalation of fugitive dust, which may contain contaminants if spills to surface soils have occurred. Owing to the location of the site, dermal contact with soil is probably insignificant. On-Base residents may be exposed through inhalation of volatiles, although this pathway is not expected to be significant based on the halon vapor monitoring results. Once the sampling data has been analyzed, these pathways may be dropped from the assessment based on lack of contamination.

Land to the north and west of the site is unoccupied and open, therefore wildlife may be exposed via inhalation of volatiles and ingestion of potentially contaminated plants reaching the groundwater table (if releases have occurred). The site itself does not offer suitable habitat, and dermal contact with soil deposited off site is expected to be insignificant.

8.3.4 SWMUs 126 and 36--Building 1000 Waste Oil Tank and Oil/Water Separator

SWMU 126, a UST, is located adjacent to the Building 1000 Oil/Water Separator (SWMU 36). These two units are considered a single site. The tank is used for storage of oil removed from vehicle and equipment washwater collected in the oil/water separator. The age and integrity of the tank are not known. As the tank fills, excess oil is pumped to drums which are moved to the DRMO Waste Storage Area (SWMU 75). The tank has not been pumped out in 10 or more years, according to site personnel. The site is fenced but accessible.

Groundwater flows to the northwest, potentially transporting contaminants (if any) towards the Lost River Drainage Basin. According to groundwater modeling at nearby SWMU 104, the Army Landfill, groundwater does not reach Malone Draw. Furthermore, it is unknown whether groundwater discharges to the drainages and arroyos. The tank does not have any secondary containment structures; however, rainfall runoff is not likely to reach the Lost River Drainage Basin which is several miles away, or any other surface water body. The land surrounding the unit is mainly parking lots. Workers are located on site, and the site is located approximately 2 miles northwest of the Main Base area.

Since the site is covered with gravel, the potential for release of fugitive dust to the air is low. The potential for releases to soil and groundwater and for subsurface gas generation is unknown, since the tank's integrity is unknown. Although no releases have been reported or documented, their occurrence would impact soil and possibly groundwater. Groundwater is not used; therefore, there is no exposure pathway for this medium. Dermal contact with soil is not expected from site activities. The only complete pathway for contaminant migration from a release is inhalation of volatiles, which is expected to be insignificant because of the small size of the site, but should be assessed.

If leaks have occurred, groundwater (if affected) may have been contaminated. Wildlife may be exposed through inhalation of volatiles and ingestion of plants potentially contaminated by groundwater.

8.3.5 SWMUs 125 and 32--Building 868 Fire Water Tank and Oil/Water Separator

SWMU 125, a UST, is located near Building 868 adjacent to the Oil/Water Separator (SWMU 32), nearly 2 miles west of the Main Base area. These two units are considered a single site. The tank is used to store oil removed from fire suppression water and rinsate water from floor washing collected in the oil/water separator. The tank is currently active and began operation in 1986. The site is covered with cement and asphalt and is used as an outside break area.

There is no secondary containment system for the unit. Rainfall runoff is probably caught in ditches and low areas. The land surrounding the unit is used for a flight line. No spills have been reported from the unit; however, the integrity of the tank is unknown. Subsurface soils may be contaminated and subsurface gas generation may be a factor if releases have occurred. In addition, if leaks have occurred, groundwater may potentially be contaminated.

Groundwater beneath the site flows to the southwest. Since it is not used, there is no complete pathway for on-site workers or on-Base residents for this medium. Inhalation of subsurface volatiles migrating to the air may occur if there was a release; however, the site is covered with concrete which would reduce the amount of volatiles entering the air. Unless sampling activities reveal unsuspected contamination, no human exposure pathways are currently identified for this site.

The site offers no habitat for animals; therefore, there are no on-site ecological concerns. If releases to groundwater have occurred, animals may be exposed

through ingestion of potentially contaminated plants off site, and inhalation of volatiles migrating from groundwater.

8.3.6 SWMUs 39, 127, and 135--Building 1092 Waste Oil Tank, Oil/Water, and Oil/Water Separator Drainage Pit

SWMU 127, a UST, is located adjacent to the Building 1092 Oil/Water Separator (SWMU 39), north of the Main Base area. These two units, along with SWMU 135, the Building 1092 Oil/Water Separator Drainage Pit, are all considered a single site. SWMU 127 collected waste oil and waste fuel from the oil/water separator. The drainage pit manages wastewater containing the soluble components of jet fuels. There is no liner in the pit and wastewater was allowed to infiltrate the soil or evaporate. SWMUs 127, 39, and 135 are currently inactive and were operated from 1979 to 1991. The units are located 1/10 of a mile north of Sable Road and east of the new SPACECOM facility. SWMU 135 has had past releases to soil and, therefore, possibly to groundwater. Hydrocarbon contamination has been detected in the water table aquifer in the vicinity of the unit. The site remains fenced and locked.

SWMUs 127, 139, and 135 in the RFI was investigated as part of the IRP as Site 31. The findings of the investigation and of the accompanying risk assessment concluded that, although surficial contamination was present and one well exhibited slight contamination, no risk was present and no further action was recommended (Decision Document 7). However, since no recent investigations have occurred at the SWMUs and past actions indicate some groundwater contamination, additional investigation activities will be performed as part of the Phase I RFI (see Section 4.7 in the Work Plan).

If the results of the Phase I RFI warrant them, an additional investigation and a risk assessment will be performed as necessary.

8.3.7 SWMUs 40, 128, and 138--Building 1166 Waste Oil Tank, Oil/Water Separator, and Oil/Water Separator Drainage Pit

SWMU 128, a UST, is located adjacent to the Building 1166 Oil/Water Separator (SWMU 40), northwest of the Main Base area. These two SWMUs along with SWMU 138, the oil/water separator drainage pit, are considered a single site. The tank stores oil removed from wastewater collected in the oil/water separator. The drainage pit, located just south of the separator, receives wastewater effluent from the separator. The units are not fenced and are accessible.

Groundwater in the area flows to the south and may discharge to the Lost River Drainage Basin. However, it is unknown whether seeps or springs occur in the arroyo. Surface water runoff from the site drains into the Lost River Drainage Basin. The site is 4 to 5 miles from the Main Base area, and there are some employees on site.

Subsurface gas generation may occur at SWMUs 128 and 40 if releases have occurred. However, results from the halon vapor monitoring system installed around the tank indicate that no releases have occurred and that the integrity of the tank is intact. Releases to groundwater from SWMU 138 may occur since the drainage pit is unlined. The potential for the release of volatiles to the air is high since the pit is open. Fugitive dust generation is likely to occur from SWMU 138, as is dermal contact with soil, since the pit is not fenced or covered.

Potential pathways for on-site workers include:

- Inhalation of volatiles and fugitive dust;
- Dermal contact with soil; and
- Incidental ingestion of soil.

Potential ecological concerns arising from this site include:

- Inhalation of volatiles released to the air by soil and groundwater (if any);
- Ingestion of groundwater if it is discharged to the Lost River Drainage Basin;
- Ingestion of soil while grooming and foraging;
- Dermal contact with soil; and
- Ingestion of contaminated plants.

8.3.8 SWMU 118--Building 21 Pesticides Holding Tank

SWMU 118 was an aboveground plastic tank located near Building 21 in the Main Base area. This unit stored excess pesticide and pesticide rinsewater from spray applicators. The tank was underlain by soil and held liquids and organics. The pesticides were stored until the tank was full, at which time the contents were applied as with other pesticides. Some overflow apparently infiltrated the soil beneath the unit. The old tank was removed about one year ago and the soil was removed and replaced with clean soil.

The Building 21 Entomology shop area, of which SWMU 118 is a part, was investigated in 1991 as IRP Site 16. The findings of the investigation, as well as the accompanying risk assessment, determined that the risk to human health and the environment from releases from the site was acceptable and no further action was recommended. However, neither the source or the extent of the contamination present was determined and EPA has recommended further investigations at this SWMU.

As part of the RFI, some additional investigation will be performed (see Section 4.9 of the Work Plan). If the results of the RFI warrant them, an additional investigation and a risk quantification will be performed as necessary. Pathways included in the Site 16 risk assessment were inhalation of volatiles and fugitive dust by on-Base

residents. On-site workers were not considered significantly exposed. Pathways and receptors will be reconsidered based on new data if another risk assessment is performed.

8.3.9 SWMU 129--Building 1191 Spill Tank

SWMU 129 is located behind Building 1191 at the current equestrian center north of the Main Base area. The site consisted of up to four catch tanks for spills from Building 1191. Information indicates that the tanks may have been crushed and buried with concrete. However, existing documentation is conflicting for both the location and disposition of the tanks. Water was detected in the tanks before they were destroyed, indicating that there may have been leaks.

Groundwater in the area flows to the northwest towards the Lost River Drainage Basin, which is over a mile away. It is unknown if the groundwater releases to surface water. On-Base residents are located several miles southeast of the site and would probably not be affected by the site. There are no on-site workers, though the area is used recreationally and there is a playground close to the site.

A risk assessment done for IRP Site 36 (SWMU 178--Building 1191 Fuel Runoff Pits) concluded that no risk was present from activities and releases (if any) at the site. The RI consisted of the installation and sampling of five groundwater monitoring wells. The area investigated included and brackets the location of SWMU 129. However, further activities to assess whether a release has occurred have been recommended by the EPA and additional investigations are being performed as part of the Phase I RFI. If the findings of these investigations warrant them, an additional investigation and a risk assessment will be performed. Soil exposure pathways will need to be evaluated if contamination is found. Wildlife may potentially be exposed through inhalation of volatiles from soil and ingestion of potentially contaminated plants, if releases have occurred. Dermal contact with soil should be evaluated. In addition, inhalation of volatiles from subsurface soil may be a pathway for individuals using the stables and the horses.

8.3.10 SWMU 54--Building 702 Waste Accumulation Area and SWMU 55--Building 702A Waste Accumulation Area

SWMUs 54 and 55 were waste accumulation areas located near Building 702, northeast of the Main Base area. SWMU 54 consisted of a temporary steel plating on top of gravel on which used oil and solvents were stored in various containers. This unit was closed in 1987 and SWMU 55 was opened. SWMU 55 is currently in use and consists of a metal storage building in which waste is temporarily stored. Past releases to soil at SWMU 54 have been reported and the soil was excavated down to 3 ft and backfilled. SWMU 55 appears to be in good condition, although the metal drop pans and the wooden pallets on which the drums are stored are stained. Neither unit had a secondary containment system. Rainfall runoff probably drains to ditches which release the water to low lying areas off-Base where it evaporates or absorbs. The sites are not fenced and are accessible.

Groundwater ranges seasonally from southwest to the east. Past releases to soil have been reported, therefore, groundwater may be potentially contaminated. It is unknown whether groundwater discharges in Dillard Draw located east of the site, and surface water runoff from the area may drain to nearby Dillard Draw. The Main Base area is about 1 mile south of the site. Since both SWMUs are covered with gravel, fugitive dust generation is not expected to be a problem. Volatilization is probably insignificant from both SWMUs because of their small size.

On-site workers and on-Base residents are not expected to be exposed to contaminants from the site. Infrequent recreational exposure may occur at Dillard Draw. Potential exposure pathways, if releases have occurred and past activities have not remediated/contained them, include:

- Inhalation of volatiles from groundwater;

- Incidental ingestion of surface water; and
- Dermal contact with groundwater while wading.

Exposure via these pathways is expected to be very low. Realistic exposure assumptions will be incorporated into the assessment as the investigation progresses. Wildlife may be exposed through:

- Inhalation of volatiles from Dillard Draw;
- Ingestion of groundwater in Dillard Draw; and
- Ingestion of potentially contaminated plants.

8.3.11 SWMU 56--Building 807 Waste Accumulation Area

SWMU 56, located northwest of Building 807, is an inactive drum storage area for waste oils and solvents from maintenance of jet aircraft. The drums were placed on wooden pallets over airport runway matting; drums of product fuel were kept on the pad as well. There was no secondary containment system, and the site is not fenced and is easily accessible. The site was used from about 1978 to 1990. Releases to soil and groundwater may have occurred in the past. The area is now covered with gravel, and the soil is stained.

The groundwater beneath the site flows to the southwest and there are no receptors. The site appears to pond during heavy rains rather than draining to surface water. The surrounding land is used for parking or consists of areas of soil that are not used. The Main Base area is roughly 1.5 miles from the site. The West Base area is within 1 mile of the site. Owing to the small area of the site, it is unlikely that volatiles would pose a threat to the Main Base area residents. There are no workers on-site.

The site is not vegetated and is not expected to provide habitat for wildlife. Ingestion of potentially contaminated plants by wildlife off-site should be assessed if releases are determined to have occurred.

8.3.12 SWMU 63--Building 867 Waste Accumulation Area

SWMU 63, a drum storage area, is located northwest of Building 867. It was used to store paint and paint thinner mixtures from 1984 to 1987. The drums were placed on a pallet with a drip pan underneath; however, it was reported during the literature search that the unit had been mismanaged. Releases to soil have occurred, and light stains were noted on the soil in the past. The site is not fenced and is accessible.

Groundwater flow beneath the site is to the southwest and there are no receptors. Surface water runoff is probably caught in ditches and percolates into the soil. During heavy rain, some runoff may reach the sewage lagoons. The Main Base area is about 1 mile to the southeast. The unit is located near the flight lines, and the land surrounding the area where the unit was is mainly covered with dirt and some gravel.

On-site workers are not expected to be exposed to the contaminants in the soil. The unit covers a very small area, which is not directly next to any buildings; therefore, inhalation of volatiles and incidental ingestion of soil should be insignificant. Residents off site are not affected by the unit.

Because of the small area of the unit, and because the unit is not vegetated and is in a parking area, on-site ecological exposure is not expected. The main ecological pathway of concern is ingestion of plants with root-systems extending to the groundwater, which may be potentially contaminated if releases to soil have migrated to the groundwater table.

8.3.13 SWMU 71--Building 1178A Waste Accumulation Area

SWMU 71, an inactive drum storage area, is located near Building 1178, adjacent to the Lost River Drainage Basin. It was used as a less-than-90-day storage area for paint thinners and solvents. Drums were placed on concrete pads with no secondary containment system. The pads and surrounding soil are slightly stained. The unit is not fenced and is easily accessible.

Groundwater flows south toward the Lost River Drainage Basin. Surface water runoff drains to a low point in the parking lot; however, in the event of heavy rain, it may flow into the Drainage Basin. The Main Base area is about 5 miles from the site. Surrounding land is used for parking lots and is paved or graveled.

The potential for exposure to on-site workers is low, since the unit is empty, graveled over, and does not appear to be in the way of mainstream traffic. Volatiles from potential soil contamination may be released to air; however, because of the size of the site, inhalation of volatiles is expected to be insignificant. Groundwater potentially contaminated by the site may discharge into the Lost River Drainage Basin producing volatiles. However, discharge of groundwater to surface water has not been confirmed or identified. Main Base residents are located too far away to be affected by site contaminants.

Since the unit is not vegetated and is located in a parking lot, direct exposure to ecological receptors is not expected. Ingestion of plants potentially contaminated by groundwater, and ingestion of water from the Lost River Drainage Basin should be assessed.

8.3.14 SWMU 78--Trim Pad 3 Waste Accumulation Area

SWMU 78, an inactive drum storage area, is located on Trim Pad 3 in the West Base area. The site consisted of an oil bowser, drums, and a metal shed on top of the concrete pad. Waste oil from flight line support vehicles was stored in the bowser and

drums. Currently, the concrete pad is all that remains of the unit. Containers were also stored outdoors on a concrete pad which sloped toward a ditch. The site is not fenced and is accessible.

Groundwater beneath the site flows to the southwest. Surface water runoff may potentially enter the sewage lagoons south of the site. The Main Base area is almost 2 miles to the east. Release of contaminants to the soil and groundwater has not been reported, but stains have been observed on the concrete pad, which is weathered and cracked in places.

Workers near the unit are not expected to be exposed to contaminants since the area is well vegetated (keeping fugitive dust generation down) and paved. On-Base residents are not expected to be impacted by the site.

Animals may be exposed to contaminants in soil directly surrounding the site if releases off the pad occurred. They may also be exposed to contaminants contained in standing water in the adjacent ditch after rains. Potential exposure pathways (if releases off the pad have occurred) are:

- Inhalation of volatiles from the soil;
- Ingestion of water;
- Incidental ingestion of soil while grooming and foraging;
- Dermal contact with soils; and
- Ingestion of potentially contaminated plants.

8.3.15 SWMU 75--DRMO Waste Storage Area

SWMU 75, a waste accumulation area (RCRA-regulated), is located near the Civil Engineering Open Storage Area. The unit is a greater-than-90-day storage area for hazardous wastes and also stores and handles various non-hazardous wastes. The startup date for this unit was 1980, and the site is currently active. Wastes containing organic and inorganic compounds are stored at the site. Wastes are transported off-site by various contractors for resale, recycling, reclamation, or disposal. The unit is bermed and connected to a sewer system. Some catch basins were cracked at the time of the background literature search, but drip pans had been placed in these locations. In the past, rusted, dented and open drums were observed and an oil spill was documented on 2 May 1985. The site is fenced and access is controlled.

Groundwater beneath the site flows to the south. There is no known direct discharge of contaminants from the site to surface water sources. The nearest residence is about 1000 ft away; the nearest school and park are about 3000 ft away.

Due to the release controls and sealed drums, the potential for exposure through inhalation, ingestion, or dermal contact is deemed to be low. On-site workers and Main Base residents may be exposed through inhalation of volatiles.

Since the catch basins were observed to be cracked, groundwater may have received contamination. Dillard Draw is over a mile away to the south, but may potentially receive contamination from groundwater. No seeps or springs have been confirmed to release groundwater to Dillard Draw, however. Dillard Draw may be used for wading at times when the water level is high enough. Therefore, there may be a low amount of recreational exposure through:

- Inhalation of volatiles from water;

- Incidental ingestion of water; and
- Dermal contact with water.

Significant incidental ingestion is not expected during wading activities. As the investigation progresses, realistic exposure scenarios for recreational use of Dillard Draw will be incorporated into the assessment.

Wildlife may use Dillard Draw as a water source; therefore, ingestion of water is considered as a potential ecological pathway. Ingestion of plants potentially contaminated by groundwater is also a pathway for wildlife.

8.3.16 SWMU 91--Building 816 Washrack

SWMU 91, an inactive washrack, is located on the south side of Building 816. The period of operation for this unit is unknown. It collected washwater from vehicle washing and maintenance. The washrack is a sloped concrete pad, diked on two sides. The water was collected by a drain in the center of the pad; however, the pad is cracked and in poor condition. The site is not fenced and is accessible.

Groundwater under the site flows to the southwest. Surface water runoff is toward the south toward the sewage lagoons. The Main Base area is approximately 2 miles to the east of the site. Surrounding land is used for the flight line area and is paved and graveled. Building 816 is also adjacent to the site.

On-site workers are not expected to ingest fugitive dust from the gravel cover. Inhalation of volatiles should be assessed, however, if releases have occurred. Since the site is closed, dermal contact with soil is not anticipated. Main Base residents are located approximately 2 miles from the site; however, volatiles are probably dispersed before reaching that area.

The unit itself does not provide habitat for wildlife. Exposure may occur through ingestion of plants potentially contaminated by groundwater (if affected) off-site.

8.3.17 SWMU 136--Building 1119 Washrack Drainage Pit

SWMU 136, a liquid drainage area, is located next to the Building 1119 washrack. The unit was in operation from 1980 to 1990. Wastewater was released directly to the soil at this unit; the ground surface is partially covered with gravel. The washrack has not been used in two years and, though the unit is called a drainage pit, there is not an actual pit. The unit is fenced and access is controlled.

Groundwater under the site flows west/northwest, and probably does not reach surface water. Surface runoff flows to the northwest and southwest, according to topography maps. The Lost River Drainage Basin is over a mile to the northwest, and probably does not receive surface water runoff from the site. The surrounding land is used to store generators, trucks, and trailers. Soil around the washrack was reported to have been removed when use of the washrack ceased. The site is about 5 miles from the Main Base area.

Assuming soil was replaced, on-site workers are not expected to be exposed to contaminated soil or fugitive dust. Volatiles may be released from subsurface soils, and releases may have occurred to groundwater since the rack drained directly to soil. The only potential exposure pathway to on-site workers is through inhalation of volatiles, if present. Main Base residents are too far away to be affected by the site.

The area is not widely vegetated and does not appear to offer food or habitat to birds. Groundwater is 25-30 ft deep; therefore, plants are not expected to reach the water table, potentially absorbing contaminants. No ecological receptors are identified.

8.3.18 SWMU 141--Pad 9 Drainage Pit

SWMU 141, an inactive liquid drainage area, is located near the Pad 9 Washrack. The exact dates of operation are not known. The unlined pit collected washwater from the Pad 9 Washrack, and measured 30 ft long by 30 ft wide by 12 ft deep. It is now a shallow depression and has salt cedar growth in it. It is also slightly radioactive from having received washwater from the decontamination of jets that flew through radioactive blast materials. The unit is not fenced, but is located in a remote area.

Groundwater beneath the site flows southwest. Surface water runoff enters the pit and leaches into soil and groundwater; thus, past releases to soil and possibly groundwater have potentially occurred. The Main Base area is about 2 miles from the site, and probably does not receive volatiles.

It is not known if there are on-site workers. Assuming that there are, they may be exposed via inhalation of volatiles, if present, and radioactive materials, if present. Workers in the West Base area may also be exposed via inhalation of volatiles and radioactive materials if either type of compounds are present.

Wildlife may be exposed via inhalation of volatiles, if present, and radioactive materials from soil and ingestion of plants potentially contaminated by groundwater.

8.3.19 SWMU 164--Building 1080 Pond

SWMU 164, a surface impoundment, is located southeast of Building 1080. It has been active since 1956. It is used to collect runoff from the asphalt-covered drone aircraft ramp area near Building 1080. The soils in the unlined pond are known to contain metals. A 10,000-gal. fuel spill was reported to have occurred north of the site in November 1992, and may have run into the pond. There were also reports of standing product just north of the site as a result of the November 1992 spill. The site is not fenced and is accessible.

Groundwater beneath the site flows to the west and has no receptors. Surface water runoff ponds at the site until it evaporates or leaches into soil. The surrounding land most likely provides habitat for wildlife. It is heavily vegetated and overgrown with salt cedar. The Main Base area is approximately 1.5 miles southeast of the site and probably does not receive contaminants.

Because of the size of the unit, approximately 2 acres, on-site workers should be assessed for:

- Inhalation of volatiles and fugitive dust;
- Incidental ingestion of soil; and
- Dermal contact with soil.

Wildlife in the area may be exposed via:

- Inhalation of volatiles and fugitive dust;
- Ingestion of contaminated surface water on-site;
- Ingestion of contaminated soil from grooming and foraging;
- Dermal contact with soil; and
- Ingestion of potentially contaminated plants.

On the basis of previous groundwater modeling conducted at the Base, groundwater would take over 1000 years to reach the Lost River Drainage Basin and it is unknown if releases to surface water occur.

8.3.20 SWMU 124--Building 752 Waste Oil Tank

SWMU 124, a waste oil tank, is located approximately 150 ft west of Building 752. The tank has been in operation since 1986. It is used to store waste oil, crank case oil, and hydraulic fluid. The unit rests on a wooden cradle on a concrete pad. There are no secondary containment structures, and rain has caused puddles in the area. A small spill was reported to have occurred when a valve was replaced. The surface soil was observed to be slightly stained. Nothing has been put into the tank in about 6 years, and the contents of the tank are composed of waste oils, although it is now believed they are considered unknown. The site is not fenced.

Surface water drains toward Ponds A and B. The site is approximately 100 ft from a jogging track, and about 1 mile from the Main Base area.

Since the tank is in good condition, leaks are not suspected to have occurred. Owing to the small spill that occurred, there may be some volatiles in the air. However, due to the size of the site and nature of the contaminants, inhalation of volatiles is suspected to be insignificant. No human receptors have been identified. The area around the site may provide suitable habitat for wildlife. Potential exposure pathways are:

- Inhalation of volatiles and fugitive dust;
- Incidental ingestion of soil while grooming or foraging;
- Dermal contact with soil; and
- Ingestion of contaminated plants.

8.3.21 SWMU 155--Sludge Drying Beds

SWMU 155, an inactive wastewater treatment plant unit, is located north of Pond A. The dates of operation were from the 1950s through 1982. The beds were used

to dewater sludge from the wastewater treatment plant. The beds were unlined, approximately 1 ft deep, and no secondary containment was present. The wastewater contained domestic sewage, dissolved hydrocarbons, solvents, industrial cleaners, paint stripper, methanol, acetone, formaldehyde, and other wastes. There is no evidence that the beds existed and they may have been scraped clean. The site is fenced.

Surface water runoff enters Pond B. The Main Base area is over 1 mile from the site, and a jogging track is about 100 ft from the site.

At closure, the drying beds were excavated and backfilled with soil. Contamination, if present, is overlain by the backfill. It is not known from where the backfill was obtained. Assuming the site was remediated, the only exposure pathway involves uptake of potentially contaminated groundwater by plants which are subsequently eaten by wildlife.

8.3.22 SWMU 156--Imhoff Tanks

SWMU 156, an inactive wastewater treatment plant unit, is located south of Building 752. The unit was in use from the 1950s to 1982; it received wastewater from the wastewater treatment plant headworks. The unit consisted of five tanks that were approximately 28.5 to 40 ft deep, depending on the as-built plan reviewed. The tanks may still contain sludge and their integrity is unknown. The tanks lie above and below groundwater. The unit is not fenced, but is currently covered with soil and a fence surrounds the lagoons.

Groundwater flows southwest and has no surface water receptors; surface water runoff flows into Pond B. The Main Base area is about 1 mile to the northeast, and a jogging track is about 100 ft from the site. The overall site is not vegetated; however, the tanks are covered with mounded noncontaminated soil that is grassed at the top.

The potential for the release of volatiles is unknown since the condition of the tanks is unknown. Main Base area residents are not expected to be impacted by volatiles since the tanks are buried, contamination is suspected to be deep, and volatiles would probably be dispersed before reaching the Main Base area. This pathway is included for on-site workers and recreational receptors (joggers and golfers) because they are closer to the site.

Recreational exposure includes the following pathways:

- Inhalation of volatiles and fugitive dust from soil;
- Incidental ingestion of soil; and
- Dermal contact with soil.

Wildlife may be exposed through:

- Inhalation of volatiles from soil; and
- Ingestion of potentially contaminated plants.

Dermal contact with soil from the site through deposition off-site is probably insignificant, since the site is covered with clean soil.

8.3.23 SWMU 184--Wastewater Recirculating Line

SWMU 184, a concrete pipe, is located along the east side of Pond B, running from Pond F to the splitter box. The startup date is unknown and the unit may be currently active. It supplies oxygenated water for mixing with incoming raw sewage to decrease the anaerobic nature of the influent. The integrity of the pipe is unknown. The lagoons are fenced.

Surface runoff from the site drains into Pond B; however, surface contamination is not expected. The Main Base area is approximately 1 mile northeast of the site and the Base golf course is adjacent to the site to the east. The jogging track is about 200 ft north of the site.

Since the line is buried, dermal contact is not expected as an exposure pathway for wildlife or on-site workers or recreational receptors. However, inhalation of volatiles should be assessed for receptors at these locations if leakage has occurred.

Wildlife may be exposed via ingestion of plants. Inhalation of volatiles may be a pathway for wildlife; however, this pathway is extremely difficult to quantitate in animals.

8.3.24 SWMUs 177, 181, and 179--Building 1176 Sumps, Drainage Trough, and Discharge Box

These SWMUs were previously investigated as part of IRP Site 39; results are presented in the *Remedial Investigation Report--Investigation, Study and Recommendation for 29 Waste Sites* (Radian, 1992). IRP Site 39 encompassed all SWMUs involved in the fueling and detanking of test sleds. This site contains SWMU 177 (Building 1176 Sumps), SWMU 181 (Building 1176 Drainage Troughs), and SWMU 179 (Discharge Box).

Organic and inorganic contaminants were detected in site soils and in downgradient monitor wells at concentrations below detection limits. The risk assessment determined that although there was no risk to on-site workers, the contamination present did pose a concern to wildlife, especially the White Sands Pupfish and the indicator species, the black-tailed jackrabbit.

Groundwater beneath the site flows to the south, and potentially discharges to the Lost River Drainage Basin; however, no known seeps or springs have been determined in the Lost River Drainage Basin. Surface water runoff also drains toward the

basin. The Main Base area is over 5 miles to the southeast. The potential of subsurface gas generation from the site was reported as high. Releases are known to have occurred to the soil and groundwater. The area around this site is highly vegetated.

On-site workers may be exposed via:

- Inhalation of fugitive dust;
- Inhalation of volatiles from soil and standing water; and
- Inhalation of volatiles from the Lost River Basin.

However, as noted previously, the risk assessment conducted as part of the RI did not find any concerns for on-site workers. Main Base residents are not expected to be affected by site contaminants.

Wildlife may be exposed via:

- Inhalation of volatiles from water and soil at the site;
- Ingestion of standing water at the site;
- Ingestion of water at the Lost River Drainage Basin;
- Incidental ingestion of soil while grooming and foraging;
- Dermal contact with soil potentially contaminated by overflows at the site and by soil in the Lost River Drainage Basin; and
- Ingestion of potentially contaminated plants.

The White Sands Pupfish and terrestrial animals may be affected by groundwater releasing to the Lost River Drainage Basin if groundwater discharge actually occurs.

8.3.25 SWMU 101--Building 121 Landfill

SWMU 101, an inactive landfill, is southeast of Building 121, about 1000 ft from the Base property line. The landfill was in operation from 1942 to 1958, and was used for domestic and hospital solid wastes, drums containing waste oils and solvents, and incineration ash. Building 121 and other structures partially cover the landfill. The wastes were placed on unlined soil and there are no surface runoff controls. The site is fenced and access is controlled.

As part of the IRP investigations performed at the Base, the Building 121 landfill was investigated in 1987 as IRP Site 10. The findings of the investigation and of the risk assessment concluded that the landfill posed no significant risk to human health or the environment. As per the Decision Document prepared by Walk, Haydel, and Associates, Inc. in 1990, the site is considered closed. No further investigation is planned as part of the RFI.

8.3.26 SWMU 183--Air Base Sewer System

SWMU 183, the Base sewer system, is located throughout Holloman AFB. It is a belowground pipeline that conveys domestic and industrial wastewater from various locations to the wastewater treatment plant. The integrity of the pipeline is unknown, but its length, location, and various ages render it impractical to perform integrity testing or location-specific investigation.

Depending on the actual integrity of the pipeline, on-site workers, main Base area residents, joggers, and golfers may be exposed via inhalation of volatiles.

Wildlife may be exposed via ingestion of plants and inhalation of volatiles if leaks in the pipeline have occurred.

As discussed in Section 4.27, the entire sewer system is being replaced. Contaminated soils will be removed as discovered.

8.3.27 Site 28: AOC-U--Lost River Basin

The Lost River Drainage Basin is a large basin that receives drainage from various SWMUs and IRP sites. It is primarily unvegetated. This area is a habitat for a variety of species, including the blacktailed jackrabbit, White Sands Pupfish, and birds. This site will be sampled to determine the potential extent of contamination and the sources will be identified.

On-site workers near the Lost River Drainage Basin and downwind of the basin may be exposed through:

- Inhalation of volatiles and fugitive dust; and
- Incidental ingestion of soil.

Wildlife may be exposed to contaminants at this site via:

- Inhalation of volatiles from water and soil;
- Inhalation of fugitive dust;
- Ingestion of surface water;
- Incidental ingestion of soil;
- Incidental dermal contact with water;
- Dermal contact with soil; and
- Ingestion of plants.

8.4 Summary

This section outlined a preliminary list of potential exposure pathways and receptors, should releases have occurred at any of the sites under investigation. Of the 41 SWMUs included in this investigation, SWMUs 127/39/135, 118, 129, 177/181/179, and 101 were associated with previous investigations. SWMUs 127, 39, and 135 were investigated in association with IRP Site 31. No risk was present at this site and no further action was recommended. Additional investigation will be performed at this site, and if necessary, another risk assessment will be conducted. SWMU 101 was investigated in association with IRP Site 10. This site poses no significant risk and is considered closed. SWMU 118 was investigated in association with IRP Site 16. The risk assessment concluded that the site poses acceptable risks to human health and the environment and no further action was recommended. SWMU 129 was included in the area investigated as part of IRP Site 36. A risk assessment for the site determined that no significant risk was present and no further action was recommended. However, since waste constituents were detected, additional investigations were recommended to determine if a release has occurred. SWMUs 177, 181, and 179 were investigated in a 1991 RI as IRP Site 39. The risk assessment concluded that the site does not pose a threat to on-site workers, but does pose a concern to the environment, especially to the White Sands Pupfish.

Owing to the current population of Holloman AFB, both residential (including recreational) and occupational, most exposure pathways are considered. In some cases, these involve conservative assumptions, such as the migration of volatiles in air from a small SWMU to the Main Base area. Because the extent of potential contamination is unknown at these SWMUs, even the most conservative potential pathways and receptors were considered. As the investigation progresses, these assumptions will be revised to reflect realistic conditions. It is suspected that one of these pathways will be deleted from the assessment and, depending on the data, new pathways may be added.

9.0 RFI PHASE I SCHEDULE AND ADMINISTRATIVE OUTLINE

The schedule of activities for the Phase I RFI work is presented in Figure 9-1. The schedule allows 24 months to perform all Phase I activities and submit a draft report of findings to the U.S. EPA, Region VI. This is a tentative schedule and subject to change by the Base in coordination with U.S. EPA. The selection of a laboratory and an RFI Contractor may alter the schedule because of delays in the bidding and selection process. In addition, other ongoing environmental programs overlap the RFI and require coordination of both scheduling and investigation activities. Several SWMUs included in the Base's federal permit (specifically 141--the Pad 9 Drainage Pit and 181, 179, and 177 - Building 1176 sumps, discharge box, and drainage trough) are being investigated under the Base's IRP. Although they are included and discussed in the RFI Phase I Work Plan, actual scheduling and investigation will proceed under the IRP.

The administrative outline required for this Phase I RFI Work Plan, as specified in the Base's HSWA Permit, is to:

> "Describe the objectives of the investigation and the overall technical and analytical approach to completing all actions necessary to characterize the nature, direction, rate, movement, and concentration of releases of hazardous waste or hazardous constituents from specific units or groups of units, and their actual or potential receptors. The RFI Work Plan shall detail all proposed activities and procedures to be conducted at the facility, the schedule for implementing and completing such investigations, the qualifications of personnel performing or directing the investigations, including Contractor personnel, and the overall management of the RFI (Section IV, Condition H.2.1.a). In addition, the RFI Work Plan shall discuss sampling and data collection, quality assurance, and data management procedures, including formats for documenting and tracking data and other results of the investigations, and health and safety procedures (Section IV, Condition H.2.1.b)."

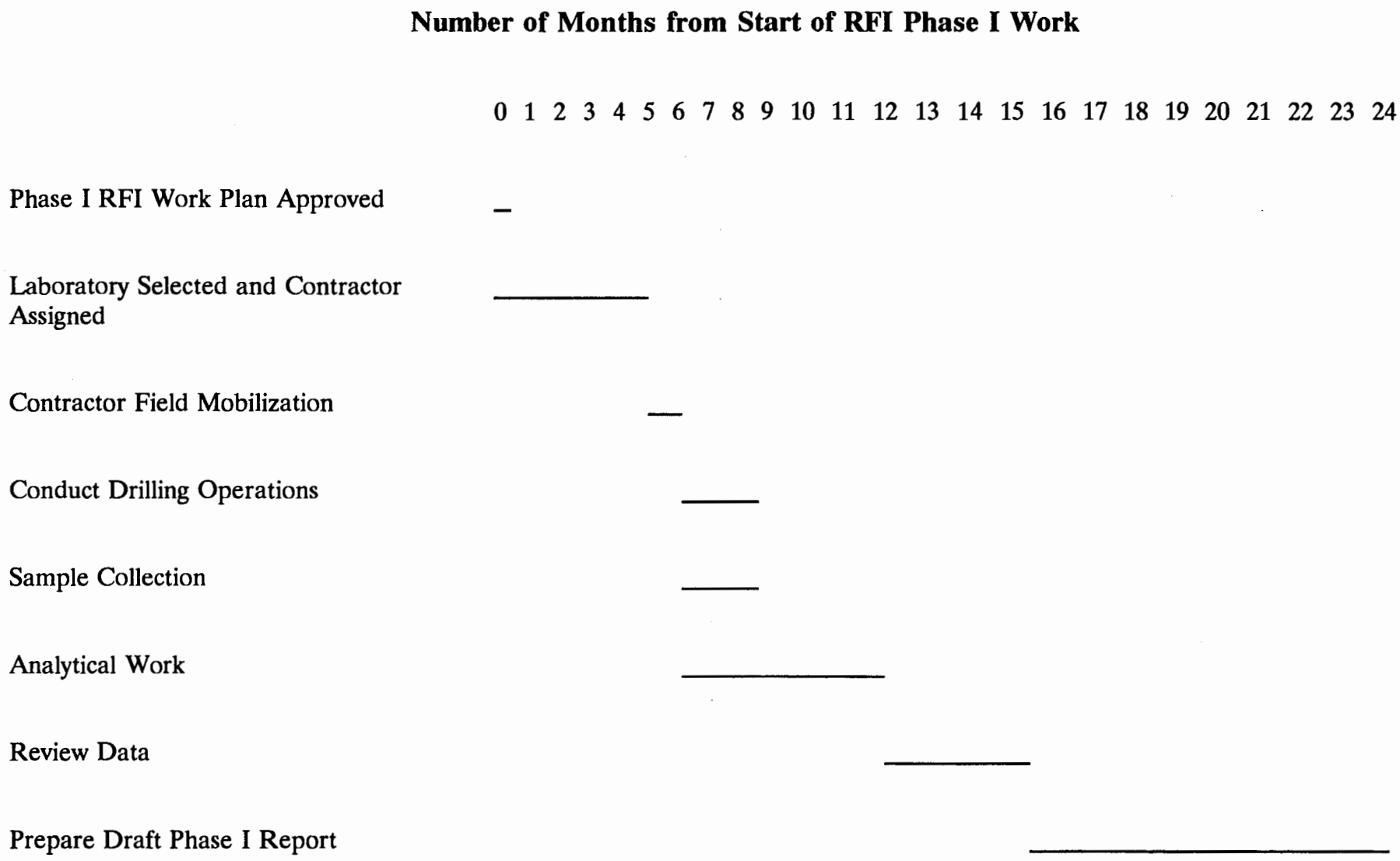


Figure 9-1. Holloman AFB, NM, RFI Phase I Schedule

The requirements for the administrative outline are satisfied in several places in the Work Plan and in its associated plans as presented in Table 9-1.

Table 9-1

Location of Administrative Requirements in the Phase I RFI Work Plan

Administrative Outline Requirement	Location in Phase I RFI Work Plan
Definition of RFI Objectives	Section 1.0 (general) and Section 4.0 (Site Specific)
Technical and Analytical Approach	Section 3.0 (Methods), Section 4.0 (Site Specific), and the Quality Assurance Project Plan
Schedule of Tasks	Section 9.0
Key Project Personnel Qualifications and Overall RFI Management	Project Management Plan (to be submitted upon selection of Laboratory and RFI Contractor)
Identification of Potential Migration Pathways and Potential Receptors	Section 8.0
Data Management Procedures and Plans	Section 6.0
Health and Safety Procedures	Health and Safety Plan (to be developed and submitted upon selection of the RFI Contractor)
Community Relations	Community Relations Plan

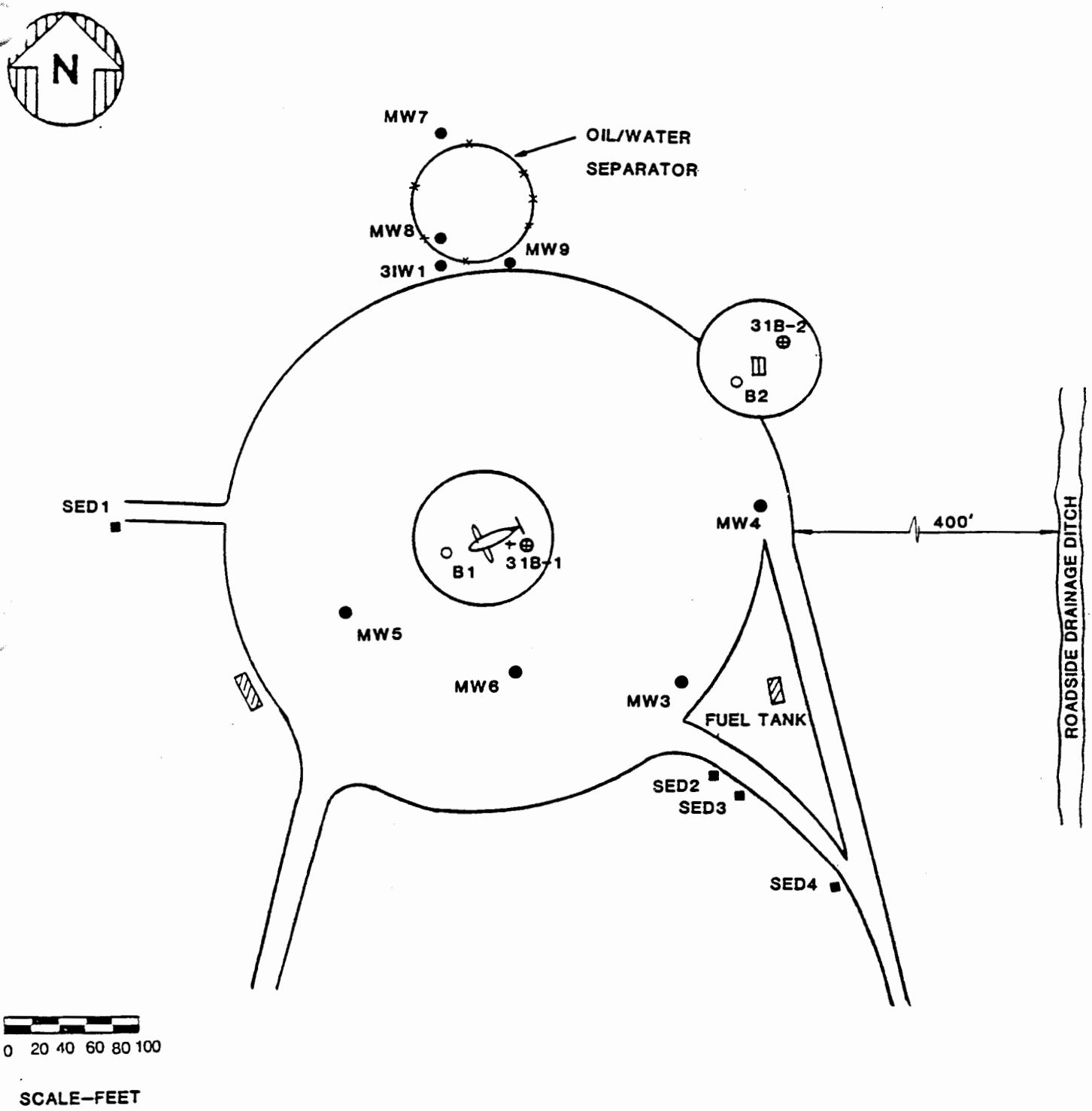
10.0 IMPLEMENTATION OF INTERIM MEASURES

Holloman AFB will define and implement, as necessary, appropriate interim measures that would protect human health and the environment from hazards associated with releases of hazardous wastes or hazardous constituents from solid waste management units at the Base. The criteria for implementing these measures would focus on determining whether the consequences of no action or delayed action would result in the further migration of wastes or constituents and/or the possible exposure of environmental receptors to hazardous wastes or constituents. If such conditions are discovered during the Phase I RFI, the Base will coordinate with U.S. EPA, Region VI, regarding the scope and timing of interim measures.

TO VIEW THE MAP AND/OR MAPS WITH THIS DOCUMENT, PLEASE CALL THE HAZARDOUS WASTE BUREAU AT 505-476-6000 TO MAKE AN APPOINTMENT

Appendix A

Walk, Haydel, and Associates, Installation Restoration Program Remedial Investigation Report for Holloman AFB, New Mexico, New Orleans, LA, 1989.



