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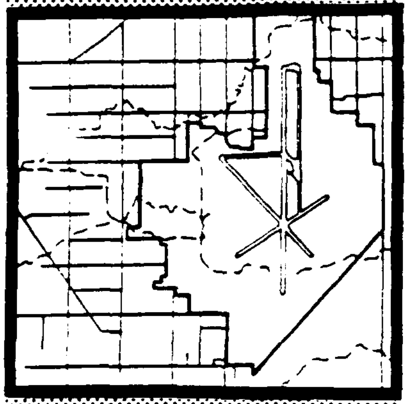
INSTALLATION RESTORATION PROGRAM (IRP)
McCLELLAN AIR FORCE BASE



PREPARED BY:
Radian Corporation
10395 Old Placerville Road
Sacramento, California 95827

NOVEMBER 1991

Operable Unit B Remedial Investigation Sampling & Analysis Plan

FINAL

PREPARED FOR:
McCLELLAN AFB / EM
McCLELLAN AFB, CALIFORNIA 95652-5990

United States Air Force
Air Force Center for Environmental Excellence
Environmental Services Office
Environmental Restoration Division (AFCEE/ESR)
Brooks Air Force Base, Texas 78235-5000

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INSTALLATION RESTORATION PROGRAM (IRP)
STAGE 7

OPERABLE UNIT B
REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN

FINAL

FOR

McCLELLAN AFB/EM
McCLELLAN AFB, CALIFORNIA 95652-5990

NOVEMBER 1991

PREPARED BY:

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10395 Old Placerville Road
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AF CONTRACT NO. F33615-90-D-4013, DELIVERY ORDER NO. 0002
CONTRACTOR CONTRACT NO. 269-007, DELIVERY ORDER NO. 0002

United States Air Force
Air Force Center for Environmental Excellence
Environmental Services Office
Environmental Restoration Division (AFCEE/ESR)
Brooks AFB, Texas 78235-5000

PREFACE

Radian Corporation is the contractor for the Installation Restoration Program (IRP), Stage 7 Remedial Investigation/Feasibility Study (RI/FS) at McClellan Air Force Base (AFB), California. The work is being performed for the United States Air Force Center for Environmental Excellence (AFCEE), Environmental Services Office/Environmental Restoration Division (ESO/ER) under Air Force Contract No. F33615-90-D-4013, Delivery Order 0002.

This Operable Unit B Remedial Investigation Sampling and Analysis Plan (OU B RI SAP) Report describes the work to be conducted to identify, investigate, and characterize areas of soil contamination in OU B of McClellan AFB.

Key Radian project personnel were:

Nelson H. Lund, P.E.--Contract Program Manager
Jack D. Gouge'--Delivery Order Manager
Thomas F. Cudzilo--Technical Project Manager
Ty Thompson--Project Director
Kiefer Mayenkar--Assistant Project Director

Radian acknowledges the cooperation of the McClellan AFB Office of Environmental Management. In particular, Radian acknowledges the assistance of Mr. Mario Ierardi, Mr. Bud Hoda, and Ms. Elaine Anderson.

The work presented herein was accomplished between August 1990 and September 1991. Mr. Patrick Haas, AFCEE-ESO/ER, was the Technical Project Manager.

Approved:
Nelson H. Lund, P.E.
Contract Program Manager

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified

1b. RESTRICTIVE MARKINGS N/A

2a. SECURITY CLASSIFICATION AUTHORITY N/A

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A

3. DISTRIBUTION/AVAILABILITY OF REPORT [redacted]

4. PERFORMING ORGANIZATION REPORT NUMBER(S) N/A

5. MONITORING ORGANIZATION REPORT NUMBER(S) N/A

6a. NAME OF PERFORMING ORGANIZATION Radian Corporation

6b. OFFICE SYMBOL (If applicable)

7a. NAME OF MONITORING ORGANIZATION ESO/ER

6c. ADDRESS (City, State, and ZIP Code)
10395 Old Placerville Road
Sacramento, CA 95827

7b. ADDRESS (City, State, and ZIP Code)
Brooks AFB, TX 78235-5501

8a. NAME OF FUNDING/SPONSORING ORGANIZATION ESO/ER

8b. OFFICE SYMBOL (if applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-90-D-4013

8c. ADDRESS (City, State, and ZIP Code)
Brooks AFB, TX 78235-5501

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSING NO.

11. TITLE (Include Security Classification)
McClellan AFB, California. Remedial Investigation/Feasibility Study, Operable Unit B Sampling and Analysis Plan, Final (Unclassified).

12. PERSONAL AUTHOR(S) Radian Corporation

13a. TYPE OF REPORT Final

13b. TIME COVERED FROM 08/29/90 TO 11/20/91

14. DATE OF REPORT (Year, Month, Day) 91/11/20

15. PAGE COUNT 680

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This Sampling and Analysis Plan (SAP) presents the technical approach for conducting a remedial investigation of Sites, Potential Release Locations (PRLs), and Study Areas (SAs) in Operable Unit (OU) B of McClellan Air Force Base.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT
XX UNCLASSIFIED/LIMITED ___ SAME AS RPT ___ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL Mr. P. Haas

22b. TELEPHONE (Include Area Code) 1-800-821-4528

22c. OFFICE SYMBOL ESO/ER

DD FORM 1473, 84 MAR
83 APR edition may be used until exhausted
All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
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NOTICE

This Sampling and Analysis Plan (SAP) has been prepared for the Air Force for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the SAP relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action is in the public interest. The limited objectives of this SAP, the ongoing nature of the IRP, and the evolving knowledge of site conditions and chemical effects on the environment and human health, all must be considered when evaluating this SAP since subsequent facts may become known which may make this SAP premature or inaccurate. Acceptance of this SAP in performance of the contract under which it was prepared does not mean that the Air Force adopts the conclusion, recommendation, or other views expressed herein, which are those of the contract only and do not necessarily reflect the official position of the Air Force.

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1.0 INTRODUCTION

In 1979, officials at McClellan Air Force Base (AFB) began to suspect that past waste disposal practices may be contaminating the groundwater in the area. Selecting a proactive approach, McClellan AFB voluntarily created a groundwater contamination committee, which identified at least four areas of potential groundwater contamination needing further investigation. Subsequent investigations confirmed contamination, and McClellan AFB developed a comprehensive program to maintain drinking water quality and to remediate the contamination. In 1981, the United States Department of Defense (DOD) developed the Installation Restoration Program (IRP) to investigate hazardous material disposal sites on DOD facilities; McClellan AFB's comprehensive program was revised to conform with the IRP. Since then, numerous investigations and studies have been performed under the IRP.

On 22 July 1987, McClellan AFB was listed on the U.S. Environmental Protection Agency's (U.S. EPA) National Priorities List (NPL). After being included on the NPL, McClellan AFB integrated the ongoing IRP with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, Superfund Amendments and Reauthorization Act of 1986 (SARA); National Oil and Hazardous Substances Contingency Plan (NCP); pertinent provisions of the Resource Conservation and Recovery Act (RCRA) statutes; Executive Order 12580; and all applicable or relevant and appropriate state laws and regulations.

To integrate the IRP with CERCLA and SARA, McClellan AFB adopted the CERCLA Remedial Response Process, which consists of three main phases: Identification, Investigation, and Cleanup. The three phases and the separate elements in the phases are illustrated in Figure 1-1. The goal of the Remedial Response Process is remedial action leading to cleanup of contamination where such action is feasible.

The CERCLA process is typically conducted at single sites in a limited geographic area where wastes are known to have been released to soil or groundwater. At McClellan AFB (2,952 acres), 170 sites[1] that are known to be contaminated or where

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[1] Throughout this work plan, the word "site" is used as a geographical reference to a building, the place an activity occurred, or an area under investigation in OU B. The words "site," "location," or "area" have been used interchangeably as geographic references. The word "site" is not intended to imply the confirmed presence of soil or groundwater contamination; such a reference would be to a "Site."