LEGEND

- ● MONITORING WELL
- ○ SOIL BORING
- — FENCE
- ■ SEDIMENT SAMPLE
- ⊕ PHASE II SOIL BORINGS

FIGURE 7-1

SITE 31
FIRE DEPARTMENT TRAINING AREA

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION
HOLLOMAN AFB, NEW MEXICO

TABLE 7-1

SITE 31 - SOIL

ORGANICS (ug/kg)

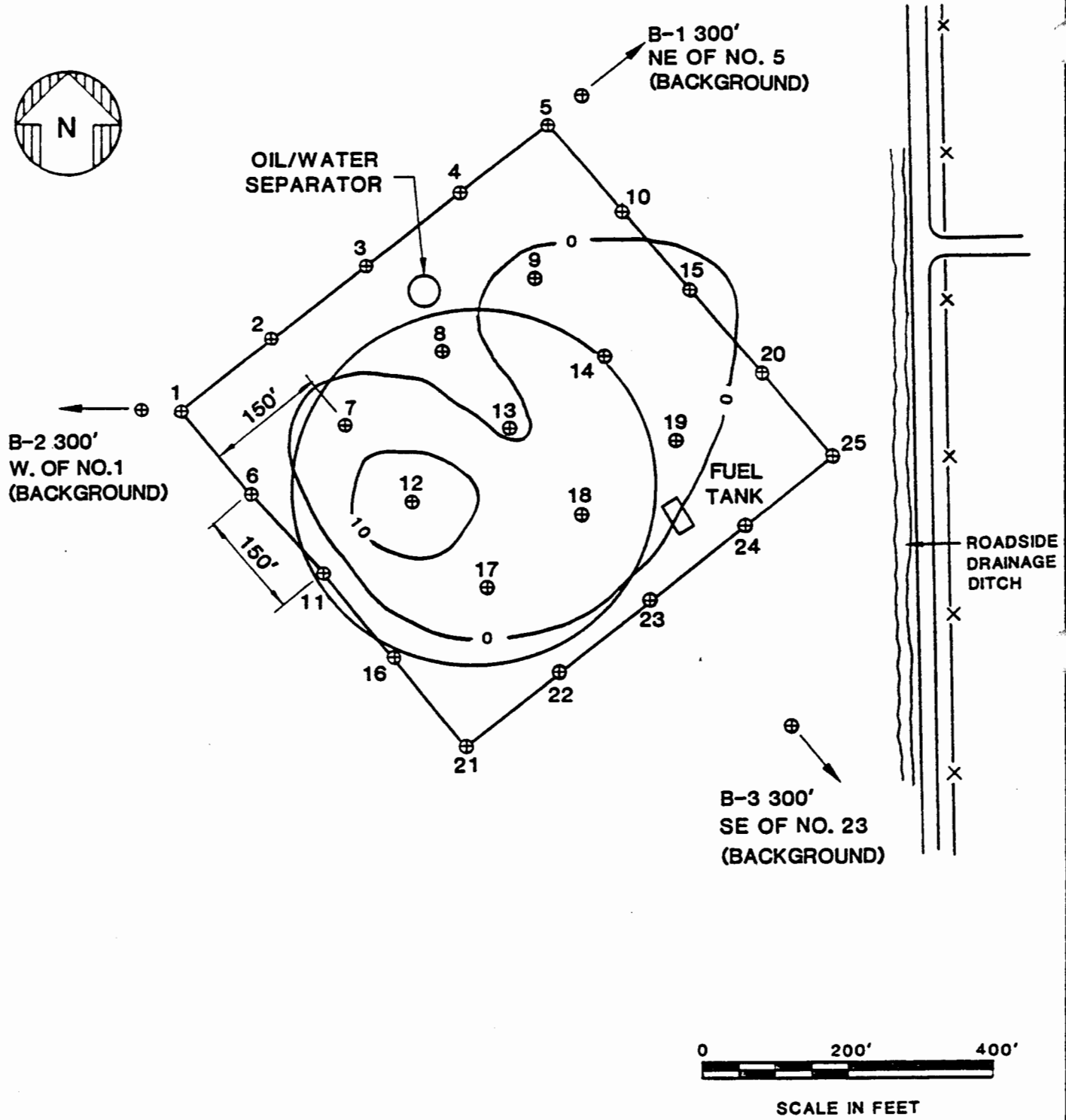
	Depth (ft)	Boring B1	B2	B7	B8	B9
Volatiles						
Benzene	20	-*	-*	(-)	-	(3000)
Bromodichloromethane		-	-		(1000)	(-)
Ethylbenzene		-	-		(15000)	(51000)
Toluene		-	-		(16000)	(52000)
Total Xylenes		-	-		(27000)	(98000)
	25			(-)	(-)	(-)
Acetone	30			(-)	(630)	(-)
Base/Neutral Extractables**						
	0	-	-			
	2.5	-	-			
	5	-	-			
	10	-	-			
	20	-			(-)	
	25					(-)
	30	-	-	(-)	(-)	

- Not detected
( ) Stage II data
* One surrogate recovery value not reported
** B7, B8, and B9 samples also analyzed for acid extractables

TABLE 7-2
SITE 31 - SOIL
TRPH/LEAD/TIC

	Depth (ft)	Boring B1	B2	B7	B8	B9
TRPH (mg/kg)	0	3870	-			
	2.5	43	25			
	5	77	53			
	10	22	21			
	20	63	-	(28)	(103)	(386)
	25			(42)	(-)	(18)
	30	-	29	(-)	(17)	(19)
Lead (mg/kg)	0	3.7	11.2			
	2.5	2.9	0.8			
	5	3.3	0.7			
	10	1.7	2.1			
	20	0.3	1.1			
	25					
	30	1.5	1.2			
Tentatively Identified Compounds (ug/kg)	20					
Cyclohexane						(27000)
Ethylcyclohexane					(12000)	(61000)
Methylcyclohexane					(31000)	(92000)
3-Methylcyclohexane					(10200)	
Methylcyclopentane						(11000)
(Z)2,2-Dimethyl-3-Hexane						(47000)
Trans 1,3-Dimethyl cyclohexane						(19000)
1,1,3-Trimethylcyclo-hexane						(26000)

- Not detected
( ) Stage II data



LEGEND

⊕ PORE VAPOR LOCATION

10 TOTAL ORGANIC VAPOR CONCENTRATION CONTOUR (PPM)

FIGURE 7-2

PORE VAPOR LOCATIONS

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION
HOLLOMAN AFB, NEW MEXICO

TABLE 7-3

SITE 31 - GROUNDWATER

VOLATILE ORGANICS (ug/L)

	Monitoring Well				
	31W1	MW3	MW4	MW5	MW5-D
Volatiles					
Benzene	1880	-	(-)	-	-
Chlorobenzene	6	-	(-)	-	-
Dibromomethane	808	-	(-)	-	-
Ethylbenzene	2560	-	(-)	-	-
Methylene Chloride	-	-	(-)	-	-
Styrene	98	-	(-)	-	-
Toluene	2460	-	(-)	-	-
Total Xylenes	2300	-	(-)	-	-
4-Methyl-2-Pentanone	1420	-	(-)	-	-

	Monitoring Well			
	MW6	MW7	MW8	MW9
Volatiles				
Benzene	- *	(-) *	(26600)	(26100)
Chlorobenzene	-	(-)	-	-
Dibromomethane	-	(-)	-	-
Ethylbenzene	-	(-)	(6000)	(15600)
Methylene Chloride	-	(29)	-	-
Styrene	-	(-)	-	-
Toluene	-	(-)	(6100)	(19700)
Total Xylenes	-	(-)	(4800)	(13700)
4-Methyl-2-Pentanone	-	(-)	-	-

-	Not detected
( )	Stage II data
*	Sample analyses outside QC limits - one surrogate recovery out-of-range
D	Field duplicate

TABLE 7-4

SITE 31 - GROUNDWATER

BNA ORGANICS (ug/L)

	Monitoring Well					
	31W1	MW3	MW4	(MW4)	MW5	MW5-D
Base/Neutral Extractables*						
2-Methylnaphthalene	(92)	-	33	(-)	-	-
2-Methylphenol	(72)	-	-	(-)	-	-
4-Methylphenol	(320)	-	-	(-)	-	-
Naphthalene	(200)	-	17	(-)	-	-
Pentachlorophenol	(91)	-	-	(-)	-	-
Phenol	(74)	-	-	(-)	-	-
2,4-Dimethylphenol	(50)	-	-	(-)	-	-

	Monitoring Well				
	MW6	MW7	MW8	MW8-LD	MW9
Base/Neutral Extractables*					
Bis(2-ethylhexyl)phthalate	-	(-)	(-)	(-)	(12)
Di-n-Butylphthalate	-	(-)	(-)	(12)	(-)
Diethylphthalate	-	(-)	(-)	(215)	(-)
2,6-Dinitrotoluene	-	(59)	(-)	(-)	(-)
2-Methylnaphthalene	-	(-)	(96)	(135)	(-)
Naphthalene	-	(-)	(139)	(178)	(160)
Nitrobenzene	-	(-)	(60)	(80)	(-)
N-Nitroso-di-N-propylamine	-	(12)	(-)	(-)	(-)
Pentachlorophenol	-	(-)	(-)	(-)	(149)

- Not detected
( ) Stage II data
D Field duplicate
LD Laboratory duplicate
W1 and MW9 samples also analyzed for acid extractables

TABLE 7-5

SITE 31 - GROUNDWATER

TRPH/LEAD

	Monitoring Well				
	31W1	31W1-D	MW3	MW4	MW5
TRPH (mg/L)	1136		-	-	-
	(6)	(7)			(-)
LEAD (ug/L)	11		14	8	-
	(25)	(35)			

	Monitoring Well				
	MW5-D	MW6	MW7	MW8	MW9
TRPH (mg/L)	96	-	(-)	(3)	(5)
LEAD (ug/L)	-	7			

- Not detected
( ) Stage II data
D Field duplicate

TABLE 7-6

SITE 31 - SEDIMENT

ORGANICS/TRPH/LEAD

	Sediment Samples			
	SED1	SED2	SED3	SED4
Acid/Base/Neutral Extractables (ug/kg)	-	-	-	-
TRPH (mg/kg)	26	36	-	-
Lead (mg/kg)	18	12	11	7

- Not Detected

TABLE 7-7

SITE 31

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Soil* Average	Soil* Maximum	Water Average	Water Maximum	New Mexico Water Standards[a]	Federal Drinking Water Standards Primary MCL[b]	Federal Drinking Water Standards Secondary MCL[c]	Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
Volatiles									
Benzene	1,340	1,340	18,193	26,600	10	5	-	0 (0.67)	-
Chlorobenzene	-	-	6	6	-	-	-	488	-
Dibromomethane	-	-	808	808	-	-	-	-	-
Ethylbenzene	1,115	1,723	8,053	15,600	750	-	-	2,400	-
4-Methyl-2-pentanone	-	-	1,420	1,420	-	-	-	-	-
Styrene	-	-	98	98	-	-	-	-	-
Toluene	4,213	6,440	9,420	19,700	750	-	-	15,000	-
Total xylenes	9,700	15,180	6,933	13,700	620	-	-	-	-
BNAs									
2,6-Dinitrotoluene	-	-	59	59	-	-	-	-	-
2-Methylnaphthalene		-	89	135	30**	-	-	-	-
Naphthalene	-	-	134	200	30**	-	-	Insufficient data	-

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NEW ORLEANS—MOBILE—BATON ROUGE

TABLE 7-7 (Continued)

SITE 31

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Soil* Average	Soil* Maximum	Water Average	Water Maximum	New Mexico Water Standards(a)	Federal Drinking Water Standards Primary MCL(b)	Federal Drinking Water Standards Secondary MCL(c)	Water Quality Criteria(d)	Drinking Water - Farm Animals(e)
BNAs									
Nitrobenzene	-	-	70	80	-	-	-	19,800	-
2,4-Dimethylphenol			50	50	5***	-	-	400	-
2-Methylphenol			72	72	5***	-	-	-	-
4-Methylphenol			320	320	5***	-	-	-	-
Phenol			74	74	5***	-	-	0.0035	-
Pentachlorophenol			120	149	-	-	-	0.00101	-
Metals									
Lead	-	-	30	35	50	50	-	50	100

MCL Maximum Contaminant Level
( ) Concentrations in parentheses correspond to midpoint of risk range for potential carcinogens
\- Not given
* Estimated maximum groundwater concentrations based on soil analyses.
** Total naphthalene plus monomethylnaphthalenes, 30 ug/l.
*** For domestic water supplies, phenols.
(a) ER, New Mexico Water Quality Regulations, 2/13/87.
(b) ER, EPA National Drinking Water Regulations, Part 141.11 (7/31/87) and Part 141.61 (7/22/88).
(c) ER, EPA National Secondary Drinking water Regulations, Part 143.3, 10/21/88.
(d) USEPA, SPHEM, 10/86.
(e) National Academy of Sciences and National Academy of Engineering, 1974.

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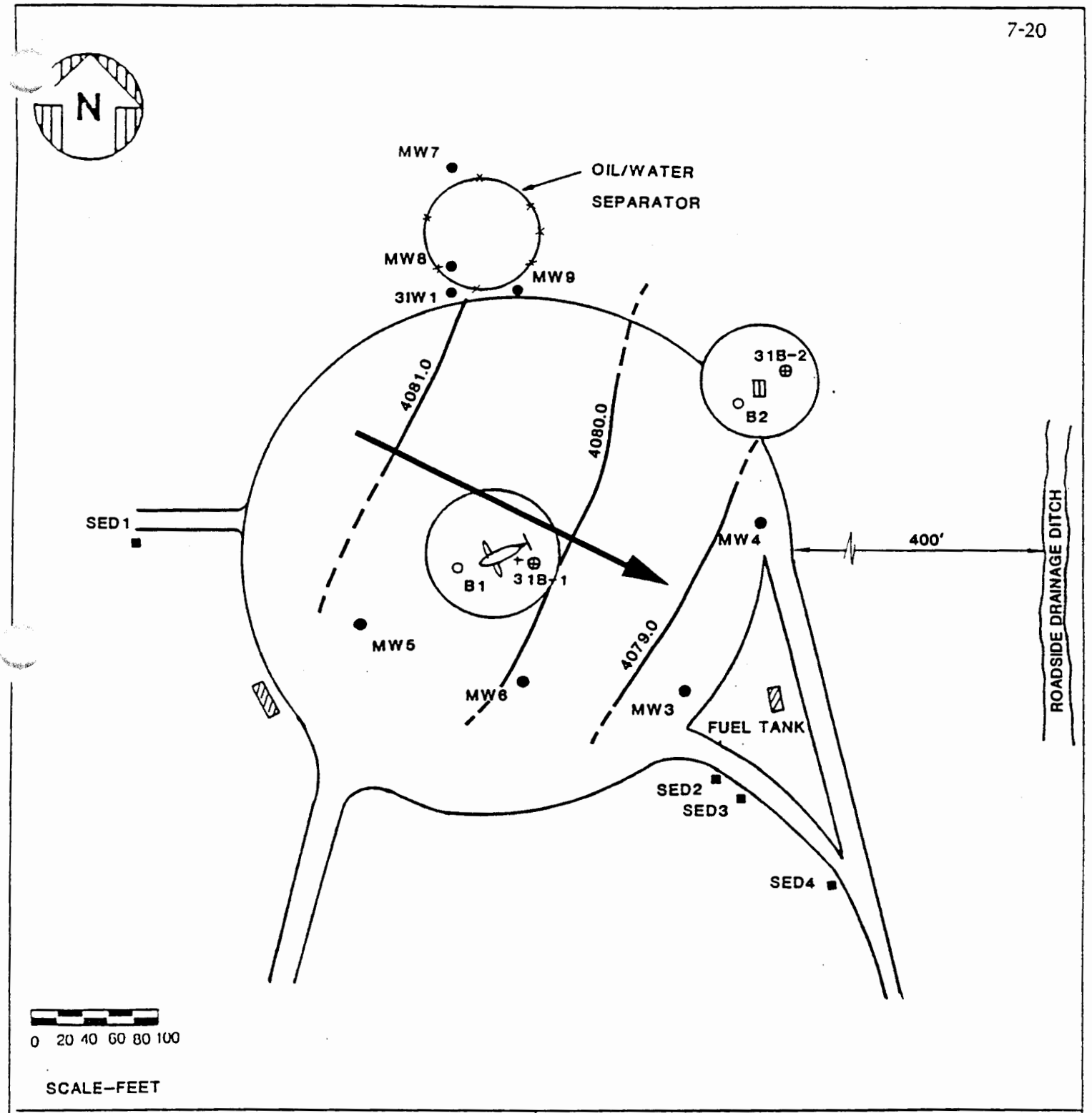

LEGEND

- ● MONITORING WELL
- ○ SOIL BORING
- FENCE
- ■ SEDIMENT SAMPLE
- ⊕ PHASE II SOIL BORINGS
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

FIGURE 7-3

SITE 31
GROUNDWATER CONTOUR MAP

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION
HOLLOMAN AFB, NEW MEXICO

WH&A 1012 (REV.3/83)

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TABLE 7-9

SITE 31

RELEASE CONCENTRATIONS

Constituents	Release Transport Medium	Release Source/ Mechanism	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Benzene*	Groundwater	Contaminated Soil/Site Leaching	18,193	26,600
Dibromomethane	Groundwater	Contaminated Soil/Site Leaching	808	808
Ethylbenzene*	Groundwater	Contaminated Soil/Site Leaching	8,053	15,600
4-Methyl-2-pentanone	Groundwater	Contaminated Soil/Site Leaching	1,420	1,420
Styrene	Groundwater	Contaminated Soil/Site Leaching	98	98
Toluene*	Groundwater	Contaminated Soil/Site Leaching	9,420	19,700
Total xylenes*	Groundwater	Contaminated Soil/Site Leaching	9,700	15,200
2,6-Dinitrotulene	Groundwater	Contaminated Soil/Site Leaching	59	59
2-Methylnaphthalene	Groundwater	Contaminated Soil/Site Leaching	89	135

TABLE 7-9 (Continued)

SITE 31

RELEASE CONCENTRATIONS

Constituents	Release Transport Medium	Release Source/ Mechanism	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
2-Methylphenol	Groundwater	Contaminated Soil/Site Leaching	72	72
4-Methylphenol	Groundwater	Contaminated Soil/Site Leaching	320	320
2,4-Dimethylphenol	Groundwater	Contaminated Soil/Site Leaching	50	50
Naphthalene	Groundwater	Contaminated Soil/Site Leaching	134	200
Pentachlorophenol	Groundwater	Contaminated Soil/Site Leaching	120	149
Phenol	Groundwater	Contaminated Soil/Site Leaching	74	74

* Higher of water and soil concentrations listed on Table 7-7 was included in this table.

TABLE 7-10

SITE 31

EXPOSURE POINT CONCENTRATIONS

Constituents	Release Transport Medium	Exposure Point	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Benzene	Groundwater	Nearest hypothetical off-base well*	LT 182	LT 266
Dibromomethane	Groundwater	Nearest hypothetical off-base well*	LT 8	LT 8
Ethylbenzene	Groundwater	Nearest hypothetical off-base well*	LT 81	LT 156
4-Methyl-2-pentanone	Groundwater	Nearest hypothetical off-base well*	LT 14	LT 14
Styrene	Groundwater	Nearest hypothetical off-base well*	LT 0.98	LT 0.98
Toluene	Groundwater	Nearest hypothetical off-base well*	LT 94	LT 197
Total xylenes	Groundwater	Nearest hypothetical off-base well*	LT 97	LT 152
2,6-Dinitro-toluene	Groundwater	Nearest hypothetical off-base well*	LT 0.59	LT 0.59

TABLE 7-10 (Continued)

SITE 31

EXPOSURE POINT CONCENTRATIONS

Constituents	Release Transport Medium	Exposure Point	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
2-Methyl-naphthalene	Groundwater	Nearest hypothetical off-base well*	LT 0.89	LT 1
2-Methyl-phenol	Groundwater	Nearest hypothetical off-base well*	LT 0.72	LT 0.72
2,4-Dimethyl-phenol	Groundwater	Nearest hypothetical off-base well*	LT 1	LT 1
4-Methylphenol	Groundwater	Nearest hypothetical off-base well*	LT 3	LT 3
Naphthalene	Groundwater	Nearest hypothetical off-base well*	LT 1	LT 2
Pentachloro-phenol	Groundwater	Nearest hypothetical off-base well*	LT 1	LT 2
Phenol	Groundwater	Nearest hypothetical off-base well*	LT 0.74	LT 0.74

* 3000 feet southeast of site

LT Less Than

TABLE 7-11
SITE 31
COMPARISON OF EXPOSURE POINT CONCENTRATIONS AND STANDARDS AND CRITERIA (ug/L)

Constituents	Exposure Point Concentrations: Best Estimates	Exposure Point Concentrations: Upper Bound Estimates	New Mexico Water Standards[a]	Federal Drinking Water Standards: Primary MCL[b]	Federal Drinking Water Standards: Secondary MCL[c]	Water Quality Criteria[d]	Drinking Water-Farm Animals[e]
Benzene	LT 182	LT 266	10	5	-	0(0.67)	-
Dibromomethane	LT 8	LT 8	-	-	-	-	-
2,6-Dinitrotoluene	LT 0.59	LT 0.59	-	-	-	-	-
Ethylbenzene	LT 81	LT 156	750	-	-	2,400	-
2-Methylnaphthalene	LT 0.89	LT 1	30*	-	-	-	-
4-Methyl-2-pentanone	LT 14	LT 14	-	-	-	-	-
2-Methylphenol	LT 0.72	LT 0.72	5**	-	-	-	-
4-Methylphenol	LT 3	LT 3	5**	-	-	-	-
2,4-Dimethylphenol	LT 1	LT 1	5**	-	-	400	-
Naphthalene	LT 1	LT 2	30*	-	-	Insufficient data	-
Pentachlorophenol	LT 1	LT 2	5**	-	-	0.00101	-
Phenol	LT 0.74	LT 0.74	5**	-	-	0.0035	-
Styrene	LT 0.98	LT 0.98	-	-	-	-	-
Toluene	LT 94	LT 197	750	-	-	15,000	-
Total xylenes	LT 97	LT 152	620	-	-	-	-

MCL Maximum Contaminant Level
( ) Concentrations in parentheses correspond to midpoint of risk range for potential carcinogens
\- Not given
* Total naphthalene plus monomethylnaphthalenes, 30 ug/L.
** For domestic water supplies, phenols.
LT Less Than
(a) ER, New Mexico Water Quality Regulations, 2/13/87.
(b) ER, EPA National Drinking Water Regulations, Part 141.11 (7/31/87) and Part 141.61 (7/22/88).
(c) ER, EPA National Secondary Drinking Water Regulations, Part 143.3, 10/21/88.
(d) USEPA, SPHEM, 10/86.
(e) National Academy of Sciences and National Academy of Engineering, 1974.

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TABLE 7-12

SITE 31

RESULTS OF TOXICITY ASSESSMENT

Constituents	Upper Bound Estimates (ug/L)	Toxic Dose Concentrations (mg/kg)	Water Volumes Required To Reach Toxicity Concentrations (L)
Benzene	LT 266	714.5	1,343,000
2,6-Dinitrotoluene	LT 0.59	405.5	343,644,000
4-Methyl-2-pentanone**	LT 14	166	5,928,500
Styrene	LT 0.98	11.6	5,918,300
Dibromomethane**	LT 8	137.7	8,606,200

* Rounded to lower 100 liters.

** No toxicological data available for oral route; therefore, lethal data were used. Results are actually concentrations and volumes required to cause death.

LT Less Than

Appendix B

Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992.

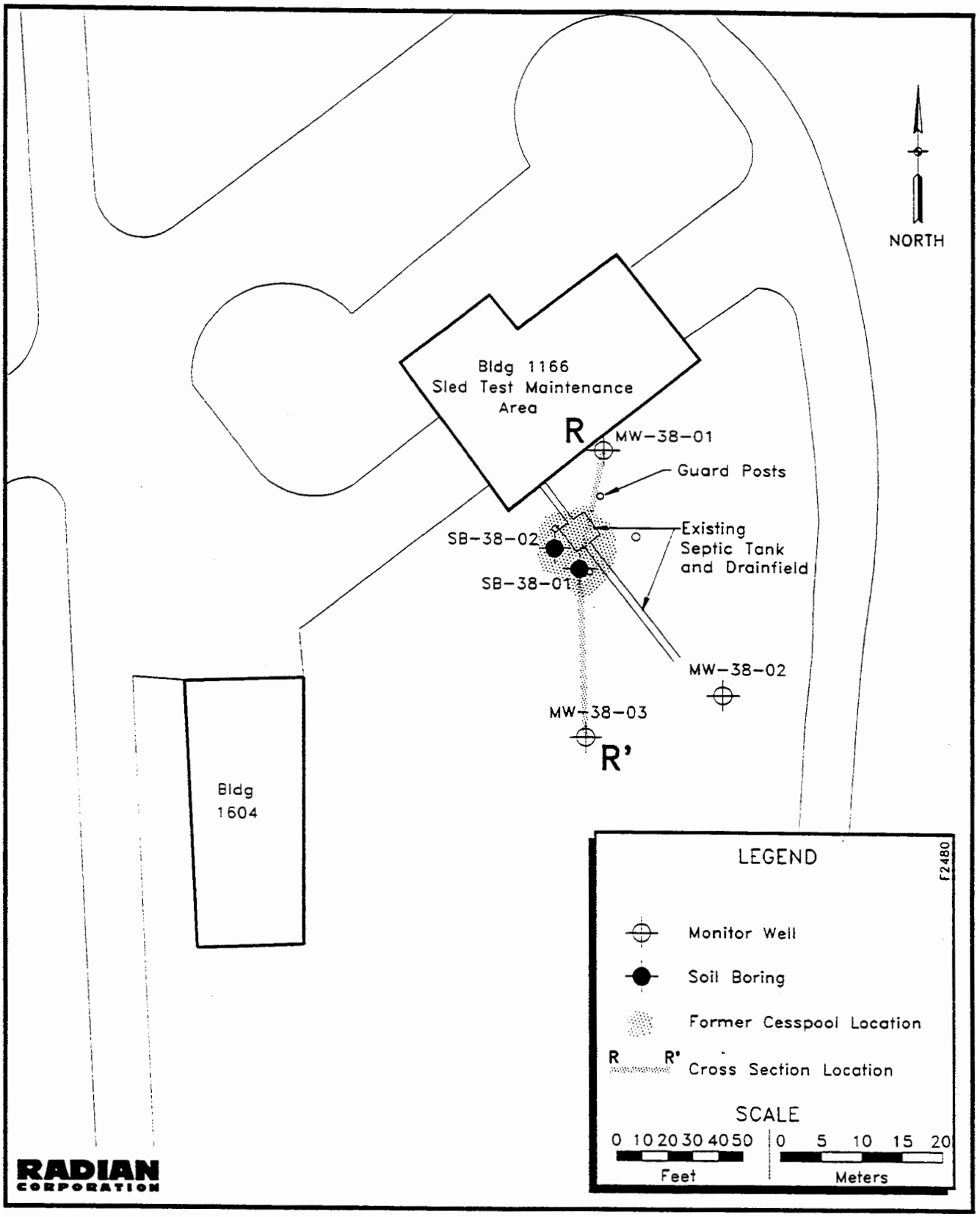


Figure 4-61. Soil Boring, Monitor Well, and Cross Section Locations for Site 38

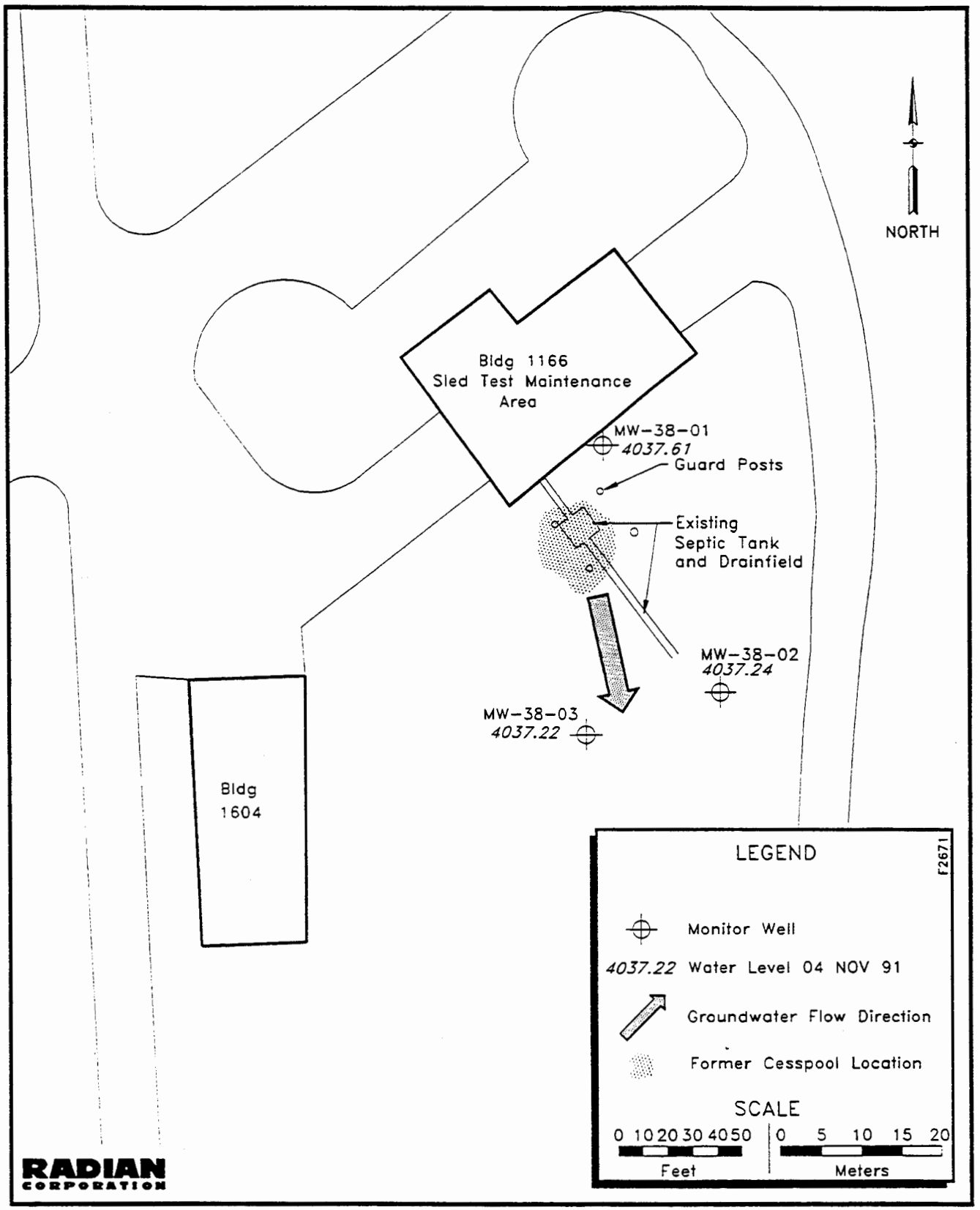


Figure 4-63. Monitor Well Locations and Groundwater Flow Direction for Site 38

Table 4-83

Concentrations of Inorganic and Organic Analytes in Site 38 Soil Samples

Location:	SB-38-01				SB-38-02			
Sample ID: Depth:	91JUL1H038-001 0 - 10 ft		91JUL1H038-002 10 - 20 ft		91JUL1H038-003 0 - 10 ft		91JUL1H038-004 10 - 20 ft	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
Inorganic results								
SW6010 - Metals (mg/kg)								
Chromium	6.7 @	(1.9)	4.1 @	(3.4)	5.7 @	(3.4)	5.6 @	(3.7)
Nickel	5.5 @	(3.8)	ND	(6.8)	ND	(6.9)	ND	(7.5)
Zinc	19	(3.8)	7.6 @	(6.8)	14 @	(6.9)	11 @	(7.5)
SW7060 - Arsenic (mg/kg)	1.6 @	(0.37)	0.56 @	(0.36)	1.1 @	(0.37)	0.73 @	(0.36)
SW7421 - Lead (mg/kg)	2.5	(0.28)	0.70 @	(0.27)	20	(1.1)	1.1 @	(0.27)
Organic results								
EPA 418.1 - TRPH (mg/kg)	24.4 @	(12.6)	29.1 @	(12.1)	1540	(250)	18.4 @	(12.6)
SW8240 - Volatile Organics (ug/kg)								
Methylene chloride	37 JB	(130)	78 JB	(120)	52 JB	(130)	240 B@	(130)
Toluene	7.7 J	(130)	7.2 J	(120)	6.2 J	(130)	8.9 J	(130)

NOTE: Table presents only constituents detected in soil at this site.
@ = Measured result is less than five times the detection limit.
ND = Not Detected, at the reported detection limit.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.
J = Detected below the detection limit.

Table 4-84

Concentrations of Inorganic Analytes in Site 38 Groundwater Samples

Location: Sample ID:	MW-38-01 38-01-01		MW-38-02 38-02-01		MW-38-03 38-03-01	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)
EPA 160.1 - Total Dissolved Solids (mg/L)	15000	(10)	15000	(10)	5500	(10)
EPA 300.0 - Chloride (mg/L)	3700	(26)	3800	(26)	900	(2.6)
EPA 300.0 - Sulfate (mg/L)	4900	(5.0)	3900	(5.0)	1900	(5.0)
EPA 340.2 - Fluoride (mg/L)	1.5	(0.10)	1.4	(0.10)	2.1	(0.10)
EPA 353.1 - Nitrate-Nitrite (mg/L)	110	(4.4)	130	(4.4)	110	(4.4)
EPA 365.2 - Total Phosphorus (mg/L)	0.33	(0.020)	0.084 @	(0.020)	0.19	(0.020)
SW6010 - Metals (mg/L)						
Antimony	ND	(0.20)	0.14 @	(0.10)	ND	(0.10)
Copper	0.047 @	(0.040)	ND	(0.020)	0.059 @	(0.020)
Nickel	0.047 @	(0.040)	ND	(0.020)	ND	(0.020)
Zinc	0.047 @	(0.040)	ND	(0.020)	0.027 @	(0.020)
SW7421 - Lead (mg/L)	0.0078 @	(0.0060)	ND	(0.0060)	0.013 @	(0.0060)

NOTE: Table presents only constituents detected in groundwater at this site.
@ = Measured result is less than five times the detection limit.
ND = Not Detected, at the reported detection limit.

Table 4-85

Concentrations of Organic Analytes in Site 38 Groundwater Samples

Location: Sample ID:	MW-38-01 38-01-01		MW-38-02 38-02-01		MW-38-03 38-03-01	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)
SW8240 - Volatile Organics (μg/L)						
Chloroform	1.3 J	(5.0)	2.0 J	(5.0)	ND	(5.0)
Methylene chloride	30	(5.0)	49	(5.0)	18 @	(5.0)
Trichloroethene	3.1 J	(5.0)	2.8 J	(5.0)	ND	(5.0)

NOTE: Table presents only constituents detected in groundwater at this site.
J = Detected below the detection limit.
ND = Not Detected, at the reported detection limit.
@ = Measured result is less than five times the detection limit.

Appendix C

Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992.

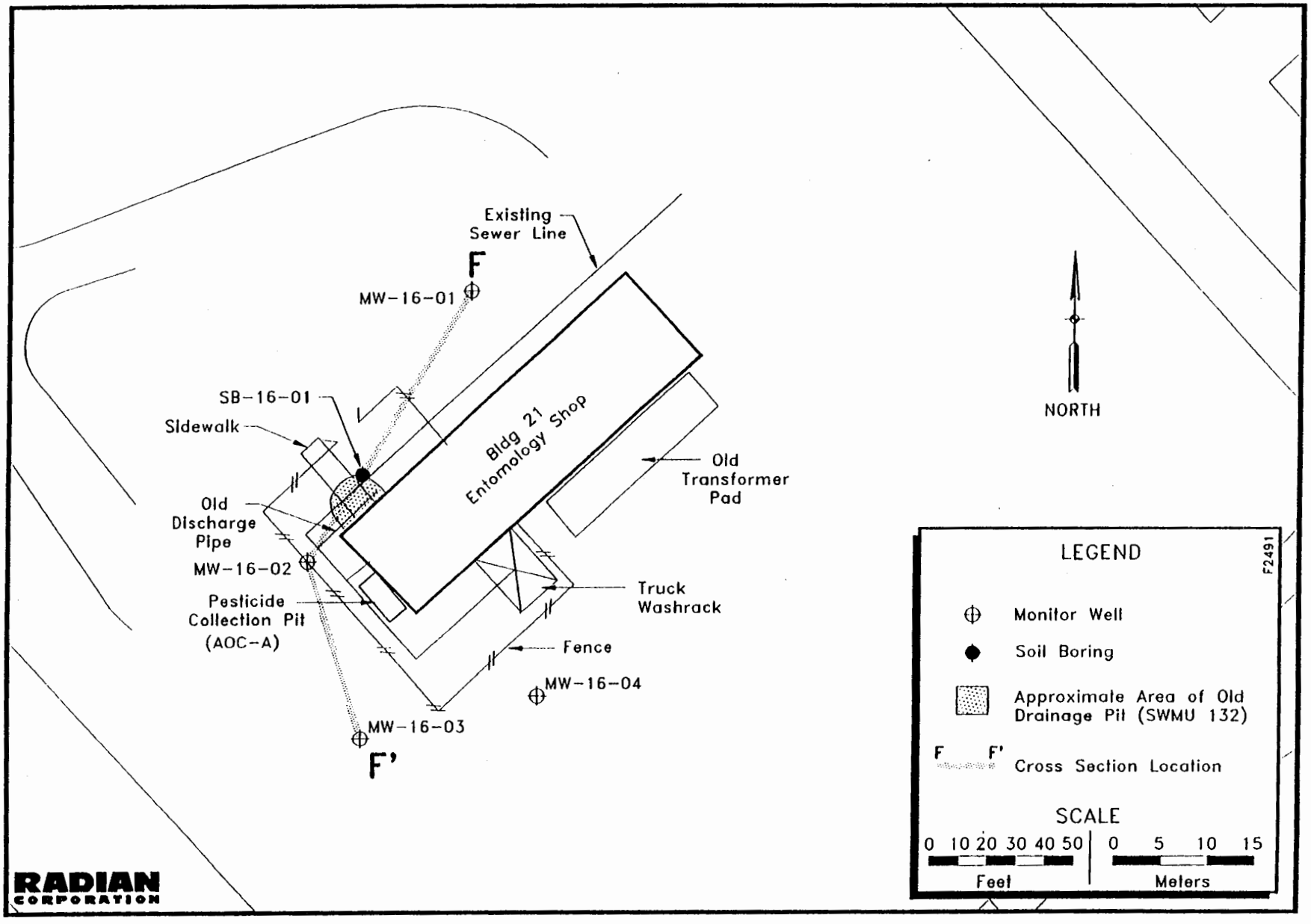


Figure 4-22. Soil Boring, Monitor Well, and Cross Section Locations for Site 16

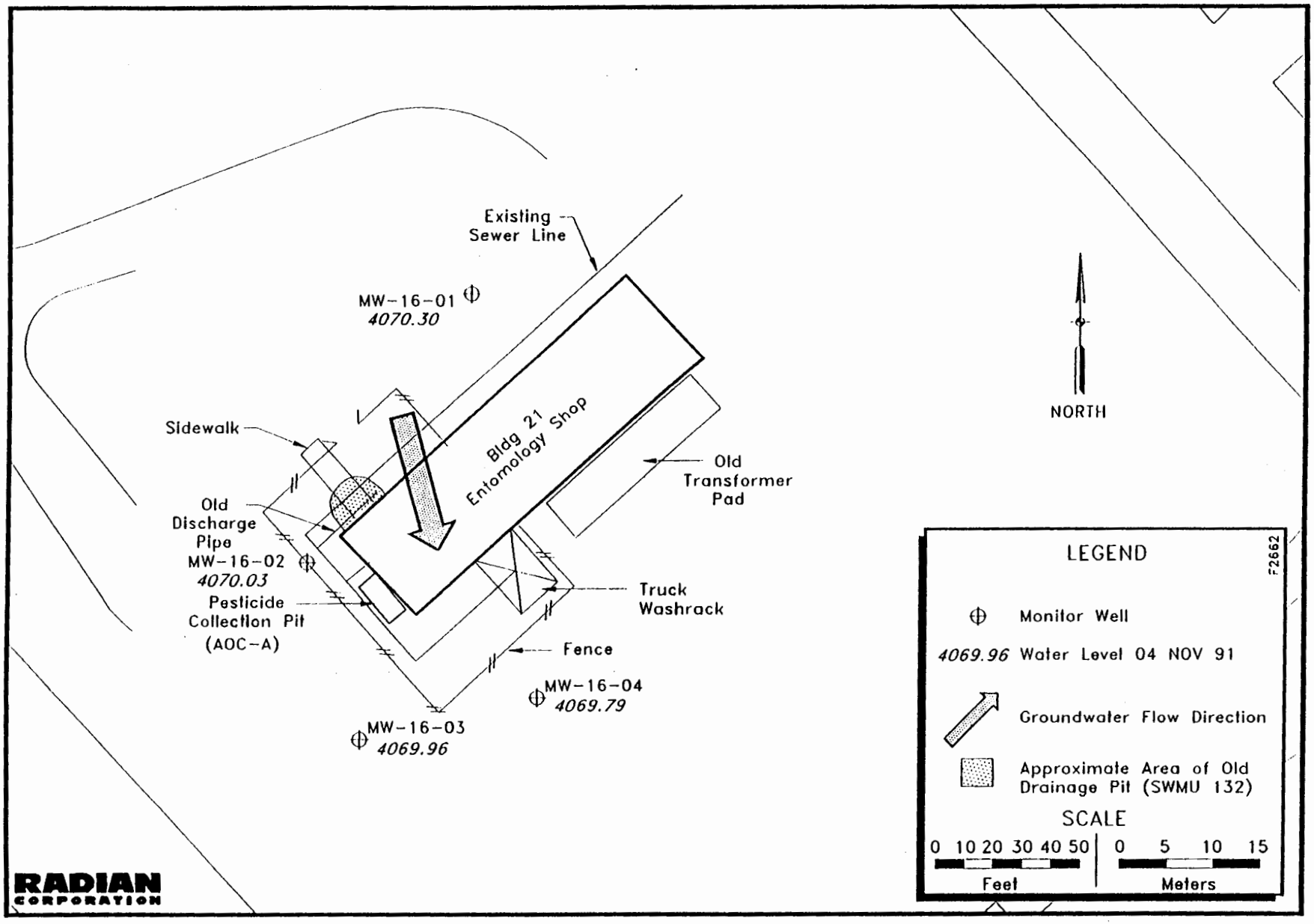


Figure 4-24. Monitor Well Locations and Groundwater Flow Direction for Site 16

Table 4-37

Concentrations of Organic Analytes in Site 16 Soil Samples

Location:	SB-16-01			
Sample ID: Depth:	91JULH016-001 0 - 2 ft		91JULH016-002 2 - 4 ft	
Analyses	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	30.1 @	(10.7)	ND	(12.5)
SW8080 - Organochlorine Pesticides (ug/kg)				
4,4'-DDT	12 C	(1.1)	ND	(1.2)
alpha-BHC	0.19 J	(0.53)	ND	(0.60)
delta-BHC	0.65 X@	(0.53)	ND	(0.60)
SW8140 - Organophosphorus Pesticides (ug/kg)				
Methyl parathion	1.5 J	(4.9)	ND	(5.5)
SW8240 - Volatile Organics (ug/kg)				
Ethyl benzene	ND	(110)	14 J	(120)
Methyl ethyl ketone	ND	(2200)	300 J	(2400)
Methylene chloride	140 B@	(110)	1200 B	(120)
Toluene	5.7 JB	(110)	9.0 JB	(120)
Xylenes	ND	(110)	77 JB	(120)

NOTE: Table presents only constituents detected in soil at this site.
ND = Not Detected, at the reported detection limit.
C = Presence and quantitation of analyte confirmed by second column analysis.
J = Detected below the detection limit.
X = SW8080--Presence of analyte confirmed by second column analysis, but quantitation was not confirmed.
@ = Measured result is less than five times the detection limit.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.

Table 4-38

Concentrations of Inorganic Analytes in Site 16 Groundwater Samples

Location: Sample ID:	MW-16-01 16-01-01		MW-16-02 16-02-01		MW-16-03 16-03-01		MW-16-04 16-04-01	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
EPA 160.1 - Total Dissolved Solids (mg/L)	3800	(10)	4700	(10)	4000	(10)	4500	(10)
EPA 300.0 - Chloride (mg/L)	250	(1.3)	490	(1.3)	430	(1.3)	300	(1.3)
EPA 300.0 - Sulfate (mg/L)	2100	(2.5)	2300	(2.5)	2100	(2.5)	2800	(2.5)
EPA 340.2 - Fluoride (mg/L)	3.1	(0.10)	3.0	(0.10)	1.8	(0.10)	2.2	(0.10)
EPA 353.1 - Nitrate-Nitrite (mg/L)	4.4	(0.044)	9.1	(0.11)	4.9	(0.089)	9.5	(0.11)
EPA 365.2 - Total Phosphorus (mg/L)	0.11	(0.020)	0.24	(0.020)	0.40	(0.020)	0.30	(0.020)

NOTE: Table presents only constituents detected in groundwater at this site.

Table 4-39

Concentrations of Organic Analytes in Site 16 Groundwater Samples

Location: Sample ID:	MW-16-01 16-01-01		MW-16-02 16-02-01		MW-16-03 16-03-01		MW-16-04 16-04-01	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
SW8080 - Organochlorine Pesticides (μg/L)								
4,4'-DDT	ND	(0.019)	ND	(0.019)	ND	(0.019)	0.018 JC	(0.020)
Dieldrin	0.15 C	(0.0095)	ND	(0.0095)	ND	(0.0095)	ND	(0.0098)
Endrin	ND	(0.0095)	ND	(0.0095)	ND	(0.0095)	0.013 X@	(0.0098)
Heptachlor epoxide	ND	(0.0095)	ND	(0.0095)	0.012 X@	(0.0095)	0.080 X	(0.0098)
alpha-BHC	1.5 CD	(0.19)	0.022 X@	(0.0095)	ND	(0.0095)	ND	(0.0098)
beta-BHC	0.11 C	(0.0095)	ND	(0.0095)	ND	(0.0095)	ND	(0.0098)
delta-BHC	0.22 C	(0.0095)	ND	(0.0095)	ND	(0.0095)	ND	(0.0098)
gamma-BHC	1.0 CD	(0.19)	0.17 C	(0.0095)	0.017 X@	(0.0095)	0.040 X@	(0.0098)
SW8140 - Organophosphorus Pesticides (μg/L)								
Methyl parathion	0.019 J	(0.028)	ND	(0.028)	ND	(0.029)	ND	(0.029)
SW8240 - Volatile Organics (μg/L)								
1,1,1-Trichloroethane	ND	(5.0)	ND	(5.0)	ND	(5.0)	20 @	(5.0)
1,1-Dichloroethane	ND	(5.0)	ND	(5.0)	ND	(5.0)	2.3 J	(5.0)
Benzene	2.3 J	(5.0)	ND	(5.0)	ND	(5.0)	ND	(5.0)
Chlorobenzene	63	(5.0)	1.3 J	(5.0)	ND	(5.0)	ND	(5.0)
Chloroform	2.2 J	(5.0)	ND	(5.0)	1.3 J	(5.0)	1.7 J	(5.0)
Methylene chloride	5.9 @	(5.0)	ND	(5.0)	10 @	(5.0)	18 @	(5.0)
Trichloroethene	4.2 J	(5.0)	23 @	(5.0)	15 @	(5.0)	8.1 @	(5.0)

NOTE: Table presents only constituents detected in groundwater at this site.
ND = Not Detected, at the reported detection limit; J = Detected below the detection limit; C = Presence and quantitation of analyte confirmed by second column analysis; X = SW8080--Presence of analyte confirmed by second column analysis, but quantitation was not confirmed; @ = Measured result is less than five times the detection limit; D = Secondary dilution required for this analyte.

Table 4-40

Groundwater Analytes Detected Above Risk-Based Action Levels at Site 16

Analyte	Location ID	Result		Action Level
Groundwater Results (mg/L)				
Benzene	MW-16-01	0.0023	J	0.001
Dieldrin	MW-16-01	0.00015	C	0.000002
Fluoride	MW-16-01	3.1		2
Fluoride	MW-16-02	3		2
Fluoride	MW-16-04	2.2		2
Heptachlor epoxide	MW-16-03	0.000012	X@	0.000004
Heptachlor epoxide	MW-16-04	0.00008	X	0.000004
Methylene chloride[a]	MW-16-01	0.0059	@	0.005
Methylene chloride[a]	MW-16-03	0.01	@	0.005
Methylene chloride[a]	MW-16-04	0.018	@	0.005
Trichloroethene	MW-16-01	0.0042	J	0.003
Trichloroethene	MW-16-02	0.023	@	0.003
Trichloroethene	MW-16-03	0.015	@	0.003
Trichloroethene	MW-16-04	0.0081	@	0.003
alpha-BHC	MW-16-01	0.0015	CD	0.000006
alpha-BHC	MW-16-02	0.000022	X@	0.000006
gamma-BHC	MW-16-01	0.001	CD	0.00003
gamma-BHC	MW-16-02	0.00017	C	0.00003
gamma-BHC	MW-16-04	0.00004	X@	0.00003

Note: Result units were changed to match action level units for this table.

J = Detected below the detection limit.
C = Presence and quantitation of analyte confirmed by second column analysis.
X = SW8080–Presence of analyte confirmed by second column analysis, but quantitation was not confirmed.
@ = Measured result is less than five times the detection limit.
[a] Methylene chloride was determined to be a laboratory contaminant in a QA/QC review and is, therefore, not considered to be above the action level in samples from the site.
D = Secondary dilution required for this analyte.

Appendix D

Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992.

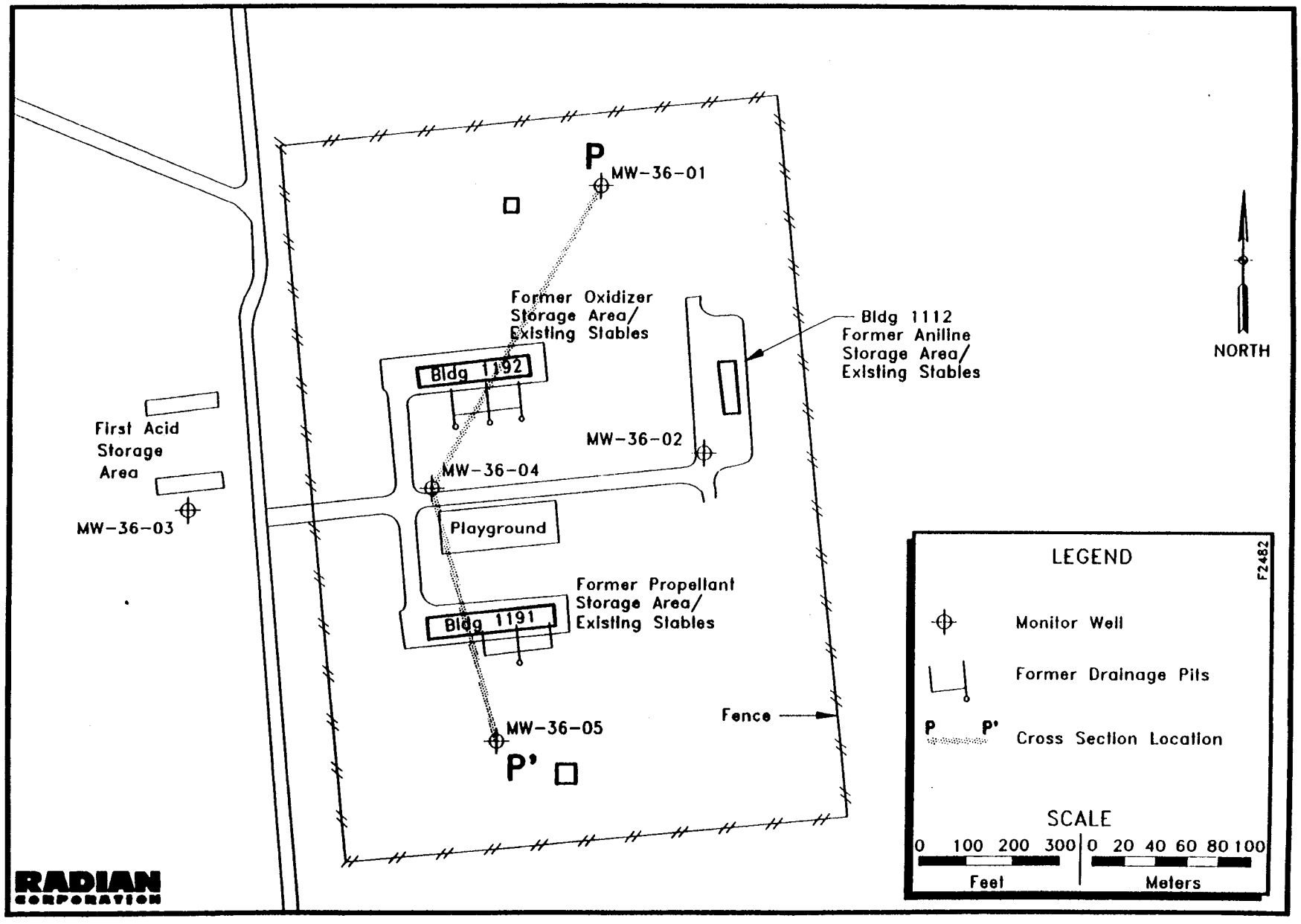


Figure 4-55. Monitor Well and Cross Section Locations for Site 36

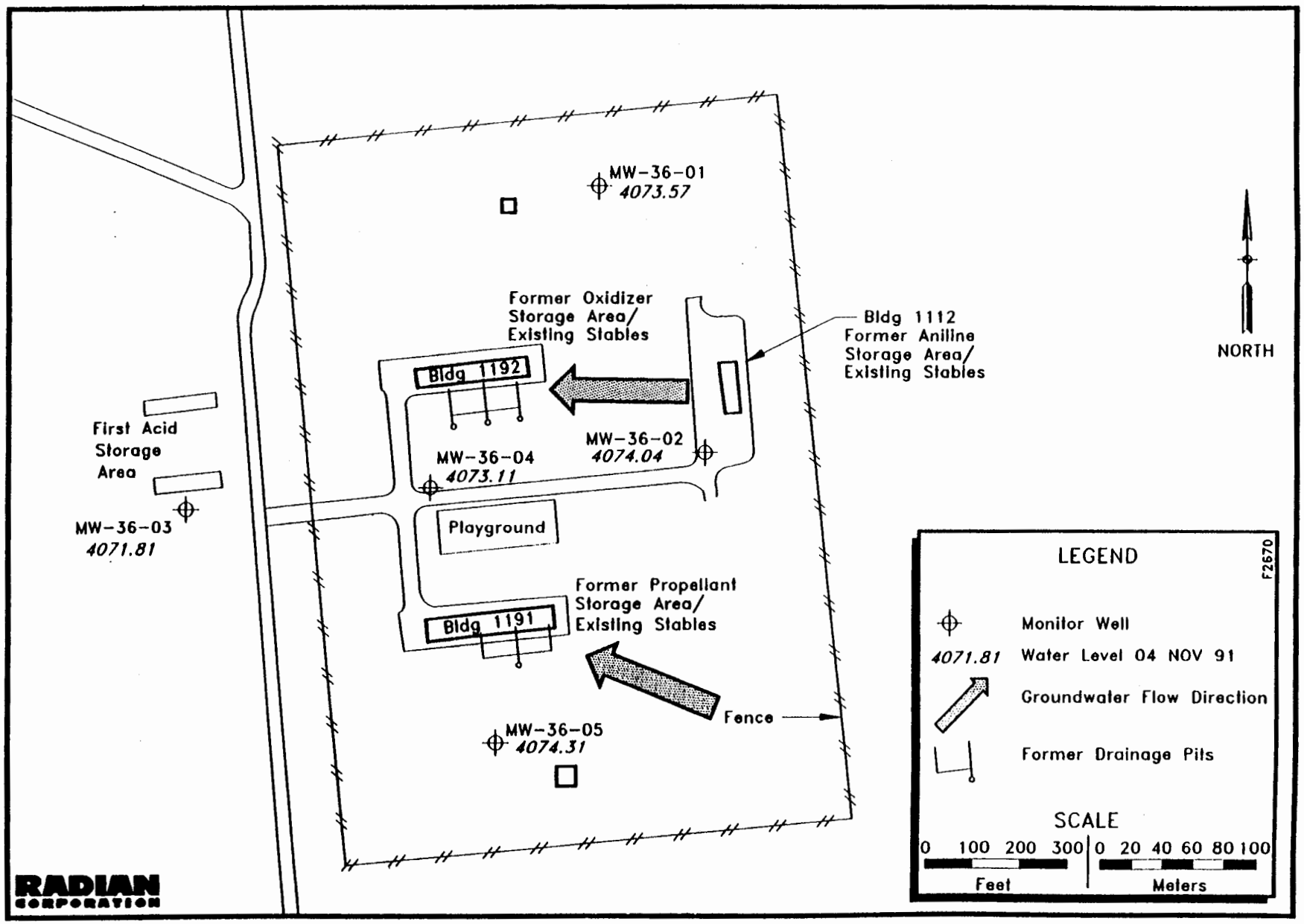


Figure 4-57. Monitor Well Locations and Groundwater Flow Direction for Site 36

Table 4-74

Concentrations of Inorganic Analytes in Site 36 Groundwater Samples

Location	MW-36-01		MW-36-02		MW-36-03	
Sample ID	36-01-01		36-02-01		36-03-01	
Analyte	Result	(DL)	Result	(DL)	Result	(DL)
EPA 160.1 - Total Dissolved Solids (mg/L)	9800	(10)	11000	(10)	10000	(10)
EPA 300.0 - Chloride (mg/L)	3900	(26)	3500	(26)	3300	(26)
EPA 300.0 - Sulfate (mg/L)	2000	(5.0)	3000	(5.0)	3100	(5.0)
EPA 340.2 - Fluoride (mg/L)	2.2	(0.10)	2.6	(0.10)	2.1	(0.10)
EPA 353.1 - Nitrate-Nitrite (mg/L)	32	(0.44)	29	(0.44)	68	(2.2)
EPA 365.2 - Total Phosphorus (mg/L)	0.35	(0.020)	0.22	(0.020)	0.29	(0.020)
SW6010 - Metals (mg/L)						
Antimony	ND	(0.20)	ND	(0.20)	ND	(0.20)
Beryllium	0.0045 @	(0.0040)	ND	(0.0040)	ND	(0.0040)
Chromium	0.048 @	(0.020)	ND	(0.020)	ND	(0.020)
Nickel	0.066 @	(0.040)	0.042 @	(0.040)	ND	(0.040)
Zinc	0.17 @	(0.040)	0.059 @	(0.040)	ND	(0.040)
SW7421 - Lead (mg/L)	0.017 Z@	(0.0060)	ND Z	(0.0060)	ND Z	(0.0060)
SW7740 - Selenium (mg/L)	0.011 @	(0.0050)	0.012 @	(0.0050)	0.014 @	(0.0050)

Table 4-74

(Continued)

Location: Sample ID:	MW-36-04 36-04-01		MW-36-05 36-05-01	
Analyses	Result	(DL)	Result	(DL)
EPA 160.1 - Total Dissolved Solids (mg/L)	12000	(10)	11000	(10)
EPA 300.0 - Chloride (mg/L)	3500	(26)	3000	(26)
EPA 300.0 - Sulfate (mg/L)	3700	(5.0)	3300	(5.0)
EPA 340.2 - Fluoride (mg/L)	2.8	(0.10)	1.9	(0.10)
EPA 353.1 - Nitrate-Nitrite (mg/L)	97	(2.2)	59	(2.2)
EPA 365.2 - Total Phosphorus (mg/L)	0.18	(0.020)	0.20	(0.020)
SW6010 - Metals (mg/L)				
Antimony	ND	(0.20)	0.10 @	(0.10)
Beryllium	ND	(0.0040)	ND	(0.0020)
Chromium	ND	(0.020)	ND	(0.010)
Nickel	0.046 @	(0.040)	0.035 @	(0.020)
Zinc	ND	(0.040)	0.028 @	(0.020)
SW7421 - Lead (mg/L)	ND Z	(0.0060)	0.0076 Z@	(0.0060)
SW7740 - Selenium (mg/L)	0.017 @	(0.0050)	0.017 @	(0.0050)

NOTE: Table presents only constituents detected in groundwater at this site.
ND = Not Detected, at the reported detection limit.
@ = Measured result is less than five times the detection limit.
Z = SW6010, SW7421--Analyte detected in method blank.

Table 4-75

Concentrations of Organic Analytes in Site 36 Groundwater Samples

Location: Sample ID:	MW-36-01 36-01-01		MW-36-02 36-02-01		MW-36-03 36-03-01	
Analyte	Result	(DL)	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (μg/L)	1540	(200)	1380	(200)	1710	(200)
SW8240 - Volatile Organics (μg/L)						
Acetone	ND	(100)	ND	(100)	7.6 JB	(100)
Benzene	ND	(5.0)	ND	(5.0)	ND	(5.0)
Bromodichloromethane	ND	(5.0)	ND	(5.0)	1.5 J	(5.0)
Chloroform	ND	(5.0)	3.1 J	(5.0)	2.6 J	(5.0)
Chloromethane	ND	(10)	ND	(10)	ND	(10)
Ethyl benzene	ND	(5.0)	ND	(5.0)	ND	(5.0)
Methylene chloride	2.7 JB	(5.0)	13 B@	(5.0)	12 B@	(5.0)
Toluene	ND	(5.0)	0.28 J	(5.0)	0.32 J	(5.0)
Trichloroethene	ND	(5.0)	ND	(5.0)	24 @	(5.0)

Table 4-75

(Continued)

Location: Sample ID:	MW-36-04 36-04-01		MW-36-05 36-05-01	
Analyte	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (μg/L)	2690	(200)	1250	(200)
SW8240 - Volatile Organics (μg/L)				
Acetone	6.8 JB	(100)	2.9 J	(100)
Benzene	ND	(5.0)	0.75 J	(5.0)
Bromodichloromethane	ND	(5.0)	ND	(5.0)
Chloroform	1.5 J	(5.0)	1.3 J	(5.0)
Chloromethane	ND	(10)	1.4 J	(10)
Ethyl benzene	ND	(5.0)	0.35 J	(5.0)
Methylene chloride	16 B@	(5.0)	1.5 JB	(5.0)
Toluene	ND	(5.0)	ND	(5.0)
Trichloroethene	1.9 J	(5.0)	ND	(5.0)

NOTE: Table presents only constituents detected in groundwater at this site.
J = Detected below the detection limit.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.
ND = Not Detected, at the reported detection limit.
@ = Measured result is less than five times the detection limit.

Table 4-76

Groundwater Analytes Detected Above Risk-Based Action Levels at Site 36

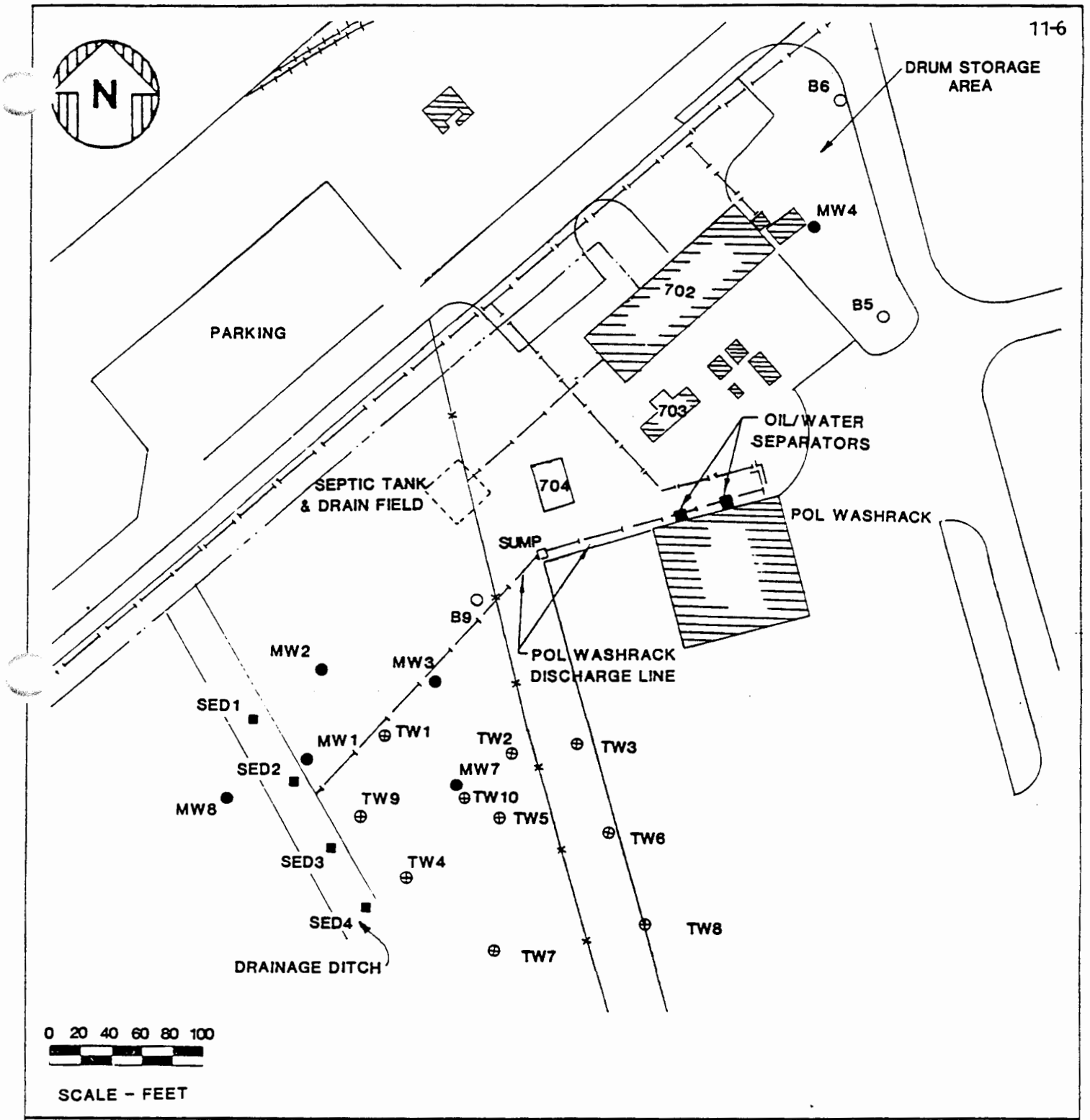
Analyte	Location ID	Result	Action Level
Groundwater Results (mg/L)			
Antimony	MW-36-05	0.1 @	0.01
Beryllium	MW-36-01	0.0045 @	0.000008
Fluoride	MW-36-01	2.2	2
Fluoride	MW-36-02	2.6	2
Fluoride	MW-36-03	2.1	2
Fluoride	MW-36-04	2.8	2
Lead	MW-36-01	0.017 Z@	0.015
Methylene chloride[a]	MW-36-02	0.013 B@	0.005
Methylene chloride[a]	MW-36-03	0.012 B@	0.005
Methylene chloride[a]	MW-36-04	0.016 B@	0.005
Trichloroethene	MW-36-03	0.024 @	0.003

Note: Result units were changed to match action level units for this table.

@ = Measured result is less than five times the detection limit.
Z = SW6010, SW7421--Analyte detected in method blank.
[a] Methylene chloride was determined to be a laboratory contaminant in a QA/QC review and is, therefore, not considered to be above the action level in samples from the site.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.

Appendix E

Walk, Haydel, and Associates, Installation Restoration Program Remedial Investigation Report for Holloman AFB, New Mexico, New Orleans, LA, 1989.



LEGEND

- ● MONITORING WELL
- ○ SOIL BORING
- ⊕ TEMPORARY WELL
- ■ SEDIMENT SAMPLE
- SEWAGE/DRAINAGE LINE
- WATER LINE
- FENCE
- GAS LINE
- RAILROAD

FIGURE 11-2

SITE 54

TEMPORARY WELL LOCATIONS

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION

HOLLOMAN AFB, NEW MEXICO

WH&A 1012 (REV.3/83)

WALK, HAYDEL & ASSOCIATES, INC.
ENGINEERS
NEW ORLEANS—MOBILE—BATON ROUGE

TABLE 11-1

SITE 54 - SOIL

VOLATILE ORGANICS (ug/kg)

	Depth (ft)	Borings				
		B1	B2	B3	B4	B5
Methylene chloride	2.5	4	-	-	-	
2-Butanone	5	-	-	10	-	
Ethylbenzene		-	-	4	-	
Methylene chloride		7	-	-	-	
Toluene		-	-	1	-	
Total Xylenes		-	-	7	-	
Benzene	10	-	-	130	-	-
Ethylbenzene		-	-	1500	-	-
Methylene chloride		4	-	-	-	-
Toluene		-	-	670	-	-
Total Xylenes		-	-	2100	-	-

- Not detected

TABLE 11-1 (continued)

SITE 54 - SOIL

VOLATILE ORGANICS (ug/kg)

	Depth (ft)	Borings				
		B6	B7	B8	B9	B9-D
	0	-				
	5					
Ethylbenzene			(20000)	(-)	(18000)	
Toluene			(5000)	(-)	(-)	
Total Xylenes			(39000)	(-)	(24000)	
Ethylbenzene	7.5		(7000)	(-)	(38000)	(16000)
Total Xylenes					(41000)	(10000)
	10		(-)*			
	15				(-)*	
	20			(-)		

- Not detected
D Field duplicate
( ) Stage II data
* Elevated limits due to matrix interference (x1000)

TABLE 11-2

SITE 54 - SOIL

BNA/TRPH

	Depth (ft)	Borings				
		B1	B2	B3	B4	B5
Acid/Base/Neutral Extractables (ug/kg)						
	2.5	-	-	-	-	
	5	-	-	-	-	
	10	-	-	-	-	-
	12.5					-
	15					-
TRPH (mg/kg)	0					
	2.5	-	16	-	-	
	5	-	-	5315	-	
	10	-	-	-	-	31
	12.5					-
	15					-

- Not detected

TABLE 11-2 (continued)

SITE 54 - SOIL

BNA/TRPH

	Depth (ft)	Borings B6	B7	B8	B9
Acid/Base/Neutral Extractables (ug/kg)					
	0	-			
	5				
2-Methylnaphthalene			(-)	(-) *	(1296)
Naphthalene			(-)	(-)	(157)
	7.5				
2-Methylnaphthalene		-	(-)	(-) *	(1206)
Naphthalene			(-)	(-)	(307)
	10		(-)		
	15	-			(-)
	20				
TRPH (mg/kg)	0	-			
	5		(522)	(-)	(157)
	7.5	-	(104)	(-)	(210)
	10		(-)		
	15	-			(35)
	20			(-)	

\- Not detected
* Acid extractables not valid due to out-of-range surrogate recoveries
( ) Stage II data

TABLE 11-3

SITE 54 - SOIL

TENTATIVELY IDENTIFIED COMPOUNDS (ug/kg)

	Borings/Depth (ft)				
	B7/5	B7/7.5	B7/10	B9/5	B9/7.5
Methylcyclopentane	31000				
3-Methylcylopentane	15000				
3-Methylpentane		14000	11000	11000	
Trans-1,3-Dimethyl-cyclopentane					13000
Trans-1,3-Dimethyl-cyclohexane					6000
1,1,3-Trimethylcyclohexane					17000
Trans-2,2-Dimethyl-3-hexane					21000
2,2,3,3-Tetramethylhexane	1800				1150
1-Ethyl-2Methylbenzene					423
3-Methylnonane					1828
1,3,5-Trimethylbenzene	703			663	2065
2,4,6-Trimethyldecane	15442			6738	
2,6,7-Trimethyldecane	1380			1003	2157
2,5,6-Trimethyldecane	10000	1129			4734
7-Methyl-Tridecane	11380	2293		6670	3923
2,6,10-Trimethyldodecane	9531	3530		6075	3348
Tetradecane	21250	9014			8702
2,6-Dimethylheptadecane	14843	6649		10143	5929
Heptadecane				4103	
1-iodododecane	8645	3459		5842	3348
Heptadecane	6145	2455		4103	2286
2,6,10,15-Tetramethylheptadecane					1991
1,1,2-Trimethyl cyclohexane				23000	
2,4,6,10,14-Tetramethylpentadecane				2652	
2-Methylheptene	703				
Propyl-cyclohexane	1223				
Hexatriacontane	1953				
Docosane	677				

Note: Table 11-3 is all Stage II data.

TABLE 11-4

SITE 54 - SOIL

METALS (mg/kg)

B7

	Depth (ft)			
	5	5 - FD	7.5	10
Antimony	-	-	-	-
Arsenic	3	3	3	4
Barium	39	92	81	63
Beryllium	2	2	2	2
Cadmium	1	1	1	2
Chromium	12	13	10	12
Copper	30	27	28	38
Iron	11799	11861	8974	9232
Lead	6	7	5	6
Manganese	265	124	121	130
Mercury	-	-	-	-
Nickel	18	16	11	13
Selenium*	-	-	-	-
Silver	1	2	2	3
Sodium	2105	1901	1149	1052
Thallium	-	-	-	-
Zinc	33	30	24	29

Note: Table 11-4 is all Stage II data
* Elevated detection limits due to matrix interference (10 mg/kg)
FD Field duplicate
\- Not detected

TABLE 11-4 (continued)

SITE 54 - SOIL

METALS (mg/kg)

B9

	Depth (ft)			
	5	7.5	7.5 - FD	15
Antimony	-	-	-	-
Arsenic	3	5	4	1
Barium	62	93	102	24
Beryllium	2	2	2	2
Cadmium	1	1	1	2
Chromium	12	11	17	12
Copper	28	22	24	28
Iron	9816	10359	14696	9108
Lead	5	7	7	5
Manganese	38	112	342	89
Mercury	-	-	-	-
Nickel	11	10	17	10
Selenium*	-	-	-	-
Silver	1	1	2	2
Sodium	548	484	623	667
Thallium	-	-	-	-
Zinc	26	26	40	24

Note: Table 11-4 is all Stage II data
- Not detected
FD Laboratory duplicate
* Elevated detection limit due to matrix interference (10 mg/kg)

TABLE 11-4 (continued)

SITE 54 - SOIL

METALS (mg/kg)

B8

	Depth (ft)			
	5	7.5	20	20-FD
Antimony	-	-	-	-
Arsenic*	-	-	5	-
Barium	12	24	33	33
Beryllium	0.5	0.8	0.5	0.5
Cadmium	0.3	0.4	-	0.3
Chromium	2	4	4	4
Copper	10	11	9	9
Iron	1244	2503	3226	3216
Lead	2	4	6	6
Manganese	12	21	52	51
Mercury	-	-	-	-
Nickel	1	5	6	6
Selenium	-	-	-	-
Silver	0.5	0.5	0.5	--
Sodium	151	292	1037	1034
Thallium	-	-	-	-
Zinc	4	9	11	11

Note: Table 11-4 is all Stage II data
- Not detected
FD Field duplicate
* Elevated detection limit due to matrix interference (2 mg/kg)

TABLE 11-5

SITE 54 - SEDIMENT

ORGANICS/TRPH

	Sediment				
	SED1	SED2	SED2-D	SED3	SED4
Volatiles (ug/kg)					
		-			-
Acid/Base/Neutral Extractables (ug/kg)					
	-			-	-
TRPH (mg/kg)					
	54	105	52	131	49

- Not detected
D Laboratory duplicate

TABLE 11-6

SITE 54 - GROUNDWATER

ORGANICS (ug/L)

	Monitoring Well						
	MW1	MW2	MW3	MW4	MW7	MW7(FP)	MW8
Volatiles							
Benzene	697 (-)	- (-)	1330 (5000)	-	(5400)	(4650000)	(-)
Chlorobenzene	5 (-)	- (-)	- (-)	-	(-)	(1050000)	(-)
Ethylbenzene	- (-)	- (-)	212 (12400)	-	(-)	(8150000)	(-)
2-Hexanone	- (-)	- (-)	- (-)	-	(-)	(3750000)	(-)
4-methyl-2-pentanone	45 (-)	- (-)	- (-)	-	(-)	(1450000)	(-)
Tetrachloroethene	43 (-)	- (-)	- (-)	-	- (-)	- (-)	(-)
Toluene	5 (-)	- (-)	144 (700)	-	(7300)	(2700000)	(-)
Total Xylenes	139 (-)	- (-)	91 (1400)	-	(-)	(10100000)	(-)
Acid/Base/Neutral Extractables							
2,4-Dimethylphenol	25	-	-	-	-		(-)*
2-Methylnaphthalene	-	-	-	-	(21)		(-)
4-Methylphenol	11	-	-	-	-		(-)
Naphthalene	-	-	11	-	(14)		(-)

- Not detected
(FP) Floating product
( ) Stage II data
* Corps of Engineers lab data

TABLE 11-7

SITE 54 - GROUNDWATER

TENTATIVELY IDENTIFIED COMPOUNDS (ug/L)

	Monitoring Well		
	MW2	MW3	MW7 (FP)
Hexane	30	334	-
1,5-Hexadiyne	-	3482	-
Pentane (ACN)(DOT)	-	-	2655000
Cyclohexane (DOT)	-	-	9785000
Methylcyclopentane	-	-	4714000
2,2,3-Trimethylhexane	-	-	3061000
3-Methylpentane	-	-	4470000
Methylcyclohexane	-	-	20195000
Ethylcyclopentane	-	-	1303000
2,2,3-Trimethylhexane	-	-	2952000
2,4,4-Trimethyl-2-Pentene	-	-	3711000
1,1,3-Trimethylcyclohexane	-	-	3160000

Note: Table 11-7 is all Stage II data
- Not detected

TABLE 11-8

SITE 54 - GROUNDWATER

TRPH (mg/L)

	Monitoring Well						
	MW1	MW2	MW3	MW4	MW7	MW7 (FP)	MW8
TRPH (mg/L)							
	335 (2)	-	1 (2)	-	(13)	(96000)	(-)

- Not detected
FP Floating product
( ) Stage II data

TABLE 11-9

SITE 54 - GROUNDWATER

METALS (ug/L)

	Monitoring Well			
	MW1	MW2	MW2 - FD	MW3
Antimony	39	59	-	33
Arsenic	149	-*	-*	115
Barium	384	353	286	90
Beryllium	11	12	9	5
Cadmium	10	5	-	4
Chromium	66	44	41	20
Copper	169	146	98	74
Iron	48080	27379	26783	12800
Lead	37	87	37	-*
Manganese	2588	173	235	4487
Mercury	-	-	-	-
Nickel	175	66	50	133
Selenium	-*	-*	-*	-*
Silver	7	-	-	-
Sodium	1361129	335697	332272	823632
Thallium	-	-	-	-
Zinc	180	107	117	51

Note: Table 11-9 is all Stage II data
* Elevated detection limits due to matrix interference (arsenic 100 ug/L, lead and selenium 50 ug/l)
\- Not detected
FD Field duplicate

TABLE 11-9 (continued)

SITE 54 - GROUNDWATER

METALS (ug/L)

	Monitoring Wells				
	MW7	MW7-LD	MW7 (FP)	MW8	MW8-FD
Antimony	-	-	-	-	-
Arsenic	-	-	-	-*	-*
Barium	87	78	-	1033	896
Beryllium	4	4	-	15	14
Cadmium	4	-	-	7	-
Chromium	14	10	-	128	110
Copper	53	44	-	178	16
Iron	8889	7677	28	103664	89882
Lead	9	8	62	41	47
Manganese	2665	2593	-	138	1076
Mercury	-	-	0.415	-	-
Nickel	44	42	-	127	113
Selenium*	-	-	-	-	-
Silver	11	-	-	32	13
Sodium	1939810	177610	-	3170000	3035980
Thallium	-	-	-	-	-
Zinc	44	39	3	316	273

Note: Table 11-9 is all Stage II data
- Not detected
FD Field duplicate
LD Laboratory duplicate
FP Floating product
* Elevated detection limit due to matrix interference (aresenic 100 ug/L, selenium 50 ug/L)

TABLE 11-10

SITE 54

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Constituent Concentrations: Soil* Average	Soil* Maximum	Water Average	Water Maximum	New Mexico Water Standards[a]	Federal Drinking Water Standards: Primary MCL[b]	Secondary MCL[c]	Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
Organics									
Benzene	58	58	3,107	5,400	10	5	-	0 (0.67)	-
2-Butanone	83	83	-	-	-	-	-	-	-
Chlorobenzene	-	-	5	5	-	-	-	488	-
2,4-Dimethyl-phenol	-	-	25	25	-	-	-	400	-
Ethylbenzene	410	1,280	6,306	12,400	750	-	-	2,400	-
Methylene chloride	21	30	-	-	100	-	-	0 (0.19)	-
2-Methyl-naphthalene	N/A	N/A	21	21	30**	-	-	-	-
4-Methyl-2-pentanone	-	-	45	45	-	-	-	-	-
4-Methylphenol	-	-	11	11	5***	-	-	-	-
Naphthalene	N/A	N/A	13	14	30**	-	-	Insufficient data	-
Tetrachloro-ethene	-	-	43	43	20	-	-	0 (0.88)	-
Toluene	230	620	2,037	7,300	750	-	-	15,000	-
Total xylenes	2,800	6,400	543	1,400	620	-	-	-	-
Hexane	-	-	182	334	-	-	-	-	-
1,5-Hexadiyne	-	-	3482	3482	-	-	-	-	-

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TABLE 11-10 (Continued)

SITE 54

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Constituent Concentrations Water Average	Constituent Concentrations Water Maximum	New Mexico Water Standards[a]	Federal Drinking Water Standards Primary MCL[b]	Federal Drinking Water Standards Secondary MCL[c]	Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
Metals							
Antimony	44	59	-	-	-	146	-
Arsenic	132	149	100	50	-	0.025	200
Barium	368	1,033	1,000	1,000	-	-	-
Beryllium	9	15	-	-	-	0 (0.0039)	-
Cadmium	6	10	10	10	-	10	50
Chromium	52	128	50	50	-	50	1,000
Copper	102	178	1,000	-	1,000	1,000	500
Lead	38	87	50	50	-	50	100
Nickel	106	175	200	-	-	15.4	-
Silver	14	32	50	50	-	50	-
Zinc	136	316	10,000	-	5,000	5,000	25,000

MCL Maximum Contaminant Level
( ) Concentrations in parentheses correspond to midpoint of risk range for potential carcinogens
\- Not given
* Estimated maximum groundwater concentrations based on soil analyses.
** Total naphthalene plus monomethylnaphthalene, 30 ug/L
*** For domestic water supplies; phenols, 5 ug/L.
N/A Not available since no Koc values are published for these compounds. Concentrations in soils cannot be converted to values expected to be transferred to groundwater.
(a) ER, New Mexico Water Quality Regulations, 2/13/87.
(b) ER, EPA National Drinking Water Regulations, Part 141.11 (7/31/87) and Part 141.61 (7/22/88).
(c) ER, EPA National Secondary Drinking Water Regulations, Part 143.3, 10/21/88.
(d) USEPA, SPHEM, 10/86.
(e) National Academy of Sciences and National Academy of Engineering, 1974.

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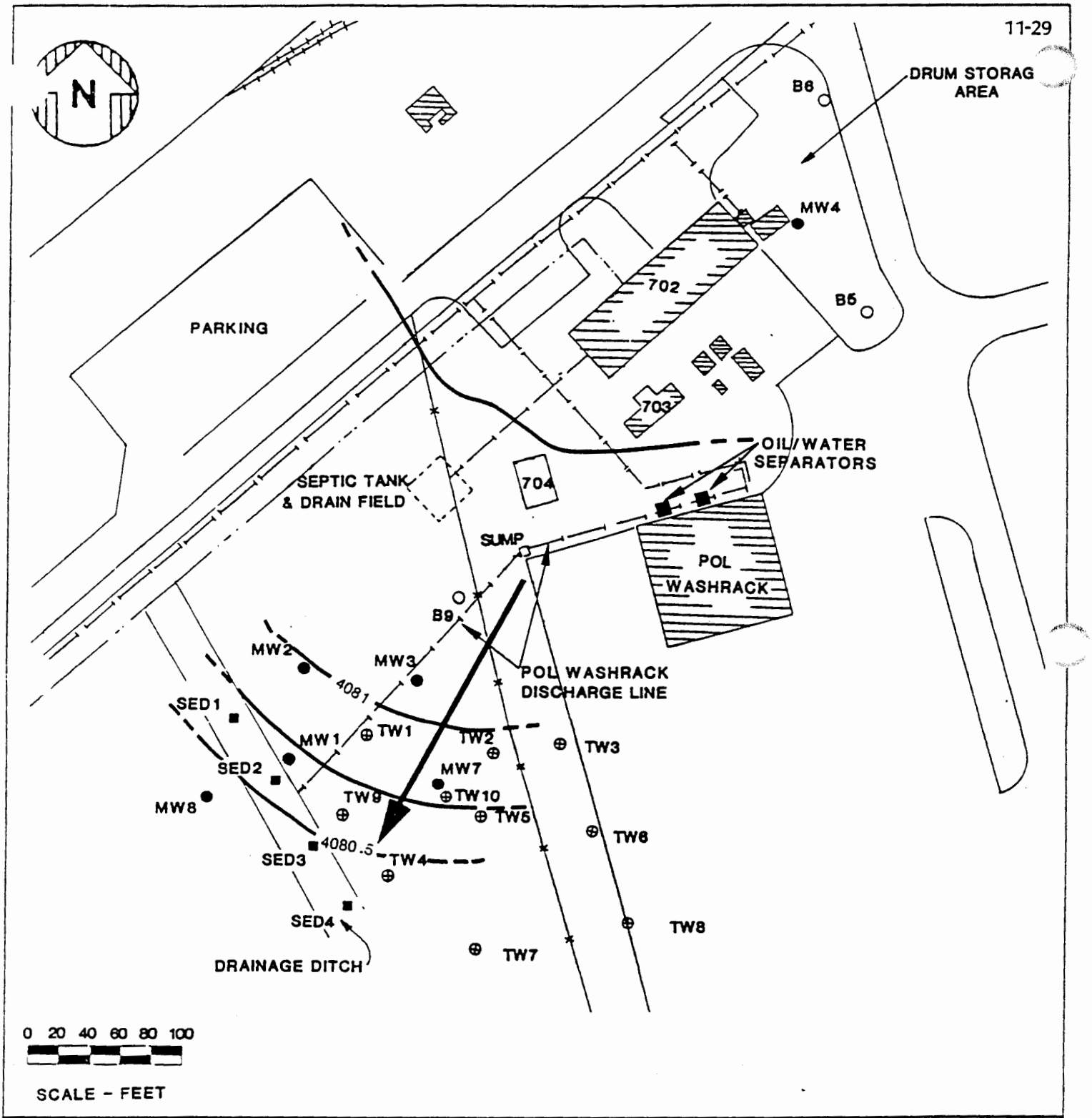

LEGEND:

- ● MONITORING WELLS
- ○ SOIL BORING
- ⊕ TEMPORARY WELL
- SEDIMENT SAMPLE
- SEWAGE/DRAINAGE LINE
- WATER LINE
- FENCE
- GAS LINE
- RAILROAD
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

FIGURE 11-3

SITE 54
GROUNDWATER CONTOUR MAP

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION
HOLLOMAN AFB, NEW MEXICO

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TABLE 11-12

SITE 54

RELEASE CONCENTRATIONS

Constituents	Release Transport Medium	Release Source/ Mechanism	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Benzene	Groundwater	Contaminated Soil/Site Leaching	3107	5400
2-Butanone	Groundwater	Contaminated Soil/Site Leaching	83	83
Ethylbenzene	Groundwater	Contaminated Soil/Site Leaching	6306	12400
1,5-Hexadiyne	Groundwater	Contaminated Soil/Site Leaching	3482	3482
Hexane	Groundwater	Contaminated Soil/Site Leaching	182	334
2-Methylnaphthalene	Groundwater	Contaminated Soil/Site Leaching	21	21
4-Methyl-2-pentanone	Groundwater	Contaminated Soil/Site Leaching	45	45
4-Methylphenol	Groundwater	Contaminated Soil/Site Leaching	11	11
Naphthalene	Groundwater	Contaminated Soil/Site Leaching	13	14
Tetrachloroethene	Groundwater	Contaminated Soil/Site Leaching	43	43

TABLE 11-12 (Continued)

SITE 54

RELEASE CONCENTRATIONS

Constituents	Release Transport Medium	Release Source/ Mechanism	Best Estimates (ug/l)	Upper Bound Estimates (ug/l)
Toluene	Groundwater	Contaminated Soil/Site Leaching	2037	7300
Total xylenes	Groundwater	Contaminated Soil/Site Leaching	2800	6400
Arsenic	Groundwater	Contaminated Soil/Site Leaching	132	149
Barium	Groundwater	Contaminated Soil/Site Leaching	368	1033
Beryllium	Groundwater	Contaminated Soil/Site Leaching	9	15
Chromium	Groundwater	Contaminated Soil/Site Leaching	52	128
Lead	Groundwater	Contaminated Soil/Site Leaching	38	87

TABLE 11-13

SITE 54

EXPOSURE POINT CONCENTRATIONS

Constituents	Release Transport Medium	Exposure Point	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Benzene	Groundwater	Nearest hypothetical off-base well*	LT 31	LT 54
2-Butanone	Groundwater	Nearest hypothetical off-base well*	LT 0.83	LT 0.83
Ethylbenzene	Groundwater	Nearest hypothetical off-base well*	LT 63	LT 124
1,5-Hexadiyne	Groundwater	Nearest hypothetical off-base well*	LT 35	LT 35
Hexane	Groundwater	Nearest hypothetical off-base well*	LT 2	LT 3
2-Methylnaphthalene	Groundwater	Nearest hypothetical off-base well*	LT 0.21	LT 0.21
4-Methyl-2-pentanone	Groundwater	Nearest hypothetical off-base well*	LT 0.45	LT 0.45
4-Methylphenol	Groundwater	Nearest hypothetical off-base well*	LT 0.11	LT 0.11
Naphthalene	Groundwater	Nearest hypothetical off-base well*	LT 0.13	LT 0.14
Tetrachloroethene	Groundwater	Nearest hypothetical off-base well*	LT 0.43	LT 0.43
Toluene	Groundwater	Nearest hypothetical off-base well*	LT 20	LT 73
Total xylenes	Groundwater	Nearest hypothetical off-base well*	LT 28	LT 64
Arsenic	Groundwater	Nearest hypothetical off-base well*	LT 1	LT 2

TABLE 11-13 (continued)

SITE 54

EXPOSURE POINT CONCENTRATIONS

Constituents	Medium	Exposure Point	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Barium	Groundwater	Nearest hypothetical off-base well*	LT 4	LT 10
Beryllium	Groundwater	Nearest hypothetical off-base well*	LT 0.09	LT 0.15
Chromium	Groundwater	Nearest hypothetical off-base well*	LT 0.52	LT 1
Lead	Groundwater	Nearest hypothetical off-base well*	LT 0.38	LT 0.87

* 2.6 miles south-southwest of site
LT Less Than

TABLE II-14

SITE 54

COMPARISON OF EXPOSURE POINT CONCENTRATIONS WITH STANDARDS AND CRITERIA (ug/L)

Constituents	Exposure Point Concentrations		New Mexico Water Standards[a]	Federal Drinking Water Standards		Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
	Best Estimates	Upper Bound Estimates		Primary MCL[b]	Secondary MCL[c]		
Organics							
Benzene	LT 31	LT 54	10	5	-	0 (0.67)	-
2-Butanone	LT 0.83	LT 0.83	-	-	-	-	-
Ethylbenzene	LT 63	LT 124	750	-	-	2,400	-
1,5-Hexadiyne	LT 35	LT 35	-	-	-	-	-
Hexane	LT 2	LT 3	-	-	-	-	-
2-Methylnaphthalene	LT 0.21	LT 0.21	30*	-	-	-	-
4-Methyl-2-pentanone	LT 0.45	LT 0.45	-	-	-	-	-
4-Methylphenol	LT 0.11	LT 0.11	5**	-	-	-	-
Naphthalene	LT 0.13	LT 0.14	30*	-	-	insufficient data	-
Tetrachloroethene	LT 0.43	LT 0.43	20	-	-	0 (0.88)	-
Toluene	LT 20	LT 73	750	-	-	15,000	-
Total xylenes	LT 28	LT 64	620	-	-	-	-
Arsenic	LT 1	LT 2	100	50	-	0.025	200
Barium	LT 4	LT 10	1,000	1,000	-	-	-

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TABLE 11-14 (Continued)

SITE 54

COMPARISON OF EXPOSURE POINT CONCENTRATIONS WITH STANDARDS AND CRITERIA (ug/L)

Constituents	Exposure Point Concentrations		New Mexico Water Standards[a]	Federal Drinking Water Standards		Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
	Best Estimates	Upper Bound Estimates		Primary MCL[b]	Secondary MCL[c]		
Metals							
Beryllium	LT 0.09	LT 0.15	-	-	-	0 (0.0039)	-
Chromium	LT 0.52	LT 1	50	50	-	50	1,000
Lead	LT 0.38	LT 0.87	50	50	-	50	100

MCL Maximum Contaminant Level
( ) Concentrations in parentheses correspond to midpoint of risk range for potential carcinogens
\- Not given
* Total naphthalene plus monomethylnaphthalene, 30 ug/L
** For domestic water supplies; phenols 5 ug/L
LT Less Than
(a) ER, New Mexico Water Quality Regulations, 2/13/87.
(b) ER, EPA National Drinking Water Regulations, Part 141.11 (7/31/87) and Part 141.61 (7/22/88).
(c) ER, EPA National Secondary Drinking Water Regulations, Part 143.3, 10/21/88.
(d) USEPA, SPHEM, 10/86.
(e) National Academy of Sciences and National Academy of Engineering, 1974.

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TABLE 11-15

SITE 54

RESULTS OF TOXICITY ASSESSMENT

Constituents	Upper Bound Estimates (ug/L)	Toxic Dose Concentrations (mg/kg)	Water Volumes Required To Reach Toxicity Concentrations* (L)
Benzene	LT 54	331	3,069,400
Beryllium	LT 0.15	0.0467	155,600
2-Butanone**	LT 0.83	218	130,000,000
Hexane	LT 3	8,768	1,461,333,300
4-Methyl-2-pentanone**	LT 0.45	166	184,444,400

* Rounded to the lower 100 liters.

** No toxicological data available; therefore, lethal data were used. Results are actually concentrations and volumes required to cause death.

LT Less Than

Appendix F

Radian Corporation, Project Assessment Report of the Sewage Lagoon System, March 1980 - July 1990, Holloman AFB, New Mexico, August 1990.

Lagoon F [a]

	Liquid (mg/l)	Sludge (mg/kg)
Organics:		
Diethyl phthalate		1.6
Metals:		
Aluminum		1500.
Antimony		79.
Arsenic	0.02	
Barium	2.1	230.
Cadmium	0.06	1.2
Calcium	240.	26,000.
Copper	0.21	19.
Iron		140.
Magnesium	130.	3000.
Manganese	0.18	55.
Potassium	17.	440.
Selenium	0.02	
Silver		
Sodium	510.	850.
Zinc	0.05	21.
Cyanide		
Fluoride	1.0	2.2
Phenols, total	0.02	
Sulfide		230.

[a] Results of Appendix IX sample analysis of one aqueous sample taken from Pond F. Only analytes detected are shown above.

Appendix G

Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992.