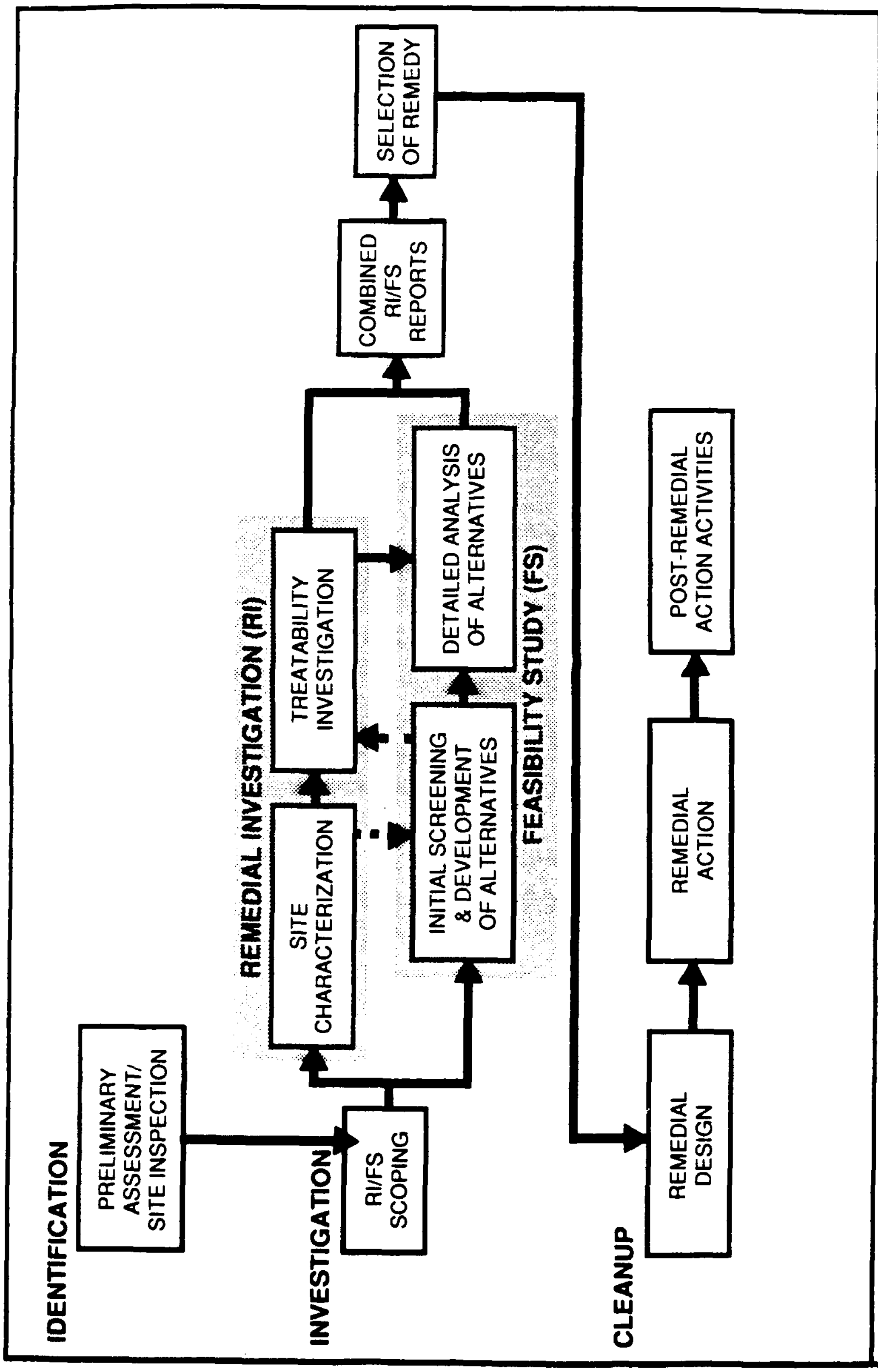

Figure 1-1. CERCLA Remedial Response Process.

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the potential for contamination exists, have been identified. Each of the sites and adjacent areas that may be recognized during the identification phase will be brought into the process. To efficiently and cost effectively evaluate sites through the process, McClellan AFB has been divided into eight geographic areas that have been designated Operable Units (OUs) (Figure 1-2). Boundaries of OUs enclose areas which include groups of sites and potential groundwater contamination on and adjacent to McClellan AFB. A strategy has been developed to advance each OU through the CERCLA process. On the basis of the strategy, OUs where groundwater contamination has been identified and where the contaminants are migrating toward water supply wells are given priority. In keeping with that strategy, OU B, covering the southwest portion of McClellan AFB and the adjacent off-base area, is the first OU to advance through the CERCLA process and will be followed by OU A.

The identification phase of the CERCLA process has been completed for OU B. The draft OU B Preliminary Assessment Summary Report (Radian, 1990a), identified 44 sites which require characterization. In addition to the specific sites where contaminants may have been discharged, contaminants which have entered groundwater will be characterized. Groundwater contamination has been previously investigated in the OU B Groundwater Remedial Investigation (OUBGRI), the Preliminary Groundwater Operable Unit Remedial Investigation (PGOURI), and the McClellan AFB Groundwater Sampling and Analysis Program (GSAP). Although short-term actions to mitigate contaminants in groundwater have been proposed in the OU B Engineering Evaluation/Cost Analysis-Environmental Assessment [(OU B EE/CA-EA), 1990e], additional actions will be needed to complete remediation of the groundwater beneath OU B. A comprehensive Remedial Investigation (RI) and Feasibility Study (FS) will provide the basis for selection of appropriate and feasible remedies for sites and groundwater requiring cleanup in OU B.

To advance the selection of appropriate and feasible remedies in OU B, each site and potentially affected pathway of contaminant migration will be evaluated through the comprehensive process that includes Site Characterization, Initial Screening and Development of Alternatives, Treatability Investigation, and Detailed Analysis of Alternatives. The data required to complete the RI/FS report prior to remedy selection will be compiled in the Site Characterization and Treatability Investigations for OU B. To obtain all data necessary to determine the nature and extent of contamination and to select remedies, a comprehensive Sampling and Analysis Plan (SAP) is needed.