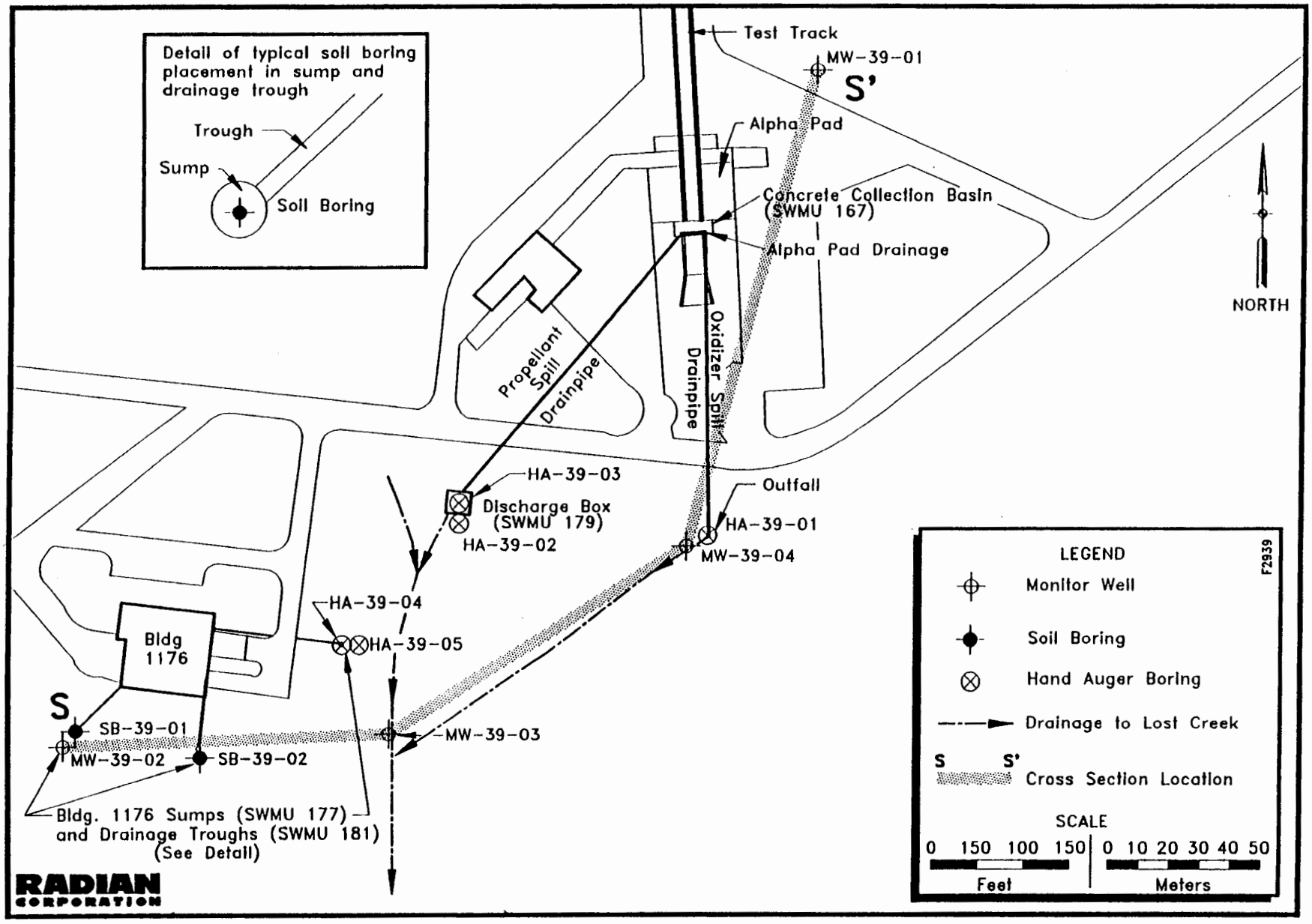


Figure 4-64. Hand Auger Boring, Soil Boring, Monitor Well, and Cross Section Locations for Site 39

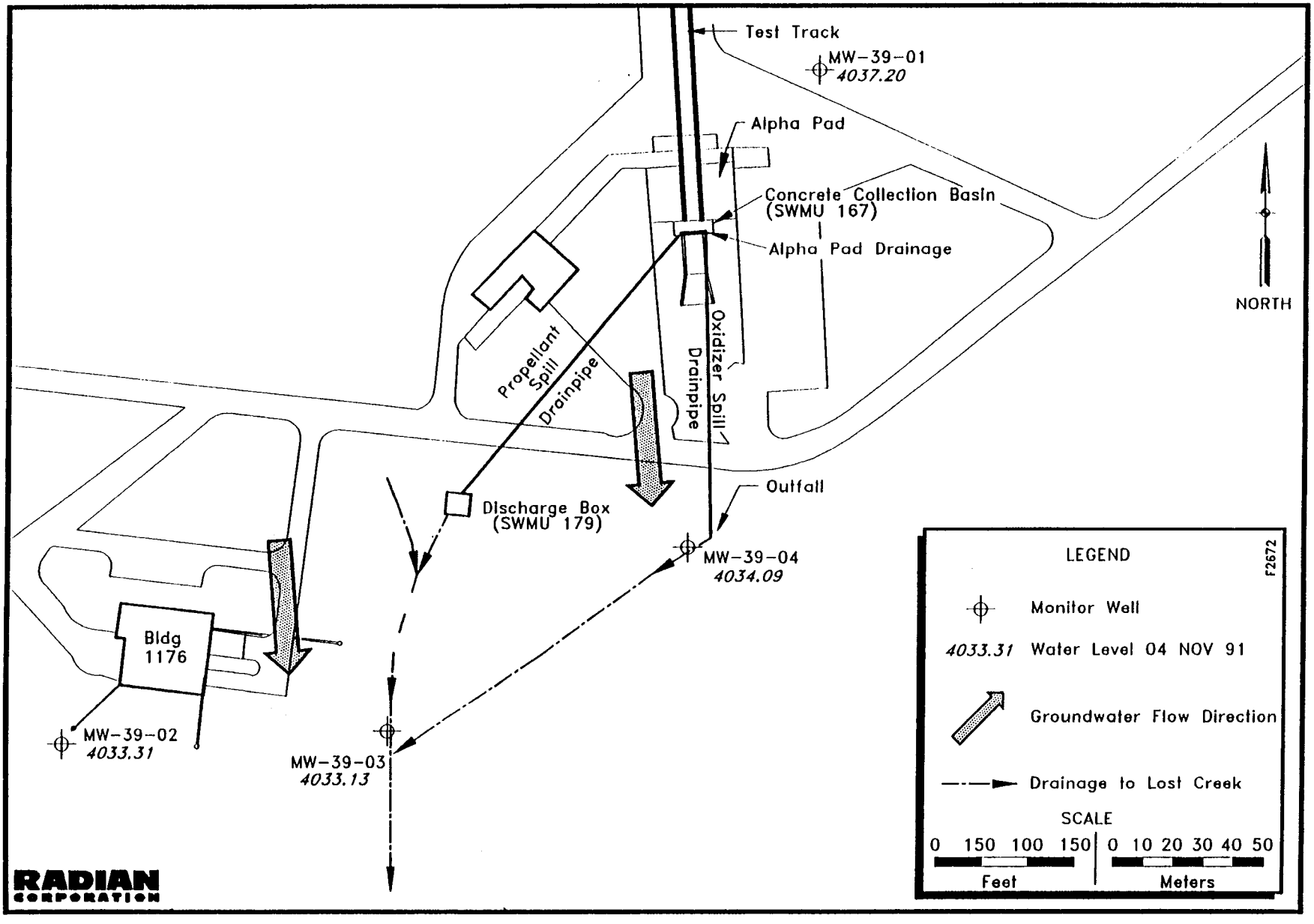


Figure 4-66. Monitor Well Locations and Groundwater Flow Direction for Site 39

Table 4-87

Concentrations of Inorganic Analytes in Site 39 Soil Samples

Location:	SB-39-01				SB-39-02			
Sample ID: Depth:	91JUL1H039-001 7.5 - 9.5 ft		91JUL1H039-002 10 - 12 ft		91JUL1H039-003 10 - 12 ft		91JUL1H039-004 15 - 17 ft	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
SW6010 - Metals (mg/kg)								
Beryllium	ND	(0.36)	ND	(0.49)	ND	(0.45)	0.58 @	(0.49)
Cadmium	0.98 @	(0.89)	ND	(1.2)	30	(1.1)	4.3 @	(1.2)
Chromium	5.6 @	(1.8)	3.2 @	(2.4)	78	(2.3)	25	(2.4)
Copper	6.0 @	(3.6)	ND	(4.9)	82	(4.5)	5.1 @	(4.9)
Nickel	ND	(3.6)	ND	(4.9)	14 @	(4.5)	8.6 @	(4.9)
Silver	ND	(1.8)	ND	(2.4)	ND	(2.3)	ND	(2.4)
Zinc	52	(3.6)	8.4 @	(4.9)	380	(4.5)	60	(4.9)
SW7060 - Arsenic (mg/kg)	2.6	(0.45)	0.66 @	(0.43)	2.0	(0.40)	2.0 @	(0.44)
SW7421 - Lead (mg/kg)	16	(1.1)	1.0 @	(0.24)	77	(4.3)	9.2	(0.98)
SW7471 - Mercury (mg/kg)	ND	(0.056)	ND	(0.064)	ND	(0.068)	ND	(0.060)

Table 4-87

(Continued)

Location:	HA-39-01		HA-39-02		HA-39-03	
Sample ID: Depth:	91JUJJ039-007 0 - 2 ft		91JUJJ039-008 0 - 2 ft		91JUJJ039-009 0 - 2 ft	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)
SW6010 - Metals (mg/kg)						
Beryllium	ND	(0.46)	0.57 @	(0.37)	0.58 @	(0.57)
Cadmium	ND	(1.2)	7.3	(0.92)	7.8	(1.4)
Chromium	8.6 @	(2.3)	26	(1.8)	47	(2.9)
Copper	14 @	(4.6)	91	(3.7)	140	(5.7)
Nickel	6.5 @	(4.6)	23	(3.7)	21 @	(5.7)
Silver	ND	(2.3)	ND	(1.8)	12 @	(2.9)
Zinc	30	(4.6)	250	(3.7)	180	(5.7)
SW7060 - Arsenic (mg/kg)	1.6 @	(0.44)	28	(3.6)	34 @	(9.3)
SW7421 - Lead (mg/kg)	180	(13)	1300	(110)	1100	(140)
SW7471 - Mercury (mg/kg)	ND	(0.064)	0.063 @	(0.050)	ND	(0.069)

Table 4-87

(Continued)

Location:	HA-39-04		HA-39-05	
Sample ID: Depth:	91JULH039-005 0 - 2 ft		91JULH039-006 0 - 2 ft	
Analyses	Result	(DL)	Result	(DL)
SW6010 - Metals (mg/kg)				
Beryllium	ND	(0.48)	ND	(0.47)
Cadmium	38	(1.2)	4.0 @	(1.2)
Chromium	190	(2.4)	130	(2.4)
Copper	110	(4.8)	19 @	(4.7)
Nickel	31	(4.8)	58	(4.7)
Silver	ND	(2.4)	ND	(2.4)
Zinc	540	(4.8)	130	(4.7)
SW7060 - Arsenic (mg/kg)	3.7	(0.45)	0.99 @	(0.45)
SW7421 - Lead (mg/kg)	210	(14)	10	(0.68)
SW7471 - Mercury (mg/kg)	0.074 @	(0.053)	ND	(0.060)

NOTE: Table presents only constituents detected in soil at this site.
ND = Not Detected, at the reported detection limit.
@ = Measured result is less than five times the detection limit.

Table 4-88

Concentrations of Organic Analytes in Site 39 Soil Samples

Location:	SB-39-01				SB-39-02			
Sample ID: Depth:	91JUL1H039-001 7.5 - 9.5 ft		91JUL1H039-002 10 - 12 ft		91JUL1H039-003 10 - 12 ft		91JUL1H039-004 15 - 17 ft	
Analytes	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	678	(25.5)	26.3 @	(13.3)	2620	(283)	543	(14.4)
SW8240 - Volatile Organics (ug/kg)								
1,1,1-Trichloroethane	ND	(130)	430000 D	(17000)	87000 D	(3500)	900	(140)
1,1,2-Trichloroethane	ND	(130)	95 J	(130)	ND	(140)	ND	(140)
1,1-Dichloroethane	ND	(130)	260 @	(130)	170 @	(140)	69 J	(140)
1,1-Dichloroethene	ND	(130)	ND	(130)	ND	(140)	44 J	(140)
1,2-Dichloroethane	ND	(130)	140 @	(130)	ND	(140)	ND	(140)
Chloromethane	44 J	(250)	ND	(270)	ND	(280)	ND	(270)
Ethyl benzene	2.9 J	(130)	4.3 J	(130)	81 J	(140)	ND	(140)
Methylene chloride	510 B@	(130)	630 B@	(130)	1400 B	(140)	530 B@	(140)
Tetrachloroethene	ND	(130)	430 @	(130)	95000 D	(3500)	300 @	(140)
Toluene	12 JB	(130)	3400 B	(130)	82 JB	(140)	12 JB	(140)
Trichloroethene	ND	(130)	40000 D	(3400)	11000 D	(1400)	47 J	(140)
Xylenes	8.1 J	(130)	23 J	(130)	290 @	(140)	ND	(140)

Table 4-88

(Continued)

Location:	HA-39-01		HA-39-02		HA-39-03	
Sample ID: Depth:	91JUJJ039-007 0 - 2 ft		91JUJJ039-008 0 - 2 ft		91JUJJ039-009 0 - 2 ft	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	50.2 @	(13.4)	660	(24)	811	(35)
SW8240 - Volatile Organics (μg/kg)						
1,1,1-Trichloroethane	ND	(140)	ND	(110)	ND	(150)
1,1,2-Trichloroethane	ND	(140)	ND	(110)	ND	(150)
1,1-Dichloroethane	ND	(140)	ND	(110)	ND	(150)
1,1-Dichloroethene	ND	(140)	18 J	(110)	ND	(150)
1,2-Dichloroethane	ND	(140)	ND	(110)	ND	(150)
Chloromethane	ND	(280)	ND	(230)	ND	(300)
Ethyl benzene	ND	(140)	ND	(110)	ND	(150)
Methylene chloride	720	(140)	350 @	(110)	36 J	(150)
Tetrachloroethene	ND	(140)	ND	(110)	ND	(150)
Toluene	9.1 J	(140)	8.0 J	(110)	9.1 J	(150)
Trichloroethene	ND	(140)	ND	(110)	ND	(150)
Xylenes	ND	(140)	ND	(110)	ND	(150)

Table 4-88

(Continued)

Location:	HA-39-04		HA-39-05	
Sample ID: Depth:	91JUL1H039-005 0 - 2 ft		91JUL1H039-006 0 - 2 ft	
Analyses	Result	(DL)	Result	(DL)
EPA 418.1 - TRPH (mg/kg)	20700	(610)	95.6	(12.4)
SW8240 - Volatile Organics (μg/kg)				
1,1,1-Trichloroethane	ND	(120)	ND	(130)
1,1,2-Trichloroethane	ND	(120)	ND	(130)
1,1-Dichloroethane	ND	(120)	ND	(130)
1,1-Dichloroethene	ND	(120)	22 J	(130)
1,2-Dichloroethane	ND	(120)	ND	(130)
Chloromethane	ND	(240)	ND	(260)
Ethyl benzene	ND	(120)	5.9 J	(130)
Methylene chloride	54 J	(120)	260 @	(130)
Tetrachloroethene	ND	(120)	28 J	(130)
Toluene	8.9 J	(120)	9.3 J	(130)
Trichloroethene	ND	(120)	ND	(130)
Xylenes	38 J	(120)	13 J	(130)

NOTE: Table presents only constituents detected in soil at this site.
ND = Not Detected, at the reported detection limit.
D = Secondary dilution required for this analyte.
J = Detected below the detection limit.
@ = Measured result is less than five times the detection limit.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.

Table 4-89

Concentrations of Inorganic Analytes in Site 39 Groundwater Samples

Location: Sample ID:	MW-39-01 39-01-01		MW-39-02 39-02-01		MW-39-03 39-03-01		MW-39-04 39-04-01	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
EPA 160.1 - Total Dissolved Solids (mg/L)	11000	(10)	13000	(10)	14000	(10)	2600	(10)
EPA 300.0 - Chloride (mg/L)	2200	(26)	4200	(26)	4500	(26)	39	(0.26)
EPA 300.0 - Sulfate (mg/L)	4300	(5.0)	4400	(5.0)	3500	(5.0)	ND	(0.050)
EPA 340.2 - Fluoride (mg/L)	1.8	(0.10)	1.5	(0.10)	1.9	(0.10)	0.77	(0.10)
EPA 353.1 - Nitrate-Nitrite (mg/L)	48	(1.1)	87	(1.1)	49	(1.1)	0.52	(0.022)
EPA 365.2 - Total Phosphorus (mg/L)	0.22	(0.020)	0.18	(0.020)	0.21	(0.020)	0.093 @	(0.020)
SW6010 - Metals (mg/L)								
Beryllium	ND	(0.0020)	0.0029 @	(0.0020)	0.0025 @	(0.0020)	ND	(0.0020)
Cadmium	ND	(0.0050)	0.0059 @	(0.0050)	ND	(0.0050)	ND	(0.0050)
Chromium	ND	(0.010)	0.020 @	(0.010)	0.021 @	(0.010)	ND	(0.010)
Copper	ND	(0.020)	ND	(0.020)	0.12	(0.020)	ND	(0.020)
Nickel	ND	(0.020)	0.030 @	(0.020)	0.038 @	(0.020)	ND	(0.020)
Zinc	ND	(0.020)	0.071 @	(0.020)	0.058 @	(0.020)	0.024 @	(0.020)
SW7421 - Lead (mg/L)	ND	(0.0030)	0.0078 @	(0.0030)	0.011 @	(0.0030)	0.019	(0.0030)
SW7740 - Selenium (mg/L)	0.015 @	(0.0050)	0.015 @	(0.0050)	0.013 @	(0.0050)	ND	(0.0050)

NOTE: Table presents only constituents detected in groundwater at this site.
ND = Not Detected, at the reported detection limit.
@ = Measured result is less than five times the detection limit.

Table 4-90

Concentrations of Organic Analytes in Site 39 Groundwater Samples

Location: Sample ID:	MW-39-01 39-01-01		MW-39-02 39-02-01		MW-39-03 39-03-01		MW-39-04 39-04-01	
Analyses	Result	(DL)	Result	(DL)	Result	(DL)	Result	(DL)
SW8240 - Volatile Organics (ug/L)								
1,1,1-Trichloroethane	ND	(5.0)	240 D	(10)	ND	(5.0)	1.8 J	(5.0)
1,1-Dichloroethane	ND	(5.0)	0.59 J	(5.0)	ND	(5.0)	ND	(5.0)
1,1-Dichloroethene	ND	(5.0)	9.6 @	(5.0)	ND	(5.0)	ND	(5.0)
Acetone	24 J	(100)	ND	(100)	3.5 J	(100)	ND	(100)
Carbon tetrachloride	ND	(5.0)	5.8 @	(5.0)	ND	(5.0)	ND	(5.0)
Chloroform	0.35 J	(5.0)	2.1 J	(5.0)	0.81 J	(5.0)	ND	(5.0)
Chloromethane	ND	(10)	0.72 J	(10)	ND	(10)	ND	(10)
Methylene chloride	14 B@	(5.0)	10 B@	(5.0)	15 B@	(5.0)	15 B@	(5.0)
Tetrachloroethene	0.19 J	(5.0)	1.1 J	(5.0)	0.37 J	(5.0)	ND	(5.0)
Trichloroethene	0.25 J	(5.0)	59	(5.0)	2.7 J	(5.0)	ND	(5.0)

NOTE: Table presents only constituents detected in groundwater at this site.
ND = Not Detected, at the reported detection limit.
D = Secondary dilution required for this analyte.
J = Detected below the detection limit.
@ = Measured result is less than five times the detection limit.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.

Table 4-91

Soil and Groundwater Analytes Detected Above Risk-Based Action Levels at Site 39

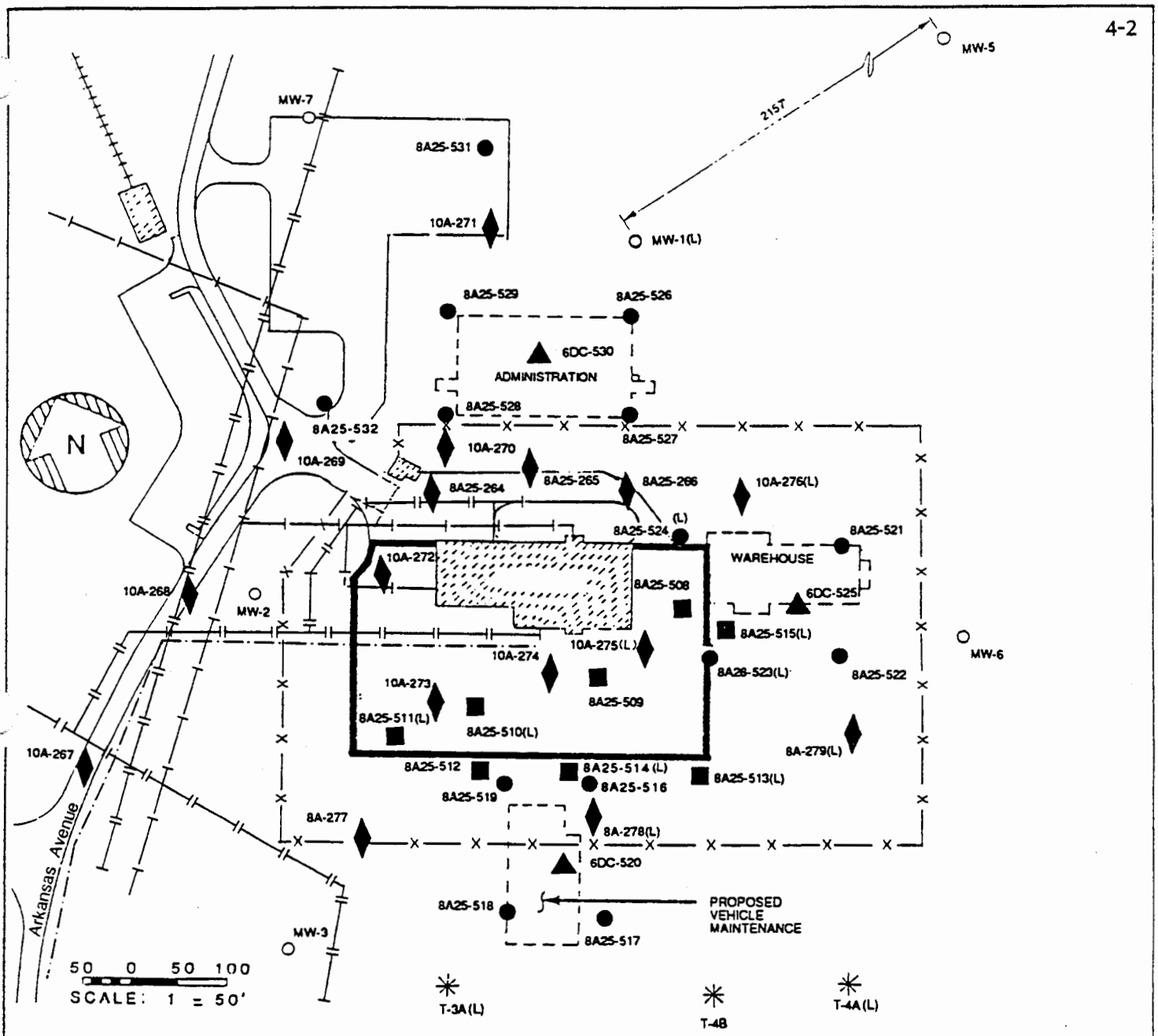
Analyte	Location ID	Result		Action Level
Soil Results (mg/kg)				
Arsenic	HA-39-02	28		24
Arsenic	HA-39-03	34	@	24
Beryllium	HA-39-02	0.57	@	0.2
Beryllium	HA-39-03	0.58	@	0.2
Beryllium	SB-39-02	0.58	@	0.2
Lead	HA-39-01	180		32
Lead	HA-39-02	1300		32
Lead	HA-39-03	1100		32
Lead	HA-39-04	210		32
Tetrachloroethene	SB-39-02	95	D	14
Groundwater Results (mg/L)				
1,1,1-Trichloroethane	MW-39-02	0.24	D	0.06
Beryllium	MW-39-02	0.0029	@	0.000008
Beryllium	MW-39-03	0.0025	@	0.000008
Cadmium	MW-39-02	0.0059	@	0.005
Carbon tetrachloride	MW-39-02	0.0058	@	0.0003
Lead	MW-39-04	0.019		0.015
Methylene chloride[a]	MW-39-01	0.014	B@	0.005
Methylene chloride[a]	MW-39-02	0.01	B@	0.005
Methylene chloride[a]	MW-39-03	0.015	B@	0.005
Methylene chloride[a]	MW-39-04	0.015	B@	0.005
Trichloroethene	MW-39-02	0.059		0.003

Note: Result units were changed to match action level units for this table.

@ = Measured result is less than five times the detection limit.
D = Secondary dilution required for this analyte.
[a] Methylene chloride was determined to be a laboratory contaminant in a QA/QC review and is, therefore, not considered to be above the action level in samples from the site.
B = Analyte detected in laboratory blank analysis, no blank subtraction performed.

Appendix H

Radian Corporation, Remedial Investigation (RI) Report, Volume I, Investigation, Study, and Recommendations for 29 Waste Sites, October 1992.



LEGEND:

- EXISTING HARDSTAND
- EXISTING FACILITIES
- RI SOIL BORINGS
- DENNISON CORES
- MONITORING WELLS
- TEST BORINGS
- COE BORING, JUNE 1982
- COE BORING, NOV. 1987
- SANITARY SEWER
- WATER LINE
- GAS LINE
- (L) LANDFILL MATERIAL ENCOUNTERED
- EXISTING FENCE
- PROPOSED BUILDING

FIGURE 4-1

SITE 10
OLD MAIN BASE LANDFILL

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION
HOLLOMAN AFB, NEW MEXICO

WH&A 1012 (REV.3/83)

WALK, HAYDEL & ASSOCIATES, INC.
ENGINEERS
NEW ORLEANS—MOBILE—BATON ROUGE

TABLE 4-1

SITE 10 - SOIL

VOLATILE ORGANICS (ug/kg)

	Depth (ft.)	Boring				
		8A25-523	8A25-524	8A25-528	8A25-532	8A25-532-D
Volatiles						
	7.5					
Methylene Chloride*			7			
	9	-				
	12.5					
Methylene Chloride*			8			
	13.5	-				
	15					
Acetone					34	47
Benzene					5	6
2-Butanone					210	240
Ethyl Benzene					4	5
Toluene					2	3
1,1,1-Trichloroethane					4	5
Xylene					5	2
Unknown Hydrocarbons					2-4	2-5

\- Not detected
D Field duplicate
* Also detected in laboratory blank

TABLE 4-1 (continued)

SITE 10 - SOIL

VOLATILE ORGANICS (ug/kg)

	Depth (ft.)	Boring				
		8A25-523	8A25-524	8A25-528	8A25-532	8A25-532-D
Volatile						
	22.5					
Benzene				30		
Unknown Hydrocarbons				3-4		
	27.5					
Benzene				26	3	
Hexane					6	
Methylene Chloride*					8	
Unknown Hydrocarbons				3-7		

* Also detected in laboratory blank

TABLE 4-2

SITE 10 - SOIL

BNA/PESTICIDES/PCB's/TRPH

	Depth (ft.)	Boring				
		8A25-523	8A25-524	8A25-528	8A25-532	8A25-532-D
BNA Organics Pesticides/PCB's (ug/kg)						
	7.5		-			
	9	-				
	12.5		-			
	13.5	-				
	15					
Di-n-Butylphthalate					-	480
	22.5			-		
	27.5			-	-	
TRPH (mg/kg)						
	7.5		20			
	9	36				
	12.5		51			
	13.5	-				
	15				49	
	22.5			21		
	27.5			25	69	61

\- Not detected
D Field duplicate

TABLE 4-3

SITE 10 - SOIL

METALS (mg/kg)

	8A25-523			8A25-524	
	9-10.5'	13.5-15'	7.5-9'	12.5-14'	12.5-14'-D
Antimony	-	-	-	-	-
Arsenic	5	3	2	-	-
Barium	50	79	81	37	42
Beryllium	2	2	2	2	2
Cadmium	2	3	5	3	5
Chromium	20	12	13	6	10
Copper	28	23	31	27	30
Cyanide	-	-	-	-	-
Iron	16415	9236	10428	2763	4967
Lead	5	3	4	0.5	1.6
Manganese	176	108	89	683	562
Mercury	-	-	-	-	-
Nickel	18	13	18	16	19
Selenium	-	-	-	-	-
Silver	-	2	2	3	3
Sodium	3557	2588	3149	1606	1551
Thallium	-	-	-	-	-
Zinc	44	26	31	15	68

- Not detected

TABLE 4-3 (continued)

SITE 10 - SOIL

METALS (mg/kg)

	8A25-528		8A25-532	
	22.5-24'	27.5-29'	15-16.5'	27.5-29'
Antimony	-	-	-	-
Arsenic	1	-	-	-
Barium	81	26	41	120
Beryllium	2	2	2	2
Cadmium	7	7	8	9
Chromium	16	5	7	6
Copper	18	24	19	21
Cyanide	-	-	-	-
Iron	10624	3351	2260	4452
Lead	4	0.8	0.5	1.6
Manganese	216	67	2	64
Mercury	-	-	-	-
Nickel	25	21	25	27
Selenium	-	-	-	-
Silver	2	2	2	3
Sodium	1813	1519	372	771
Thallium	-	-	-	-
Zinc	31	12	10	15

\- Not detected

TABLE 4-4

SITE 10 - GROUNDWATER

ORGANICS/PESTICIDES

	Monitoring Well						
	MW1	MW2	MW3	MW4	MW5	MW6	MW7
Volatile (ug/L)							
	-	-	-	-	-	(-)	(-)
Acid/Base/Neutral Extractables (ug/L)							
2,4-Dinitrotoluene	-	-	-	-	-	(-)	(57)
Isophorone	-	-	-	-	-	(-)	(64)
2-Methylnaphthalene	-	3	-	-	-	(-)	(-)
Naphthalene	-	15	-	-	-	(-)	(-)
Phenol	-	10	-	-	-	(-)	(-)
Pesticides/PCB (ug/L)							
Aldrin	-	-	-	-	-	(-)	(0.17)
Endosulfan I	-	-	-	-	-	(-)	(0.53)
Endrin	-	-	-	-	-	(-)	(0.12)
Heptachlor Epoxide	-	-	-	-	-	(-)	(0.86)
Methoxychlor	-	1.1	-	-	-	(-)	(-)

\- Not detected
( ) Stage II data

TABLE 4-5

SITE 10 - GROUNDWATER

TRPH/TIC

	Monitoring Well						
	MW1	MW2	MW3	MW4	MW5	MW6	MW7
TRPH (mg/L)							
	-	-	3	3	-	(-)	(-)
Tentatively Identified Compounds (ug/L)							
1-Ethyl-2-Methylbenzene		113					
1,3,5-Trimethylbenzene		49					

\- Not detected
( ) Stage II data

TABLE 4-6

SITE 10 - GROUNDWATER

METALS (ug/L)

	Monitoring Well				
	MW1	MW1-D	MW2	MW3	MW4
Antimony	-	-	-	36	47
Arsenic	21	27	LT 125*	6	21
Barium	637	656	230	169	492
Beryllium	20	19	6	6	14
Cadmium	7	-	-	-	5
Chromium	108	106	51	25	52
Copper	259	242	109	108	191
Cyanide	40	32.6	-	-	-
Iron	83308	87068	19990	16561	42660
Lead	38	45	LT 200*	22	18
Maganese	1604	1708	316	184	389
Mercury	0.294	0.294	0.881	0.427	2.012
Nickel	218	223	134	77	130
Selenium	15	15	LT 70*	37	13
Silver	26	-	16	11	17
Sodium	2817025	2842625	8749720	8544135	3269065
Thallium	-	-	LT 200*	-	-
Zinc	261	271	128	73	124

- Not detected
D Field duplicate
* Elevated detection limit due to matrix interference
LT Less Than

TABLE 4-6 (continued)

SITE 10 - GROUNDWATER

METALS (ug/L)

	Monitoring Well			
	MW5	MW6	MW7	MW7-D
Antimony	-	(-)	(38)	(-)
Arsenic	LT 125*	LT 50*	(43)	(53)
Barium	286	(474)	(677)	(694)
Beryllium	6	(11)	(20)	(21)
Cadmium	-	(12)	(14)	(12)
Chromium	37	(75)	(124)	(127)
Copper	115	(140)	(179)	(184)
Cyanide	-	(-)	(-)	(-)
Iron	23083	(58313)	(100485)	(107149)
Lead	LT 70*	LT 500*	(50)	(36)
Manganese	575	(1204)	(976)	(1773)
Mercury	-	(-)	(-)	(-)
Nickel	145	(70)	(154)	(150)
Selenium	LT 70*	LT 500*	LT 500*	LT 500*
Silver	-	22	30	6
Sodium	20438320	(13427300)	(1462100)	(1420871)
Thallium	LT 175*	LT 20*	(-)	(-)
Zinc	100	(195)	(317)	(333)

- Not detected
D Field duplicate
LT Less Than
* Elevated detection limit due to matrix interference
( ) Stage II data

TABLE 4-7

SITE 10

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Constituent Concentrations Average	Constituent Concentrations Maximum	New Mexico Water Standards[a]	Federal Drinking Water Standards Primary MCL[b]	Federal Drinking Water Standards Secondary MCL[c]	Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
Soil*							
Volatiles							
Benzene	6	13	10	5	-	0 (0.67)	-
2-Butanone	1859	1983	-	-	-	-	-
Ethylbenzene	0.2	0.2	750	-	-	2400	-
Toluene	0.3	0.4	750	-	-	15000	-
1,1,1-Trichloroethane	1	1	60	200	-	19000	-
Xylene	1	1	620	-	-	-	-
Water							
BNAs							
2,4-Dinitrotoluene	57	57	-	-	-	0 (0.11)	-
Isophorone	64	64	-	-	-	5200	-
2-Methylnaphthalene	3	3	30**	-	-	-	-
Naphthalene	15	15	30**	-	-	Insufficient data	-
Phenol	10	10	5	-	-	3500	-

WH&A 1012 (REV.3/83)
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ENGINEERS
NEW ORLEANS—MOBILE—BATON ROUGE

TABLE 4-7 (Continued)

SITE 10

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Constituent Concentrations		New Mexico Water Standards[a]	Federal Drinking Water Standards		Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
	Average	Maximum		Primary MCL[b]	Secondary MCL[c]		
Pesticides/PCBs							
Aldrin	0.17	0.17	-	-	-	0 (0.0012)	-
Endosulfan I	1	1	-	-	-	138	-
Endrin	0.12	0.12	-	0.2	-	1	-
Heptachlor epoxide	0.86	0.86	-	-	-	-	-
Methoxychlor	1	1	-	100	-	-	-
Metals							
Antimony	40	47	-	-	-	146	-
Arsenic	25	53	100	50	-	(0.025)	200
Barium	426	694	1000	1000	-	-	-
Beryllium	12	21	-	-	-	0 (0.0039)	-
Cadmium	9	14	10	10	-	10	50
Chromium	68	127	50	50	-	50	.1000
Copper	156	259	1000	-	1000	1000	500
Lead	31	50	50	50	-	50	100
Mercury	1	2.012	2	2	-	10	10
Nickel	133	223	200	-	-	15.4	-
Selenium	22	37	50	10	-	10	50
Silver	18	30	50	50	-	50	-

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TABLE 4-7 (Continued)

SITE 10

CONSTITUENT CONCENTRATIONS AND THEIR STANDARDS AND CRITERIA (ug/L)

Constituents	Constituent Concentrations		New Mexico Water Standards[a]	Federal Drinking Water Standards		Water Quality Criteria[d]	Drinking Water - Farm Animals[e]
	Average	Maximum		Primary MCL[b]	Secondary MCL[c]		
Metals (continued)							
Zinc	173	333	10,000	-	5000	5000	25,000
Cyanide	36	40	200	-	-	200	-
Tentatively Identified							
1-Ethyl-2-methyl-benzene	113	113	-	-	-	-	-
1,3,5-Trimethyl-benzene	49	49	-	-	-	-	-

MCL Maximum Contaminant Level
( ) Concentrations in parentheses correspond to midpoint of risk range for potential carcinogens
\- Not given
* Estimated maximum groundwater concentrations based on soils analyses.
** Naphthalene plus monomethylnaphthalenes, 30 ug/l.
(a) ER, New Mexico Water Quality Regulations, 2/13/87.
(b) ER, EPA National Drinking Water Regulations, Part 141.11 (7/31/87) and Part 141.61 (7/22/88).
(c) ER, EPA National Secondary Drinking Water Regulations, Part 143.3, 10/21/88.
(d) USEPA, SPHEM, 10/86.
(e) National Academy of Sciences and National Academy of Engineering, 1974.

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TABLE 4-8

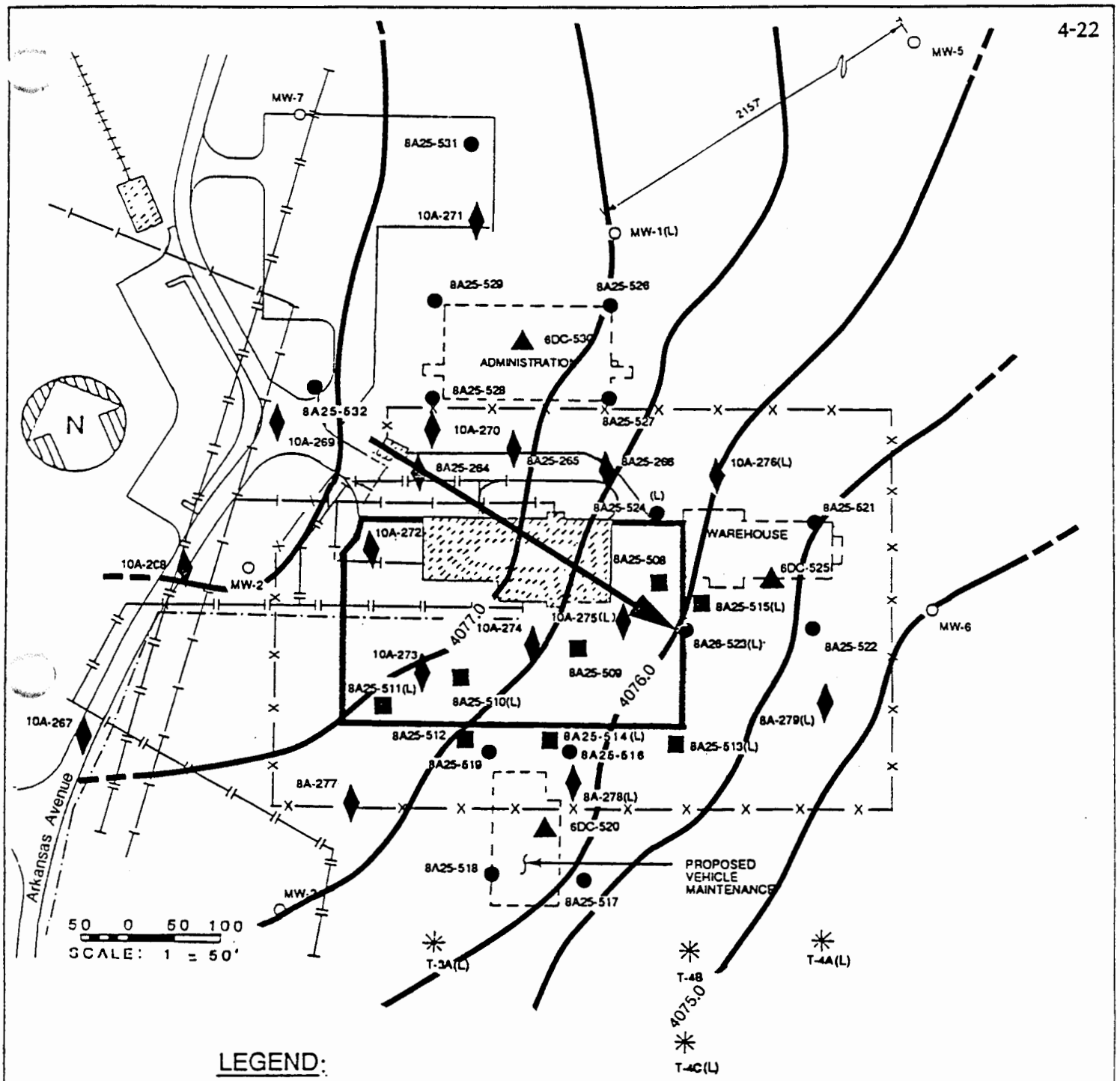
SITE 10

MATRIX OF POTENTIAL EXPOSURE PATHWAYS

Release Transport Medium	Release Source/ Mechanism	Exposure Point	Exposure Route	Pathway Complete
Air	Surface Waste/ Volatilization	Not Applicable	Not Applicable	No
	Contaminated Surface Soil/Volatilization	Not Applicable	Not Applicable	No
	Contaminated Surface Soil/Fugitive Dust	Not Applicable	Not Applicable	No
	Waste Piles/Fugitive Dust	Not Applicable	Not Applicable	No
Surface Water	Contaminated Surface Soil/Surface Runoff	Not Applicable	Not Applicable	No
	Contaminated Ground-water/Groundwater Seepage	Not Applicable	Not Applicable	No
Groundwater	Contaminated Soil (Includes surface or buried wastes)/ Site Leaching	Nearest Possible Off-Base Well*	Ingestion by livestock	Yes
Soil	Surface or Subsurface Waste/Site Leaching	Not Applicable**	Not Applicable	No
	Contaminated Surface Soil/Surface Runoff	Not Applicable	Not Applicable	No
	Contaminated Surface Soil (includes waste piles)/Fugitive Dust Deposition	Not Applicable	Not Applicable	No
	Contaminated Surface Soil/Tracking	Not Applicable	Not Applicable	No

* Assume hypothetical well just outside base boundary line, approximately 1000 feet southeast of most southeast portion of site.

** Site leaching to subsurface soil is an intermediate release transport medium to groundwater.



LEGEND:

- EXISTING HARDSTAND
- EXISTING FACILITIES
- RI SOIL BORINGS
- DENNISON CORES
- MONITORING WELLS
- TEST BORINGS
- COE BORING, JUNE 1982
- COE BORING, NOV. 1987
- SANITARY SEWER
- WATER LINE
- GAS LINE
- (L) LANDFILL MATERIAL ENCOUNTERED
- EXISTING FENCE
- PROPOSED BUILDING
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- T-4D(L)
- MW4

FIGURE 4-2

SITE 10 GROUNDWATER COUNTOUR MAP

CONTRACT NO. DACA45-86-C-0043

REMEDIAL INVESTIGATION
HOLLOMAN AFB, NEW MEXICO

TABLE 4-9

SITE 10

RELEASE CONCENTRATIONS

Constituents	Release Transport Medium	Release Source/ Mechanism	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Benzene	Groundwater	Contaminated Soil/Leaching	6	13
2-Butanone	Groundwater	Contaminated Soil/Leaching	1859	1983
2,4-Dinitrotoluene	Groundwater	Contaminated Soil/Leaching	57	57
Phenol	Groundwater	Contaminated Soil/Leaching	10	10
Aldrin	Groundwater	Contaminated Soil/Leaching	0.17	0.17
Heptachlor expoxide	Groundwater	Contaminated Soil/Leaching	0.86	0.86
Beryllium	Groundwater	Contaminated Soil/Leaching	12	21
Cadmium	Groundwater	Contaminated Soil/Leaching	9	14
Chromium	Groundwater	Contaminated Soil/Leaching	68	127
Nickel	Groundwater	Contaminated Soil/Leaching	133	223
1-Ethyl-2-methyl-benzene	Groundwater	Contaminated Soil/Leaching	113	113
1,3,5-Trimethyl-benzene	Groundwater	Contaminated Soil/Leaching	49	49

TABLE 4-10

SITE 10

EXPOSURE POINT CONCENTRATIONS

Constituents	Release Transport Medium	Exposure Point	Best Estimates (ug/L)	Upper Bound Estimates (ug/L)
Benzene	Groundwater	Nearest hypothetical* off-base well	LT 0.06	LT 0.13
2-Butanone	Groundwater	Nearest hypothetical* off-base well	LT 18.59	LT 19.83
2,4-Dinitrotoluene	Groundwater	Nearest hypothetical* off-base well	LT 0.57	LT 0.57
Phenol	Groundwater	Nearest hypothetical* off-base well	LT 0.10	LT 0.10
Aldrin	Groundwater	Nearest hypothetical* off-base well	LT 0.0017	LT 0.0017
Heptachlor epoxide	Groundwater	Nearest hypothetical* off-base well	LT 0.009	LT 0.009
Beryllium	Groundwater	Nearest hypothetical* off-base well	LT 0.12	LT 0.21
Cadmium	Groundwater	Nearest hypothetical* off-base well	LT 0.09	LT 0.14
Chromium	Groundwater	Nearest hypothetical* off-base well	LT 0.68	LT 1.27
Nickel	Groundwater	Nearest hypothetical* off-base well	LT 1.33	LT 2.23
1-Ethyl-2-methyl-benzene	Groundwater	Nearest hypothetical* off-base well	LT 1.13	LT 1.13
1,3,5-Trimethyl-benzene	Groundwater	Nearest hypothetical* off-base well	LT 0.49	LT 0.49

* 1000 feet southeast of site

LT Less Than

TABLE 4-11

SITE 10

COMPARISON OF EXPOSURE POINT CONCENTRATIONS WITH STANDARDS AND CRITERIA (ug/L)

Constituents	Exposure Point Concentrations: Best Estimates	Exposure Point Concentrations: Upper Bound Estimates	New Mexico Water Standards(a)	Federal Drinking Water Standards: Primary MCL(b)	Federal Drinking Water Standards: Secondary MCL(c)	Water Quality Criteria(d)	Drinking Water - Farm Animals(e)
Benzene	LT 0.06	LT 0.13	10	5	-	0 (0.67)	-
2-Butanone	LT 18.59	LT 19.83	-	-	-	-	-
2,4-Dinitrotoluene	LT 0.57	LT 0.57	-	-	-	0 (0.11)	-
Phenol	LT 0.10	LT 0.10	5	-	-	3500	-
Aldrin	LT 0.0017	LT 0.0017	-	-	-	0 (0.0012)	-
Heptachlor Epoxide	LT 0.009	LT 0.009	-	-	-	-	-
Beryllium	LT 0.12	LT 0.21	-	-	-	0.0039	-
Cadmium	LT 0.09	LT 0.14	10	10	-	10	50
Chromium	LT 0.68	LT 1.27	50	50	-	50	1000
Nickel	LT 1.33	LT 2.23	200	-	-	15.4	-
1-Ethyl-2-methyl-benzene	LT 1.13	LT 1.13	-	-	-	-	-
1,3,5-Trimethyl-benzene	LT 0.49	LT 0.49	-	-	-	-	-

MCL Maximum Contaminant Level
( ) Concentrations in parentheses correspond to midpoint of risk range for potential carcinogens
\- Not given
LT Less Than
(a) ER, New Mexico Water Quality Regulations, 2/13/87.
(b) ER, EPA National Drinking Water Regulations, Part 141.11 (7/31/87) and Part 141.61 (7/22/88).
(c) ER, EPA National Secondary Drinking Water Regulations, Part 143.3, 10/21/88.
(d) USEPA, SPHEM, 10/86.
(e) National Academy of Sciences and National Academy of Engineering, 1974.

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TABLE 4-12

SITE 10

RESULTS OF TOXICITY ASSESSMENT

Constituents	Upper Bound Estimates (ug/L)	Toxic Dose Concentrations (mg/kg)	Water Volumes Required To Reach Toxicity Concentrations* (L)
Aldrin	LT 0.0017	0.0018	541,100
Beryllium	LT 0.21	0.0468	111,400
2-Butanone**	LT 19.83	218	5,496,700
2,4-Dinitrotoluene	LT 0.57	207.96	182,421,000
1-Ethyl-2-methyl-benzene**	LT 1.13	398	176,106,100
Heptachlor epoxide	LT 0.0086	21.37	1,242,441,800
1,3,5-Trimethyl benzene**	LT 0.49	130	132,653,000

* Rounded to lower 100 liters.

** No toxicological data available for oral route; therefore, lethal data were used. Results are actually concentrations and volumes required to cause death.

LT Less Than

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Headquarters, Air Combat Command
Langley Air Force Base,
Virginia

Final Draft

RCRA Facility Investigation Holloman Air Force Base New Mexico

28 Sites Phase I Work Plan

Volume II

March 1993

49 CES/CEV
Holloman Air Force Base,
New Mexico

PURPOSE OF DOCUMENT

a. This Phase I RCRA Facility Investigation (RFI) Work Plan is for use by the selected RFI Contractor and Laboratory for the conduct of the Phase I RFI at Holloman Air Force Base (AFB), New Mexico. It was prepared for, and in cooperation with, the Base Environmental Office: 49 CES/CEV, 550 Tabosa Avenue, Holloman AFB, NM 88330-8458, (505) 479-3931. The RFI Work Plan includes four of the six plans required by the Base's federal Hazardous and Solid Waste Amendment (HSWA) Permit. The four plans included are: the Sampling and Field Measurements Plan; the Data Management Plan; the Quality Assurance Project Plan (QAPP); and the Community Relations Plan (CRP). Information contained in these plans is designed to: 1) facilitate the investigation of 40 RCRA solid waste management units (SWMUs) and one Area of Concern (AOC) which may have potentially released hazardous waste or hazardous constituents to the environment; and 2) to determine if a release of hazardous waste or hazardous constituents to the environment has occurred from any of the 40 SWMUs and one AOC.

b. The Sampling and Field Measurements Plan and the Data Management Plan are contained in Volume I and are referred to as the "Phase I RFI Work Plan". The Work Plan details the procedures for investigatory methods, sample collection, waste management, data management, and reporting. It also identifies the SWMU-specific potential contaminant migration pathways and the potential receptors of the contamination. Information describing each SWMU is provided as well as SWMU specific investigation and sampling plans.

c. The QAPP is contained in Volume II and presents the procedures and information necessary for the analysis and evaluation of all samples collected during the Phase I RFI. Measurement Data Quality Objectives and acceptance criteria are provided for laboratory analytical results. Analytical methods to be used for sample analysis during the investigation are cited and described.

d. The CRP, also contained in Volume II, presents the mechanisms for public dissemination of information during the conduct of the Phase I RFI. A discussion of public involvement in the RCRA process is provided, as well as information concerning the investigation and it's role in the Base's on-going suite of environmental investigations.