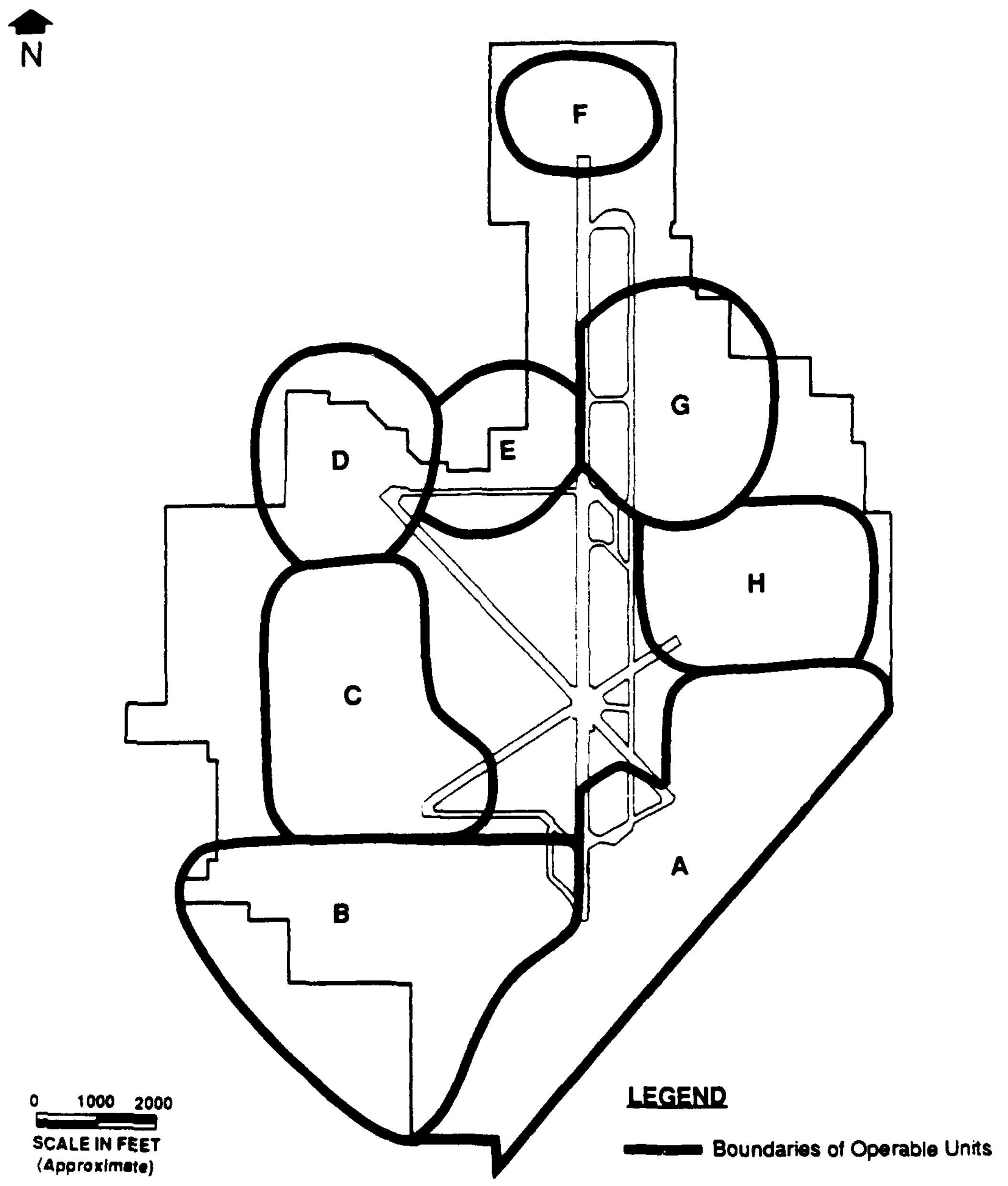

Figure 1-2. Approximate Boundaries of Operable Units at McClellan AFB.

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The purpose of the OU B RI SAP is to describe the field procedures, sample collection points, analytical methods, data handling and analysis, and decision-making criteria in the Site Characterization and Treatability Investigation elements of the RI. The objectives of the OU B RI are:

- Identification of sources of contamination of soil, soil gas, groundwater, and surface water in OU B;
- Determination of the nature and extent of contaminants with a high degree of confidence;
- Identification and characterization of migration pathways and potential receptors; and
- Evaluation of alternatives for remediation of sites or contaminated media requiring cleanup.

To attain the three objectives, the OU B RI has been divided into three phases: Source Identification, Extent Determination, and Evaluation of Remedial Alternatives. Each phase has separate objectives, data needs, and decision points. This sampling and analysis plan explains the procedure to be used for meeting the objectives, satisfying data needs, and reaching decision points with the most effective use of resources.

Work Plan Organization

The remainder of this OU B RI SAP is organized as follows:

- Section 2.0: Site Description presents background information on OU B, and discussions of previous investigations and removal actions in OU B;
- Section 3.0: Site-specific Sampling Plans contains sampling and analysis plans for each of the 44 sites which require characterization;

- Section 4.0: Data Quality Objectives describes the criteria used to establish specific data quality objectives (DQOs) for the OU B RI SAP;
- Section 5.0: Sampling Equipment and Procedures summarizes the proposed types of equipment and procedures to be used to collect soil, soil gas sediment, and surface water samples during the OU B RI;
- Section 6.0: Sample Handling and Analysis presents a summary of the proposed sampling and analytical methods to be implemented for use during the OU B RI;
- Section 7.0: Health and Safety Plan presents a brief description of the Health and Safety Plan;
- Section 8.0: Schedule contains the proposed schedule for implementing the field investigation activities proposed in the OU B RI SAP;
- Section 9.0: References is a list of references cited throughout the report;
- Appendix A: Remedial Investigation Decision Process presents the protocol to be followed for complete characterization of each site;
- Appendix B: Derivation of Levels of Concern for Health Risk Assessment presents a discussion and presentation of the calculations used to derive the levels of concern for the health risk assessment; and
- Appendix C: Health and Safety Plan is the complete plan.

2.0 SITE DESCRIPTION

McClellan Air Force Base (AFB), an Air Force Logistics Command Center, is located approximately 7 miles northeast of downtown Sacramento, California and comprises approximately 2,952 acres within irregularly configured boundaries (Figure 2-1). The base property is bounded approximately by Elkhorn Boulevard on the north, Roseville Road on the south, Watt Avenue on the east, and Raley Boulevard on the west. McClellan AFB lies near the eastern edge of the Sacramento Valley, an area characterized by low topographic relief. Its land surface slopes very gently to the west. The major drainages in the region are the Sacramento and American Rivers, which lie to the west and south, respectively.

McClellan AFB currently employs approximately 17,000 personnel, including 3,500 military personnel and approximately 13,500 civilian employees. Base operations include the management, and maintenance and repair of jet aircraft, electronics, and communications equipment.

The land on which McClellan AFB was developed was low density residential and agricultural prior to 1936. Land in the area surrounding McClellan AFB is now used for a combination of industrial, commercial, residential, and agricultural purposes. To the east of the base are low density residential subdivisions. In the area south of McClellan AFB and bordering residential areas are parcels zoned for commercial and office use. The Rio Linda community northwest of the base consists of large-lot rural residences. Some of the Rio Linda area immediately adjacent to the base has been zoned industrial-intensive. To the southwest of McClellan AFB in OU B, land use is principally low density residential, with some industrial and a few commercial parcels.

The approximate boundaries of the Operable Units (OUs) are shown in Figure 2-2. The eastern side of McClellan AFB, including OUs A and H, is densely developed, and contains the administration offices, housing for active duty personnel, and most of the repair and maintenance facilities and aircraft hangers. The western side of McClellan AFB, including OUs C and D, has fewer buildings and is dominated by large grassy fields. The northern part of the base, including OUs E, F, and G, is characterized by open fields interrupted only by the northern part of the aircraft runway and service roads.

Operable Unit B covers the southwestern portion of McClellan AFB and a portion of the residential off-base area to the south (Figure 2-3). The on-base facilities

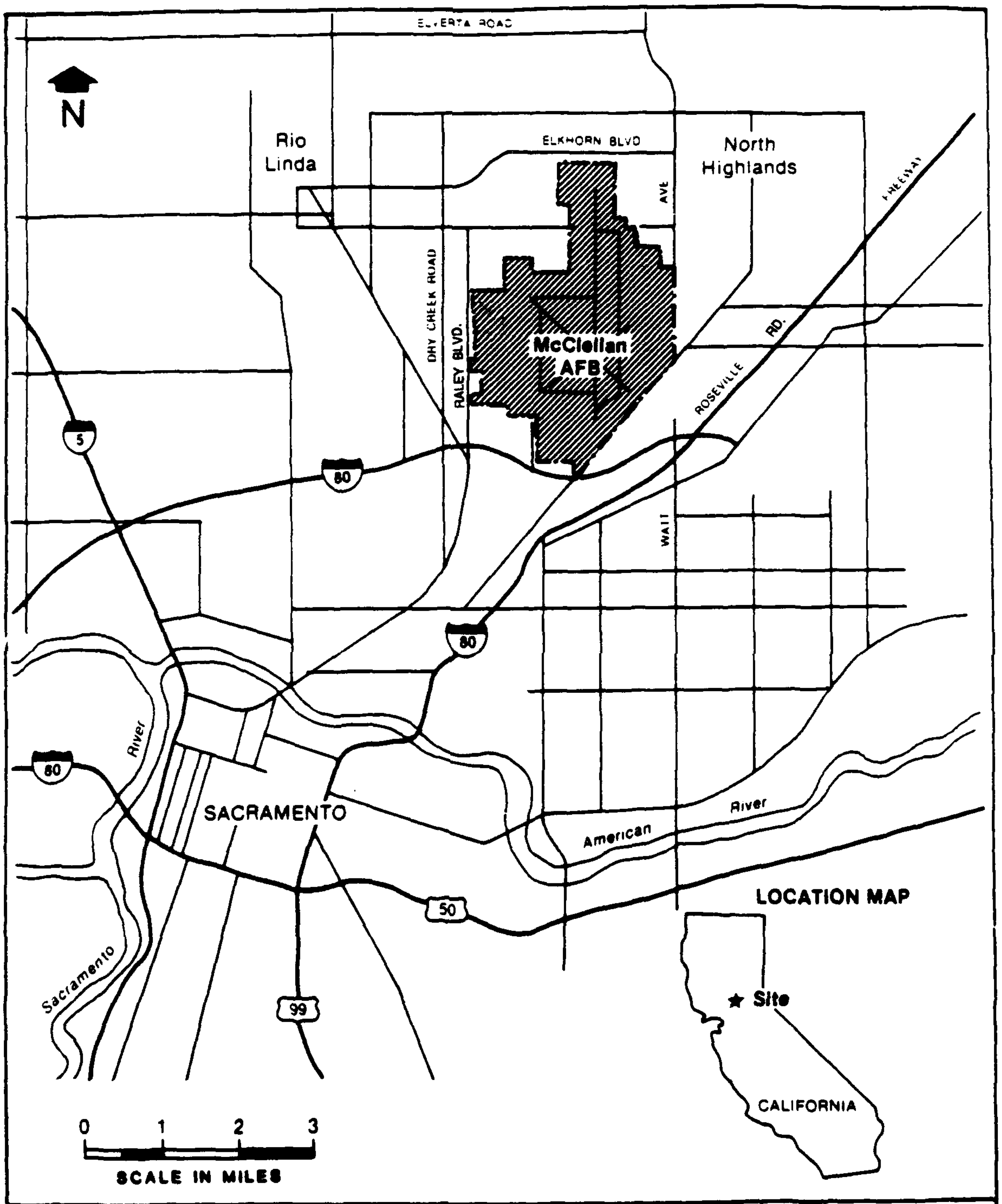

Figure 2-1. Location of McClellan Air Force Base, California.

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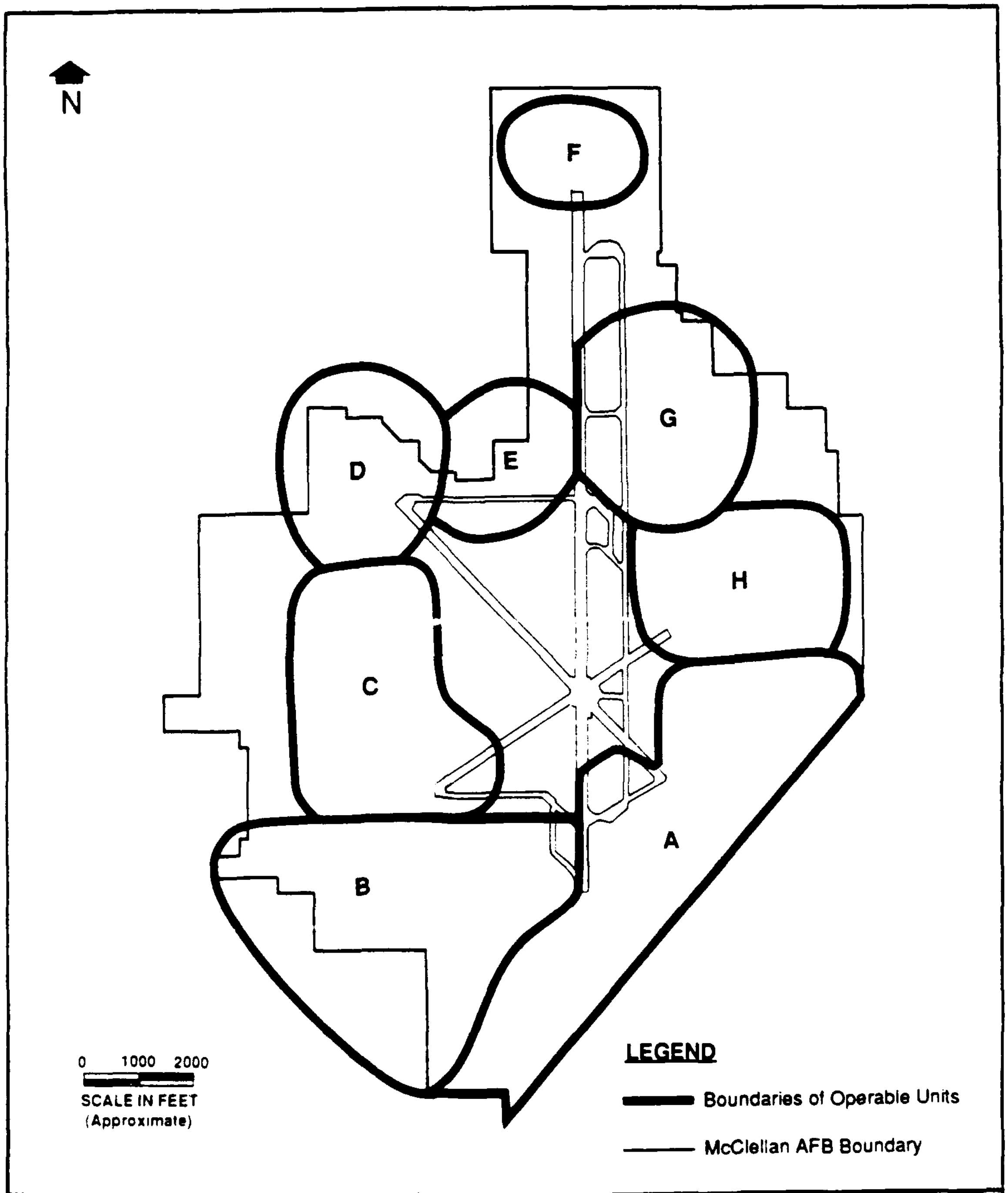

Figure 2-2. Approximate Boundaries of Operable Units at McClellan AFB.