DCN 93-269-069-29-02
RCN 269-069-29-01

RCRA FACILITY INVESTIGATION
HOLLOMAN AIR FORCE BASE
NEW MEXICO

28 SITES PHASE I WORK PLAN

Volume II

FINAL DRAFT

Prepared for:

49 CES/CEV
Holloman Air Force Base, NM

Prepared by:

Radian Corporation
8501 North MoPac Boulevard
P.O. Box 201088
Austin, Texas 78720-1088

Under Contract No. DACW45-91-D-0018 with:

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

25 March 1993

DCN 93-269-069-29-01

QUALITY ASSURANCE PROJECT PLAN (QAPP)
FOR
RCRA FACILITY INVESTIGATION
HOLLOMAN AIR FORCE BASE, NEW MEXICO
28 SITES PHASE I RFI WORK PLAN

25 March 1993 -- Revision 0

Prepared for:

Holloman Air Force Base
49 CES/CEV

Prepared By:

Radian Corporation
8501 North Mopac Boulevard
P.O. Box 201088
Austin, Texas 78720-1088

Under Contract No. DACW45-91-D-0018 with:

US Army Corps of Engineers,
Omaha District
Omaha, Nebraska

QUALITY ASSURANCE PROJECT PLAN APPROVAL

This Quality Assurance Project Plan (QAPP) was developed to ensure that all environmental data generated during the Phase I RCRA Facility Investigation (RFI) at Holloman Air Force Base (AFB), New Mexico are scientifically valid, defensible, comparable, and of known and acceptable precision and accuracy. The signatures below of key project personnel indicate concurrence with the procedures specified in the plan and a commitment to disseminate the plan and the philosophy of quality to all project personnel.

	Signature	Date
Environmental Coordinator, Holloman AFB		
Project Manager, RFI Contractor		
QA Coordinator, RFI Contractor		
Laboratory Director, Analytical Laboratory		
Project Manager, USACE		
Project Chemist, USACE		
Project QA Officer, MRD Laboratory		

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1.0 INTRODUCTION

This section provides an overview of the Phase I RFI, the purpose of the investigation, and the basis for the selection of analytical parameters included.

1.1 Scope and Purpose

This quality assurance project plan (QAPP) has been prepared for submission as part of the field and laboratory procedures and site specific sampling plans for the solid waste management units (SWMUs) subject to requirements of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Holloman AFB (the Base) in New Mexico. The QAPP is submitted by Holloman AFB in New Mexico to the United States Environmental Protection Agency (U.S. EPA, Region VI).

The QAPP provides guidance for the collection and analysis of all soil and water samples pertaining to the Phase I RFI at Holloman AFB. These RCRA-required sampling and analysis programs are collectively referred to in the QAPP as the "project". The guidance provided by the QAPP is intended to lead to the production of data that are technically defensible for all legal and regulatory purposes and of known quality. The QAPP is not, however, a work plan. It lists sample types and analytical methods, but does not specify all possible sample locations; for that information, additional sources must be consulted, particularly Section 4.0 (for site-specific sampling plans) of the Phase I RFI work plan.

This QAPP has been designed to explain sample handling and laboratory procedures that are common to all samples collected at Holloman AFB during the Phase I RFI. For example, regardless of the particular sample medium, the labeling, handling, and shipping of samples follow set procedures. Also, the chain-of-custody and sample handling requirements are similar. Likewise, following an initial sample preparation, the

determination of analyte concentrations (e.g., by gas chromatography or gas chromatography/mass spectrometry) follows standard methods with established procedures. This QAPP is intended to provide a thorough picture of these common QA/QC elements. During the course of the project, new or different procedures or methods may be incorporated into the plan, for reasons such as advances in measurement science, improvements in analytical laboratory production techniques, or changes in regulatory requirements or approaches. Any such changes or additions will be described int the written QAPP, in the form of addenda or revisions to the QAPP following approval by USEPA, Region VI.

This QAPP addresses the QA elements required by "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," U. S. Environmental Protection Agency, December 29, 1980 (QAMS-005-80).

1.2 RFI Site Identification

Phase I of this RFI has been designed to document the presence or absence of hazardous waste or hazardous constituents in the groundwater and soils due to possible releases from the solid waste management units summarized in Table 1-1.

Complete descriptions of these sites are provided in the RFI work plan, Section 2. A Phase II RFI will be conducted only if the data from Phase I document that hazardous constituents have been released to the environment from the SWMUs under investigation. The Phase II investigation would focus on determining the nature and extent of hazardous waste or hazardous constituents in the groundwater, soil, or surface water due to releases from the SWMUs. If a Phase II RFI is necessary, an addendum to this QAPP will be issued. The QAPP addendum would be subject to review and approval by U.S. EPA, Region VI. If no releases are identified in the Phase I investigation, then the RFI will be concluded.

Table 1-1

Revised List of HSWA Permit Table 2 Solid Waste Management Units (SWMUs) for 28 Sites RFI Work Plan Holloman Air Force Base, NM

SWMU No.	Unit Name
119 2[a]	Bldg 121 Waste Oil Tank Bldg. 121 Oil/Water Separator
120 15[a]	Bldg. 309 Waste Oil Tank Bldg. 309 Oil/Water Separator
121 17[a]	Bldg. 316 Waste Oil Tank Bldg. 316 Oil/Water Separator
123 22[a]	Bldg. 704 Waste Oil Tank Bldg. 704 Oil/Water Separator
126 36[a]	Bldg. 1000 Waste Oil Tank Bldg. 1000 Oil/Water Separator
125 32[a]	Bldg. 868 Fire Water Tank Bldg. 868 Oil/Water Separator
127 39[a] 135	Bldg. 1092 Waste Oil Tank Bldg. 1092 Oil/Water Separator Bldg. 1092 Oil/Water Separator Drainage Pit
138 128 40[a]	Bldg. 1166 Oil/Water Separator Drainage Pit Bldg. 1166 Waste Oil Tank Bldg. 1166 Oil/Water Separator
118	Bldg. 21 Pesticides Holding Tank
129	Bldg. 1191 Spill Tank
54 55	Bldg. 702 Waste Accumulation Area Bldg. 702A Waste Accumulation Area
56	Bldg. 807 Waste Accumulation Area
63	Bldg. 867 Waste Accumulation Area
71	Bldg. 1178A Waste Accumulation Area
78	Trim Pad 3 Waste Accumulation Area
75	DRMO Hazardous Waste Storage Area

Table 1-1

(Continued)

SWMU No.	Unit Name
91	Bldg. 816 Washrack
136	Bldg. 1119 Washrack Drainage Pit
141	Pad 9 Drainage Pit
164	Bldg. 1080 Pond
124	Bldg. 752 Waste Oil Tank
155	Sludge Drying Beds
156	Imhoff Tanks (5)
184	Wastewater Recirculating Line
177 181 179[b]	Bldg. 1176 Sumps Bldg. 1176 Drainage Trough Bldg. 1176 Discharge Box
101	Bldg. 121 Landfill
183	Air Base Sewer System
AOC-U[c]	Lost River Basin

[a] HSWA Permit, Table 3.

[b] HSWA Permit, Table 1.

[c] AOC = Area of Concern

2.0 PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

The project team for the Holloman AFB Phase I RFI will be composed of a Project Director, a Quality Assurance Coordinator, and one or more task leaders. Roles and responsibilities of key personnel are discussed below.

2.1 Roles and Responsibilities

The Contractor Project Director will be responsible for organizing and directing the technical activities of the project and for reporting the results of these activities. In this role, he/she will have overall responsibility, authority, and accountability for the project. He/she will have day-to-day interaction with the technical staff. In the execution of these duties, he/she will:

- Establish technical objectives and review and modify the work plans in accordance with client direction;
- Be responsible for responding to Work Plan revisions;
- Have responsibility for meeting all contractual requirements for the task;
- Assure technical quality of reports, memoranda, and other communications through review of results;
- Maintain contact with the USACE Project Manager and inform him/her on all aspects of the project including progress, problems, and recommended solutions;
- Have responsibility for assuring that required staffing levels and technical expertise are provided; and
- Be responsible for reviewing project staff performance through the program.

The Quality Assurance Coordinator (QAC) will be responsible for development and execution of QA activities in all phases of the project, including test plan design, execution, data reduction, and reporting. His/her responsibilities will include:

- Coordinating any external QA audit activities requested by the USACE;
- Serving as an in-house consultant to the Project Director and Task Leaders in defining data quality goals or requirements and in development of a project-specific, internal quality control system which is responsive to these goals;
- Coordinating preparation of the project quality assurance reports that document the project-specific policies, organization, objectives, functional activities, and specific QA and QC procedures and activities designed to achieve data quality goals or requirements;
- Providing independent review of the project approach, methods, and experimental design;
- Providing the mechanism whereby quality assurance problems may be brought to the immediate attention of the Project Director, if warranted, and may be brought directly to the attention of upper management for implementation of corrective action; and
- Documenting the results of all QA/QC activities in reports to internal management and to clients.

For all tasks pertaining to the conduct of the RFI a task leader will be designated. His/her responsibilities include the plans, field activities, and the RFI report.

General responsibilities of Task Leaders include:

- Responsibility for ensuring that deliverables required for their task are delivered on schedule and within budget;
- Coordination of day-to-day activities of project team members working on their task;

- Maintaining close contact with the Project Director so that schedule, budget, and/or technical problems are addressed in a timely manner;
- Coordination of day-to-day QC activities required for their respective tasks as part of the internal QC system;
- Ensuring compliance with all QC acceptance criteria as specified in the QA Plan; and
- Keeping the QA Coordinator and Project Director advised of any quality problems which arise.

The Supervising Geologist will be responsible for all on-site activities, including monitor well installation, sample collection, field analysis, chain of custody, and reporting. He/she will also be responsible for field staff. The Supervising Geologist will be responsible for completing daily quality control reports (DQCRs). Other key project personnel reporting to the Supervising Geologist include the subcontractor staff manager. Subcontractor staff managers assume ultimate responsibility for all operations in their subcontracts. Subcontractors and key personnel are discussed below.

2.2 Subcontractor Qualifications

Minimum qualifications of project subcontractors are summarized in the following subsections.

2.2.1 Analytical Laboratory

The analytical laboratory's qualifications include current US Army Corps of Engineers validation (within two years). The analytical laboratory representative will have ultimate responsibility for all analyses performed at the analytical laboratory. The assigned laboratory representative is responsible for ensuring that work is performed according to USACE's Scope of Services (SOS) for the Holloman AFB Phase I RFI and this QAPP.

2.2.2 Geotechnical Laboratory

A geotechnical testing laboratory will provide all geotechnical support. The equipment used during the testing process will be appropriately calibrated prior to testing project samples. The assigned geotechnical laboratory representative will ensure that the work is completed as outlined in the USACE's SOS for the Holloman AFB Phase I RFI and this QAPP.

2.2.3 Drilling

A drilling company will be subcontracted to provide all drilling services. This company will be a licensed New-Mexico water-well driller. The assigned representative will be responsible to complete the work as stated in the USACE's SOS for the Holloman AFB Phase I RFI.

2.2.4 Survey Activities

The surveying of boreholes and monitor wells will be completed by a licensed surveyor. The surveyor will be registered in the State of New Mexico and will follow all survey protocols outlined in the USACE SOS for this Holloman AFB Phase I RFI.

3.0 CHEMICAL DATA QUALITY OBJECTIVES

As described in Section 1.2 of the Work Plan, data quality objectives of the Holloman AFB Phase I RFI will be to:

- Determine if a release of hazardous waste or hazardous constituents has occurred at each SWMU; and
- Identify potential migration pathways through which contamination may affect human health and identify potential receptors of this contamination.

To support the overall objectives, chemical data quality objectives (DQO) must be established. The chemical DQOs are to:

- Collect samples specified in Section 4 of the Work Plan to assess whether a release has occurred at each SWMU;
- Ensure data comparability through the use of standard methods and controlled systems to collect and analyze samples;
- Provide analytical results of known and acceptable precision and accuracy; and
- Provide 90 percent data completeness for analytical results representing each matrix-method combination.

Measurement data representativeness is a function of sampling strategy and will be achieved using the procedures discussed in Sections 3 and 4 of the Work Plan. Potential for sample contamination will be minimized by the use of decontamination procedures specified in Section 3.1.3 of the Work Plan. Data comparability will be achieved using standard methods and standard units of measure as specified in the methods described in Section 7. Analytical imprecisional bias will be controlled through the use of a quality control (QC) program using prescribed QC samples and the corrective actions specified in

Section 9. Imprecision and bias in natural matrix samples will be estimated by standard QC methods such as matrix spikes, field duplicates, and trip blanks. Confirmation of chemical identity will be performed for gas chromatography (GC) analytical methods using second column confirmation procedures for samples with detected compounds or by mass spectrometry.

A quality assurance/quality control (QA/QC) program will be used to ensure that the analytical DQOs are met for the Holloman AFB Phase I RFI. QA/QC efforts are twofold. First, they provide the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project (i.e., system capability). Second, they specify quality control data to be used to define natural-matrix data quality for various measurement parameters, in terms of precision and accuracy. Control of measurement data quality (i.e., control of error sources that affect data quality) is possible for sample collection and analysis. However, matrix interference, or non-homogeneity, is not amenable to control and thus imprecision or bias due to these natural sources of error must be estimated from QC samples. For this project, sample collection error will be controlled through the use of standard sample collection methods and field logbooks. Sample analysis error will be controlled through the use of standard analytical methods, following standard operating procedures (SOPs), performed on a capable analytical system, with QC efforts as directed in published procedures. Natural matrix error will be estimated by standard QC methods such as matrix spikes, field duplicates, and trip blanks.

3.1 Analytical Capability

Efforts to control measurement error require that the analytical system be capable, in control, and appropriately sensitive for all analyses. System capability, in terms of accuracy and precision, may be documented by reporting system QC data (e.g., continuing calibration, quality control check samples (QCCS), and method spikes). System capability, in terms of sensitivity, may be documented through the use of maximum detection limits for

system blanks (e.g., reagent, system, and method blanks) and calibration standards. System control may be documented through the use of control charts or other statistical methods that indicate system performance over time.

Precision and accuracy objectives, in terms of maximum allowable imprecision and inaccuracy, for the various measurement parameters associated with site characterization efforts are presented in Table 3-1. Precision values presented in Table 3-1 represent a measure of variability for replicate measurements of the same parameter in clean-matrix, laboratory quality control check samples (QCCS), expressed in terms of the relative precent difference (RPD). RPDs compared with precision objectives in Table 3-1 are calculated from data such as duplicate QCCS results. Accuracy values for clean-matrix laboratory samples include components of both random error (i.e., variability from imprecision) and systematic error (i.e., bias), and thus reflect the total analytical error for a given measurement, expressed as a percentage of the true value. The percent difference between true and measured concentrations in continuing calibration and QCCS samples may be compared with accuracy objectives in Table 3-1. The bases for these estimates are, in most cases, described in the methods. The analytical laboratory will be able to document that the QA/QC procedure in each standard method, Chapter One and Method 8000 of SW-846, 3rd edition, or USACE Guidance Document ER 1110-1-263, was followed for all analytical work. Accuracy and precision estimates for samples in a natural matrix would not be expected to be within the objectives presented in Table 3-1 because variability of a matrix cannot be controlled.

Data completeness is a measurement of the amount of valid data obtained compared with the amount that was expected. Ultimately, the goal is to obtain valid data for all analyses. Conditions that prevent complete data capture, such as significant sample matrix difficulties, or sample loss, should be addressed in a timely fashion to determine of corrective actions should be taken. Data completeness objectives for all constituents is 90 percent.

Table 3-1

Analytical Precision and Accuracy Objectives

Parameter	Method	Precision[a]	Accuracy[b]
Metals[c]	SW6010 ICPES	20%	80-120%
Arsenic	SW7060 Graphite Furnace AA	20%	75-125%
Lead	SW7421 Graphite Furnace AA	20%	75-125%
Mercury	SW7470/7471 Cold Vapor AA	20%	80-120%
Selenium	SW7740 Graphite Furnace AA	20%	75-125%
Thallium	SW7841 Graphite Furnace AA	20%	75-125%
Pesticides/PCBs	SW8080 GC/ECD	See Method 8080, Table 3	See Method 8080, Table 3
Organophosphorus Pesticides	SW8140 GC/FPD	50% [d]	50-150% [d]
Chlorinated Herbicides	SW8150 GC/ECD	50% [d]	50-150% [d]
Volatile Organic Compounds	SW8240 GC/MS	See Method 8240, Table 6	See Method 8240, Table 6
Semivolatile Organic Compounds	SW8270 GC/MS	See Method 8270, Table 6	See Method 8270, Table 6
Dioxins and Furans	SW8280 GC/MS	50%	40-120%
Cyanide	SW9012 Colorimetric	20%	80-120%

Table 3-1

(Continued)

Parameter	Method	Precision[a]	Accuracy[b]
Total Recoverable Petroleum Hydrocarbons	E418.1 Infrared Spectrometry	20%	80-120%
Sulfide	SW9030 Titrimetric	20%	80-120%
Total Dissolved Solids (TDS)	E160.1 Gravimetric	20%	80-120%

[a] Relative percent difference (RPD) for replicate analytical determinations (exclusive of sampling variability). RPD for duplicate QCCS samples will be compared to these objectives.

[b] Total error for a single measurement in a clean, laboratory-controlled matrix, including both systematic error (bias) and random error (variability from imprecision), expressed as a percentage of the measured value. Percent recovery for QCCS or continuing calibration samples will be compared to these objectives.

[c] ICPES metals: antimony, barium, beryllium, cadmium, chromium, cobalt, copper, nickel, silver, tin, vanadium and zinc.

[d] Arbitrarily set because no method criteria is specified.

SW = Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, Third Edition.

E = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.

Sample detection limits must normally be sensitive to concentrations at or below RCRA action levels and/or health limits which are presented in Table 3-2. It is important to note that for a number of compounds, the specified reporting limit does not reach the RCRA required limit for the methods included in this investigation. Natural sample reporting limits will also depend on dilution effects. In general, dilutions will be performed only as directed in each representative method. For target analytes on gas chromatography/mass spectrometry (GC/MS) and gas chromatography (GC) analyses, dilution will be performed if the target analyte concentrations exceed the calibration range. For non-target analytes on GC/MS and GC analyses, dilutions will be performed when non-target analyte response interferes with target analyte response, and to achieve an internal standard response of approximately 20 percent of the maximum peak response. When samples are diluted after an initial undiluted analysis, data for target analytes with responses within the calibration range in the undiluted analysis will be collected and reported with target analytes that required diluted analyses, except in cases where reporting limits listed in the table exceed RCRA specified limits as previously discussed. For these compounds, high method reporting limits will not result in unusable data. If natural sample reporting limits exceed RCRA required limits for any other compounds, the analytical laboratory must document what prompted the higher reporting limits and the maximum concentrations that were allowable on the calibration curve. This level of effort is required on a sample-by-sample basis and may not be applied to batches of samples.

QC procedures used as an on-going control (i.e., feedback mechanism) for the analytical system are presented in Section 9, Table 9-1. For each method, control procedures, acceptance criteria, and corrective actions are detailed. Data for each control procedure will be evaluated against these acceptance criteria to prove the analytical system was in control during sample analyses and thus, results are defensible. This table is a summary of information from SW-846 Chapter One, Method 8000, and individual methods. As such, it is intended to be used as a guide.

Table 3-2

Analytical Methods, Method Reporting Limits, and Maximum Contaminant Levels

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
METALS (mg/L or mg/Kg)							
Antimony	ICPES	6010	0.10	10	–	0.014[d]	32[d]
Barium	ICPES	6010	0.010	1.0	1,000	–	4,000[d]
Beryllium	ICPES	6010	0.0020	0.2	–	0.000008[d]	0.2
Cadmium	ICPES	6010	0.0050	0.5	10	0.02[d]	80[d]
Chromium (total)	ICPES	6010	0.010	1.0	50	–	80,000[e] (Cr III)
Cobalt	ICPES	6010	0.010	1.0	–	–	–
Copper	ICPES	6010	0.020	2.0	–	1.3[e]	3200[e]
Nickel	ICPES	6010	0.020	2.0	–	0.7[d]	1600[d]
Silver	ICPES	6010	0.010	1.0	–	0.2[d]	400[d]
Tin	ICPES	6010	0.60	60	–	20[e]	48,000[e]
Vanadium	ICPES	6010	0.020	2.0	–	0.3[e]	560[e]
Zinc	ICPES	6010	0.020	2.0	–	7[e]	16,000[e]
Arsenic	GFAA	7060	0.0040	0.4	50	–	24[d]
Lead	GFAA	7421	0.0030	0.3	–	0.015[f]	22[e]
Mercury	CVAA	7470/ 7471	0.0002	0.02	2	–	24[e]
Selenium	GFAA	7740	0.0050	0.5	10	–	400[e]
Thallium	GFAA	7841	0.005	0.5	–	0.002[e]	6[e]
ORGANOCHLORINE PESTICIDES AND PCBs (μg/L or μg/Kg)							
Aldrin	GC/ECD	8080	0.010	1.0	–	0.000002[d]	0.04[d]
alpha-BHC	GC/ECD	8080	0.010	1.0	–	0.000006[d]	0.1[d]
beta-BHC	GC/ECD	8080	0.010	1.0	–	0.02[d]	4[d]
delta-BHC	GC/ECD	8080	0.010	1.0	–	–	–
gamma-BHC (Lindane)	GC/ECD	8080	0.010	1.0	0.2	–	0.5[d]
Chlordane (technical)	GC/ECD	8080	0.050	5.0	2	–	0.5[d]
4,4'-DDD	GC/ECD	8080	0.010	1.0	–	0.0001[d]	3[d]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
4,4'-DDE	GC/ECD	8080	0.010	1.0	–	0.0001[d]	2[d]
4,4'-DDT	GC/ECD	8080	0.020	2.0	–	0.0001[d]	2[d]
Dieldrin	GC/ECD	8080	0.010	1.0	–	0.000002[d]	0.04[d]
Endosulfan I	GC/ECD	8080	0.010	1.0	–	0.002[e]	4[e]
Endosulfan II	GC/ECD	8080	0.030	3.0	–	0.002[e]	4[e]
Endosulfan sulfate	GC/ECD	8080	0.050	5.0	–	–	–
Endrin	GC/ECD	8080	0.010	1.0	2	–	24[d]
Endrin aldehyde	GC/ECD	8080	0.020	2.0	–	–	–
Heptachlor	GC/ECD	8080	0.01	1.0	0.4	–	0.2[d]
Heptachlor epoxide	GC/ECD	8080	0.010	1.0	0.2	–	0.08[d]
Isodrin	GC/ECD	8080	0.010	1.0	–	–	–
Kepone	GC/ECD	8080	0.01	1.0	–	–	–
Methoxychlor	GC/ECD	8080	0.050	5.0	40	–	400[e]
Toxaphene	GC/ECD	8080	0.50	50	3	–	0.6[d]
PCB-1016	GC/ECD	8080	0.10	10	0.5	–	10[h]
PCB-1221	GC/ECD	8080	0.20	20	0.5	–	10[h]
PCB-1232	GC/ECD	8080	0.20	20	0.5	–	10[h]
PCB-1242	GC/ECD	8080	0.10	10	0.5	–	10[h]
PCB-1248	GC/ECD	8080	0.10	10	0.5	–	10[h]
PCB-1254	GC/ECD	8080	0.20	20	0.5	–	10[h]
PCB-1260	GC/ECD	8080	0.20	20	0.5	–	10[h]
ORGANOPHOSPHORUS PESTICIDES (μg/L or μg/Kg)							
Dimethoate	GC/FPD	8140	0.20	20	–	0.007[d]	16[d]
Disulfoton	GC/FPD	8140	0.20	20	–	0.001[d]	3[d]
Ethyl parathion	GC/FPD	8140	0.15	15	–	0.2[e]	500[e]
Famphur	GC/FPD	8140	0.50	50	–	–	–
Methyl parathion	GC/FPD	8140	0.03	30	–	0.008[d]	20[d]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
Phorate	GC/FPD	8140	0.15	15	–	–	–
Sulfotepp	GC/FPD	8140	0.10	10	–	0.02[d]	40[d]
Thionazin	GC/FPD	8140	1.0	100	–	–	–
o,o,o-Triethylphosphorthioate	GC/FPD	8140	1.0	100	–	–	–
CHLORINATED HERBICIDES (µg/L or µg/Kg)							
2,4-D	GC/ECD	8150	1.2	120	70	–	240[d]
2,4,5-T	GC/ECD	8150	0.20	20	–	3.5[e]	8,000[e]
2,4,5-TP (Silvex)	GC/ECD	8150	0.17	17	50	–	640[e]
Dinoseb	GC/ECD	8150	0.15	15	–	0.04[d]	80[d]
VOLATILE ORGANICS (µg/L or µg/Kg)							
Acetone	GC/MS	8240	100	100	–	3.5[d]	8,000[d]
Acetonitrile	GC/MS	8240	100	100	–	0.2[d]	500[d]
Acrolein	GC/MS	8240	75	75	–	3.5[d]	8,000[d]
Acrylonitrile	GC/MS	8240	50	50	–	0.00006[d]	1.3[d]
Benzene	GC/MS	8240	5.0	5.0	5	0.0001[d]	24[d]
Bromodichloromethane	GC/MS	8240	5.0	5.0	–	0.0003[d]	5[d]
Bromomethane	GC/MS	8240	10	10	–	0.05[d]	100[d]
Carbon disulfide	GC/MS	8240	5.0	5.0	–	3.5[d]	8,000[d]
Carbon tetrachloride	GC/MS	8240	5.0	5.0	5	–	5[d]
2-Chloro-1,3-butadiene	GC/MS	8240	2.5	25	–	0.7[d]	1,600[d]
Chlorobenzene	GC/MS	8240	5.0	5.0	–	0.7[d]	1,600[d]
Chloroethane	GC/MS	8240	10	10	–	–	–
Chloroform	GC/MS	8240	5.0	5.0	–	0.006[d]	115[d]
Chloromethane	GC/MS	8240	10	10	–	0.03[e]	500[e]
3-Chloropropene	GC/MS	8240	5.0	5.0	–	0.000002[d]	0.04[d]
Dibromochloromethane	GC/MS	8240	5.0	5.0	–	0.004[d]	80[d]
1,2-Dibromo-3-chloropropane	GC/MS	8240	20	20	0.2	0.00003[e]	0.3[e]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
1,2-Dibromoethane	GC/MS	8240	5.0	5.0	–	4×10^{-7} [e]	0.008 [e]
Dibromomethane	GC/MS	8240	5.0	5.0	–	–	–
trans-1,4-Dichloro-2-butene	GC/MS	8240	10	10	–	–	–
Dichlorodifluoromethane	GC/MS	8240	20	20	–	7[d]	16,000 [d]
1,2-Dichloroethane	GC/MS	8240	5.0	5.0	5	–	8[d]
trans-1,2-Dichloroethene	GC/MS	8240	5.0	5.0	100	–	1,600 [d]
1,1-Dichloroethane	GC/MS	8240	5.0	5.0	–	3.5 [e]	8,000 [e]
1,1-Dichloroethene	GC/MS	8240	5.0	5.0	7	–	10[d]
1,2-Dichloropropane	GC/MS	8240	5.0	5.0	5	–	10[d]
cis-1,3-Dichloropropene	GC/MS	8240	5.0	5.0	–	0.0002 [e]	4 [e]
trans-1,3-Dichloropropene	GC/MS	8240	5.0	5.0	–	0.0002 [e]	4 [e]
Ethyl benzene	GC/MS	8240	5.0	5.0	700	–	8,000[d]
Ethyl methacrylate	GC/MS	8240	15	15	–	3 [e]	7,200 [e]
2-Hexanone	GC/MS	8240	50	5.0	–	–	–
Iodomethane	GC/MS	8240	5.0	5.0	–	–	–
Methylene chloride	GC/MS	8240	5.0	5.0	–	0.005[d]	90[d]
2-Butanone (MEK)	GC/MS	8240	100	100	–	1.8 [e]	4,000 [e]
Methyl methacrylate	GC/MS	8240	10	10	–	3 [e]	6,400 [e]
4-Methyl-2-pentanone (MIBK)	GC/MS	8240	5.0	5.0	–	2 [e]	4,000 [e]
Propanenitrile	GC/MS	8240	100	100	–	–	–
Styrene	GC/MS	8240	5.0	5.0	100	–	23[d]
1,1,1,2-Tetrachloroethane	GC/MS	8240	5.0	5.0	–	3 [e]	300 [e]
1,1,2,2-Tetrachloroethane	GC/MS	8240	5.0	5.0	–	0.002[d]	35[d]
Tetrachloroethene	GC/MS	8240	5.0	5.0	5	–	14[d]
Toluene	GC/MS	8240	5.0	5.0	1,000	–	16,000 [d]
Tribromomethane (Bromoform)	GC/MS	8240	5.0	5.0	–	0.004[d]	1,600 [d]
1,1,1-Trichloroethane	GC/MS	8240	5.0	5.0	200	–	7,200 [e]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
1,1,2-Trichloroethane	GC/MS	8240	5.0	5.0	5	–	120[d]
Trichloroethene	GC/MS	8240	5.0	5.0	5	–	60[d]
Trichlorofluoromethane	GC/MS	8240	10	10	–	10[d]	24,000[d]
1,2,3-Trichloropropane	GC/MS	8240	5.0	5.0	–	0.2[d]	500[d]
Vinyl acetate	GC/MS	8240	5.0	5.0	–	35[e]	80,000[e]
Vinyl chloride	GC/MS	8240	10	10	2	0.00002[d]	0.4[d]
Xylenes (total)	GC/MS	8240	5.0	5.0	10,000	–	160,000[d]
VOLATILE ORGANICS, Direct Injection (µg/mL or µg/g)							
1,4-Dioxane	GC/MS	8240	10	10	–	0.003[d]	64[d]
Isobutanol	GC/MS	8240	10	10	–	10[d]	24,000[d]
Methacrylonitrile	GC/MS	8240	10	10	–	0.004[d]	8[d]
SEMIVOLATILE ORGANICS (µg/L or µg/Kg)							
Acenaphthene	GC/MS	8270	10	330	–	2[d]	4,800[d]
Acenaphthylene	GC/MS	8270	10	330	–	–	–
Acetophenone	GC/MS	8270	10	330	00	3.5[e]	8,000[e]
2-Acetylaminofluorene	GC/MS	8270	10	330	–	–	–
4-Aminobiphenyl	GC/MS	8270	10	330	–	–	–
Aniline	GC/MS	8270	10	330	–	0.006[e]	120[e]
Anthracene	GC/MS	8270	10	330	–	10[d]	24,000[d]
Aramite	GC/MS	8270	10	330	–	0.001[d]	28[d]
Benzo(a)anthracene	GC/MS	8270	10	330	0.2	–	0.4[i]
Benzo(a)pyrene	GC/MS	8270	10	330	0.2	–	0.06[d]
Benzo(b)fluoranthene	GC/MS	8270	10	330	0.2	–	0.4[i]
Benzo(g,h,i)perylene	GC/MS	8270	10	330	0.2	–	2.8[i]
Benzo(k)fluoranthene	GC/MS	8270	10	330	0.2	–	0.9[i]
Benzyl alcohol	GC/MS	8270	10	330	–	10[e]	24,000[e]
4-Bromophenyl phenyl ether	GC/MS	8270	10	330	–	–	–

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
Butylbenzylphthalate	GC/MS	8270	10	330	4	–	16,000[d]
4-Chloro-3-methylphenol	GC/MS	8270	10	330	–	–	–
4-Chloroaniline	GC/MS	8270	10	330	–	0.1[d]	320[d]
Chlorobenzilate	GC/MS	8270	10	330	–	0.7[d]	1,600[d]
bis(2-Chloroethoxy)methane	GC/MS	8270	10	330	–	–	–
bis(2-Chloroethyl)ether	GC/MS	8270	10	330	–	0.00003[d]	0.6[d]
bis(2-Chloroisopropyl)ether	GC/MS	8270	10	330	–	–	–
2-Chloronaphthalene	GC/MS	8270	10	330	–	3[d]	6,400[d]
2-Chlorophenol	GC/MS	8270	10	330	–	0.2[d]	400[d]
4-Chlorophenyl phenyl ether	GC/MS	8270	10	330	–	–	–
Chrysene	GC/MS	8270	10	330	0.2	–	14[i]
Diallate	GC/MS	8270	10	330	–	0.0006[e]	11[e]
Dibenz(a,h)anthracene	GC/MS	8270	10	330	0.2	–	0.09[i]
Dibenzofuran	GC/MS	8270	10	330	–	–	–
1,2-Dichlorobenzene	GC/MS	8270	10	330	600	–	7,200[d]
1,3-Dichlorobenzene	GC/MS	8270	10	330	600	–	–
1,4-Dichlorobenzene	GC/MS	8270	10	330	75	–	290[f]
3,3'-Dichlorobenzidine	GC/MS	8270	10	330	–	0.00008[d]	2[d]
2,4-Dichlorophenol	GC/MS	8270	10	330	–	0.1[d]	240[d]
2,6-Dichlorophenol	GC/MS	8270	10	330	–	–	–
Diethylphthalate	GC/MS	8270	10	330	4	–	64,000[d]
p-Dimethylaminoazobenzene	GC/MS	8270	10	330	–	–	–
7,12-Dimethylbenz(a)anthracene	GC/MS	8270	10	330	–	–	–
3,3'-Dimethylbenzidine	GC/MS	8270	20	670	–	0.000004[e]	0.08[e]
Dimethylphenethylamine	GC/MS	8270	120	4,000	–	–	–
2,4-Dimethylphenol	GC/MS	8270	10	330	–	0.7[d]	1,600[d]
Dimethylpthalate	GC/MS	8270	10	330	4	–	80,000[e]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
4,6-Dinitro-2-methylphenol	GC/MS	8270	10	330	–	–	–
Di-n-butylphthalate	GC/MS	8270	10	330	–	3.5[d]	8,000[d]
Di-n-octylphthalate	GC/MS	8270	10	330	–	0.7[e]	1,600[e]
1,3-Dinitrobenzene	GC/MS	8270	10	330	–	0.004[d]	8[d]
2,4-Dinitrophenol	GC/MS	8270	20	670	–	0.7[d]	160[d]
2,4-Dinitrotoluene	GC/MS	8270	10	330	–	–	–
2,6-Dinitrotoluene	GC/MS	8270	10	330	–	0.000005[e]	1[e]
Diphenylamine	GC/MS	8270	10	330	–	0.9[d]	2,000[d]
bis(2-Ethylhexyl)phthalate	GC/MS	8270	10	330	–	0.003[d]	50[d]
Ethylmethane sulfonate	GC/MS	8270	10	330	–	–	–
Fluoranthene	GC/MS	8270	10	330	0.2	–	3,200[d]
Fluorene	GC/MS	8270	10	330	0.2	–	3,200[d]
Hexachlorobenzene	GC/MS	8270	10	330	1	–	0.4[d]
Hexachlorobutadiene	GC/MS	8270	10	330	–	0.0004[d]	90[d]
Hexachlorocyclopentadiene	GC/MS	8270	10	330	50	–	560[d]
Hexachloroethane	GC/MS	8270	10	330	–	0.003[d]	500[d]
Hexachlorophene	GC/MS	8270	2,000	67,000	–	0.01[d]	24[d]
Hexachloropropene	GC/MS	8270	10	330	–	–	–
Indeno(1,2,3-c,d)pyrene	GC/MS	8270	10	330	0.2	–	0.4[d]
Isophorone	GC/MS	8270	10	330	–	0.009[d]	1,700[d]
Isosafrole	GC/MS	8270	10	330	–	–	–
Methapyrilene	GC/MS	8270	50	1,700	–	–	–
3-Methylchloanthrene	GC/MS	8270	10	330	–	–	–
Methyl methanesulfonate	GC/MS	8270	50	1,700	–	–	–
2-Methyl naphthalene	GC/MS	8270	10	330	–	–	–
2-Methylphenol	GC/MS	8270	10	330	–	2[d]	4,000[d]
3-Methylphenol	GC/MS	8270	10	330	–	2[d]	4,000[d]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
4-Methylphenol	GC/MS	8270	10	330	–	2[e]	4,000[e]
Naphthalene	GC/MS	8270	10	330	–	–	320[e]
1,4-Naphthoquinone	GC/MS	8270	10	330	–	–	–
1-Naphthylamine	GC/MS	8270	10	330	–	–	–
2-Naphthylamine	GC/MS	8270	10	330	–	–	–
2-Nitroaniline	GC/MS	8270	10	330	–	–	–
3-Nitroaniline	GC/MS	8270	20	670	–	–	–
4-Nitroaniline	GC/MS	8270	20	670	–	–	–
Nitrobenzene	GC/MS	8270	10	330	–	0.02[d]	40[d]
2-Nitrophenol	GC/MS	8270	10	330	–	–	–
4-Nitrophenol	GC/MS	8270	10	330	–	–	–
4-Nitroquinoline-n-oxide	GC/MS	8270	80	2,700	–	–	–
N-Nitroso-di-n-butylamine	GC/MS	8270	10	330	–	0.000006[d]	0.1[d]
N-Nitrosodiethylamine	GC/MS	8270	10	330	–	2×10^{-7} [d]	0.005[d]
N-Nitrosodiphenylamine	GC/MS	8270	10	330	–	0.007[d]	140[d]
N-Nitroso-di-n-propylamine	GC/MS	8270	10	330	–	0.000005[d]	0.1[d]
N-Nitrosodimethylamine	GC/MS	8270	10	330	–	7×10^{-7} [d]	0.01[d]
N-Nitrosomethylethylamine	GC/MS	8270	10	330	–	0.000002[d]	0.3[d]
N-Nitrosomorpholine	GC/MS	8270	20	670	–	–	–
N-Nitrosopiperidine	GC/MS	8270	10	330	–	–	–
N-Nitrosopyrrolidine	GC/MS	8270	10	330	–	0.00002[d]	0.3[d]
5-Nitro-o-toluidine	GC/MS	8270	10	330	–	–	–
Pentachlorobenzene	GC/MS	8270	10	330	–	0.03[d]	60[d]
Pentachloroethane	GC/MS	8270	10	330	–	–	–
Pentachloronitrobenzene	GC/MS	8270	10	330	–	0.1[d]	24[d]
Pentachlorophenol	GC/MS	8270	10	330	1	0.0003[d]	6[d]
Phenacetin	GC/MS	8270	10	330	–	–	–

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
Phenanthrene	GC/MS	8270	10	330	0.2	–	–
Phenol	GC/MS	8270	10	330	–	20[d]	48,000[d]
p-Phenylenediamine	GC/MS	8270	120	4,000	–	7[e]	15,200[e]
2-Picoline	GC/MS	8270	10	330	–	–	–
Pronamide	GC/MS	8270	10	330	–	3[d]	6,000[d]
Pyrene	GC/MS	8270	10	330	0.2	1[d]	2,400[d]
Pyridine	GC/MS	8270	10	330	–	0.04[d]	80[d]
Safrole	GC/MS	8270	10	330	–	–	–
1,2,4,5-Tetrachlorobenzene	GC/MS	8270	10	330	–	0.01[d]	20[d]
2,3,4,6-Tetrachlorophenol	GC/MS	8270	10	330	–	1[d]	2,400[d]
o-Toluidine	GC/MS	8270	10	330	–	0.0001[e]	3[e]
1,2,4-Trichlorobenzene	GC/MS	8270	10	330	9	0.4[d]	800[d]
2,4,5-Trichlorophenol	GC/MS	8270	10	330	–	3.5[d]	8,000[d]
2,4,6-Trichlorophenol	GC/MS	8270	10	330	–	0.003[d]	60[d]
DIOXINS AND FURANS (ng/L or ng/g)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin	GC/MS	8280	2.0	0.080	–	–	0.000005[d]
Tetrachlorodibenzo-p-dioxins	GC/MS	8280	2.0	0.080	–	–	–
Tetrachlorodibenzo-p-furans	GC/MS	8280	1.4	0.056	–	–	0.00005[j]
Pentachlorodibenzo-p-dioxins	GC/MS	8280	2.9	0.12	–	–	0.000009[j]
Pentachlorodibenzo-p-furans	GC/MS	8280	1.8	0.072	–	–	0.000009[j]
Hexachlorodibenzo-p-dioxins	GC/MS	8280	3.6	0.14	–	–	0.00005[j]
Hexachlorodibenzo-p-furans	GC/MS	8280	2.3	0.092	–	–	0.00005[j]
Octachlorodibenzo-p-dioxins	GC/MS	8280	N/A	N/A	–	–	0.005[j]

Table 3-2

(Continued)

Parameter	Analysis		Reporting Limits[a]		Action Levels/Health-Based Levels		
	Technique	Method	Water	Soil	MCL[b] (Water) (mg/L)	RCRA[c] (Water) (mg/L)	RCRA[c] (Soil) (mg/Kg)
GENERAL (mg/L or mg/Kg)							
Cyanide	Colorimetric	9012	0.01	1.0	200	–	1,600[d]
Sulfide	Titrimetric	9030	1.0	100	–	–	–
Total Recoverable Petroleum Hydrocarbons (TRPH)	IR	418.1	0.4	40	–	–	–
Total Dissolved Solids (TDS)	Gravimetric	160.1	10	N/A	–	–	–

[a] Method Reporting Limit (MRL) is the minimum concentration of a substance that can be measured and reported for multiple instruments. MRLs are highly matrix dependent and may not always be achievable. MRLs listed in this table are based on wet weight.
[b] Federal Drinking Water Standards Maximum Contaminant Levels (MCL), Office of Drinking Water, USEPA.
[c] Values calculated using the reference dose (RfD) or slope factor (SF) with EPA's method for calculating action levels (Appendix 4 of "Draft Preliminary Standards for RCRA Risk Assessment," EPA Region VI, 20 February 1991; and 27 July 1990 Fed. Reg., "Corrective Action for SWMUs at Hazardous Waste Management Facilities," Appendix E. The source of the RfDs and SFs used in the calculation are designated by a footnote for each value in this column. Action levels may change over time, EPA IRIS database should be reviewed prior to using these levels in the deicsion-making process.
[d] RfD or SF used in calculation of HBL from Integrated Risk Information Service (IRIS), EPA, May, 1992.
[e] RfD or SF used in calculation of HBL from Health Effects Assessment Summary Tables, FY-1991 Annual, EPA, Washington D.C., January, 1991.
[f] EPA action level for lead in drinking water at the tap. Federal Register 56110. June 7, 1991.
[g] Calculated based on EPA action level for lead in drinking water.
[h] Soil cleanup criteria for nonrestricted access area 40 CFR Section 761.123.
[i] SF used in calculation of HBL calculated using method in Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons, Interim Final, ICF-Clement Associates, Fairfax, Virginia, April 1, 1988.
[j] SF calculated by toxicity equivalency factor method in 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs). EPA, March, 1989. Listed values are for 2,3,7,8-isomers, other isomers are considered noncarcinogenic and have no health-based action levels.

CVAA = Cold Vapor Atomic Absorption
GC/ECD = Gas Chromatography/Electron Capture Detector
GC/FPD = Gas Chromatography/Flame Photometric Detector
GC/MS = Gas Chromatography/Mass Spectrometry
GFAA = Graphite Furnace Atomic Absorption
ICPES = Inductively Coupled Plasma Emission Spectroscopy
IR = Infrared Spectrometry
N/A = Not Applicable

4.0 DATA QUALITY CALCULATIONS

Precision and accuracy are the two most important indicators of data quality. Precision is a measure of variability associated with a measurement system. Accuracy expresses the degree to which a measured value agrees with the true value for a given parameter. Accuracy includes elements of both bias and precision. This section provides instructions for calculating data quality in terms of precision and accuracy.

4.1 Precision

For the Phase I RFI, precision will be assessed and controlled through the use of duplicate QCCS analyses.

The relative percent difference (RPD) will be used to estimate precision for duplicate QCCS analyses and is calculated by:

$$\mathbf{RPD} = \frac{X_1 - X_2}{(X_1 + X_2)/2} \times 100$$

4.2 Accuracy

For this project, accuracy of the measurement data will be assessed and controlled by continuing calibration check samples (CCCS) and quality control check samples (QCCS). These results will be used to control accuracy within acceptable limits by requiring that they meet specific criteria. As CCCS and QCCS are analyzed, recoveries will be calculated and compared to preestablished acceptance limits (see Table 9-1). Percent recovery is calculated as the measured value divided by the actual value times 100. Overall inaccuracy will be calculated as the average of percentages not recovered (100-percent

recovery). This inaccuracy estimate includes systematic bias and random bias, and will be compared, in terms of percent recovery, with Table 3-1 and Table 3-2 to determine data acceptability.

5.0 SAMPLING PROCEDURES

The types of samples collected for the Phase I RFI will be soil, soil gas, and possibly groundwater. HydroPunch™ sampling is scoped at one SWMU but the work will be performed as part of the Base's IRP investigations. Samples will be analyzed for the presence or absence of CFR Part 264 Appendix IX compounds, or a subset of these compounds. Analytical methods performed on samples from each site are summarized in Table 3-5 of the Work Plan. Individual parameters for each analytical method are presented in Table 7-1 of this QAPP.

5.1 Sample Collection Procedures

Sample collection procedures are discussed in Section 3.3 of the Phase I RFI Work Plan, field screening techniques are discussed in Section 3.1, and soil gas survey procedures are discussed in Section 3.2. Samples will be representative with respect both to time and to spatial distribution. The majority of samples collected will be taken using grab sampling techniques. Composite samples will be collected from a limited number of the SWMUs described in Sections 4.1 through 4.28 of the Work Plan. Specifically, tank and oil/water separator contents may be sampled and composited at SWMUs 126/36 and 125/32. In addition, composite samples will be collected at SWMU 155 and, if waste material is encountered, at SWMU 156.