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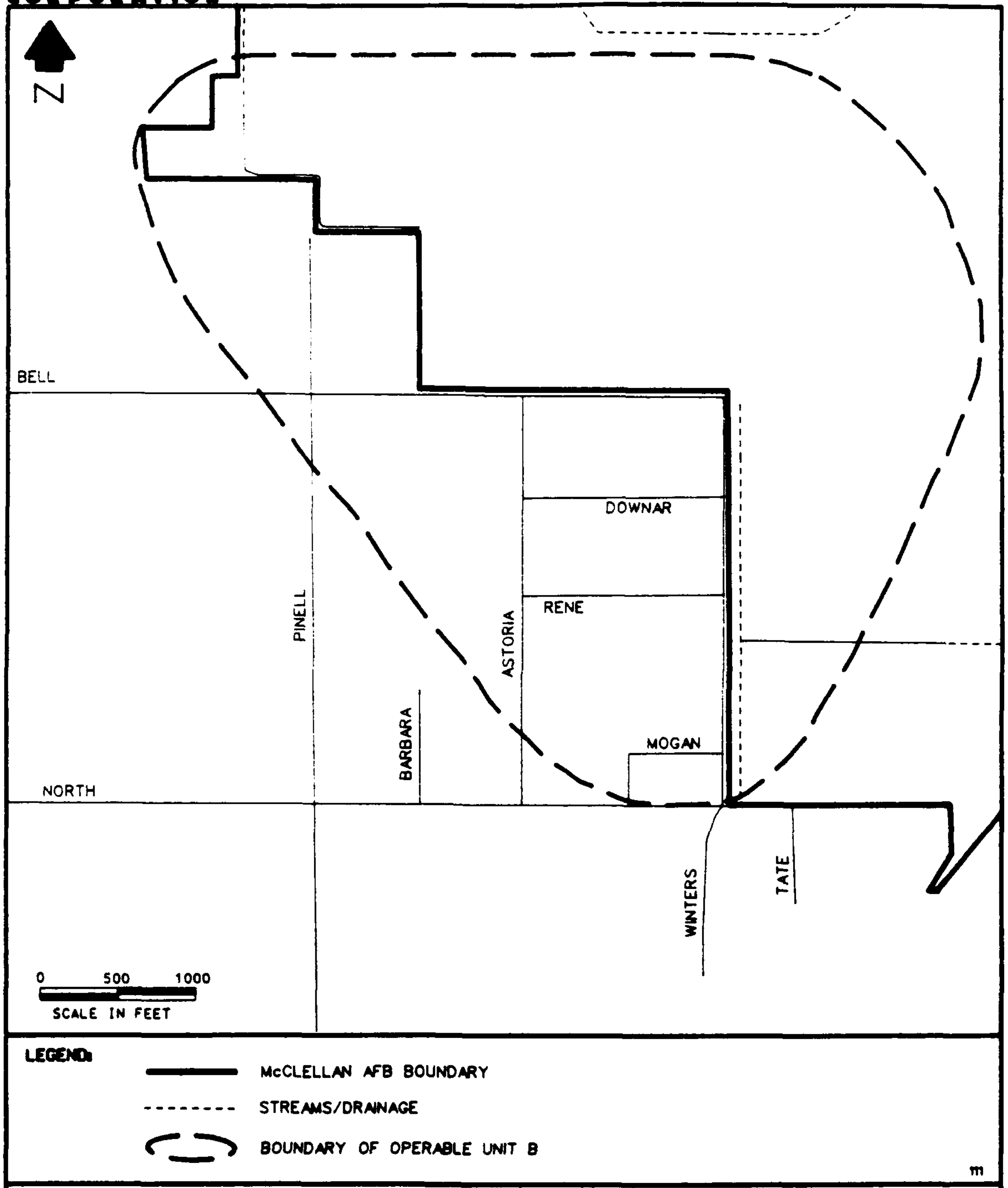

Figure 2-3. Location of Operable Unit B.

in OU B consist of open storage lots; warehouses; former waste storage, disposal, and treatment areas; maintenance facilities; underground tanks and pipelines; a dismantled plating shop; and the site of a former laboratory. Approximately half the surface area of the on-base part of OU B is occupied by open storage lots and warehouses. The off-base portion of OU B is characterized by low density residential housing, open fields, and limited commercial or industrial facilities.

2.1 Type of Facilities and Operational Status

The distribution of on-base facilities in OU B are shown in Figure 2-4. Warehouses and open storage areas, particularly those where hazardous materials handling was confirmed, are identified on Figure 2-5. In addition, three inactive waste disposal sites and three inactive waste treatment facilities are located in OU B (Figure 2-6) and are discussed in Section 2.2. There are currently no operating waste disposal or treatment facilities in OU B. However, the Defense Reutilization and Marketing Office (DRMO) maintains a hazardous materials storage lot near the western edge of OU B (Lot 3--Potential Release Location [PRL] S-13, Figure 2-5).

Both active and inactive aircraft and vehicle maintenance facilities in OU B, centered around the Building 655 area (Figure 2-4), include a paint stripping washrack (Building 658), vehicle maintenance shops (Buildings 652 and 655), a steam boiler plant (Building 656), and vehicle fueling/defueling areas (Buildings 603, 657, and 659). Until they were dismantled in 1988, a metal plating shop (Building 666) and its wastewater pretreatment plant (Industrial Wastewater Treatment Plant [IWTP] No. 4) stood to the east of Building 655. Additional maintenance facilities are the aircraft maintenance hangers located on the perimeter of Mat K, and the washracks located near Building 688.

Underground facilities include the Industrial Wastewater Line (IWL) (shown as PRL L-5 on Figure 2-5), which runs through the central portion of OU B, and the underground storage tanks located throughout OU B. Laboratories are located in Buildings 618, 620, 628, and 677. The laboratory that formerly occupied part of Building 628 was used for research and chemical analysis, and generated hazardous materials, including radionuclides; it is no longer in operation. Building 677 is an equipment calibration laboratory for flow meters and manometers, and Buildings 618 and 620 are software and electronics laboratories; these three buildings generate little or no hazardous waste.

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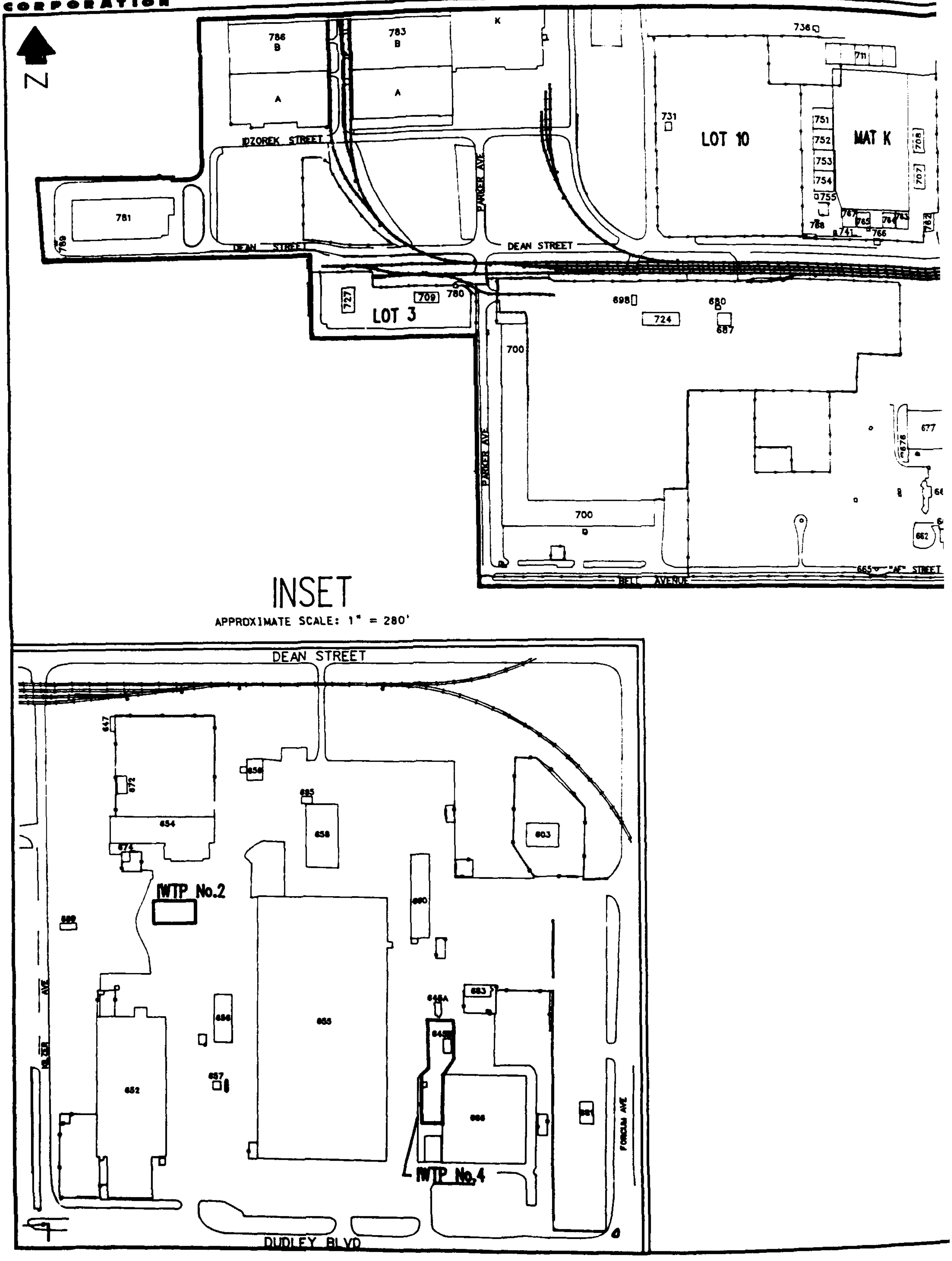

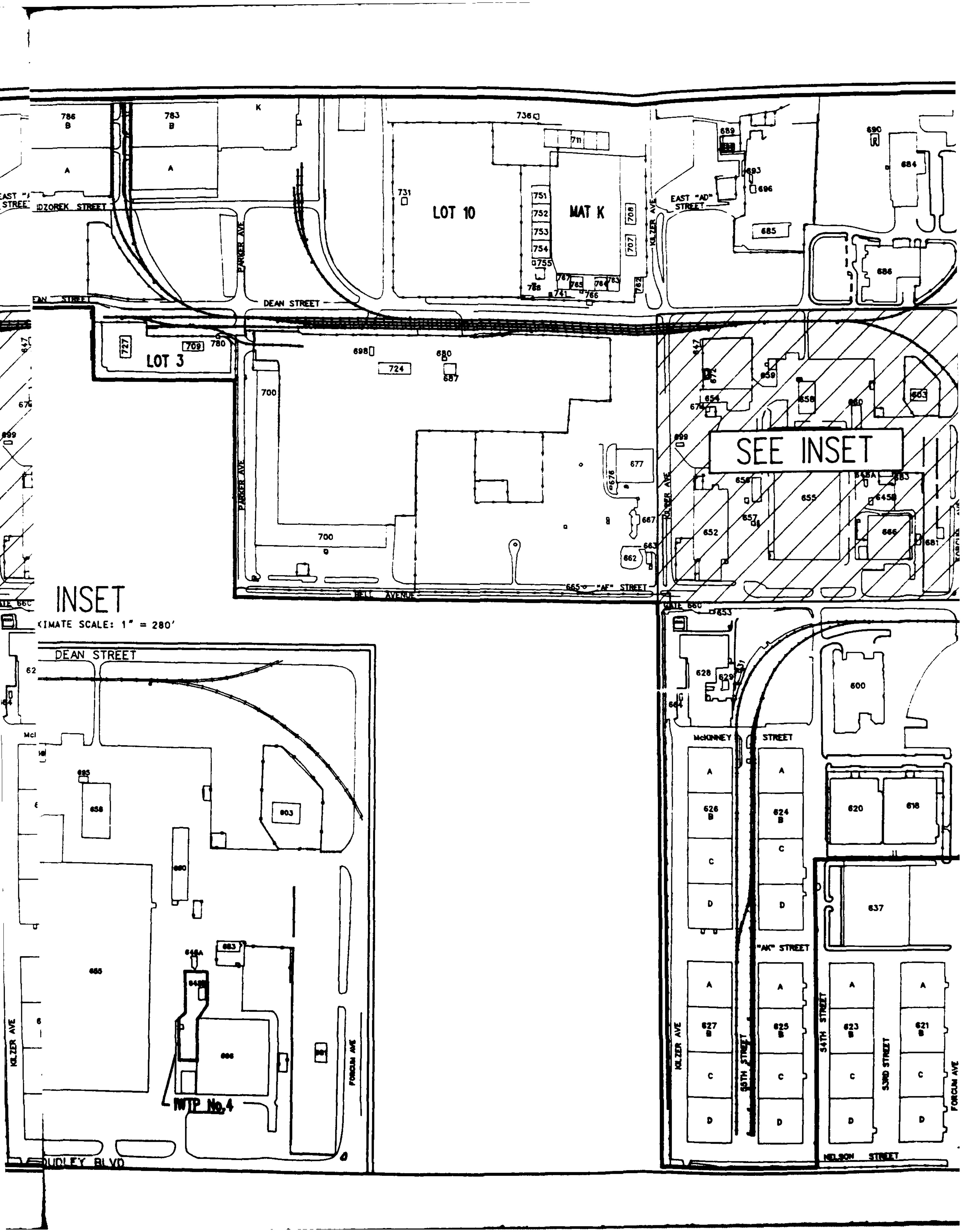

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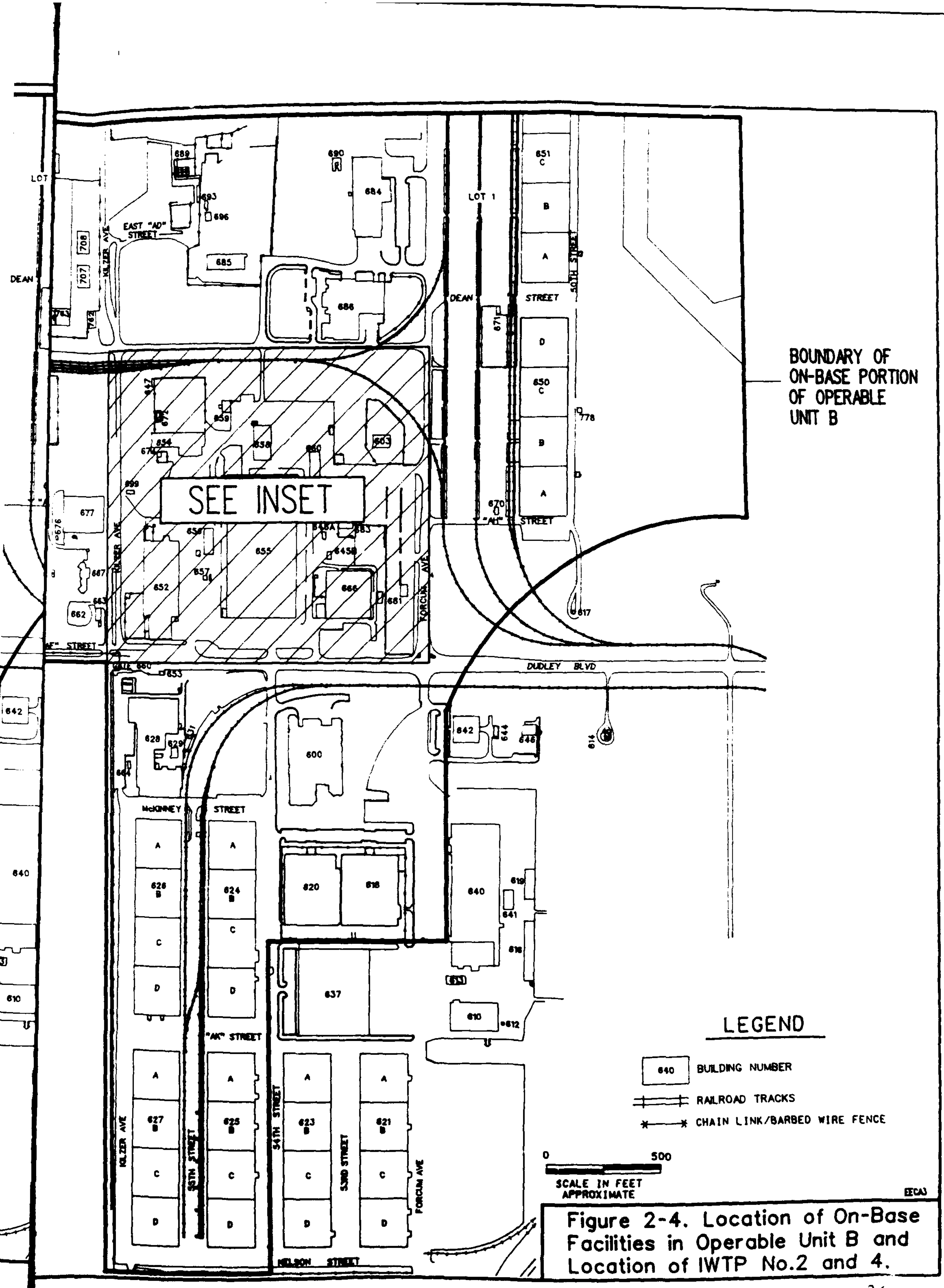
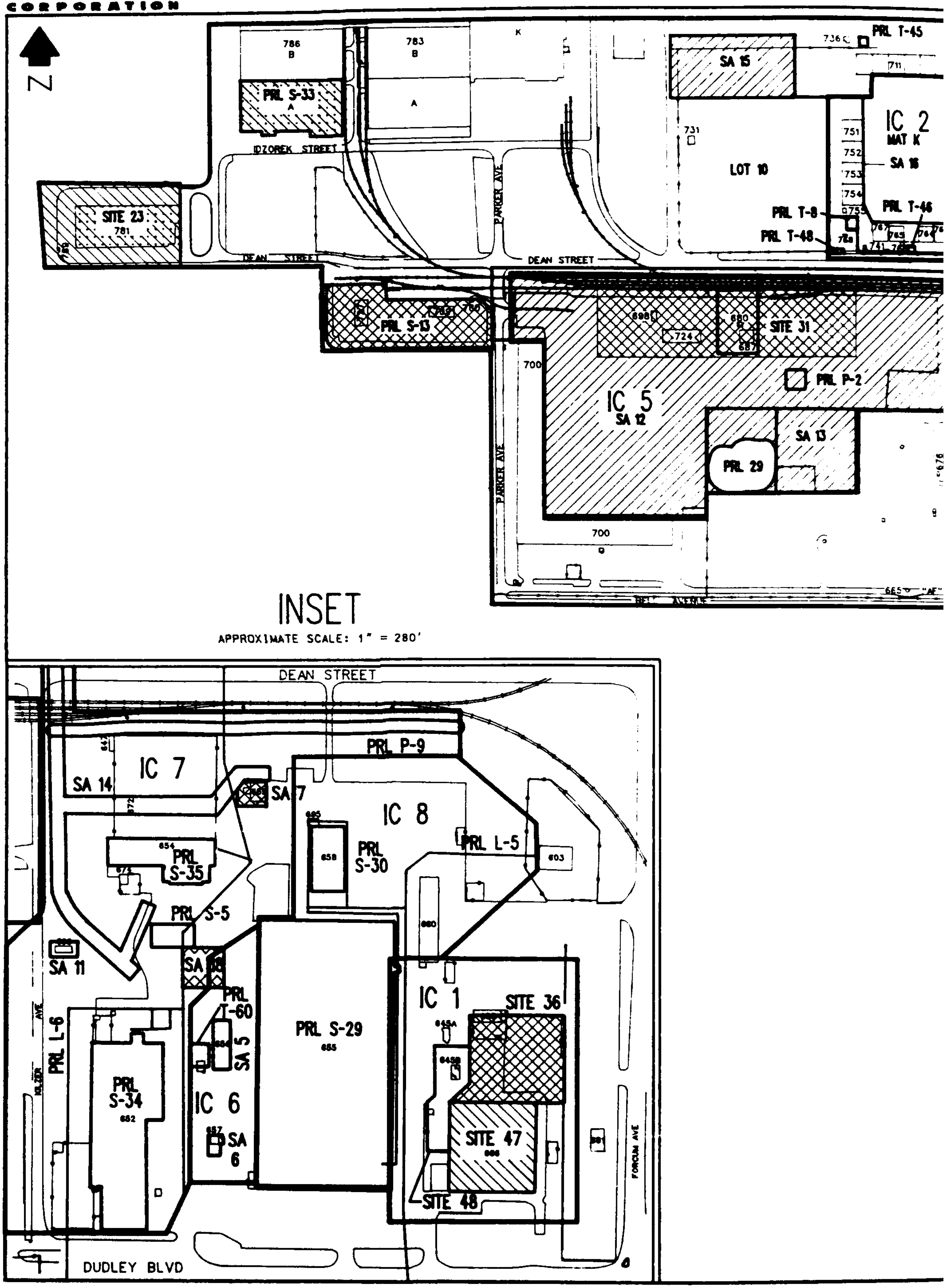