5.2 Sample Containers, Preservation Procedures, and Holding Times

To preserve the integrity of the sample before it is analyzed, proper sample containment, preservation methods, and holding times will be followed. Sample bottles, preservation methods, and holding times are given in Tables 5-1 and 5-2. The sample bottles used for this sampling effort will be precleaned and checked according to U.S. EPA protocol by the sample bottle supplier or vendor. No sample containers will be reused

Table 5-1

Summary of Sample Containers, Preservation, and Holding Times for Soil Samples

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
EPA:418.1	Total Recoverable Petroleum Hydrocarbons (TRPH)	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	N/S[b]	28 days
SW-846:6010[c]	Ag, Ba, Be, Cd, Co, Cr, Cu, Ni, Sb, Sn, Va, Zn	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S[b]	6 months
SW-846:7060[c]	As	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S[b]	6 months
SW-846:7421[c]	Pb	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S[b]	6 months
SW-846:7471[c]	Hg	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S[b]	28 days
SW-846:7740[c]	Se	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S[b]	6 months
SW-846:7841	Tl	(1) 250 mL glass or polyethylene [a]	Refrigerated at 4°C	N/S[b]	6 months
SW-846:8080[c]	Organochlorine Pesticides/PCBs	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8140	Organophosphorus Pesticides	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8150[c]	Chlorinated Herbicides	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8240[c]	Volatile Organic Compounds	(1) 250 mL glass, Teflon-lined cap	No headspace, Refrigerated at 4°C	N/S[b]	14 days
SW-846:8270[c]	Semivolatile Organic Compounds	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8280	Dioxins and furans	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	30 days	45 days
SW-846:9012	Cyanide	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	N/S[b]	14 days
SW-846:9030	Sulfide	(1) 250 mL glass, Teflon-lined cap	Refrigerated at 4°C	N/S[b]	7 days

[a] One 250 mL sample will provide sufficient quantity for all metals analyses.
[b] N/S = Not Specified
[c] Toxicity Characteristic Leaching Procedure (TCLP) analytical methods.

Table 5-2

Summary of Sample Containers, Preservation, and Holding Times for Water Samples

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
EPA:160.1	Total Dissolved Solids (TDS)	(1) 500 mL glass or polyethylene	Refrigerated at 4°C	N/S [a]	48 hours
EPA:418.1	Total Recoverable Petroleum Hydrocarbons (TRPH)	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C, pH <2 w/HCl	N/S	28 days
SW-846:6010	Sb, Ba, Be, Cd, Co, Cr, Cu, Ni, Ag, Sn, Va, Zn	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7060	As	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7421	Pb	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7470	Hg	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	28 days
SW-846:7740	Se	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:7841	Tl	(1) 500 mL glass or polyethylene [c]	Filter in Field, pH <2 w/HNO_3, Refrigerated at 4°C	N/S	6 months
SW-846:8080	Organochlorine Pesticides/PCBs	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days
SW-846:8140	Organophosphorus Pesticides	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days
SW-846:8150	Chlorinated Herbicides	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days

Table 5-2

(Continued)

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:8240	Volatile Organic Compounds	(2) 40 mL glass, Teflon-lined septa [b]	No headspace, pH <2 w/HCl, Refrigerated at 4°C	N/S	14 days
SW-846:8270	Semivolatile Organic Compounds	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	7 days	40 days
SW-846:8280	Dioxins and furans	(2) 1000 mL glass, Teflon-lined cap [b]	Refrigerated at 4°C	30 days	45 days
SW-846:9012	Cyanide	(1) 500 mL amber glass, Teflon-lined cap [b]	pH >12 w/NaOH Refrigerated at 4°C	N/S	14 days
SW-846:9030	Sulfide	(1) 500 mL glass, Teflon-lined cap [b]	Zinc Acetate, pH >9 w/NaOH Refrigerated at 4°C	N/S	7 days

[a] N/S = Not Specified
[b] Extra sample must be collected for matrix spike/matrix spike duplicate analyses.
[c] One 250 mL sample will provide sufficient quantity for all metals analyses.

during this project. Immediately following collection, all soil and water samples will be cooled to approximately 4°C with conventional ice wrapped in double-sealed plastic bags.

When collecting samples with volatile organic analysis (VOA) vials, each vial will be gently filled and capped without any headspace. Other bottles, for nonvolatile sample analyses, will be filled allowing for adequate headspace. The sample label will be affixed to the bottle and labeled as described in Section 6.1 (Sample Custody).

5.3 Sample Documentation

Sample collection will be documented using bound field notebooks with consecutively numbered pages; indelible ink will be used. Other documentation, described in Section 6, consists of chain-of-custody forms, sample labels, and chain-of-custody seals.

5.4 Field Quality Control

Samples will be collected on site for field quality control. These samples include trip and equipment blanks, as well as duplicates.

5.4.1 Blanks

A blank is an artificial sample designed to monitor the introduction of artifacts into the process. Field blanks are aliquots of analyte-free liquids or solids (i.e., water or purified sand) brought to the field in sealed containers and transported back to the laboratory with the sample containers. Trip blanks, equipment blanks, and ambient blanks are three specific types of field blanks.

Trip Blanks

A trip blank is a sample of organic-free water that is prepared in the laboratory, transported to the field, and stored with routine samples collected. The trip blank is not opened in the field, but is transported back to the laboratory with the routine samples. Trip blanks are subjected to the same handling as other samples and serve to identify contamination from sample containers or transportation and storage procedures. Trip blanks accompany samples for volatile organic analyses only. When volatile organics are detected in trip blanks, it indicates that sample handling, transportation, or storage may have contributed to investigative sample results. Results of trip blanks should not be used for blank subtraction, but rather as a tool to assess potential contamination sources.

Equipment Blanks

An equipment blank is an aliquot of deionized or organic-free water or purified sand that is poured over or through the sampling equipment, collected in a sample container, and returned to the laboratory as a sample. Equipment blanks demonstrate that a non-dedicated sampling device has been adequately cleaned.

Ambient Blanks

Ambient blanks are samples of organic-free water that are used to evaluate the extent to which airborne contaminants may affect analytical results. Organic-free water in an appropriate sampling container is exposed to ambient conditions at the sampling location, sealed, and returned to the laboratory for analysis as a sample. Ambient blanks will be collected when samples are collected downwind of possible sources of contamination.

5.4.2 Field Quality Control Procedures for Solid Samples

These procedures will focus on ensuring the collection of representative samples that are free from external contamination. Although different extraction and/or analytical procedures will be used for the various parameters of interest, certain general QC procedures are applicable to all methods. These include the following:

- QC and QA duplicate (i.e., split) solid samples will be collected at a frequency of 10 percent (1 per 10 or fewer samples) to provide a measure of method variability (i.e., total variability due to imprecision in both sampling and analytical procedures). A single sample is collected, then divided into three equal parts for the purpose of analysis. QA duplicate samples will be analyzed by the USACE MRD laboratory. Field QC duplicates will be indistinguishable from other analytical samples and will be analyzed by the contractor laboratory. QA duplicates will be assigned the same ID number as the original sample to ensure easy comparison of results.

- Matrix spike and matrix spike duplicate (MS/MSD) samples will be collected at a rate of five percent for each analysis (i.e., one MS/MSD pair per 20 samples).

- Trip blanks will accompany samples collected for volatile organic analysis at a frequency of one per cooler in which volatiles samples are shipped.

- Equipment blanks will be collected for non-dedicated equipment used during soil sampling on a 10 percent frequency. Equipment blanks will be analyzed for the same analytical parameters as the samples collected.

- Ambient condition blanks will be collected on a 10 percent frequency. Ambient blanks will be analyzed for the same parameters as the samples collected.

- Chain-of-custody forms will accompany all samples.

- Sampling apparatus will be thoroughly cleaned between each sampling to prevent cross-contamination of the samples. Decontamination procedures are presented in Section 3.1.3 of the RFI Work Plan.

5.4.3 Field Quality Control Procedures for Water Samples

QC procedures will be an integral part of each sampling methodology. These procedures will focus on ensuring the collection of representative samples which are free from external contamination. Although different extraction and/or analytical procedures will be used for the various parameters of interest, certain general QC procedures are applicable to all methods. These include the following:

- Trip blanks will be collected for volatile organic analysis at a frequency of one per cooler in which volatile samples are shipped.
- Equipment blanks will be collected for non-dedicated equipment used during groundwater sampling at a frequency of approximately 10 percent (1 per 10 or fewer samples), with a minimum of one per sampling event. Equipment blanks will be analyzed for the same analytical parameters as the samples collected.
- Ambient condition blanks will be collected on a 10 percent frequency and analyzed for the same parameters as the investigative samples collected.
- QA and QC duplicate samples will be collected at a frequency of approximately 10 percent (1 per 10 or fewer samples) to provide a measure of variability (i.e., total variability due to imprecision in sampling, handling, and analytical procedures). Three samples are collected sequentially. Field QC duplicates will be indistinguishable from other analytical samples. QA duplicate samples will be assigned the same ID number as the original sample to facilitate easy comparison of results. QA duplicates will be analyzed by USACE MRD laboratory. QC duplicates will be analyzed by the contractor laboratory
- Matrix spike and matrix spike duplicate(MS/MSD) samples will be collected at a rate of five percent for each analysis (i.e., one MS/MSD pair per 20 samples).
- Chain-of-custody forms will accompany all samples.

- Sampling apparatus, other than bailers and other dedicated equipment, will be thoroughly cleaned between uses to prevent cross-contamination of the samples. Decontamination procedures are presented in Section 3 of the RFI Work Plan.

5.4.4 Quality Control Procedures for Field Measurements

At some sites, field screening techniques will be used to select samples for analysis. At other sites, soil organic vapor (soil gas) surveys will be conducted.

- The organic vapor analyzer (OVA) will be calibrated prior to use. A known gas standard will be analyzed daily to verify that the OVA is calibrated and operating acceptably. Results of daily calibration checks will be recorded in a field logbook.
- Meters used to test groundwater pH and conductivity (if groundwater is investigated) will be calibrated daily, when in use, with pH buffer solutions and a conductivity standard. Results of calibration checks will be recorded in a field logbook.
- Gas chromatographs (GC) used for soil gas analyses will be calibrated at the beginning of each day and calibration will be verified at the end of each day. Calibration samples will contain an analyte(s) of known concentration and will be similar an analyte(s) to contaminants of interest. The contractor performing the survey will document calibration results in a logbook.
- Before analyzing any samples or standards by GC, a blank analysis will be performed. This analysis will be of ultra-zero-grade air. To demonstrate that the GC system is contaminant free, results of the method blank analyses will be below reporting limits. Results of method blanks will be reported with soil gas survey results.

6.0 SAMPLE CHAIN OF CUSTODY, PACKING, AND TRANSPORTATION

A sample label (Figure 6-1) will be affixed to all sampling containers submitted for laboratory analysis. Sample labels identify the sample by documenting the sample type, sampler(s) initials, sampling locations, depth, time, and date. The unique number assigned to each sample is also noted on the sample label. Indelible ink will be used to complete all sample labels.

A chain-of-custody form (Figure 6-2) will be used to record the number of samples collected and the corresponding laboratory analyses; indelible ink will be used. Information on this form includes time and date of sample, sample number, type of sample, sampler's name, preservatives used, and any special instructions. Samples collected for matrix spike/matrix spike duplicate analysis will be identified on the chain- of-custody form. A copy of the chain-of-custody form will be retained by the sampler, and will be maintained in a file of field documentation.

All samples will be kept cool during collection and shipment with conventional ice in sealed plastic bags. The samples will be stored upright in a durable ice chest. Sufficient packing material (i.e., vermiculite) will be used to separate the bottles, filling any intervening voids.

The ice will be placed above and around the top of the sample containers. The remaining space will be filled with additional packing material. The chain-of-custody form will be sealed in a plastic Zip-loc® bag and affixed to the top lid of the cooler. The cooler will be secured by completely wrapping it with strapping tape around both ends. If there is a drain on the cooler, it will be taped shut. The cooler will be labeled with "This Side Up" arrows on two opposing sides. Custody seals will also be affixed to coolers to indicate tampering.

Field Number _____

Sample Type: _____

Client: _____

Location: _____

Preservative: _____

Sampler: _____

Date: _____

Comment: _____

6-89-31426

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

I.D. # _____

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

6-89-31426

Figure 6-1. Example Sample Label and Custody Seal

Chain of Custody Record

Page _____ of _____

PROJECT

SITE

COLLECTED BY *(Signature)*

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES								REMARKS	ID NO. *(for lab use only)*

REMARKS

RELINQUISHED BY: | DATE | TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

Figure 6-2. Example Sample Chain-of-Custody Record

Soil and groundwater samples will be shipped to the laboratory by overnight courier on a daily basis.

Upon receipt by the laboratory, sample integrity will be inspected and documented on a chain-of-custody addendum (Figure 6-3). Sample temperatures will be checked and recorded, evidence of other preservatives will be reviewed, physical condition of each sample container will be checked, whether custody seals are intact will be recorded along with freight bill identification numbers, and chain-of-custody records will be reviewed for consistency with the shipment. If any indication of a lack of sample integrity is found, the field task leader will be contacted to discuss implementation of corrective actions.

CUSTODY NUMBER: 93- **0009**

CHAIN OF CUSTODY ADDENDUM

RECEIVED BY:_____ WORK ORDER (S):_____

DATE:_____ _____

UNPACKED DATE:_____ _____

NUMBER OF OUTER CONTAINERS RECEIVED WITH CHAIN OF CUSTODY _____ _____

CLIENT CODE:_____

(Check the appropriate answer. Add comments or explanations as needed)

CUSTODY SEAL ON COOLER/OUTER CONTAINER BY:_____

Present _____ YES _____ NO

Custody Number _____ #. _____ NO

Container sealed with tape _____ YES _____ NO

Seal is intact _____ YES _____ NO

If seal not intact, list airbill number of that container (s).

_____

SAMPLE TEMPERATURE UPON ARRIVAL BY:_____ Pyrometer #_____

The temperature of the container(s) is:(acceptable tolerance 2-6°C)

1 ____°C 2 ____°C 3 ____°C 4 ____°C 5 ____°C 6 ____°C 7 ____°C

When samples are received not requiring cooling _____ NA

If the temperature (s) are outside the acceptable range of 2-6°C

Client Services was notified, (_____CSC) _____ YES

OK to analyze samples: _____ YES _____ NO

All samples not listed below were within the acceptable temperature tolerance of 2-6°C. Samples affected and their temperatures:

Sample ID	Temp.(°C)	Sample ID	Temp.(°C)	Sample ID	Temp.(°C)

REV 11/23/92

Figure 6-3. Example Chain-of-Custody Addendum

CONDITION OF BOTTLES/CONTAINERS BY:_____ (COMMENT ANY PROBLEMS)

Bottles received match COC _____ YES _____ NO

Bottles received intact _____ YES _____ NO

Comments:

pH OF SAMPLES/PRESERVATION BY:_____ (COMMENT ANY PROBLEMS)

Acid preserved samples are <2 pH _____ YES _____ NO
(as indicated by * on COC)

Base preserved samples are >12 pH _____ YES _____ NO
(as indicated by # on COC)

Water samples for Cyanide checked _____ YES _____ NO
(as noted with a check mark on COC)

Water Sulfide samples appear to be _____ YES _____ NO
preserved with zinc acetate

_____ NA

If pH/preservation is outside acceptable limits, Client Services was notified

(_____ CSC) _____ YES ADJUST _____YES _____NO

Sample id's and pH of samples received outside of acceptable pH range. All other samples not listed are at the appropriate pH.

Sample ID	pH	Sample ID	pH	Sample ID	pH	Sample ID	pH
_____	___	_____	___	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

Comments:

SHIPPING DOCUMENTATION

Freightbill is available and attached to chain-of-custody.

_____ YES _____ NO

OTHER COMMENTS:

CLIENT CHAIN OF CUSTODY IS SIGNED/DATED WITH TIME BY SAMPLE CONTROL AS RECEIVED, WITH THE SAMPLE CONTROL ADDENDUM NUMBER NOTED IN THE COMMENTS SECTION.

_____ YES _____ NO

SAMPLE CONTROL ADDENDUM VERIFIED BY:_____DATE:_____

Figure 6-3. (Continued)

7.0 ANALYTICAL PROCEDURES

The methods and procedures that will be used to prepare and analyze samples are discussed in this section. Most chemical analyses will be performed according to the following publications:

- SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, U.S. EPA, Office of Solid Waste and Emergency Response, November 1986, third edition.
- EPA, *Methods for Chemical Analysis of Water and Wastes*, EPA Publication No. 600/4-79-020, March 1983.

Individual parameters and analytical methods to be followed are listed in Table 7-1. Information is provided for soil and groundwater matrices; However, no groundwater samples are scheduled for collection during the Phase I RFI activities. Information for analysis of groundwater samples is provided in the event that changing conditions during the actual investigation warrant their collection.

The laboratory will perform instrument-specific demonstration of capability (DOC) and method detection limit (MDL) studies to demonstrate the ability to meet project-specific reporting limits. Analyses will only be performed on instruments with valid and current MDL and DOC studies.

7.1 Total Dissolved Solids -- EPA Method 160.1

Groundwater matrix samples will be analyzed to determine the levels of dissolved solids in the groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the RFI Work Plan.

Table 7-1

Analytical Methods

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
METALS (mg/L or mg/kg)							
Antimony	Acid Digestion	3005	3050	ICPES	6010	0.10	10
Barium	Acid Digestion	3005	3050	ICPES	6010	0.010	1.0
Beryllium	Acid Digestion	3005	3050	ICPES	6010	0.0020	0.2
Cadmium	Acid Digestion	3005	3050	ICPES	6010	0.0050	0.5
Chromium	Acid Digestion	3005	3050	ICPES	6010	0.010	1.0
Cobalt	Acid Digestion	3005	3050	ICPES	6010	0.010	1.0
Copper	Acid Digestion	3005	3050	ICPES	6010	0.020	2.0
Nickel	Acid Digestion	3005	3050	ICPES	6010	0.020	2.0
Silver	Acid Digestion	3005	3050	ICPES	6010	0.010	1.0
Tin	Acid Digestion	3005	3050	ICPES	6010	0.60	60
Vanadium	Acid Digestion	3005	3050	ICPES	6010	0.020	2.0
Zinc	Acid Digestion	3005	3050	ICPES	6010	0.020	2.0
Arsenic	Acid Digestion	3020	3050	GFAA	7060	0.0040	0.4
Lead	Acid Digestion	3020	3050	GFAA	7421	0.0030	0.3
Mercury	Acid Digestion	7470	7471	CVAA	7470/7471	0.0002	0.02
Selenium	Acid Digestion	3020	3050	GFAA	7740	0.0050	0.5
Thallium	Acid Digestion	3020	3050	GFAA	7841	0.005	0.5
ORGANOCHLORINE PESTICIDES AND PCBs (µg/L or µg/kg)							
Aldrin	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
alpha-BHC	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
beta-BHC	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
delta-BHC	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
gamma-BHC (Lindane)	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
Chlordane (technical)	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.050	5.0
4,4'-DDD	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
4,4'-DDE	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
4,4'-DDT	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.020	2.0
Dieldrin	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
Endosulfan I	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
Endosulfan II	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.030	3.0
Endosulfan sulfate	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.050	5.0
Endrin	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
Endrin aldehyde	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.020	2.0
Heptachlor	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.01	1.0
Heptachlor epoxide	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
Isodrin	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.010	1.0
Kepone	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.01	1.0
Methoxychlor	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.050	5.0
Toxaphene	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.50	50
PCB-1016	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.10	10
PCB-1221	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.20	20
PCB-1232	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.20	20
PCB-1242	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.10	10
PCB-1248	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.10	10
PCB-1254	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.20	20
PCB-1260	Extraction	3510/3520	3540/3550	GC/ECD	8080	0.20	20
ORGANOPHOSPHORUS PESTICIDES (µg/L or µg/Kg)							
Dimethoate	Extraction	3510/3520	3540	GC/FPD	8140	0.20	20
Disulfoton	Extraction	3510/3520	3540	GC/FPD	8140	0.20	20
Ethyl parathion	Extraction	3510/3520	3540	GC/FPD	8140	0.15	15

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[2]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
Famphur	Extraction	3510/3520	3540	GC/FPD	8140	0.50	50
Methyl parathion	Extraction	3510/3520	3540	GC/FPD	8140	0.03	3.0
Phorate	Extraction	3510/3520	3540	GC/FPD	8140	0.15	15
Sulfotepp	Extraction	3510/3520	3540	GC/FPD	8140	0.10	10
Thionazin	Extraction	3510/3520	3540	GC/FPD	8140	1.0	100
o,o,o-Triethylphosphorthioate	Extraction	3510/3520	3540	GC/FPD	8140	1.0	100
CHLORINATED HERBICIDES (µg/L or µg/Kg)							
2,4-D	Extraction/ Esterification	8150	8150	GC/ECD	8150	1.2	120
2,4,5-T	Extraction/ Esterification	8150	8150	GC/ECD	8150	0.20	20
2,4,5-TP (Silvex)	Extraction/ Esterification	8150	8150	GC/ECD	8150	0.17	17
Dinoseb	Extraction/ Esterification	8150	8150	GC/ECD	8150	0.15	15
VOLATILE ORGANICS (µg/L or µg/Kg)							
Acetone	Purge and Trap	5030	5030	GC/MS	8240	100	100
Acetonitrile	Purge and Trap	5030	5030	GC/MS	8240	100	100
Acrolein	Purge and Trap	5030	5030	GC/MS	8240	75	75
Acrylonitrile	Purge and Trap	5030	5030	GC/MS	8240	50	50
Benzene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Bromodichloromethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Bromomethane	Purge and Trap	5030	5030	GC/MS	8240	10	10
Carbon disulfide	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Carbon tetrachloride	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
2-Chloro-1,3-butadiene	Purge and Trap	5030	5030	GC/MS	8240	25	25

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
Chlorobenzene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Chloroethane	Purge and Trap	5030	5030	GC/MS	8240	10	10
Chloroform	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Chloromethane	Purge and Trap	5030	5030	GC/MS	8240	10	10
3-Chloropropene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Dibromochloromethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,2-Dibromo-3-chloropropane	Purge and Trap	5030	5030	GC/MS	8240	20	20
1,2-Dibromoethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Dibromomethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
trans-1,4-Dichloro-2-butene	Purge and Trap	5030	5030	GC/MS	8240	10	10
Dichlorodifluoromethane	Purge and Trap	5030	5030	GC/MS	8240	20	20
1,2-Dichloroethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
trans-1,2-Dichloroethene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,1-Dichloroethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,1-Dichloroethene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,2-Dichloropropane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
cis-1,3-Dichloropropene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
trans-1,3-Dichloropropene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Ethyl benzene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Ethyl methacrylate	Purge and Trap	5030	5030	GC/MS	8240	15	15
2-Hexanone	Purge and Trap	5030	5030	GC/MS	8240	50	50
Iodomethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Methylene chloride	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
2-Butanone (MEK)	Purge and Trap	5030	5030	GC/MS	8240	100	100
Methyl methacrylate	Purge and Trap	5030	5030	GC/MS	8240	10	10

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
4-Methyl-2-pentanone (MIBK)	Purge and Trap	5030	5030	GC/MS	8240	50	50
Propanenitrile	Purge and Trap	5030	5030	GC/MS	8240	100	100
Styrene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,1,1,2-Tetrachloroethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,1,2,2-Tetrachloroethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Tetrachloroethene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Toluene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Tribromomethane (Bromoform)	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,1,1-Trichloroethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
1,1,2-Trichloroethane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Trichloroethene	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Trichlorofluoromethane	Purge and Trap	5030	5030	GC/MS	8240	10	10
1,2,3-Trichloropropane	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Vinyl acetate	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
Vinyl chloride	Purge and Trap	5030	5030	GC/MS	8240	10	10
Xylenes (total)	Purge and Trap	5030	5030	GC/MS	8240	5.0	5.0
VOLATILE ORGANICS, DIRECT INJECTION (µg/mL or µg/g)							
1,4-Dioxane	Direct Injection	8240	8240	GC/MS	8240	10	10
Isobutanol	Direct Injection	8240	8240	GC/MS	8240	10	10
Methacrylonitrile	Direct Injection	8240	8240	GC/MS	8240	10	10
SEMIVOLATILE ORGANICS (µg/L or µg/Kg)							
Acenaphthene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Acenaphthylene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Acetophenone	Extraction	3510/3520	3540	GC/MS	8270	10	330
2-Acetylaminofluorene	Extraction	3510/3520	3540	GC/MS	8270	10	330

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
4-Aminobiphenyl	Extraction	3510/3520	3540	GC/MS	8270	10	330
Aniline	Extraction	3510/3520	3540	GC/MS	8270	10	330
Anthracene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Aramite	Extraction	3510/3520	3540	GC/MS	8270	10	330
Benzo(a)anthracene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Benzo(a)pyrene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Benzo(b)fluoranthene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Benzo(g,h,i)perylene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Benzo(k)fluoranthene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Benzyl alcohol	Extraction	3510/3520	3540	GC/MS	8270	10	330
4-Bromophenyl phenyl ether	Extraction	3510/3520	3540	GC/MS	8270	10	330
Butylbenzylphthalate	Extraction	3510/3520	3540	GC/MS	8270	10	330
4-Chloro-3-methylphenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
4-Chloroaniline	Extraction	3510/3520	3540	GC/MS	8270	10	330
Chlorobenzilate	Extraction	3510/3520	3540	GC/MS	8270	10	330
bis(2-Chloroethoxy)methane	Extraction	3510/3520	3540	GC/MS	8270	10	330
bis(2-Chloroethyl)ether	Extraction	3510/3520	3540	GC/MS	8270	10	330
bis(2-Chloroisopropyl)ether	Extraction	3510/3520	3540	GC/MS	8270		
2-Chloronaphthalene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2-Chlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
4-Chlorophenyl phenyl ether	Extraction	3510/3520	3540	GC/MS	8270	10	330
Chrysene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Diallate	Extraction	3510/3520	3540	GC/MS	8270	10	330
Dibenz(a,h)anthracene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Dibenzofuran	Extraction	3510/3520	3540	GC/MS	8270	10	330

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
1,2-Dichlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
1,3-Dichlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
1,4-Dichlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
3,3'-Dichlorobenzidine	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,4-Dichlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,6-Dichlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
Diethylphthalate	Extraction	3510/3520	3540	GC/MS	8270	10	330
p-Dimethylaminoazobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
7,12-Dimethylbenz(a)anthracene	Extraction	3510/3520	3540	GC/MS	8270	10	330
3,3'-Dimethylbenzidine	Extraction	3510/3520	3540	GC/MS	8270	20	670
Dimethylphenethylamine	Extraction	3510/3520	3540	GC/MS	8270	120	4,000
2,4-Dimethylphenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
Dimethylpthalate	Extraction	3510/3520	3540	GC/MS	8270	10	330
4,6-Dinitro-2-methylphenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
Di-n-butylphthalate	Extraction	3510/3520	3540	GC/MS	8270	10	330
Di-n-octylphthalate	Extraction	3510/3520	3540	GC/MS	8270	10	330
1,3-Dinitrobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,4-Dinitrophenol	Extraction	3510/3520	3540	GC/MS	8270	20	670
2,4-Dinitrotoluene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,6-Dinitrotoluene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Diphenylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
bis(2-Ethylhexyl)phthalate	Extraction	3510/3520	3540	GC/MS	8270	10	330
Ethylmethane sulfonate	Extraction	3510/3520	3540	GC/MS	8270	10	330
Fluoranthene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Fluorene	Extraction	3510/3520	3540	GC/MS	8270	10	330

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
Hexachlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Hexachlorobutadiene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Hexachlorocyclopentadiene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Hexachloroethane	Extraction	3510/3520	3540	GC/MS	8270	10	330
Hexachlorophene	Extraction	3510/3520	3540	GC/MS	8270	2,000	67,000
Hexachloropropene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Indeno(1,2,3-c,d)pyrene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Isophorone	Extraction	3510/3520	3540	GC/MS	8270	10	330
Isosafrole	Extraction	3510/3520	3540	GC/MS	8270	10	330
Methapyrilene	Extraction	3510/3520	3540	GC/MS	8270	50	1,700
3-Methylchloanthrene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Methyl methanesulfonate	Extraction	3510/3520	3540	GC/MS	8270	50	1,700
2-Methyl naphthalene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2-Methylphenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
3-Methylphenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
4-Methylphenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
Naphthalene	Extraction	3510/3520	3540	GC/MS	8270	10	330
1,4-Naphthoquinone	Extraction	3510/3520	3540	GC/MS	8270	10	330
1-Naphthylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
2-Naphthylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
2-Nitroaniline	Extraction	3510/3520	3540	GC/MS	8270	10	330
3-Nitroaniline	Extraction	3510/3520	3540	GC/MS	8270	20	670
4-Nitroaniline	Extraction	3510/3520	3540	GC/MS	8270	20	670
Nitrobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2-Nitrophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
4-Nitrophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
4-Nitroquinoline-n-oxide	Extraction	3510/3520	3540	GC/MS	8270	80	2,700
N-Nitroso-di-n-butylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosodiethylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosodiphenylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosodipropylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosodimethylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosomethylethylamine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosomorpholine	Extraction	3510/3520	3540	GC/MS	8270	20	670
N-Nitrosopiperidine	Extraction	3510/3520	3540	GC/MS	8270	10	330
N-Nitrosopyrrolidine	Extraction	3510/3520	3540	GC/MS	8270	10	330
5-Nitro-o-toluidine	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pentachlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pentachloroethane	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pentachloronitrobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pentachlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
Phenacetin	Extraction	3510/3520	3540	GC/MS	8270	10	330
Phenanthrene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Phenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
p-Phenylenediamine	Extraction	3510/3520	3540	GC/MS	8270	120	4,000
2-Picoline	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pronamide	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pyrene	Extraction	3510/3520	3540	GC/MS	8270	10	330
Pyridine	Extraction	3510/3520	3540	GC/MS	8270	10	330
Safrole	Extraction	3510/3520	3540	GC/MS	8270	10	330

Table 7-1

(Continued)

Parameter	Preparation			Analysis		Reporting Limit[a]	
	Technique	Method (Water)	Method (Soil)	Technique	Method (Water/Soil)	Water	Soil
1,2,4,5-Tetrachlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,3,4,6-Tetrachlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
o-Toluidine	Extraction	3510/3520	3540	GC/MS	8270	10	330
1,2,4-Trichlorobenzene	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,4,5-Trichlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
2,4,6-Trichlorophenol	Extraction	3510/3520	3540	GC/MS	8270	10	330
Unsymmetrical Dimethylhydrazine (UDMH)	Extraction	3510/3520	3540	GC/MS-TIC	8270	N/A	N/A
DIOXINS AND FURANS (ng/L or ng/g)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin	Extraction	3510/3520	3540/3550	GC/MS	8280	2.0	0.080
Tetrachlorodibenzo-p-dioxins	Extraction	3510/3520	3540/3550	GC/MS	8280	2.0	0.080
Tetrachlorodibenzo-p-furans	Extraction	3510/3520	3540/3550	GC/MS	8280	1.4	0.056
Pentachlorodibenzo-p-dioxins	Extraction	3510/3520	3540/3550	GC/MS	8280	2.9	0.12
Pentachlorodibenzo-p-furans	Extraction	3510/3520	3540/3550	GC/MS	8280	1.8	0.072
Hexachlorodibenzo-p-dioxins	Extraction	3510/3520	3540/3550	GC/MS	8280	3.6	0.14
Hexachlorodibenzo-p-furans	Extraction	3510/3520	3540/3550	GC/MS	8280	2.3	0.092
Octachlorodibenzo-p-dioxins	Extraction	3510/3520	3540/3550	GC/MS	8280	10	0.40
GENERAL (mg/L or mg/Kg)							
Total Recoverable Petroleum Hydrocarbons (TRPH)	Extraction	N/A	9071	IR	418.1	0.4	40
Cyanide	Distillation	9012	9012	Colorimetric	9012	0.01	1.0
Sulfide	Distillation	9030	9030	Titrametric	9030	1.0	100
Ignitability	N/A	N/A	N/A	Flash Point	1010	N/A	N/A

Table 7-1

(Continued)

[a] Reporting Limit is the minimum concentration of a substance that can be measured and reported for multiple instruments. Reporting Limits are highly matrix dependent and may not always be achievable. Reporting limits provided in this table are based on method detection limits and practical quantitation limit guidance found in SW-846, but are not MDLs or PQLs. Reporting limits listed are on a wet-weight basis.

CVAA	=	Cold Vapor Atomic Absorption
GC/ECD	=	Gas Chromatography/Electron Capture Detector
GC/FPD	=	Gas Chromatography/Flame Photometric Detector
GC/MS	=	Gas Chromatography/Mass Spectrometry
GC/MS-TIC	=	Gas Chromatography/Mass Spectrometry--Tentatively Identified Compound
GFAA	=	Graphite Furnace Atomic Absorption
ICPES	=	Inductively Coupled Plasma Emission Spectroscopy
IR	=	Infrared Spectrometry
N/A	=	Not Applicable

Total dissolved solids (TDS) will be determined by the gravimetric method using EPA Method 160.1. A well-mixed sample is filtered, evaporated, and dried to constant weight at 180°C.

7.2 Total Recoverable Petroleum Hydrocarbons -- EPA Method 418.1

Soil samples will be analyzed to determine the natural concentrations of fluorocarbon-113 extractable petroleum hydrocarbons in the soil at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan.

Samples will be extracted following the soxhlet extraction method described in EPA Method 9071, using fluorocarbon-113. Total recoverable petroleum hydrocarbons in soil samples will be determined by the infrared spectrophotometric method described in EPA Method 418.1.

7.3 Ignitability -- SW-846 Method 1010

Waste oil from SWMUs 35, 36, 123, and 126 will be analyzed by Method 1010 to determine the flashpoint of this liquid for purposes of characterization for disposal. This technique uses a Pensky-Martens closed-cup tester and is applicable to liquids including those that tend to form a surface film or contain non-filterable, suspended solids.

The sample is heated at a slow, constant rate with continual stirring. A small flame is directed into the cup at regular intervals with simultaneous interruption of stirring. The flashpoint is the lowest temperature at which application of the test flame ignites the vapor above the sample.

7.4 Metals by ICPES -- SW-846 Method 6010

Soil and groundwater samples will be analyzed to determine concentrations of antimony, beryllium, cadmium, chromium, copper, nickel, silver, thallium, and zinc in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Groundwater samples will be prepared according to EPA Method 3005. This method describes acid digestion of aqueous samples for analysis by inductively coupled plasma emission spectroscopy (ICPES). Soil samples will be prepared according to EPA Method 3050. This method describes acid digestion of soil samples for analysis by graphite furnace atomic absorption (GFAA) or ICPES.

Following acid digestion, metals will be determined by Method 6010 which allows the simultaneous, or sequential, measurement of elements using ICPES. This method measures the element emitted light by optical spectrometry. Samples are nebulized, and the resulting aerosol is transported to the plasma torch. Element specific atomic-line emission spectra are produced which are dispersed by a grating spectrometer and monitored for intensity by photomultiplier tubes.

7.5 Arsenic by Furnace AA -- SW-846 Method 7060

Soil and groundwater samples will be analyzed to determine concentrations of arsenic in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Groundwater samples will be prepared following EPA Method 3020. This method describes acid digestion of aqueous samples for analysis by GFAA. Soil samples will be prepared following EPA method 3050. This method describes acid digestion of soil samples for analysis by GFAA or ICPES.

Following acid digestion, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element

is passed through the vapor containing ground-state atoms of arsenic. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

7.6 Lead by Furnace AA -- SW-846 Method 7421

Soil and groundwater samples will be analyzed to determine concentrations of lead in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Groundwater samples will be prepared following EPA Method 3020. This method describes acid digestion of aqueous samples for analysis by GFAA. Soil samples will be prepared following EPA method 3050. This method describes acid digestion of soil samples for analysis by GFAA or ICPES.

Following acid digestion, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of lead. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

7.7 Mercury -- SW-846 Methods 7470/7471

Soil and groundwater samples will be analyzed to determine concentrations of mercury in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Soil and groundwater samples will be prepared as directed in Methods 7471

and 7470, respectively. This closed system preparation includes heating the sample for two hours in a water bath.

Following EPA Methods 7470 and 7471 and the laboratory SOP, mercury in the sample is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrometer for detection and measurement.

7.8 Selenium by Furnace AA -- SW-846 Method 7740

Soil and groundwater samples will be analyzed to determine the natural concentrations of selenium in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Groundwater samples will be prepared following EPA Method 3020. This method describes acid digestion of aqueous samples for analysis by GFAA. Soil samples will be prepared following EPA Method 3050. This method describes acid digestion of soil samples for analysis by GFAA or ICPES.

Following acid digestion, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized according to Method 7740. Radiation from a given excited element is passed through the vapor containing ground-state atoms of selenium. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

7.9 Thallium by Furnace AA -- SW-846 Method 7841

Soil and groundwater samples will be analyzed to determine concentrations of thallium in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of

the Work Plan. Groundwater samples will be prepared following EPA Method 3020. This method describes acid digestion of aqueous samples for analysis by graphite furnace atomic absorption (GFAA). Soil samples will be prepared following EPA method 3050. This method describes acid digestion of soil samples for analysis by GFAA or ICPES.

Following acid digestion, a sample aliquot will be placed in a graphite tube in the furnace, evaporated, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of thallium. The intensity of the radiation decreases in proportion to the amount of ground-state atoms present. A monochromator isolates the characteristic radiation from the hollow cathode tube or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation.

7.10 Organochlorine Pesticides and PCBs -- SW-846 Method 8080

Soil and groundwater samples will be analyzed to determine concentrations of organochlorine pesticides and polychlorinated biphenyls (PCBs) in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Prior to analysis, groundwater samples are extracted at a neutral pH using methylene chloride as a solvent. According to EPA Method 3520 which describes a continuous liquid-liquid extraction technique, or EPA Method 3510, which describes a separatory funnel extraction technique. Prior to analysis, soil samples are also extracted using methylene chloride, but according to EPA Method 3550 which describes a sonication extraction technique, or according to EPA Method 3540, which describes a soxhlet extraction.

Method 8080 is a GC method using electron capture detection or halide-specific detection. This method is used to determine the concentration of certain organochlorine pesticides and PCBs with second column confirmation. Operating parameters and interferences are described in Method 8080.

7.11 Organophosphorus Pesticide -- SW-846 Method 8140

Soil and groundwater samples will be analyzed by Method 8140 to determine concentrations of organophosphorus pesticides in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Prior to analysis, groundwater samples are extracted at a neutral pH using methylene chloride as a solvent according to EPA Method 3520, which describes a continuous liquid-liquid extraction technique, or EPA Method 3510, which describes a separatory funnel extraction technique. Prior to analysis, soil samples are extracted using methylene chloride as a solvent according to Method 3550, which describes a sonication extraction technique, or according to Method 3540, which describes a soxhlet extraction technique.

Method 8140 is a GC method using flame photometric detection or thermionic detection. This method is used to determine the concentration of certain organophosphorus pesticides. For this project, Method 8140 analyses will be performed with a capillary column. Second column confirmation analyses will be performed for all target analytes detected. Operating parameters and interferences are described in Method 8140.

7.12 Chlorinated Herbicides -- SW-846 Method 8150

Soil and groundwater samples will be analyzed to determine concentrations of chlorinated herbicides in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Samples will be prepared as directed in Method 8150.

Method 8150 provides extraction, esterification, and GC conditions for the analysis of chlorinated acid herbicides. Second column confirmation analyses will be performed for all target analytes detected.

7.13 Volatile Organics -- SW-846 Method 8240

Soil and groundwater samples will be analyzed to determine concentrations of volatile organics in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Sample preparation for analysis of groundwater samples by Method 8240 will follow Method 5030, purge and trap. Sample preparation for analysis of soil samples by Method 8240 will also follow Method 5030, purge and trap. The procedure for low-level concentrations will be followed, when possible.

The presence and concentration of purgeable halocarbon and organic compounds (volatile organics) in groundwater and soil samples will be determined by EPA Method 8240 using a capillary column. This method uses a purge-and-trap GC/MS technique. An inert gas is bubbled through water to transfer the purgeable organic compounds from the liquid to the vapor phase. The vapor is then swept through a sorbent trap where the purgeables are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a GC capillary column where they are separated and then detected with a mass spectrometer.

7.14 Semivolatile Organics -- SW-846 Method 8270

Soil and groundwater samples will be analyzed to determine concentrations of semivolatile organics in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Groundwater samples will be prepared using Method 3520, continuous liquid-liquid extraction, or Method 3510, separatory funnel extraction. Soil samples will be prepared using either Method 3540, soxhlet extraction, or Method 3550, sonication.

Method 8270 is a GC technique used for determining acidic, basic, and neutral organic compounds that are soluble in methylene chloride. Methylene chloride extraction

is the basis of Methods 3510, 3540, and 3550. For this project, a capillary column will be used. Operating parameters and interferences are described in Methods 8270, 3510, 3520, 3540, and 3550. Eight soil samples collected from SWMU 129 will also be analyzed for unsymmetrical dimethylhydrazine (UDMH) as a tentatively identified compound (TIC) using a library search technique.

7.15 Polychlorinated Dioxins and Furans -- SW-846 Method 8280

Soil and groundwater samples will be analyzed to determine concentrations of polychlorinated dioxins and furans in the soil and groundwater at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Samples will be extracted according to either Method 3510 or 3520 (groundwater) or Method 3540 or 3550 (soil). Cleanup procedures described in Method 8280 will be performed as necessary.

Method 8280 is used to determine polychlorinated dioxins and furans (PCDD/PCDF). Retention time windows are determined for each isomer group. This is accomplished by injection of a PCDD/PCDF retention time standard that contains the first and last eluter from each isomer group. Adequate sensitivity is also verified from the retention time standard that contains $^{13}C_{12}$-2,3,7,8-TCDD at a concentration of 1.0 μg/ml.

7.16 Total Cyanide -- SW-846 Method 9012

Soil and groundwater samples will be analyzed by EPA Method 9012 to determine concentrations of cyanide at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Cyanide in the samples will be released by refluxing the sample with strong acid and a distillation of hydrocyanic acid into an alkaline scrubbing solution.

Method 9012 is used to determine concentrations of inorganic cyanide present in either simple soluble salts or complex radicals. Cyanide in the alkaline scrubbing solution is determined by ultraviolet (UV), calorimetrically.

7.17 Total Sulfide -- SW-846 Method 9030

Soil and groundwater samples will be analyzed by EPA Method 9030 to determine concentrations of total sulfide at the Holloman AFB SWMUs listed in Table 3-6 of the Work Plan. Sulfide will be released from the samples by refluxing with strong acid and a distillation of the resulting hydrogen sulfide into a scrubbing solution containing zinc acetate.

Method 9030 determines concentrations of sulfide in the zinc sulfide precipitate. Excess iodine is added to each sample that has been treated with zinc acetate to produce zinc sulfide. The excess iodine is back-titrated with sodium thiosulfate or phenylarsine oxide.

7.18 Toxicity Characteristic Leaching Procedure (TCLP)

Investigation derived wastes (soil), wastes, and waste oil samples will be analyzed for purposes of characterization. These analyses will include preparation by SW-846 Method 1311 which is the toxicity characteristic leaching procedure (TCLP).

The TCLP is used to determine the concentration of organic (semivolatile and volatile) and inorganic (metals) constituents that are leachable from waste or other material. Samples will be prepared according to TCLP procedures to characterize the material before disposal. Samples are extracted with an acidic extraction fluid for an 18-hr period using a solid-to-liquid ratio of 1:20. After the extraction period, the solids are filtered from the

liquid and the liquid is analyzed by methods outlined in SW-846. Leachates prepared for volatile analysis are prepared in a zero headspace extractor (ZHE).

Quality control is accomplished by preparing a TCLP blank at a rate of one blank per batch or 10 percent, whichever is greater. Additional leachate is prepared so that MS/MSDs may be run at a rate of 5 percent of samples or one per waste type, whichever is greater. These QA measures are in accordance with requirements set forth in SW-846 Method 1311, Section 8.0 and 40 CFR Parts 261, 264, 265, 268, 271, and 302, Volume 55 Number 126, June 29, 1990.

8.0 CALIBRATION PROCEDURES

Documented calibration procedures are necessary to provide consistency in preparing equipment for specific analytical measurements. Established calibration procedures then provide a mechanism for ensuring that measurements made with a specific type of equipment are comparable. Information is presented in this section that pertains to the calibration of analytical systems. Calibration requirements for each analytical method used for this project are described in the following subsections and are summarized in Table 8-1.

8.1 Total Dissolved Solids (TDS) -- EPA Method 160.1

This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes. A well-mixed sample is filtered through a standard glass fiber filter and the filtrate evaporated at 180°C (TDS). The residue is cooled and weighed to a constant weight.

The analytical balance is calibrated daily with a National Bureau of Standards traceable weight. An independent standard and blank are run at a minimum 10 percent frequency as method quality control.

8.2 Total Recoverable Petroleum Hydrocarbons -- EPA Method 418.1

Total recoverable petroleum hydrocarbons (TRPH) are measured by the infrared spectrophotometric technique described in EPA Method 418.1.

A multipoint calibration curve is prepared using a blank and a minimum of five standards. An acceptable calibration curve will have a calculated correlation coefficient

Table 8-1

Summary of Internal Quality Control Procedures

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
EPA:160.1	Total Dissolved Solids (TDS)	Balance Calibration	Daily-Class S	±0.0004g for 1.0000g weight	Recalibrate balance
EPA:418.1	TRPH	Multipoint Calibration	Daily	r ≥0.995	Repeat calibration
SW-846:1010	Ignitability	Calibration Check	Daily	Measured value ±10% of true value	1) Take corrective action 2) Recalibrate
SW-846:6010	Metals (ICPES)	Mixed Calibration Standards (2 concentrations)	Daily, and 10%	Measured value within ±10% of true value for element of interest	Repeat calibration
SW-846:7060 SW-846:7421 SW-846:7471 SW-846:7740 SW-846:7841	Metals (AA) Arsenic Lead Mercury Selenium Thallium	Multipoint calibration (minimum of three concentrations)	Daily, prior to analyses	r≥0.995	1) Repeat test 2) Take corrective action 3) Repeat calibration and test
		Calibration Blank	10%, or minimum of one per batch	<MRL	1) Clean system 2) Reanalyze
SW-846:8080	Organochlorine Pesticides and PCBs	Multipoint Calibration (minimum five points)	Initially, as required	RSD <20%	Repeat calibration
		Calibration Check Sample	Daily, beginning and end of sequence	Measured values ±15% of true values	Repeat 5-point calibration
SW-846:8140	Organophosphorus Pesticides	Multipoint Calibration (minimum five points)	Initially, as required	RSD <20%	Repeat calibration
		Calibration Check Sample	Daily, prior to sample analyses	Measured values ±25% of true values	Repeat 5-point calibration
SW-846:8150	Chlorinated Herbicides	Multipoint Calibration (minimum five points)	Initially and as required by calibration check	RSD <20%	Repeat calibration
		Calibration Check Sample	Daily prior to sample analyses	Measured values ±15% of true values	Repeat 5-point calibration

Table 8-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW-846:8240	Volatile Organic Compounds	Check of Mass Spectral Ion Intensities Using BFB	Daily prior to sample analyses	Refer to Method 8240 Table 3	1) Retune instrument 2) Repeat BFB analysis
		Multipoint Calibration (5-point calibration at 10-200 ppb range)	Initial calibration and as required by calibration check	RF variability for specific compounds <25% RSD	Repeat calibration
		System Performance Check	Every 12 hours	RF $\geq$0.300 (0.250 for bromoform)	1) Evaluate system 2) Repeat calibration
		Calibration Check	Every 12 hours	% Difference <30%	1) Evaluate system 2) Repeat test 3) Recalibrate
		Internal Standards	Every sample	Refer to Method 8240 Table 5	1) Inspect mass spectrometer 2) Correct problem 3) Repeat calibration 4) Reanalyze samples
SW-846:8270	Semivolatile Organic Compounds	Check of Mass Spectral Ion Intensities Using DFTPP	Daily prior to sample analysis	Refer to Method 8270 Table 3	Retune instrument Repeat DFTPP analysis
		5-Point Calibration at 10-200 ppb Range	Initial and as required by daily check	RF variability for specific compounds <30% RSD	Repeat calibration
		System Performance Check	Every 12 hours	Minimum average response factor of 0.050	1) Evaluate system 2) Repeat calibration
		Continuing Calibration Check	Every 12 hours	Single-point RF for each CCC within 30% of average multi-point RF	1) Evaluate system 2) Take corrective action 3) Repeat test 4) See lab manager
		Internal Standards	Every sample	Method 8270 Table 5	1) Inspect mass spectrometer 2) Correct problems and repeat calibration 3) Reanalyze samples

Table 8-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW-846:8280	Dioxins and Furans	Initial Calibration Multipoint, 5 Levels in Triplicate	Yearly, with fresh standards	Relative standard deviation ≤15%	1) Repeat initial calibration 2) Evaluate system 3) Repeat calibration
		Single-Point Calibration Check	Daily, every 12 hours	Agreement within 30% of value predicted from multipoint calibration curve	1) Repeat single point check 2) Repeat multipoint
		TCDD Chromatography Check	Daily	≤25% valley between 1,2,3,4-TCDD and 2,3,7,8-TCDD	Replace column
		PCDD/PCDF Retention Time Window Check	Daily, unless retention times of internal standards vary >0.2 minutes	Less than 0.2 minutes variation on internal standards	Rerun retention time standard, adjust SIM windows
		Sensitivity Check	Daily	>150,000 area counts from 334 ion from 1 μl of 1.0 ppm C_{13}-2,3,7,8-TCDD	1) Evaluate instrument 2) Take corrective action
SW-846:9012	Cyanide	Calibration Curve (minimum of five levels)	Daily, prior to sample analyses	r≥0.995	Repeat calibration
SW-846:9030	Sulfide	Standardize Iodine Solution	Daily	RPD ≤5% for duplicates	Repeat standardization
		Standardize Titrant	Daily	RPD ≤5% for duplicates	Repeat standardization

TRPH = Total Recoverable Petroleum Hydrocarbons
RF = Response Factor
RPD = Relative Percent Difference
RSD = Relative Standard Deviation
MRL = Method Reporting Limit

of 0.995 or greater. Continuing calibration check standards must be measured within ± 10% of expected value.