Figure 2-4. Location of On-Base Facilities in Operable Unit B and Location of IWTP No.2 and 4.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PRL L-5
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SA 11
SA 8
PRL T-60
SA 5
PRL S-29
655
IC 1
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PRL S-34
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SITE 48
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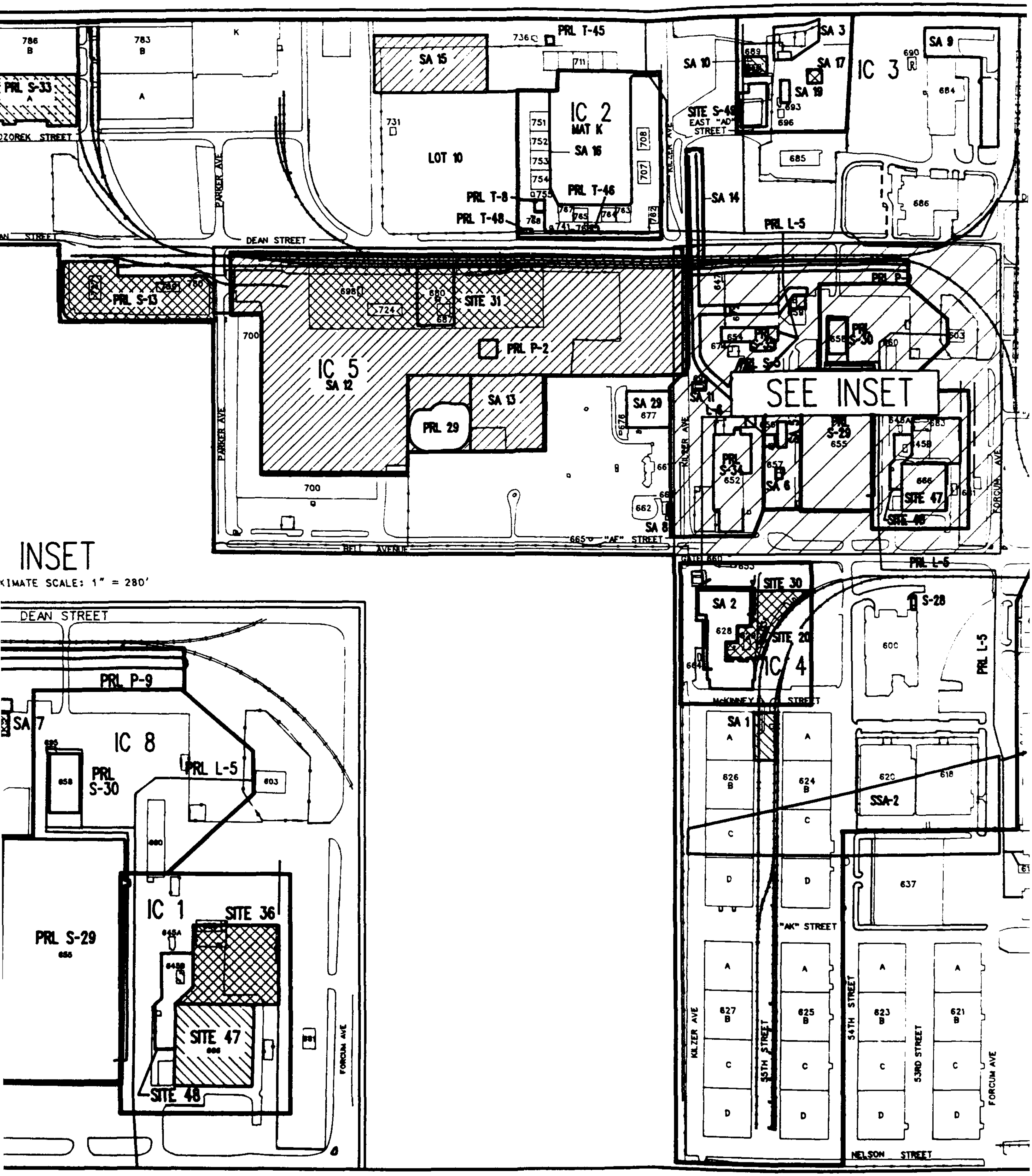