8.3 Ignitability -- SW-846 Method 1010

Prior to sample analysis, either an o-xylene or m-xylene standard is tested to verify instrument calibration. The flash point, closed cup, for o-xylene is 63°F (17°C) and the flash point for m-xylene is 77°F (25°C).

8.4 Metals by ICPES -- SW-846 Method 6010

SW-846 Method 6010 is used to measure elements with inductively coupled plasma atomic emission spectroscopy (ICPES).

Detailed calibration procedures for ICPES systems are described in SW-846, 3rd edition. A response factor is calculated daily for each metal based on three determinations of a calibration standard and calibration blank. Following calibration, a high-level calibration check sample is analyzed; agreement between the measured value and the expected value must be within 5 percent for the analyses to proceed. Calibration is verified by analyzing a QC check standard, prepared independently of calibration standards, every 10 samples; agreement within 10 percent of the expected value is required for all target analytes; otherwise, the system must be recalibrated. When a calibration check is not in agreement with the expected value (± 10%), the samples that have been analyzed since the last calibration check was made will be reanalyzed.

8.5 Metals by GFAA -- SW-846 Methods 7060, 7421, 7740, and 7841

SW-846 Methods 7060, 7421, 7740, and 7841 are graphite furnace atomic absorption (GFAA) techniques for determination of arsenic, lead, selenium, and thallium, respectively.

The calibration procedures for the graphite furnace systems are described in the respective SW-846, 3rd edition methods. A multipoint calibration curve is generated daily for each element using a calibration blank and three upscale standards. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable. Calibration will be verified every 10 samples by analyzing a QC check sample and calibration blank. Agreement within ±10 percent of the expected value is required; otherwise, a new calibration curve must be generated.

8.6 Mercury by CVAA -- SW-846 Methods 7470 and 7471

SW-846 Methods 7470 and 7471 are cold vapor atomic absorption (CVAA) techniques for determination of mercury in aqueous and soil samples, respectively.

The calibration procedures for the CVAA system is described in the respective SW-846, 3rd edition methods. A multipoint calibration curve is generated daily using a calibration blank and three upscale standards. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable. Calibration will be verified every 10 samples by analyzing a QC check sample and calibration blank. Agreement within plus or minus 15 percent of the expected value is required; otherwise, a new calibration curve must be generated.

8.7 Organochlorine Pesticides and PCBs -- SW-846 Method 8080

Samples for organochloride pesticides and PCBs are analyzed by gas chromatography following SW-846 Method 8080. Method 8080 is used to determine the concentration of various organochlorine pesticides and polychlorinated biphenyls (PCBs).

The external standard quantitation discussed in the method is used to quantitate all pesticides/PCBs. The retention time window is calculated for each pesticide/PCB after adjusting the GC operating conditions for the routine retention times of 4,4'-DDT. The gas chromatograph/electron capture detector is initially calibrated at a minimum of five concentrations. The average calibration factor is acceptable if the relative standard deviation (RSD) for the calibration factors at each level does not exceed 20 percent. Concentration of the components in a standard varies depending on the response of the compounds in the analytical system. Breakdown of 4,4'-DDT and endrin is also monitored; breakdown may not exceed 20 percent. A single-point calibration check must agree within ±15 percent of the multipoint response; otherwise, the instrument is recalibrated. The single-point calibration check analyses are performed at the beginning and end of each analytical sequence, as required by Method 8080.

8.8 Organophosphorus Pesticides -- SW-846 Method 8140

Method 8140 is a gas chromatographic (GC) method used to determine the concentration of various organophosphorus pesticides.

The external standard quantitation method is used to quantitate all pesticides. The retention time window is calculated for each pesticide after adjusting the GC operating conditions for the routine retention times of each parameter of interest. The instrument is calibrated at a minimum of five concentrations. The average calibration factor is acceptable if the RSD for the calibration factors at each level does not exceed 20 percent.

Concentrations of the components in a standard varies, depending on the response of the compounds in the analytical system. A daily single-point calibration check must agree within ±15 percent of the initial multipoint response; otherwise, the instrument is recalibrated. The single-point calibration check analyses are performed at the beginning and end of each analytical sequence, as required by Method 8080.

8.9 Chlorinated Herbicides -- SW-846 Method 8150

Method 8150 is a GC method for determining certain chlorinated acid herbicides.

The external standard quantitation method is used to quantitate all herbicides. The retention time window is calculated for each herbicide after adjusting the GC operating conditions for the routine retention times of each parameter of interest. The GC/ECD is initially calibrated at a minimum of five concentrations. The average calibration factor is acceptable if the RSD for the calibration factors at each level does not exceed 20 percent. Concentration of the components in a standard will vary, depending on the response of the compounds in the analytical system. A daily single-point calibration check must agree within ±15 percent of the multipoint response, otherwise, or the instrument is recalibrated.

8.10 Volatile Organics -- SW-846 Method 8240

Samples for volatile organics will be analyzed by scanning GC/MS following SW-846 Method 8240, 3rd ed. Analyte identification and quantitation will be performed using response factors and retention times generated from a five-point calibration curve, relative to the closest eluting of three internal standards. The three internal standards are:

- Bromochloromethane;
- 1,4-Difluorobenzene; and

- Chlorobenzene-d_5.

Tentatively identified compounds are identified only when a good match (Purity & Fit >.75) is obtained between the unknown spectra and the library spectra. The tentatively identified compound is then quantitated using a response factor of 1.0, with respect to the closest eluting internal standard.

The mass spectrometer will be tuned daily to give an acceptable spectrum for bromofluorobenzene (BFB). Relative ion abundance criteria for BFB are given in SW-846.

System performance will be verified initially and after every 12 hours to ensure a minimum average response factor of 0.3 (0.25 for bromoform) for the following system performance check compounds (SPCCs):

- Chloromethane;
- 1,1-Dichloroethane;
- Bromoform;
- 1,1,2,2-Tetrachloroethane; and
- Chlorobenzene.

A 5-point calibration, used for generating response factors, will be performed daily. The RSD must be less than 25 percent for the five response factors calculated for each of the following calibration check compounds (CCCs):

- 1,1-Dichloroethene;
- Chloroform;
- 1,2-Dichloropropane;

- Toluene;
- Ethylbenzene; and
- Vinyl chloride.

A continuing (every 12 hours) calibration check will be performed, following the system performance check, using the CCCs listed above. A single concentration of each CCC will be analyzed and a response factor calculated.

8.11 Semivolatile Organics -- SW-846 Method 8270

Semivolatile extracts are analyzed by GC/MS following SW-846 Method 8270, 3rd edition. All samples are prepared following extraction procedures outlined in SW-846, 3rd edition. Identification and quantitation is performed using response factors and retention times generated from a five-point calibration curve, relative to the closest eluting of seven internal standards. The seven internal standards are:

- Dichlorobenzene-d_4;
- Naphthalene-d_8;
- Acenaphthene-d_{10};
- Phenanthrene-d_{10};
- Chrysene-d_{12};
- Perylene-d_{12}; and
- 1,4-Dichlorobenzene.

The mass spectrometer is tuned daily to give an acceptable spectrum for DFTPP; DFTPP ion abundance criteria are specified in SW-846 Method 8270.

System performance is verified initially and every 12 hours to ensure a minimum average response factor of 0.050 for the following system performance check compounds (SPCC):

- N-Nitroso-di-n-propylamine;
- Hexachlorocyclopentadiene;
- 2,4-Dichlorophenol; and
- 4-Nitrophenol.

A five-point calibration, used for generating response factors, is performed initially using 20-, 50-, 80-, 120- and 160-μg/mL standards. The variability for specific ion response factors for Method 8270 calibration check compounds (CCC) must be less than 25 percent RSD over the range calibrated. The CCCs are:

- Phenol;
- 1,4-Dichlorobenzene;
- 2-Nitrophenol;
- 2,4-Dichlorophenol;
- Hexachlorobutadiene;
- 4-Chloro-3-methylphenol;
- Acenaphthene;
- 2,4,6-Trichlorophenol;
- N-Nitroso-di-n-phenylamine;
- Pentachlorophenol;
- Fluoranthene;

- Di-n-octylphthalate; and
- Benzo(a)pyrene.

A continuing calibration check is performed every 12 hours using the CCCs listed above. A single concentration of each CCC is analyzed and a response factor (RF) calculated. The single-point RF for each CCC must be within 30 percent of the average five-point RF; otherwise, a new five-point calibration must be generated.

8.12 Dioxins and Furans (PCDDs/PCDFs) -- SW-846 Method 8280

Instrumentation Calibration and tuning

PCDDs/PCDFs are analyzed according to the procedures outlined in Method 8280, SW-846, 3rd ed. Since Radian has representative cogeners of each isomer group of PCDD/PCDS, more internal standards are used than in the basic method. Mass calibration of the instrument are preformed daily with PFTBA and verified using DFTPP ion abundance criteria (as specified in SW-846 Method 8270) for mass 198 and greater. Adherence to Method 8280 criteria for isotopic ratio measurements for PCDDs and PCDFs is then verified.

PCDD/PCDF Retention Time Group Determination

Since selected-ion-monitoring mass spectrometry was used for PCDD/PCDF analysis, it is first necessary to determine the retention time windows for each isomer group. This is accomplished by injection of a PCDD/PCDF retention time standard that contains the first and last eluter from each isomer group. The isomer group retention time analysis is performed once at the beginning of each project and again if retention times shift more than 0.2 minutes. Adequate sensitivity is also verified from the retention time standard that contains 2,3,7,8-TCDD at a concentration of 0.2 μg/mL.

Chromatography Performance Check

A TCDD chromatographic test mixture is analyzed daily to verify that there is at least 25 percent valley resolution between 2,3,7,8-TCDD and 1,2,3,4-TCDD.

PCDD/PCDF Calibration

Response factors (RF) for each PCDD/PCDF isomer class are determined from an initial five point calibration at 0.1-, 0.2-, 0.5-, 1.0-, and 2.5-μg/mL concentrations. This five-point calibration is performed in triplicate and the average response factors are calculated. The response factors determined for each isomer class must not have a percent RSD greater than 15 percent. Radian uses a calibration standard containing the following analytes:

- 2,3,7,8-TCDF;
- 1,2,3,7,8-PeCDF;
- 2,3,4,7,8,-PeCDF;
- 1,2,3,8,9-PeCDF;
- 1,2,3,4,7,8-HxCDF;
- 1,2,3,4,8,9-HxCDF;
- 1,2,3,4,6,7,8-HpCDF;
- OCDF;
- 2,3,7,8-TCDD;
- 1,2,3,7,8-PeCDD;
- 1,2,3,4,7-PeCDD;
- 1,2,3,4,7,8-HxCDD;
- 1,2,3,4,6,7,8-HpCDD; and
- OCDD.

Where more than one isomer per isomer group is present, the average RF iss used.

For quantitation, the following mixture of internal standards is contained in the calibration standard solutions. This mixture is also added to each sample before extraction:

- $^{13}C_{12}$-2,3,7,8-TCDD;
- $^{13}C_{12}$-2,3,7,8-TCDF;
- $^{13}C_{12}$-1,2,3,7,8-PeCDD;
- $^{13}C_{12}$-1,2,3,7,8-PeCDF;
- $^{13}C_{12}$-1,2,3,6,7,8-HxCDD;
- $^{13}C_{12}$-1,2,3,4,7,8-HxCDF;
- $^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD;
- $^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF;
- $^{13}C_{12}$-OCDD; and
- $^{13}C_{12}$-OCDF.

Each isomer class is quantitated using a C-13 internal standard from that class.

Daily Response Factor Check

The 1.0μg/mL PCDD/PCDF standard is analyzed at the beginning of each working day to verify that the RFs obtained for that day agree to within ±30 percent of those obtained from the initial five-point calibration in triplicate. Also, isotope ratios for each PCDD/PCDF isomer class are verified to be within ±15 percent of their theoretical values.

8.13 Total Cyanide -- SW-846 Method 9012

Method 9012 is used to determine the concentration of inorganic cyanide in an aqueous waste or leachate. The method detects inorganic cyanides that are present as either sample soluble salts or complex radicals. It is used to determine the values for both total cyanide and cyanide amenable to chlorination. The cyanide, as hydrocyanic acid (HCN), is released by refluxing the sample with a strong acid and catalyst and distillation of the HCN into an absorber-scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution is then determined by automated colorimetry.

A daily calibration curve is prepared using a blank and a minimum of five standards, with a correlation coefficient greater than 0.995. A high and a low standard are distilled and compared with similar values on the curve to ensure that the distillation technique is reliable. The distilled standards must agree within ±15 percent of the undistilled standards.

8.14 Total Sulfide -- SW-846 Method 9030

Method 9030 is used to measure the concentration of total and dissolved sulfides in drinking, surface, and saline waters. Excess iodine is added to a sample that has been treated with zinc acetate to produce zinc sulfide. The iodine oxidizes the sulfide to sulfur under acidic conditions. The excess iodine is back titrated with sodium thiosulfate or phenylarsine oxide to a starch end point.

The thiosulfate solution is standardized daily against primary standard potassium dichromate. The iodine solution is standardized daily against the standardized thiosulfate solution. The iodine solution is considered acceptable if the relative percent difference is less than 5 percent.

9.0 INTERNAL QUALITY CONTROL

Internal quality control (QC) procedures to be used for laboratory testing and analysis are presented in Table 9-1. Preparation and analysis of QC samples will be according to the descriptions presented in Section 7 of this QAPP.

Most analytical methods to be used in this project require the measurement system to initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Results of control samples, which are analyzed at a 10% frequency to monitor any changes in the quality of data being produced, indicate which corrective actions are necessary to correct an out-of-control condition. An out-of-control condition is defined as:

- Detection of any compounds of interest in a method blank at concentrations equal to or greater than the reporting limit (or required detection limit);
- Failure to meet the acceptance criteria for recovery of any compound of interest in a QC sample; or,
- Exceeding the acceptance criteria for matrix spike recovery and subsequent failure to meet the acceptance criteria for a QC check sample for the same parameter(s). Any parameter that fails the matrix spike test but passes the QC check sample test will be flagged as suspect for the parameter due to matrix effects.

When an out-of-control situation is detected, efforts will be undertaken to determine the cause. Corrective actions for routine QC checks are outlined in Table 9-1. Procedures related to corrective actions are described below.

Table 9-1

Summary of Internal Quality Control Procedures

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
EPA:160.1	Total Dissolved Solids (TDS)	Laboratory Duplicate analysis	5%	RPD <15%	1) Obtain third value 2) Flag data
		Field Duplicate sample	10%	None	Used to determine sampling/analytical variability
		Equipment blank	10%	None	Used to determine sources of contamination
		Ambient blank	10%	None	Will be used to assess sources of contamination
EPA:418.1	TRPH	Laboratory Control sample or QCCS	5%, or 1 per 20 samples	Recovery between 90-110%	Repeat calibration
		Method Blank	1 per batch	<MRL	Used to assess analytical contamination
		Matrix Spike	5%	50-150% Recovery	1) Run check sample (QCCS) 2) Correct Problem 3) Flag data
		Matrix Spike Duplicate	5%	RPD $\leq$50% and Recovery 50-150%	1) Run check sample (QCCS) 2) Correct Problem 3) Flag data
		QA Duplicate Sample (USACE[b])	10%	None	Will be used to determine sampling/analytical variability
		Field Equipment Blank	10%	None	Will be used to determine sources of contamination
		Duplicate sample	10%	None	Used to assess sampling/analytical variability
		Ambient blank	10%	None	Will be used to assess sources of contamination

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency*	Acceptance Criteria	Corrective Action
SW-846:6010	Metals (ICPES)	Laboratory QC check sample analysis (QCCS)	1 per digestion batch ≤20 samples	Measured value within ±20% of true value for element of interest	Repeat calibration
		Method blank	1 per digestion batch ≤20 samples	All analytes <MRL	1) Reanalyze 2) Recalibrate 3) Reanalyze 4) Redigest samples if reanalysis fails
		Calibration blank	10%	All analytes <MRL	1) Rerun 2) Clean system 3) Reanalyze sample 4) Redigest samples if reanalysis fails
		Calibration check	10%	Measured value within ±10% of true value for element of interest	Repeat calibration
		Matrix spike analysis	5%	75-125% Recovery	1) Analyze method spike (or QCCS) 2) If method spike is ok; flag data 3) If method spike not ok; see lab supervisor and reanalyze samples
		Matrix spike duplicate	5%	Relative percent difference ≤20% and 75-125% recovery	1) Analyze method spike (or QCCS) 2) If method spike is ok; flag data 3) If method spike not ok; see lab supervisor and reanalyze samples
		ICPES interference check	Run at beginning and end of daily run	80-120% of true value for EPA check sample elements	1) Repeat calibration 2) See lab manager
		ICP linear range check	Quarterly	Measured value within ±5% of expected value	Tests upper limit of ICP linear range

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:6010 (Continued)	Metals (ICPES) (Continued)	QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability
		Field Duplicate field sample	10%	None	Determine sampling/analytical variability
		Equipment blanks	10%	None	Used to determine sources of contamination
		Ambient blank	10%	None	Will be used to assess sources of contamination
SW-846:8270	Semivolatile Organic Compounds	Laboratory Check of mass spectral ion intensities using DFTPP	Daily prior to sample analysis	Refer to method	Retune instrument Repeat DFTPP analysis
		Quality Control Check Sample (QCCS)	5%	Method 8270 Table 6	1) Evaluate system, correct as needed 2) Recalculate data or reanalyze extract 3) If QCCS still fails, reextract and reanalyze QCCS and all samples in the batch
		System performance check	Every 12 hours	Minimum average response factor of 0.050	1) Evaluate system 2) Repeat calibration
		Surrogate spikes	Every sample	Method 8270 Table 8	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails, reextract and reanalyze samples 4) Flag data and report analysis and reanalysis results
		Internal standards	Every sample	Method 8270 Table 5	1) Inspect mass spectrometer 2) Correct problems and repeat calibration 3) Reanalyze samples

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8270 (Continued)	Semivolatile Organic Compounds (Continued)	Method blank	Daily prior to sample analysis	<MRL except for phthalate esters which may be 5 x MRL	1) Run solvent blank 2) Evaluate system
		Matrix spike	5%	Method 8270 Table 6	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) Flag data if QCCS passes
		Matrix spike duplicate	5%	≤50% RPD and recovery within limits of method (Table 6 of Method 8270)	1) Run check samples (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) Flag data if QCCS passes
		QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability
		Field Equipment blank	10%	None	Will be used to determine sources of contamination
		Duplicate field sample	10%	None	Will be used to determine analytical variability
		Ambient blank	10%	None	Will be used to assess sources of contamination
SW-846:8150	Herbicides	Laboratory Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails, reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Quality control check sample (QCCS)	5%	±15% of true value	1) Recalibrate 2) Reanalyze affected samples
		Method blank	5%	All analytes <MRL	Used to assess contamination

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8150 (Continued)	Herbicides (Continued)	Matrix spike	5%	Refer to method	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability
		Field Duplicate field samples	10%	None	Will be used to determine sampling and analytical variability
		Equipment blanks	10%	None	Used to assess sources of contamination
		Ambient blank	10%	None	Will be used to assess sources of contamination
SW-846:8240	Volatile Organic Compounds	Laboratory Check of mass spectral ion intensities using BFB	Daily prior to sample analysis	Method 8240 Table 3	1) Retune instrument 2) Repeat BFB analysis
		System performance check	Every 12 hours	RF $\geq$0.300 (0.250 for bromoform)	1) Evaluate system 2) Repeat calibration
		Surrogate spikes	Every sample	Method 8240 Table 8	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Reanalyze sample 4) Flag data and report analysis and reanalysis results

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8240 (Continued)	Volatile Organic Compounds (Continued)	Internal standards	Every sample	Method 8240 Table 5	1) Inspect mass spectrometer 2) Correct problem 3) Repeat calibration 4) Reanalyze samples
		Method blank	Daily prior to analyses	<MRL	1) Run solvent blank 2) Reanalyze blank and samples
		Matrix spike	5%	Method 8240 Table 6	1) Run check samples (QCCS) 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	≤50% RPD and recovery within limits of Method 8240 Table 6	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability
		Field Duplicate field samples	10%	None	Used to determine sampling/analytical variability
		Equipment blank	10%	None	Will be used to determine sources of contamination
		Trip blank	One per sample ice chest	None	Will be used to determine sources of contamination

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8080	Organochlorine Pesticides and PCBs	Laboratory DDT and endrin degradation check sample	Daily prior to analyses	Degradation ≤20% (see method)	1) Follow maintenance in Method 8000, see Section 7.7 2) Recalibrate
		Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Method blank	5%	<MRL	Used to assess contamination
		QC check sample (QCCS)	5%	Method 8080 Table 3	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Method 8080 Table 3	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits, Method 8080 Table 3	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability
		Field Duplicate field samples	10%	None	Will be used to determine analytical variability

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8080 (Continued)	Organochlorine Pesticides and PCBs (Continued)	Equipment blanks	10%	None	Used assess sources of contamination
		Ambient blank	10%	None	Will be used to assess sources of contamination
SW-846:8140	Organophosphorus Pesticides	Laboratory Surrogate spikes	Every sample	Based on method	1) Evaluate system 2) Recalculate data and/or reanalyze extract 3) Analyze QCCS, if QCCS fails, reextract and reanalyze sample 4) Flag data and report analysis and reanalysis results
		Method blank	5%	<MRL	Used to assess contamination
		QC check sample (QCCS)	5%	Refer to method	1) Evaluate system 2) Repeat test for criteria that failed
		Matrix spike	5%	Refer to method	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		Matrix spike duplicate	5%	RPD <50% and recovery within method specified limits	1) Analyze QCCS 2) Correct problem 3) If QCCS is ok; flag data 4) If QCCS is not ok; reanalyze samples
		QA duplicate sample (USACE[b])	10%	None	Used to quantitate analytical variability
		Field Duplicate field samples	10%	None	Will be used to determine analytical variability

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8140 (Continued)	Organophosphorus Pesticides (Continued)	Equipment blanks	10%	None	Used to assess sources of contamination
		Ambient blank	10%	None	Used to assess sources of contamination
SW-846:7060 SW-846:7421 SW-846:7471 SW-846:7740 SW-846:7841	Metals (AA) Arsenic Lead Mercury Selenium Thallium	Laboratory QC check sample (QCCS)	10%	Measured value within ±20% of expected value	Repeat calibration
		Calibration blank	10%	<MRL	1) Clean system 2) Reanalyze
		Preparation blank	10%	<MRL	1) Reanalyze 2) Clean system 3) Redigest and reanalyze
		Matrix spike	5%	75-125% Recovery	1) Run check sample (QCCS) 2) Correct problem 3) if QCCS fails, reanalyze samples 4) If not, flag data
		Matrix Spike Duplicate	5%	Within 20% RPD and 75-125% Recovery	1) Run check sample (QCCS) 2) Correct problem 3) If QCCS fails, reanalyze samples 4) If not, flag data
		QA duplicate sample (USACE[b])	10%	None	Will be used to determine sampling/analytical variability
		Field Duplicate sample	10%	None	Determine sampling/analytical variability
		Equipment Blank	10%	None	Will be used to determine sources of contamination

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:8280	Dioxins and Furans	Laboratory TCDD chromatography check	Daily	25% valley between 1,2,3,4-TCDD and 2,3,7,8-TCDD	Replace column
		PCDD/PCDF retention time window check	Daily, unless retention times of internal standards vary >0.2 minutes	Less than ±0.2 minutes variation on internal standards	Rerun retention time standard, adjust SIM windows
		Sensitivity check	Daily	>150,000 area counts from 334 ion from 1 μl of 1.0 ppm C_{13}-2,3,7,8-TCDD	1) Evaluate instrument 2) Take corrective action
		Method blank	5%	<MRL	Used to assess contamination
		Duplicate analyses	5%	Not specified	Used to assess method imprecision
		Surrogate spike	Every sample	Method specified limits of 40-120%	Flag data
		QC Check Sample (QCCS)	10%	40-120% Recovery	1) Evaluate system 2) Recalculate data 3) Reanalyze standard 4) Correct problem 5) Reanalyze affected samples
		QA duplicate sample (USACE[b])	10%	None	Will be used to determine sampling/analytical variability
		Field Duplicate samples	10%	None	Used to assess sampling/analytical variability
		Equipment blank	10%	None	Will be used to determine sources of contamination
		Ambient blank	10%	None	Will be used to determine sources of contamination

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:9012	Cyanide	Laboratory QC Check Standard (QCCS)	10%	±15% error	1) Reanalyze 2) Repeat calibration 3) Reanalyze affected samples
		Method blank	1 per batch ≤20 samples	<MRL	1) Clean instrument/equipment 2) Rerun test
		Duplicate analysis	5%	RPD ≤20%	Obtain third value
		Matrix spike	5%	75-125%	1) Check calculation 2) Analyze QCCS 3) If QCCS ok; flag data 4) If QCCS not ok; reanalyze samples
		QA duplicate sample (USACE[b])	10%	None	Will be used to determine sampling/analytical variability
		Field Duplicate sample	10%	None	Used to assess sampling/analytical variability
		Equipment Blank	10%	None	Will be used to determine sources of contamination
		Ambient blank	10%	None	Will be used to determine sources of contamination
SW-846:9030	Sulfide	Laboratory Matrix spike	5%	75-125% Recovery	1) Check calculations 2) Reanalyze 3) Flag data
		Matrix spike duplicate	5%	RPD ≤20% and 80-120% Recovery	1) Check calculations 2) Reanalyze 3) Flag data
		Method blank	One per batch ≤20 samples	<MRL	1) Reanalyze blank 2) Reanalyze samples
		Duplicate analyses	5%	RPD ≤15%	1) Obtain third value

Table 9-1

(Continued)

Analytical Method	Parameter	Quality Control Check	Frequency[a]	Acceptance Criteria	Corrective Action
SW-846:9030 (Continued)	Sulfide (Continued)	QA duplicate sample (USACE[b])	10%	None	Will be used to determine sampling/analytical variability
		Field Duplicate sample	10%	None	Used to assess sampling/analytical variability
		Equipment blank	10%	None	Will be used to determine sources of contamination
		Ambient blank	10%	None	Will be used to determine sources of contamination

[a] Frequencies for duplicate samples and field blanks are computed based on the total number of samples taken for and the number of analyses specified in the SOW.

[b] USACE required QA duplicate samples to be analyzed by USACE MRD Laboratory.

QCCS = Quality Control Check Sample
TRPH = Total Recoverable Petroleum Hydrocarbons
RF = Response Factor
RPD = Relative Percent Difference
MRL = Method Reporting Limit

During the course of the Holloman AFB Phase I RFI, it will be the responsibility of the laboratory staff, Project Director, Task Leaders, and other project team members to see that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem(s). Laboratory analysts and/or supervisors will initiate corrective action in the event of QC results which exceed acceptance criteria specified in Table 9-1. Corrective action may also be initiated upon identification of some other problems or potential problems. Corrective action may also be initiated by the Laboratory Quality Officer if QC data or other anomalies are noted during data review.

For this project, the following corrective actions will be implemented when surrogate spike compounds are recovered outside the method criteria:

- Check to be sure there are no errors in calculations, surrogate solutions, and internal standards. Also, check instrument performance;
- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem;
- Analyze an extracted quality control check sample (QCCS);
- If the QCCS compounds are recovered within criteria, flag data as matrix effect; and
- If the QCCS compounds are recovered outside criteria, reextract and reanalyze the sample; report both sets of results.

Both analyses will be reported. A brief description of the analysis and the corrective action taken will be included in the laboratory report. These corrective actions are summarized in Table 9-1.

9.1 Method Blank

A method blank is an aliquot of reagent water, or clean solid matrix, taken through the analytical process as though it were an actual sample. The purpose of a method blank analysis is to monitor and control laboratory sources of contamination. At a minimum, one laboratory method blank will be analyzed daily for each method of analysis.

9.2 Trip Blank

A trip blank is a sample of organic-free water that is prepared in the laboratory, transported to the field, and stored with the collected samples. The trip blank is not opened in the field, but is subjected to the same handling as the other samples. Trip blanks serve to identify contamination from sample containers or transportation and storage procedures. Trip blanks accompany samples for volatile organic analyses only. A trip blank will be included with each cooler shipped to the laboratory that contains VOC samples.

9.3 Equipment Blanks

An equipment blank is an aliquot of ASTM Type II water or purified sand poured over or through the sampling equipment. The equipment blank demonstrates that the sampling equipment has been adequately cleaned. Equipment blanks will be collected at a 10 percent frequency and analyzed for all matrices and parameters that the investigative samples are analyzed for.

9.4 Ambient Blanks

An ambient condition blank is an aliquot of ASTM Type II or reagent-grade water that is poured into a sample container at the sampling site. Ambient blanks will be collected when samples are collected downwind of possible contaminantion sources.

Ambient blanks provide data to identify contamination due to ambient conditions at the site. Ambient blanks will be collected at a frequency of approximately 10 percent and will be analyzed for the same parameters as the investigative samples collected.

9.5 Matrix Spike

A matrix spike (MS) is a split from a field sample spiked with known concentrations of reference materials and taken through the entire preparation and analytical measurement procedures. The MS allows the laboratory to assess the efficiency of extraction/digestion, accuracy of the analysis, and possible matrix effects. MS analyses will be performed on a five percent frequency for each matrix as required by SW-846.

9.6 Matrix Spike Duplicate

A matrix spike duplicate (MSD) is a second aliquot of the same sample as the matrix spike that is also spiked. Method precision for the matrix can be estimated by calculating the relative percent differences between the recoveries of the spiking compounds. MSD analyses will be performed on a five percent frequency for each matrix.

9.7 Duplicate Sample

Duplicate solid samples will be collected by splitting a single into two equal parts for the purpose of analysis. Duplicate water samples will be included in the project by collecting two samples from the same location at the same time. Unique sample numbers will be assigned to field duplicates so that they will be indistinguishable from other analytical samples. The purpose of collecting and analyzing duplicate samples is to provide a measure of method variability (i.e., total variability from imprecision in both sampling and analytical procedures). Duplicate samples will be collected at a frequency of 10 percent (1 per 10 or fewer samples) and analyzed for all matrices and parameters. Both QA duplicates

(analyzed by USACE MRD laboratory) and QC duplicates (analyzed by contractor laboratory) will be included.

9.8 Quality Control Check Sample

A quality control check sample (QCCS) is a sample having a known concentration of reference materials spiked into an aliquot of deionized water. It is taken through the sample preparation process as well as the analytical measurement process. The purpose of a QCCS analysis is to determine whether failure to meet QC acceptance criteria for an MS is due to matrix interference in the sample, or to out-of-control conditions associated with the analytical system.

9.9 Surrogate Compound

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to extraction and analysis by Methods 8240, 8270, 8280, 8080, 8140, 8150, and 8015. Percent recoveries are calculated and reported for each surrogate. Surrogate spike recoveries can be used to assess method accuracy of individual samples.

9.10 Internal Standard

Internal standards are similar in analytical behavior to the compounds of interest and are not affected by method or matrix interferences. Internal standard calibration procedures are followed for volatile and semivolatile organic analyses. One or more internal standard is added to all samples analyzed, including calibrations standards.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

All analytical data generated will be extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, review, and reporting by the analytical laboratory. Data will also be reviewed by the Phase I RFI Contractor QA Coordinator.

10.1 Data Reduction, Validation, and Reporting by the Laboratory

The data analysis required to calculate sample concentrations will proceed according to procedures outlined in the analytical methods identified in Table 7-1. Data reduction involves taking instrument responses or other raw data and calculating concentrations for each target analyte. Data validation involves examining the systems producing the data to be sure they are operating properly and quality objectives have been met. Data will be reviewed and validated by the analyst and/or laboratory manager. Data will be validated for conformance with method specifications including:

- Calibration;
- Duplicate analysis;
- Blank analysis;
- Spike analysis;
- Sample data calculations; and
- Quality control sample frequency.

The QC activities implemented in this project will provide a basis for assessing the accuracy and precision of all data. Frequencies and acceptance criteria for these tests are presented in Table 9-1. Calculations are presented in Section 4 of this QAPP.

10.2 Data Review and Validation by the RFI Contractor

In addition, data will be reviewed by an independent party not associated with the laboratory (i.e., Phase I RFI Contractor QA Coordinator) to ensure that analytical results received from the laboratory are valid and meet the quality assurance objectives. Data quality calculations used during this review to estimate precision and accuracy are presented in Section 4 of this QAPP.

10.3 Electronic Data Reporting for IRPIMS

All analytical results generated during this Phase I RFI will be maintained in an electronic database consistent with the IRPIMS data management systems and requirements. Detailed discussions of IRPIMS reporting and management systems requirements are presented in Section 6 of the Work Plan.

11.0 QUALITY ASSURANCE AUDITS

The purpose of quality assurance audits discussed in this QAPP is to provide an objective, independent assessment of a measurement effort. QA auditing ensures that sample collection, data generating, data gathering, and measurement activities produce reliable and useful results. Cases can occur in which inadequacies are identified in the measurement system. In such cases, audits provide the mechanism for beginning the process of corrective action implementation.

Quality assurance audits play an important role in an overall QA/QC program. This section describes the role of the QA auditor and the nature of QA audits.

A QA auditor is the person who designs and/or performs QA performance and systems audits. Since QA audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. However, the auditor must be familiar enough with the objectives, principles, and procedures of the measurement efforts to be able to perform a thorough and effective evaluation of the measurement system. Especially important is the ability to identify components of the system that are critical to overall data quality. For this reason, the audit focuses heavily on those elements. The auditor's technical background and experience should also provide a basis for appropriate audit standard selection, audit design, and data interpretation.

Quality assurance audits may include both internal and external audits of field and laboratory activities. External audits are those conducted by an independent organization or technical support group and may include participation in interlaboratory comparison studies and certification testing. Internal laboratory audits are conducted by the Laboratory's QA Coordinator. External laboratory and field audits may be conducted by the Phase I RFI Contractor QA Coordinator if indicated during the program.

The following paragraphs describe the purpose of several types of audits and identify the questions that are, and are not, addressed by each type of audit.

11.1 Technical Systems Audits

A technical systems audit is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. It is an assessment of overall effectiveness. It represents an objective and insightful evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. Typically, the audit consists of observations and documentation of all aspects of the measurement effort.

Technical systems audits should be based on the approved Quality Assurance Project Plan (QAPP). These audits review questions regarding:

- Calibration procedures and documentation;
- Completeness of data forms, notebooks, and other reporting requirements;
- Data review and validation procedures;
- Data storage, filing, and record-keeping procedures;
- Sample custody procedures;
- Quality control procedures and documentation;
- Operating conditions of facilities and equipment;
- Documentation of maintenance activities; and
- Systems and operations overview.

Detailed systems audit checklists may be prepared prior to each audit. The checklist delineates the critical aspects of each methodology and measurement system, and

are used by auditors to document all observations. The checklists are based on audit criteria specified by the QA Coordinator and the applicable QAPP.

Technical Systems Audits do not answer quantitative questions about the measurement system. The organization's policies regarding the role of QA are not answered. Concerns involving assessments of the data quality indicators are also not addressed.

11.2 Performance Evaluation Audits

The purpose of performance evaluation audits is to quantitatively assess the measurement data quality. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data. This is accomplished by challenging the measurement system with accepted reference standards. These reference standards may be submitted to the laboratory as if they were additional field samples; consequently, providing an evaluation without the laboratory being aware of the audit.

Performance evaluation audits answer questions regarding the following:

- Accuracy and precision of the measurement system;
- The quality control data as compared with the actual data collected;
- The measurement system as a function of established control limits; and
- Significant deviations of the quality over time.

Although the answers to these questions will help determine when a system is out of control, questions as to the appropriate corrective action may not always be evident. Questions regarding qualitative issues, such as management policies, sample

custody procedures, record-keeping, and data handling systems are not addressed in a performance evaluation audit.

11.3 Audits of Data Quality

The purpose of data quality audits is to assess data quality indicators. Audits for data quality provide information required to characterize data quality by answering questions regarding:

- Adequacy of data recording and transfer;
- Precision and bias of resultant data;
- Adequacy of data calculation, generation, and processing;
- Documentation of procedures; and
- Identification of data quality indicators to inform users of limitations and applicability.

Audits of data quality answer questions of whether the data collection efforts need modifications, and whether the use and documentation of quality control procedures are adequate. Audits of data quality do not, however, answer technical questions such as those concerning the operating conditions of facilities and equipment.

11.4 Post-Audit Debriefing

Following each audit, a post-audit debriefing session is conducted. The purpose of this session is to discuss preliminary audit results with the audit participants. If the audit reveals a critical deficiency, recommendations for corrective action should be presented. The debriefing session is followed by a detailed audit report that identifies areas of concern and recommendations for corrective actions.

12.0 CORRECTIVE ACTION

During the course of the field investigation, it will be the Phase I RFI Contractor Project Director's responsibility to notify the USACE Project Manager of any situation prompting significant changes which may effect data quality (i.e., a change in sampling or borehole locations). Appropriate corrective actions to take will be determined by USACE. Monthly reports will include confirmation notices of all circumstances associated with corrective actions taken.

It will be the responsibility of the Laboratory Supervisor to see that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem. Problems requiring major corrective action will be documented by the use of "Malfunction Reporting Forms." An example of such a form is presented in Figure 12-1. The project QA Coordinator will be included in the distribution for each malfunction report issued for this program. The Laboratory Supervisor will initiate corrective action in the event that QC results which exceed acceptability limits or if some other problem or potential problem is identified.

Potential problems identified by the QA Coordinator on the basis of QC data or audit results will be documented by use of "Information Request Forms". An example of such a form is presented in Figure 12-2. Corrective action may also be initiated by the QA Coordinator on the basis of QC data, audit results, or responses to information requests.

MALFUNCTION REPORT

Malfunction Report Number _____

Malfunction Type _____
1 - QC Limits Exceeded
2 - Documentation
3 - Other (explain)

Urgency Level _____
1 - Requires immediate attention
2 - Should be addressed within 7 days
3 - Requires written explanation within 14 days

Laboratory: _____ Reported to: _____

Location: _____ Position: _____

Contract: _____

Date/Time of Malfunction: _____ Date Reported: _____

Malfunction Reported by: _____

Matrix: ☐ Solid ☐ Water ☐ Air ☐ Other _____

Description of Problem: _____

Action: _____

Date/Time Resolved: _____ By Whom: _____

(Upon completion, send copies to distribution listed and return original to person who reported the malfunction.)

Distribution: _____ _____ _____ _____ _____ _____

White - Original Yellow - Laboratory Supervisor's Copy Pink - Originator's Copy

Figure 12-1. Malfunction Reporting Form

INFORMATION REQUEST

IR #: _____ **Distribution Copies To:** _____
TO: _____ _____
FROM: _____ _____
DATE: _____ _____

Project Reference: _____ **LAB Reference:** _____
Information Required:

Support Documentation Required: ☐ Yes ☐ No

Date Information Required: _____

Response:

Follow-up Required: ☐ Yes ☐No

Additional Comments:

Date Resolved: _____ **Verified By:** _____

WHITE: Return with information YELLOW: Retain for your records PINK: File Copy GOLD: Originator's Copy

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4-88-30369

Figure 12-2. Information Request Form

13.0 PREVENTATIVE MAINTENANCE

The primary objective of a preventative maintenance program is to help ensure the timely and effective completion of a measurement effort. A preventative maintenance program is designed to minimize the down time of crucial sampling and/or analytical equipment because of expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- Establishment of maintenance responsibilities;
- Establishment of maintenance schedules for major and/or critical instrumentation and apparatus; and
- Establishment of an adequate inventory of critical spare parts and equipment.

Each of these efforts are discussed in the following sections.

13.1 Maintenance Responsibilities

Equipment and apparatus used in environmental measurement programs fall into two general categories:

- Equipment that is permanently assigned to a specific laboratory (e.g., Metals Laboratory, GC/MS Laboratory, etc.); and
- Equipment that is available for field or laboratory use on an as-needed basis (e.g., field sampling equipment, mobile laboratories, etc.).

Maintenance responsibilities for permanently assigned equipment are assigned to the respective laboratory managers. The laboratory managers then establish maintenance procedures and schedules for each major equipment item. Specific responsibilities for

specific items may be delegated to laboratory personnel, although the laboratory managers retain responsibility for ensuring adherence to prescribed protocol.

Nonassigned equipment includes field pH and conductivity meters, water level meter, thermometer, real-time monitoring instrumentation, and OVA or HNu instrumentation. Equipment in this category requires three related maintenance efforts:

- Ensuring that available equipment is functional and ready for use;
- Maintenance during use; and
- Check-out and servicing after use.

13.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. A schedule is established for all routine maintenance activities (Table 13-1). Note that this schedule will be subject to change should conditions warrant. Other maintenance activities may also be identified as requiring attention on an as-needed basis. In addition, field testing equipment (e.g., pH meters) will be inspected prior use and serviced or replaced as necessary. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service personnel provide primary maintenance for many major instruments (e.g., GC/MS instruments, atomic absorption spectrometers, analytical balances, etc.). Maintenance activities are documented in a maintenance log which indicates the required frequency for each procedure and provides for dated entries. An example is presented as Figure 13-1.

Table 13-1

Instrument Maintenance Schedule

Instrument	Maintenance	Frequency
AA	Tuning/Service Call	Quarterly
	Clean Fan Filter	Annually
	Replace Lamps	As Needed
	Change Tubing	As Needed
	Clean Windows	As Needed
	Clean or Replace Cones	As Needed
ICPES	Check Disc Drive	Daily
	Run Diagnostics	Daily
	Clean Torch	Weekly
	Clean Nebulizer	Weekly
	Clean Fan Filter	Monthly
	Replace Pump Oil	Quarterly
	Replace Tubing	As Needed
GC/MS	Clean Fan Filter	Quarterly
	Replace Vacuum Pump Oil	Semi-Annually
	Replace Filaments	As Needed
	Clean Ion Source	As Needed
	Replace Electron Multipliers	As Needed
	Replace Septa	As Needed
	Replace Column	As Needed
	Replace Injector Liners	As Needed
	Replace Organic Filters	As Needed
	Replace Oxygen Traps	As Needed
GC	Clean Detector	As Needed
	Replace Septa	As Needed
	Replace Column	As Needed
	Replace Injector Liners	As Needed
	Replace Splitter	As Needed
Balances	Service	Annually
OVA-FID	Recharge or Replace Battery	As Needed
	Monitor Fuel and/or Combustion Air Supply Gauges	Hourly
	Perform Routine Maintenance as Described in the Manual	As Needed
	Check for Leaks	Daily

Table 13-1

(Continued)

Instrument	Maintenance	Frequency
HNu-PID	Recharge or Replace Battery Replace or Clean Lamps Clean or Replace Filter Check for Leaks	As Needed As Needed As Needed Daily
pH Meter	Check Fuse and Sensor Clean Meter Rinse Probe	Weekly As Needed After Each Measurement
Conductivity Meter	Clean Meter Recharge or Replace Battery	As Needed As Needed
Water Level Meter	Clean Meter Wipe Probe Dry and Place Into Probe Holder Recharge or Replace Battery	As Needed After Each Measurement As Needed
Thermometer	Clean Replace	As Needed If broken or mercury separates

Project No.
Book No. 23032 TITLE Maintenance - HP-#5

from Page No.

4-27-90 Installed new splitter, DB-608 on Side A (9572543) and DB-5 on Side B (9721141). Baked out for 24 hrs
RGM
DB-608 (# 9639445) & DB-5 (#9672424) were taken off

6/22/90 New splitter installed; ≅ 15 in cut off of each column
HM, RGM

10/5/90 - cut off 1" from each column.
- Plugged off both detectors and cooked at 350°C for about 4 hours.
- Both columns were baked at 275°C for 4 hours with carrier gas flowing, but detached from the detector ends.
MST.

10/24/90 - Replaced Tee splitter.
- Cut off ~12" from each column.
- All peaks - nice + sharp with no tailing.
MST

10/29/90 - Both ECD signals are high. (150 + 300)
- took out both detectors + sent back to HP for cleaning.
Part # for ECD 14233 - 64570 - $515/each.
MST.

To Page No.

Witnessed & Understood by me.	Date	Invented by	Date

Figure 13-1. Example of Maintenance Log

13.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. This inventory should emphasize those parts (and supplies) that:

- Are subject to frequent failure;
- Have limited useful lifetimes; or
- Cannot be obtained promptly should failure occur.

Field sampling task leaders and the respective laboratory managers will be responsible for maintaining an adequate inventory of necessary spare parts.

14.0 QUALITY ASSURANCE REPORTING

Effective management of a field sampling and analytical effort requires timely assessment and review of field activities. This will require effective interaction and feedback between the Project Director, QA Coordinator, field team members, and USACE.

The Project Director and appropriate project team members will be responsible for keeping the QA Coordinator up to date regarding the status of their respective tasks so that quick and effective solutions can be implemented should any data quality problems arise. The use of daily quality control reports (DQCR) also provides an effective mechanism for ensuring ongoing evaluation of measurement efforts. The DQCRs are submitted to the USACE Project Manager weekly. These DQCRs may address some or all of the following as appropriate:

- Weather conditions;
- Summary of activities and work performed;
- Summary of calibration data and QC data;
- Summary of unscheduled maintenance activities;
- Summary of problems and corrective actions taken;
- Health and safety levels and actions; and
- Work scheduled for the next day.

14.1 Quality Assurance Reporting

Major project reports will include QA/QC sections that summarize QC data collected during the program, as well as any major QA problems and resolutions. The QA/QC section in the final Phase I RFI report will include an assessment of measurement

accuracy, precision, and completeness as described in Sections 3 and 4 of this QAPP. It will also summarize any QC problems and resolutions that occurred during sample collection and any analytical anomalies experienced.

Problems requiring swift resolution will be brought to the immediate attention of the USACE Project Manager via the malfunction reporting/corrective action scheme discussed in Section 12.

14.2 QAPP Revisions

In the event that changes to the QAPP are needed, the following steps will be taken:

- Identify and discuss problems or deficiencies in the QAPP with the Phase I RFI Contractor's Project Director and Project Manager;
- The Project Director/Project Manager team determines changes to be made;
- Potential changes will be submitted to USACE Project Manager for approval; and
- When approved by USACE Project Manager, QAPP will be revised and changes will be implemented by project team.

DCN 92-269-069-29-01

COMMUNITY RELATIONS PLAN (CRP) FOR RCRA FACILITY INVESTIGATION HOLLOMAN AIR FORCE BASE NEW MEXICO

28 SITES PHASE I RFI WORK PLAN

25 March 1993—Revision 0

Prepared for:

HOLLOMAN AIR FORCE BASE
49 CES/CEV

Prepared by:

Radian Corporation
8501 North MoPac Boulevard
P.O. Box 201088
Austin, Texas 78720-1088

Under Contract No. DACW45-91-D-0018

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

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1.0 Introduction

The United States Air Force has been designated as the lead government agency in cleanup efforts at Holloman Air Force Base (the Base), New Mexico. As the lead agency the Air Force must ensure public involvement in all site-related decisions at the Base. Therefore, the Air Force is implementing a community relations plan (CRP) that will ensure public involvement throughout the life of the cleanup efforts at the Base.

This CRP is consistent with federal guidance for community relations efforts and satisfies the policies established by the U.S. Environmental Protection Agency (U.S. EPA). The CRP is being conducted as part of the remedial investigation/feasibility study (RI/FS) and the Resource Conservation and Recovery Act (RCRA) corrective action process at the Base.

The RI/FS process was developed in response to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The fundamental purpose of an RI/FS is to characterize the nature and extent of risks posed by an uncontrolled hazardous waste site and to evaluate potential remedial options.

1.1 The RCRA Corrective Action Program

The RCRA corrective action program was initiated in 1984 by the Hazardous and Solid Waste Amendments (HSWA) to RCRA. The purpose of this program is to determine if hazardous waste or hazardous constituents have been released to the environment from waste management units. If a release is found, the program evaluates remedial options and follows through with remedial actions.

The Air Force is performing investigations in accordance with the RCRA corrective action program, known as a RCRA facilities investigation (RFI). In addition, the Base is subject to the requirements of the Air Force's Installation Restoration Program (IRP). A comparison of the phases of the RCRA corrective action program and the IRP is shown in Figure 1–1. Together, the RCRA corrective action program and the IRP establish a framework for developing, implementing, and monitoring response actions.

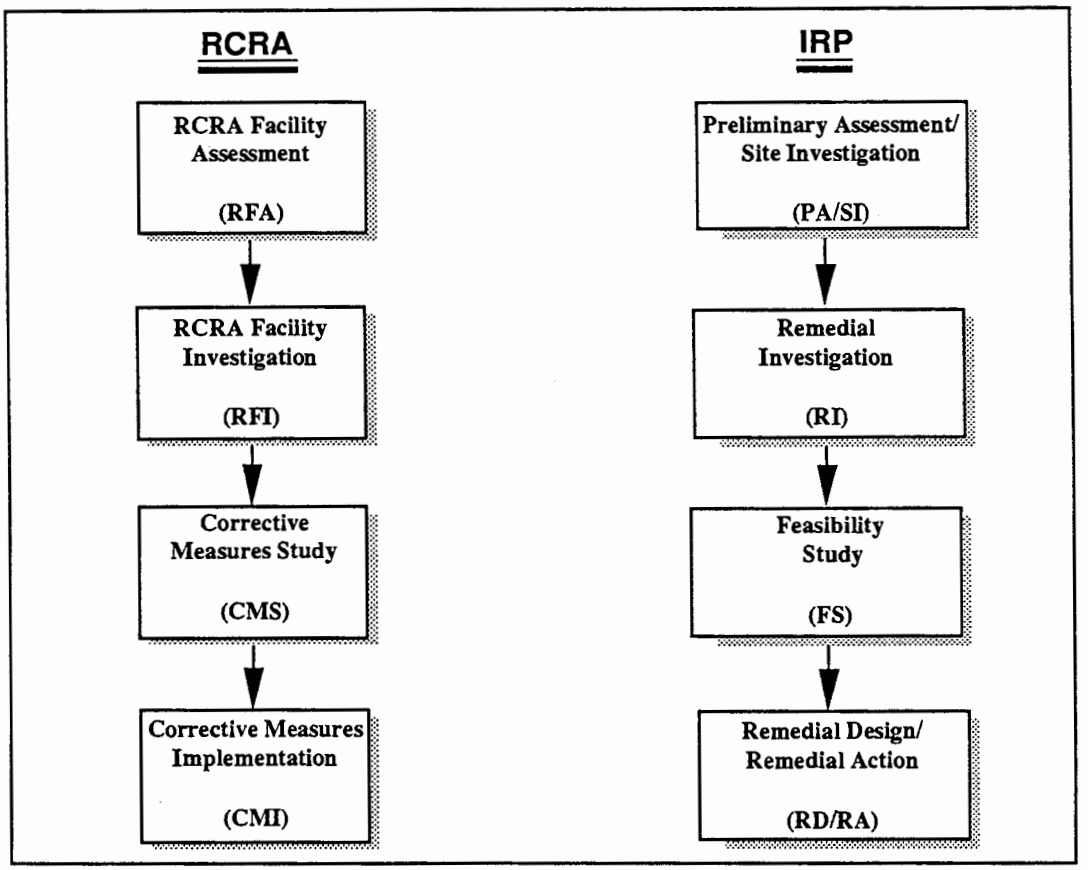

Figure 1–1. Comparison of RCRA Corrective Action and IRP Phases

1.2 The IRP Remedial Process

The IRP essentially follows the CERCLA remedial action program. The major steps of the IRP process, with their RCRA equivalents, are:

- **Remedial Investigation/Feasibility Study (RCRA Facility Investigation/Corrective Measures Study)**—The purpose of the remedial investigation, or RFI, is to collect data

necessary to adequately characterize the site for the purpose of developing and evaluating effective remedial action alternatives and to assess the risks to human health and the environment. If a situation is identified at any time during the process that poses an immediate danger to human health or the environment, a removal action will be conducted.

- **The FS** is conducted concurrently with the RI to the extent possible. The purpose of the FS, or CMS, is to develop and analyze various remedial action alternatives and to recommend appropriate actions. When the FS is completed, a preferred alternative will be identified and presented to the public in a proposed plan. The proposed plan will contain a discussion of the preferred alternative and other alternatives that were considered. A public comment period and an opportunity for a public meeting will be provided for the public to review and comment on the proposed plan.
- **Treatability Investigations**—If existing information is insufficient to evaluate alternatives adequately, tests may be necessary to evaluate the effectiveness of a particular remedial technology for treating specific wastes found at the facility. In some situations, a study may be necessary to develop a more accurate cost estimate for particular treatment technologies.
- **Decision Document**—A responsiveness summary will be prepared summarizing significant comments and new relevant information submitted during the public comment period, along with the lead agency response to each issue, which is part of the decision document. A decision document is prepared using information received during the public comment period and the RFI to select a corrective action alternative. The decision document will include all facts, analyses of facts, comparison of alternatives, and site-specific policy determinations considered during the selection process.

- **Remedial Design/Remedial Action (Corrective Measures Implementation)**—The remedial design/remedial action (RD/RA), or CMI, includes development of the actual design of the selected remedial action and implementation of it through construction. After completion of the final engineering design, a fact sheet will be prepared and made available to the public before the start of the remedial action.

The time needed to complete these steps is different for each facility. For example, an RFI may take two years for completion; design of a long-term cleanup solution may require 12 to 18 months; implementation of the final long-term cleanup may require several years; and treatment of contaminated groundwater may take decades.

1.3 Community Relations Under RCRA

Policy and Guidelines for Public Involvement

Public involvement in the permitting of hazardous waste treatment, storage, and disposal facilities provides an opportunity for all potentially affected and interested parties to become informed about and involved in the permitting process. Whether the final determination is to issue or deny a permit, public involvement ensures that decision makers are better informed.

Early public involvement can provide decision makers with advance notice of citizens' concerns. It can also provide valuable information and ideas for consideration in developing environmentally protective permit conditions. The result will be permits better matched to particular facilities and their respective communities, and which will ultimately serve more effectively as a basis for sound hazardous waste management practices.

Indeed, an active and early public involvement program may reduce delays in the permit process by decreasing the likelihood of time-consuming and expensive litigation by parties whose concerns have not been heard or addressed.

Objectives and Rationale

The objectives of encouraging public involvement in RCRA permitting are as follows:

- Create early and continuing opportunities for public participation in RCRA permitting activities.

- ❑ Ensure public understanding of the RCRA program and of the implications of not awarding a final RCRA permit to a facility.
- ❑ Obtain the public's input to assist in evaluating a permit's environmental soundness.
- ❑ Create equal and open access to the permitting process.
- ❑ Ensure agency understanding of and responsiveness to public concerns.
- ❑ Anticipate conflicts and provide early means for resolution.
- ❑ Foster trust and openness between EPA, Region VI or the state and the public.
- ❑ Emphasize the responsibilities of agency and program management for promoting effective public involvement in decision making.

Key Areas of Public Interest

Because of certain provisions in the 1984 RCRA amendments (HSWA), and the debate over enactment of those amendments, public interest in the RCRA permitting program has broadened and public involvement in the program will become more complex.

The following issues, in particular, are likely to be of special concern.

1. *Groundwater protection.* There have been reports of widespread failure to comply with RCRA's groundwater protection requirements. The removal of wastes from Superfund sites to RCRA facilities has intensified concern over the possibility of groundwater contamination and its effects on human health.
2. *Protective standards and enforcement for operating units.* Public interest is already strong on the question of whether RCRA's design standards and operating specifications (e.g., landfill liner requirements) are strict enough and are being met. Citizens may not be aware of new RCRA standards. They may also question the federal or state agency's ability to adequately monitor permit requirements.
3. *Exposure assessments and ATSDR referrals.* Section 247 of the 1984 RCRA amendments requires each final permit application for a landfill or sur-

face impoundment to be accompanied by information on the potential for the public to be exposed to hazardous constituents through releases from the facility. There may be considerable local interest in this information.

4. *Corrective action.* Significant public interest can be expected in all facets of corrective action requirements. Have releases occurred from a facility? Have any releases been cleaned up? Will corrective action be sufficient to prevent future releases? What kinds of investigations will be conducted to determine the need for corrective action?
5. *Permit process itself.* The length of time involved in issuing a permit as well as the adequacy of public involvement opportunities are examples of issues related to the permit process (as opposed to the contents of permits) that may be of public concern. When joint U.S. EPA/state RCRA permitting is conducted, the public may also have difficulty understanding the coordination process and the differences between federal and state requirements.
6. *Transportation of hazardous wastes.* Many times the public's strongest concern centers on hazardous wastes being transported to or from a facility. The common nature of traffic accidents and the proximity of transportation routes to homes and schools heighten the public's concern over releases during transportation. Often, though, the sheer volume of traffic and the associated noise and congestion are of even greater concern.
7. *Consequences of permit denial.* Whether an operating permit is approved or denied, the consequences will be of interest to the public. Economic impacts on employment, property values, and the local tax base are all likely to generate concern. Denial may lead to special concerns because the public may not at first appreciate its environmental implications. Denying a permit for incineration, for example, might mean that the applicant has to continue to landfill wastes.

To derive full benefit from expanded public involvement, it is important to ensure that the members of the community in which the facility is located have the opportunity to provide input on permit conditions as early as possible before the draft permit has been written. For example, the local public should have the opportunity to comment on conditions requiring corrective action. If there is no opportunity for public input before the draft permit has been prepared, it may be impossible to provide the local public a meaningful voice in making decisions on the permit. Although the public may comment on and provide input to the development of permit conditions, the final decision on permit conditions and on whether to issue or deny a permit rests with U.S. EPA, Region VI or authorized states.

The following are three critical elements for public involvement in the RCRA permitting program for targeted facilities.

1. **Field Assessment**—A field assessment should be conducted for each targeted facility by the public involvement coordinator for the following purposes:

   ❑ To identify major community concerns regarding the facility;

   ❑ To identify the citizens, officials, and groups in the area who are especially interested in the facility and should be kept apprised of developments; and

   ❑ To identify the best means to provide information to the public and, in return, to obtain public comment and input.

2. **Public Involvement Plan**—On the basis of the field assessment, a public involvement plan detailing appropriate public involvement activities keyed to milestones in the RCRA permit process should be developed. This plan indicates the actions U.S. EPA, Region VI or the state will take to facilitate public involvement in the decision-making process for the permit on the basis of the interests and concerns of the public and the best channels for communicating with the local public, as identified in the field assessment.

3. **Public Involvement Activities**—Public involvement activities will vary by facility and by the stage in the permitting process at which public involvement efforts are initiated. The following types of activities, however, will be necessary in each instance:
   - ❑ Outreach activities, such as informal informational briefings and meetings;
   - ❑ Dialogue and assimilation activities, such as work sessions, public meetings, and public hearings; and
   - ❑ Response activities, including informal responses to questions, concerns, and requests from the public during the permit process as well as formal, final responsiveness summaries.

1.4 The CRP Objectives

The objectives of the CRP are to:

- ❑ Assess existing community concerns about planned and ongoing studies at the Base, including all phases of cleanup activities, and determine how and when the public would like to be involved in the decision-making process.
- ❑ Establish procedures for accurate and timely release of information to potentially affected and interested citizen groups, elected officials, public interest groups, agency officials, and the media.
- ❑ Establish methods to facilitate communication between the Air Force and the community at large.
- ❑ Articulate and clarify key issues for the public regarding contamination at the Base.
- ❑ Be responsive to the needs and concerns of public interest groups, agency officials, and the media.
- ❑ Receive and understand all the information that the various interest groups have to communicate.
- ❑ Search for a consensus of the decisions that are being developed through the process.

The CRP will respond to current community concerns. This is a dynamic process, since community concerns are expected to change over time. As the cleanup process progresses through its various stages, the CRP will evolve to meet the public's changing information needs.

2.0 Site Background

2.1 Site Location and Description

Holloman AFB is an active Air Force facility located in Otero County in south-central New Mexico, about 75 miles north–northeast of El Paso, Texas (see Figure 2–1). The Base covers more than 55,000 acres.

The Base is near the east center of a flat desert area of the Tularosa Basin, an internally drained depression between the Sacramento Mountains on the east and the San Andres Mountains on the west.

Dry washes border the east and south portions of the Base, and the White Sands National Monument lies to the west. Lost River, which is normally dry but flows in a gorge about 25 ft deep and several hundred feet wide, crosses the Base from the northeast to the southwest. The surface slopes uniformly in a southwest direction from a 4125-ft elevation at the northeast corner to the 4050-ft elevation at the southwest corner of the Base.

Because of the relative flatness, the caliche-base soil, and the lack of external drainage, stormwaters tend to collect in small depressions in and about the Base. However, no serious problems have been encountered, since the rainfall generally evaporates quickly. The terrain in the general vicinity varies considerably: pine-covered mountain areas, isolated buttes, large tracts of flat desert, gypsum sand dunes, level beds, and dry lake beds.

The nearest residential and commercial area is the City of Alamogordo, which is located seven miles east of the Base. The Base also operates several off-base installations:

- Silver City Radar Site;
- El Paso Radar Site;
- Boles and San Andres Well Field Area; and
- Bonita Lake.

2.2 Site History

Holloman AFB, formerly Alamogordo Army Air Field, began as a temporary facility during World War II. At the end of the war, the airfield was briefly inactivated.

After being transferred in March 1947 to the Air Material Command, the Base had as its mission to "provide facilities and accomplish development and testing of pilotless aircraft, guided missiles, and allied equipment in support of the Air Material Command Research and Development Program."

To support this mission, quantities of petroleum, oils, lubricants, solvents, and protective coatings have been used, resulting in the generation of wastes at the Base.

In 1951 when the Air Research and Development Command was formed, Holloman AFB was placed under the guidance of the Air Force Missile Test Center. The next year the Base was named as one of the development centers of the Air Research and Training Development Command and became Holloman Air Development Center. Five years later, the Base was designated as the Air Force Missile Development Center under the Air Force Systems Command. The Base

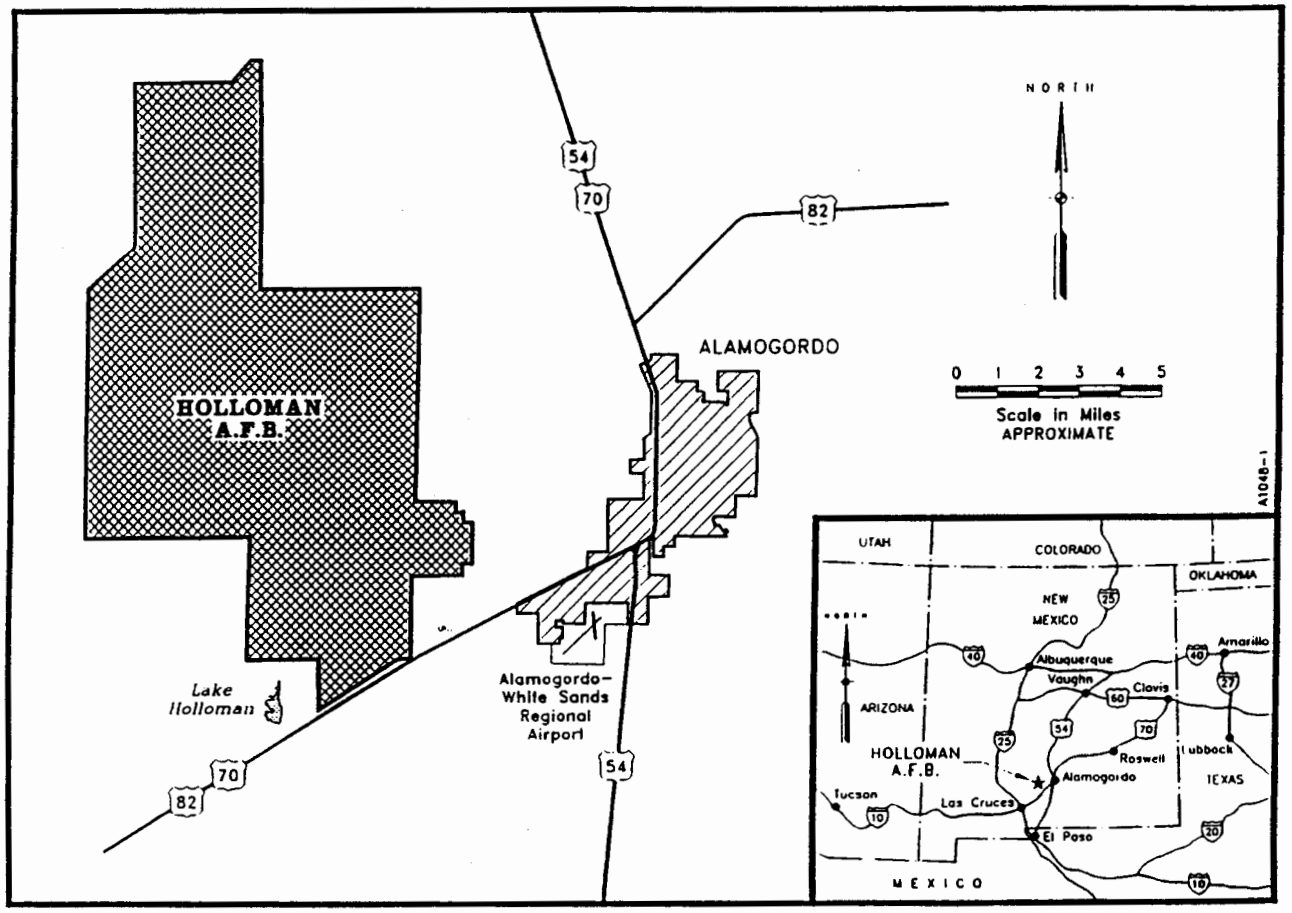

Figure 2–1 Location of Holloman AFB, Alamogordo, New Mexico

was transferred to the Tactical Air Command on January 1, 1971, with the 49th Tactical Fighter Wing assuming host responsibilities. Six years later, the 479th Tactical Training Wing was assigned to Holloman AFB. The 833rd Air Division was reactivated on December 1, 1980, and became operational at the Base.

The 833rd Air Division was deactivated November 1991 and replaced by the 49th Fighter Wing. Today, the 49th Fighter Wing continues to provide leadership for the Base, which has three single runways. There are also several tenant organizations at the Base, the most significant being the Primate Research Laboratory operated by New Mexico State University.

Holloman AFB was transferred from the Tactical Air Command to the Air Combat Command on June 1, 1992. The Base is not currently on the National Priority List, or NPL. (The U.S. EPA uses specific criteria to rank a site before assigning it NPL status.)

Past Waste Generation

Wastes have been generated and disposed of at the Base since the beginning of industrial operations there in 1942. The major industrial operations that have occurred at the Base include jet engine repair, pneumatic and hydraulic systems maintenance, aerospace ground equipment maintenance, corrosion control, vehicle maintenance, and nondestructive inspections. Over time, these industrial operations have generated varying quantities of waste oils, recoverable fuels, spent solvents, and cleaners.

2.3 Summary of Environmental Investigations

During the initial RFA (conducted in 1988), at least 217 solid waste management units (SWMUs) were identified. The current RFI at Holloman AFB covers 40 SWMUs and 1 area of concern (AOC), arranged into 28 sites. This CRP is designed to address community concerns with respect to these 28 sites, which are shown in Table 2-1 and described in more detail in Appendix A.

Specific results of previous investigations, including discussions on the nature and extent of contamination at each source area, will be published and placed in the information repositories. Information repositories are discussed in Section 4.0.

Past Investigations

Since the 1980s, the Air Force has investigated several waste management sites at the Base. As a result of the 1983 records search, the Air Force decided to investigate several Holloman AFB sites further.

An RFA for the U.S. EPA, Region VI was conducted in 1988. On the basis of this review of the Base's SWMUs, U.S. EPA, Region VI has directed that a number of such units be evaluated for releases of contaminants to the environment.

Current Investigations

In 1992, the U.S. Army Corps of Engineers contracted Radian Corporation to prepare the RFI work plan for the 40 SWMUs and the 1 AOC on the Base. I some cases, two or more SWMUs are close enough together to make separate investigation impractical. Therefore, the units have been grouped together for RFI purposes. However, when referred to verbally or in writing, the units should be cited by their respective SWMU number or AOC letter. During site visits in November 1992, information was collected on the history and current use of the 40 SWMUs and the 1 AOC. This information will form the basis of site-specific sampling plans to determine whether releases of hazardous constituents/wastes have occurred at the site and, if so, the nature and extent of the releases.

Table 2–1
Holloman AFB RFI 40 SWMUs and 1 AOC

SWMU No.	Unit Name
119	Bldg. 121 Waste Oil Tank
2	Bldg. 121 Oil/Water Separator
120	Bldg. 309 Waste Oil Tank
15	Bldg. 309 Oil/Water Separator
121	Bldg. 316 Waste Oil Tank
17	Bldg. 316 Oil/Water Separator
123	Bldg. 704 Waste Oil Tank
22	Bldg. 704 Oil/Water Separator

Continued

Table 2–1
(Continued)

SWMU No.	Unit Name
126	Bldg. 1000 Waste Oil Tank
36	Bldg. 1000 Oil/Water Separator
125	Bldg. 868 Fire Water Tank
32	Bldg. 868 Oil/Water Separator
127	Bldg. 1092 Waste Oil Tank
39	Bldg. 1092 Oil/Water Separator
135	Bldg. 1092 Oil/Water Separator Drainage Pit
138	Bldg. 1166 Oil/Water Separator Drainage Pit
128	Bldg. 1166 Waste Oil Tank
40	Bldg. 1166 Oil/Water Separator
118	Bldg. 21 Pesticides Holding Tank
129	Bldg. 1191 Spill Tank
54	Bldg. 702 Waste Accumulation Area
55	Bldg. 702A Waste Accumulation Area
56	Bldg. 807 Waste Accumulation Area
63	Bldg. 867 Waste Accumulation Area
71	Bldg. 1178A Waste Accumulation Area
78	Trim Pad 3 Waste Accumulation Area1
75	DRMO Hazardous Waste Storage Area
91	Bldg. 816 Washrack
136	Bldg. 1119 Washrack Drainage Pit

Continued

Table 2–1
(Continued)

SWMU No.	Unit Name
141	Pad 9 Drainage Pit
164	Bldg. 1080 Pond
124	Bldg. 752 Waste Oil Tank
155	Sludge Drying Beds
156	Imhoff Tanks (5)
184	Wastewater Recirculating Line
177	Bldg. 1176 Sumps
181	Bldg. 1176 Drainage Trough
179	Bldg. 1176 Discharge Box
101	Bldg. 121 Landfill
183	Air Base Sewer System
AOC-U	Lost River Basin

3.0 Community Relations Background

3.1 Community Profile

The City of Alamogordo is located in Otero County in south–central New Mexico. Founded in 1898, the city grew to become the trade center for area livestock and agriculture. With White Sands National Monument only 14 miles away, Alamogordo is also an important recreation area. White Sands Missile Range, site of the first test of the Atomic Bomb on July 16, 1945, is a major tourist attraction. The city's population has increased from 3000 in 1940 to over 30,000 in 1990.

3.2 Impact on Community

Since its activation in 1942, Holloman AFB has had a close relationship with the City of Alamogordo. At no time in the past years of activity has there been contention within the community about the operation of the Base, its mission for national defense, or its responsibility as a corporate citizen.

The Base provides a significant annual economic contribution to the City of Alamogordo, and employs over 1300 government-paid civilians and 4600 military personnel.

3.3 Community Involvement Profile

Holloman AFB has been involved with the community in a variety of ways. The Base participates actively in local events and sports activities, conducts Base tours, sponsors an annual Base open house (e.g., "Community Appreciation Day '92"), and supports the local schools in various ways (e.g., a Science Advisor Program). The Base also provides equipment for civic events such as the Christmas parade, and provides speakers to various downtown engagements. Alamogordo and Otero County have historically shown strong support for the Base.

The Base commanding officer and executive officer attend meetings of the Alamogordo city council and chamber of commerce.

3.4 Key Community Concerns and Issues

The primary concern is centered on potential impacts to groundwater and soil. Any activity, past or present, that would affect water and/or soil quality is the focus of both the RFI and the CRP proposed for the Base.

Ongoing efforts to provide local citizens the opportunity to express concerns and issues will be made throughout the RFI activities at the Base. The RFA at Holloman AFB and the subsequent HSWA permitting process served as the field assessment phase of the RCRA public involvement process as described on p. 7 of this document. (During the permitting process, the Base received only one comment from the public.) Just as RCRA required a public comment period on the draft permit before beginning the RFI, other comment periods and public meetings will be held at significant milestones.

In addition, the U.S. EPA, Region VI requires that a notice of final decision on whether to issue or deny RCRA permits be sent to anyone who has submitted written comments on the draft decision. The response to comments allows a community member additional opportunities to express concerns.

4.0 Objectives of the Community Relations Program

The CRP for the environmental cleanup process at Holloman AFB has four objectives. The objectives were developed on the basis of both U.S. EPA, Region VI guidance and consideration of the information presented in Section 3.0 of this document. These objectives will guide the community relations activities throughout the cleanup process.

1. Provide the Community with Information—Articulate and Clarify Key Issues

The Air Force will provide accurate information to citizens about cleanup activities and respond promptly to any inquiries from community members. Information will be made avaliable to concerned citizens, public interest groups, elected officials, the media, and agency officials through the development of fact sheets, press releases, and newsletters. In addition, the Air Force will initiate community meetings and maintain the information repositories.

An information repository is the place where all information on response actions are available to the public, and will contain a copy of all items made available to the public.

Two information repositories have been established as part of the Holloman AFB RFI. Documents will be made available to the public and are relevant to the public's understanding of the cleanup activities on the Base. (See Appendix B for hours and location of both information repositories.)

The public will receive a variety of information about the Base's activities from a variety of publications, which may include fact sheets that are prepared as part of the Technical Review Committee (TRC) meeetings.

Fact sheets are designed to inform the public of the progress of RFI and closure activities at the Base. They will address ongoing issues; summarize the TRC meetings; and announce upcoming public and TRC meetings and other community relations activities. Fact sheets should also provide the names of persons whom the public may contact to obtain additional information.

Fact sheets, which are ideal for discussing technical material in a readable style that helps the public understand a particular topic, will be sent to the media, to TRC members, and to individuals on the mailing list. Copies of the fact sheets will be placed in both information repositories.

2. Establish Communication Between the Base and the Community at Large

Communication with the community during the RFI will allow the Base to understand the community's perspective on issues related to the site and to become more aware of its information needs.

The Base will respond to community concerns and issues by establishing telephone lines with personnel able to field questions and comments on a variety of technical issues and environmental concerns. The Holloman AFB Public Affairs Office will oversee all community relations activities for the Base RFI. The primary contacts are Maj. Earl Shellner and 2nd Lt. Christina Harvey. They may be contacted by calling (505) 479-5406 or by writing to 49 FW/PA, 490 First Street, Suite 2800, Holloman AFB, NM 88330–8277.

The contact for technical information about this RFI will be 49 CES/CEV (Environmental Engineering). Since technical activities are conducted under the auspices of 49 FW/LGC and 49 CES/CEV, personnel of these offices will act as advisors to 49 FW/PA.

Representatives of U.S. EPA, Region VI and the New Mexico Environment Department (NMED) are also available concerning any environmental issues. An element of the CRP at the Base is the Technical Review Committee (TRC). The TRC, which meets twice a year, serves as an advisory body for the Base by reviewing the results of field investigations and proposed remedial actions.

3. Respond to Community Concerns and Needs that Arise During the RFI

A major objective of the CRP is to identify concerns as they develop and to address these concerns quickly and appropriately. Community meetings, the media, and correspondence will be used to achieve this objective. In addition, the Air Force will establish a

contact person and a telephone line to monitor community concerns, as noted in Objective 2.

4. Provide for Citizen Input and Involvement During the CMI Process

It may be necessary to reissue the proposed plan for additional public comment if new information becomes available that significantly changes the basic features of the CMI remedy.

Public comments that do not significantly change the basic features of the removal will be addressed in the responsiveness summary section of the decision document. The responsiveness summary is a written summary of significant comments, criticisms, and new information submitted during the public comment period and the Air Force's response to each comment.

The responsiveness summary serves two functions:

- ❑ Provides the decision makers with information about the views of the community and potentially responsible parties regarding the proposed remedial action and any alternatives; and
- ❑ Documents how public comments have been considered during the decision-making process and provides answers to major comments raised.

The responsiveness summary will be divided into four sections:

A. Overview

This section will describe the selected remedy and any changes in the proposed plan, feasibility study, and any new alternatives suggested by the public that the Base has not previously considered.

B. Background on Community Involvement

This section will provide a brief history of interests in the Base community and will identify key public issues. Public comments and concerns on modifications in the investigation or removal actions will be noted. A list of community relations activities conducted to date will be included as an attachment to the responsiveness summary.

C. Summary of Comments Received and Air Force Responses

This section will include comments received from all interested parties in the community, the community's technical advisors, U.S. EPA, Region VI, NMED, and local officials. Included within each category of comments will be the Air Force's response. Possible categories might include technical comments, concerns regarding alternative remedies, and public participation. Significant community concerns that cannot be addressed by the Base because of lack of jurisdiction will be noted, with an explanation of why no action by the Air Force will occur.

D. Provide for Effective Management of the CRP

The CRP will be implemented during the RFI and will continue throughout the entire corrective action program. The Base will coordinate and implement all community relations activities. Each activity will be carefully monitored and evaluated by the Air Force, U.S. EPA, Region VI, and NMED to determine its effectiveness in meeting the CRP objectives. Where necessary, the Base will modify or revise the CRP to ensure that the community's needs are met. These revisions will be documented as addenda to the CRP.

5.0 Community Relations Techniques

1. **Develop a Site Mailing List**
   - ❑ Respond to community concerns.
   - ❑ Mail fact sheets and newsletters to those on the list.

2. **Prepare Information Fact Sheets**
   - ❑ Provide the community with detailed information about site activities, announce community and TRC meetings, discuss environmental issues, and provide information about documents that are available in the information repositories.
   - ❑ Include the name, address, and telephone number of an Air Force representative responsible for inquiries about Holloman AFB.
   - ❑ Publish fact sheets, as appropriate, throughout the RFI at the Base.

3. **Maintain Information Repositories**
   - ❑ Inform the public of the Air Force's activities at Holloman AFB.
   - ❑ Include additional information on site activities not specifically used for a response action (i.e., fact sheets, newspaper articles, etc.).
   - ❑ Handle on a case-by-case basis individual requests for copies of additional documents.

5. **Hold Semiannual Public Meetings**
   - ❑ Provide an opportunity for community-wide comments on site activities and to propose alternative cleanup methods.
   - ❑ Inform the community of the progress of all RFI activities.

6. **Involve Community to Support Selection of a Remedy**
   - ❑ Helps the Air Force support selection of a remedy during the cleanup process, the proposed plan, RFI, and supporting analysis. This information is included in the information repositories, and is available for public comment.
   - ❑ Provides at least a 30-day comment period on the proposed cleanup actions.

- ❑ Announce comment period two weeks in advance in local media (newspapers, radio, television).

7. **Prepare Decision Documents and Responsiveness Summary**
   - ❑ Describes the community's comments and the Air Force's responses during the 30-day comment period and the community meetings.
   - ❑ Place the complete decision documents in the information repositories, with a notice of availability published in the local newspaper.

6.0 Technical Review Committee

The Base has established a Technical Review Committee (TRC) in conjunction with the ongoing IRP at Holloman AFB. The TRC reviews and comments on actions and proposed actions for removal of hazardous substances at the Base. The TRC includes representatives from the Air Force, U.S. EPA, Region VI, NMED, and the community.

The TRC meets twice a year to discuss both the results of field investigations and proposals for interim final cleanup activities. In the future, these discussions should be held before any public meetings with the community as a review process only.

7.0 Glossary

AFB—Air Force Base
AOC—Area of concern
ATSDR—Agency for Toxic Substances and Disease Registry
CERCLA—Comprehensive Environmental Response, Compensation and Liability Act
CMI—Corrective measures implementation
CMS—Corrective measures study
CRP—Community relations plan
FS—Feasibility study
HSWA—Hazardous and Solid Waste Amendments
IRP—Installation Restoration Program
NMED—New Mexico Environment Department
NPL—National Priorities List
PA/SI—Preliminary assessment/site investigation
RCRA—Resource Conservation and Recovery Act
RD/RA—Remedial design/remedial action
RFA—RCRA facility assessment
RFI—RCRA facility investigation
RI—Remedial investigation
SARA—Superfund Amendments and Reauthorization Act
SWMU—Solid waste management unit
TRC—Technical Review Committee
U.S. EPA—U.S. Environmental Protection Agency

APPENDICES

Appendix A
Technical Description of the 40 SWMUs and the 1 AOC

SWMU No. 119 Building 121 Waste Oil Tank
SWMU No. 2 Building 121 Oil/Water Separator

Description: The tank (119) is a below-ground, 200-gal. waste oil storage tank. It is connected to the separator (2), which received rinsate from a nearby vehicle washrack. A halon vapor monitoring system installed around the tank has shown evidence of releases during past operations.

SWMU No. 120 Building 309 Waste Oil Tank
SWMU No. 15 Building 309 Oil/Water Separator

Description: The tank (120) is underground and adjacent to Building 309. The oil/water separator (15) is located next to the building and is currently hooked in line between the building and the new oil/water separator. Before the new separator was installed, the old separator drained directly to the sewer system. It is not known when or if the old separator was disconnected from the tank.

SWMU No. 121 Building 316 Waste Oil Tank
SWMU No. 17 Building 316 Oil/Water Separator

Description: The units are associated with the flight simulator in Building 316. The only known waste entering the unit is hydraulic fluid from the simulator. The separator is connected to the sewer system for discharge of water. A vapor monitoring system around the tank is in place and routinely checked. No evidence of a release has been found.

SWMU No. 123 Building 704 Waste Oil Tank
SWMU No. 22 Building 704 Oil/Water Separator

Description: Currently inactive, is adjacent to a washrack at the petroleum, oil, and lubricant area. A new oil/water separator is currently in use. In the past a variety of fuels were "treated/stored" by these units.

SWMU No. 126 Building 1000 Waste Oil Tank
SWMU No. 36 Building 1000 Oil/Water Separator

Description: SWMU No. 126 is an active unit. Receives drainage from vehicle maintenance shop. Separator contains oil.

SWMU No. 125 Building 868 Fire Water Tank
SWMU No. 32 Building 868 Oil/Water Separator

Description: Underground tank covered by a concrete pad and asphalt outside aircraft maintenance hangers. Contains fire suppression water that may contain AFFF (fire-fighting foam) and some oil and grease. Separator is contained in concrete pad.

SWMU No. 127 Building 1092 Waste Oil Tank
SWMU No. 39 Building 1092 Oil/Water Separator
SWMU No. 135 Building 1092 Oil/Water Separator Drainage Pit

Description: Units are associated with the old fire-training area; JP-4 primary fuel used. Separator received drainage of fuel/fire-training water. Fuel stored in tank and water drained into the pit. The pit is not lined. The tank is monitored using a vapor detection system (halon). Tank is empty but condition is not known; capacity is 500 gal. These units are part of IRP Site 31. Extensive investigation as well as a risk assessment has been performed. The risk assessment indicates no risk is present and no further action was recommended in the report. Several (four to five) groundwater monitoring wells are present but no recent sampling has occurred.

SWMU No. 128 Building 1166 Waste Oil Tank
SWMU No. 138 Building 1166 Oil/Water Separator Drainage Pit
SWMU No. 40 Building 1166 Oil/Water Separator

Description: An active site; no previous work done here. Tank has halon vapor monitoring system in place. No evidence of releases during monitoring period has been found. Separator contained oily black liquid.

SWMU No. 118 Building 21 Pesticide Holding Tank

Description: Also called IRP Site 16, four groundwater monitoring wells are currently in place: one upgradient, three downgradient (actual tank is gone). SWMU consists of an unlined rectangular concrete box filled with soil. Spills occurred on underlying soils inside and outside of box. Extensive soil sampling of area already performed, as well as a risk assessment, which concluded that no risk is presented and recommended no further action. Data and recommendations included in the 29 Sites RI report.

SWMU No. 129 Building 1191 Spill Tank

Description: At site of current equestrian center, it is actually two buildings with two trough systems and two tanks each (for a total for four tanks). Possibly, the tanks were crushed and covered with concrete and troughs were filled with concrete also. Tanks were used to store spills of unconventional fuels (UDMH, analine, oxidizers, propellants). Only one tank location is partially known. Some previously done work in association with IRP Site 36. IRP includes some groundwater monitoring wells.

SWMU No. 54 Building 702 Waste Accumulation Area
SWMU No. 55 Building 702A Waste Accumulation Area

Description: SWMU No. 54 was a temporary (steel plating) waste accumulation area that stored solvents and waste oil. SWMU No. 55 is a metal storage shed that stores flammable liquids. The area underneath and around the shed is graveled. SWMU No. 54 no longer exists in its original state.

SWMU No. 56 Building 807 Waste Accumulation Area

Description: Covered with gravel. Some staining visible. Jet fuel and 7808 oil stored here.

SWMU No. 63 Building 867 Waste Accumulation Area

Description: Currently inactive and covered with gravel and soil. Paints and solvents formerly stored.

SWMU No. 71 Building 1178A Waste Accumulation Area

Description: Inactive; was a storage area that stored paint thinners and solvents (for perhaps less than 90 days), including acetone and toluene (F003 and F005). Consists of three small concrete pads close together. Evidence of staining on pads and soil. No berms or secondary containment. No previous work done.

SWMU No. 78 Trim Pad 3 Waste Accumulation Area

Description: A circular concrete pad that previously had a portable metal pad on which diesel, waste oil, and hydraulic fluid were stored.

SWMU No. 75 DRMO Hazardous Waste Accumulation Area

Description: Currently a RCRA-permitted unit. No evidence of a release.

SWMU No. 91 Building 816 Washrack

Description: Used for vehicle cleaning. The pad is cracked concrete. Has a drain plate and a pipe (may be plugged). No berms on either end and no groundwater information within two miles.

SWMU No. 136 Building 1119 Washrack Drainage Pit

Description: Washrack not used in two years. No "pit" associated with it. Wash water runs off either end. No tank, separator, or sewer line hookup associated with pad. Vehicles, generators, other equipment washed on pad. No previous work done at site. Soil around pad was dug approximately 8 ft deep (one backhoe bucket width) and inspected for

visual contamination. None was observed and soil was pushed back in holes.

SWMU No. 141 Pad 9 Drainage Pit

Description: SWMU No. 141 consists of drain, drainline, and drainage pit. Drainline is full of soil and pit is now just a shallow depression (although it was once 12 ft deep). Dense salt cedar growth in pit. The salt cedars are slightly radioactive (planes that flew through radioactive clouds were washed down here). This site will be investigated under the new PA/SI (IRP Site 27). Background search has been done; sampling is scheduled.

SWMU No. 164 Building 1080 Pond

Description: A shallow depression that catches runoff from the drone aircraft ramp area. Overgrown with salt cedar.

SWMU No. 124 Building 752 Waste Oil Tank

Description: An aboveground tank on a wooden cradle on a concrete pad located by the lagoons. Exact contents are unknown but are probably waste oils from around the Base.

SWMU No. 155 Sludge Drying Beds

Description: Three beds with drain systems. Located at the sewage lagoons. Sludge/water from SWMU No. 156 (Imhoff Tanks) was put here. After drying, sludge was used as a soil conditioner around the Base. Believed that beds were completely scraped prior to "closure." No evidence of beds exists now.

SWMU No. 156 Imhoff Tanks (5)

Description: Inactive, covered with soil. Five concrete tanks, circular, approximately 40 ft deep (from plans). Installed in the 1950s. No previous work done. Stored sewage sludge (included listed wastes), decanted to sludge drying beds. Is not known if tanks still contain sludge.

SWMU No. 184 Wastewater Recirculating Line

Description: Line runs between Ponds A and B from the splitter box to Pond F. May not be currently active.

SWMU No. 177 Building 1176 Sumps
SWMU No. 181 Building 1176 Drainage Trough
SWMU No. 179 Discharge Box

Description: Is part of IRP Site 39. Previously investigated during the 29 Sites RI. Monitoring wells in place and many soil borings done.

SWMU No. 101 Building 121 Landfill

Description: Is IRP Site 10. Already investigated, no further action recommended.

SWMU No. 183 Air Base Sewer System

Description: Being replaced slowly; should be complete in 10 years. Sewer system stretches for literally miles and miles. Unlikely to be able to perform integrity test on all of it. Drains stormwater, domestic wastewaters, and industrial wastewater.

AOC-U Lost River Drainage Basin

Description: A large drainage basin that receives drainage from various SWMUs and IRP sites. Primarily nonvegetated. Habitat for the White Sands pupfish and blacktailed jackrabbits.

Appendix B
Documents in the Information Repositories

All five information repositories will contain an identical set of documents. Documents that will be maintained in the information repositories:

- Site investigation reports
- Chain-of-custody forms
- Guidance documents
- RFI reports
- CRP
- Fact sheets and newsletters
- Public comments repositories (in-(cluding a late comments section)
- Index to documents in record

Locations of the information repositories:

New Mexico State University Library
Las Cruces, NM 88003
(505) 646-2932
M–F 8:00 a.m.–5:00 p.m.
Sat. & Sun. 12:00 p.m.–5:00 p.m.

Alamogordo Public Library
Alamogordo, NM 88003
(505) 437-9058
M–F 8:00 a.m.–5:00 p.m.
Sat. & Sun. 12:00 p.m.–5:00 p.m.

University of New Mexico at Albuquerque Library
Albuquerque, NM 87131
(505) 277-5761
M–F 8:00 a.m.–5:00 p.m.
Sat. & Sun. 12:00 p.m.–5:00 p.m.

Santa Fe Public Library
Santa Fe, NM 87215
(505) 984-6780
M–F 8:00 a.m.–5:00 p.m.
Sat. & Sun. 12:00 p.m.–5:00 p.m.

Holloman AFB Library
Holloman AFB, NM 88330
(505) 479–6511
M–F 8:00 a.m.–5:00 p.m.
Sat. & Sun. 12:00 p.m.–5:00 p.m.

Appendix C
Site Mailing List

Elected Officials:

Federal

U.S. Senator Jeff Bingaman
148 Loretto Town Centre
505 South Main Street
Las Cruces, NM 88002
(505) 523-6561

U.S. Senator Pete Domenici
1065-D South Main Street, Suite I
Las Cruces, NM 88005
(505) 526-5475

U.S. Representative Joseph Skeen
1065-B South Main Street, Suite A
Las Cruces, NM 88001
(505) 527-1771

State

Bruce King, Governor
Governor's Office, State Capital Bldg
Santa Fe, NM 87503
(505) 827-3000

David Townsend
District 53 Representative
2607 St. Andrews Court
Alamagordo, NM 88310
(505) 437-5605

Mariano Torrez
District 51 Representative
616 10th Street
Alamogordo, NM 88310
(505) 437-3800

City of Alamogordo

Dan King, Mayor
511 Tenth Street
Alamagordo, NM 88310
(505) 479-7781

Chamber of Commerce
1301 N. White Sands Blvd.
Alamogordo, NM 88310
(505) 437-6120

Committee of "50" (Jim Randall)
P.O. Box 1952
Alamogordo, NM 88310
(505) 437-6264

Supt. of Alamogordo Public Schools
1222 Indiana Avenue
Alamogordo, NM 88310
(505) 439-2000

Otero Public Health Office
1207 East 8th Street
Alamagordo, NM 88310
(505) 437-9340

Otero Soil and Water Conservation Dist.
2920 N. White Sands Blvd.
Alamagordo, NM 88310
(505) 437-1030

Alamogordo Environmental
Improvement Division
ATTN: Mr. Guenther Diehl
411 10th Street, Room 106
Alamagordo, NM 88310
(505) 437-7115

Geophysics System Officer
County of Otero
ATTN: Mr. Dan Schwebke
P.O. Box 1749
Alamagordo, NM 88311-1749
(505) 437-7636

Otero County Commission
1000 North New York Avenue
Alamagordo, NM 88310
(505) 437-7427

Department of Public Safety
700 Virginia Avenue
Alamagordo, NM 88310
(505) 437-2505

Planning and Zoning Commission
ATTN: Mr. Howard Moffitt
511 10th Street
Alamagordo, NM 88310
(505) 439-4230

Otero County Commission
ATTN: Mr. Robert D. Bishop
511 10th Street
Alamagordo, NM 88310
(505) 437-7427

State and Federal

NMED
Harold Runnels Bldg.
ATTN: Mssrs. Dennis McQuillan,
David Morgan, and Steve Cary
1190 St. Francis Dr.
Santa Fe, NM 87503
(505) 827-2850

U.S. Department of the Interior
Bureau of Land Management
ATTN: Mr. Scott Ludwig
1800 Marquess
Las Cruces, NM 88005
(505) 525-8228

U.S. Fish and Wildlife Services
Environmental Specialist
ATTN: Mr. Tom O'Brien
3530 Pan American Hwy, NE, Suite D
Albuquerque, NM 87107
(505) 883-7877