KILZER AVE
DUDLEY BLVD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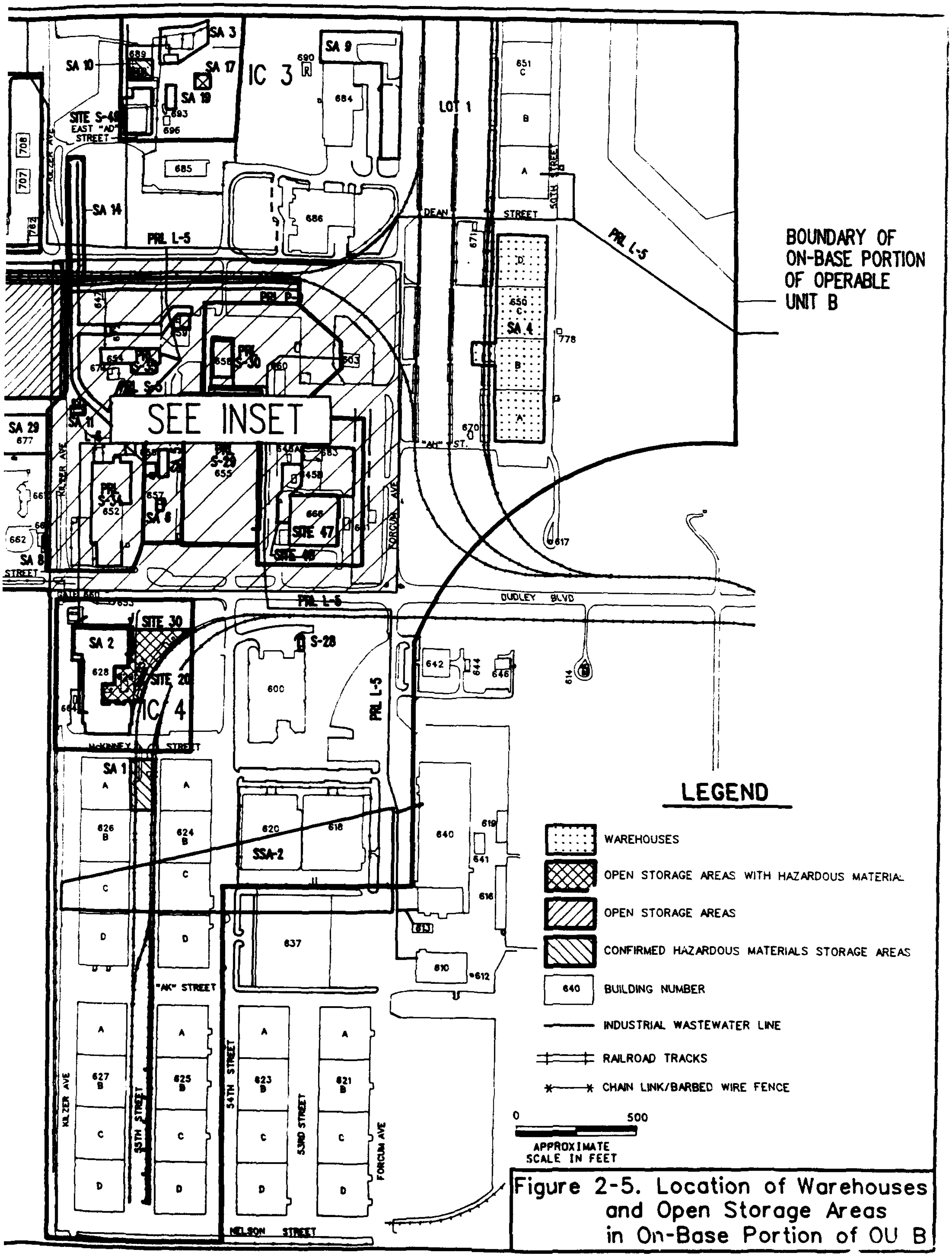

Figure 2-5. Location of Warehouses and Open Storage Areas in On-Base Portion of OU B

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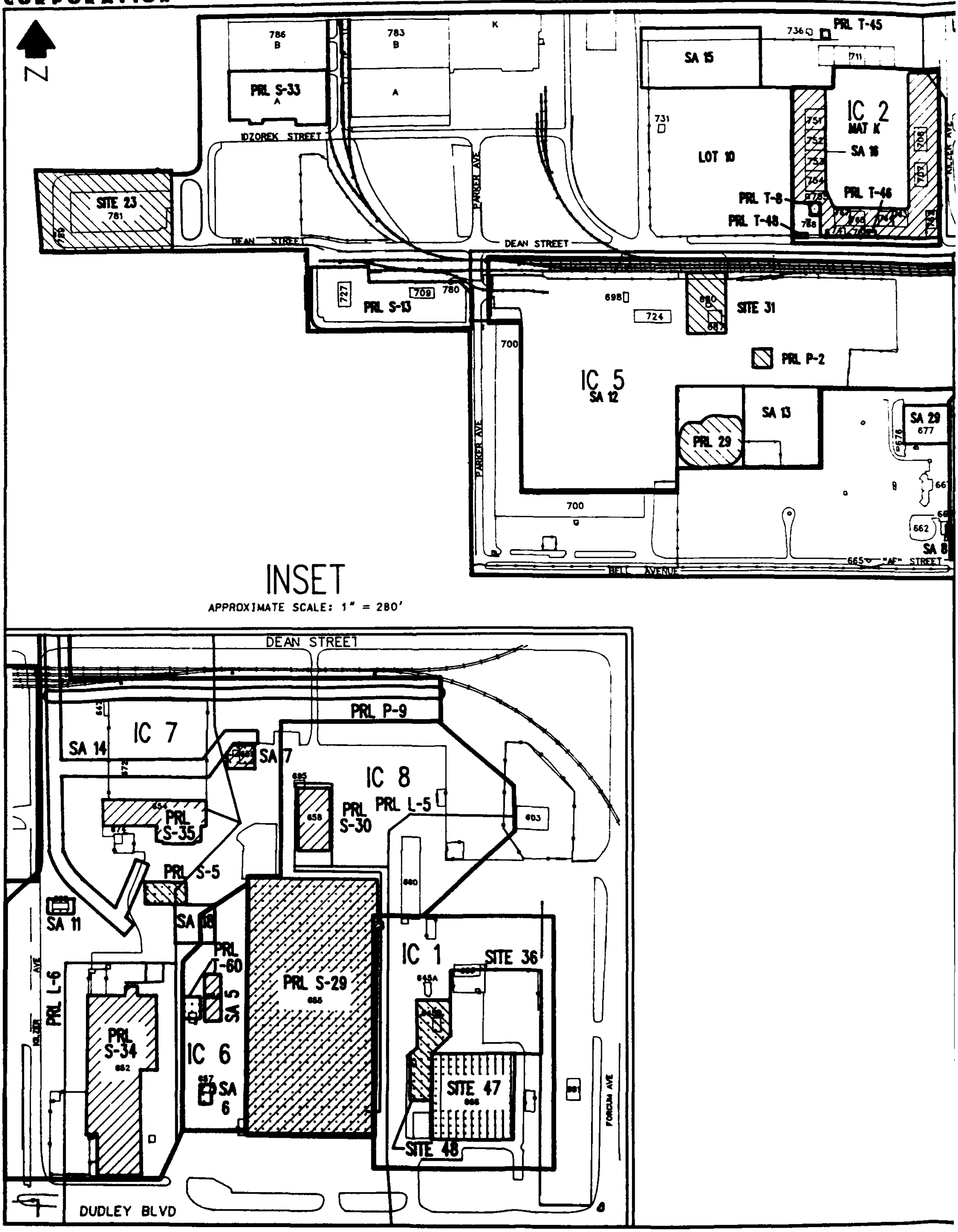
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FORCUM AVE
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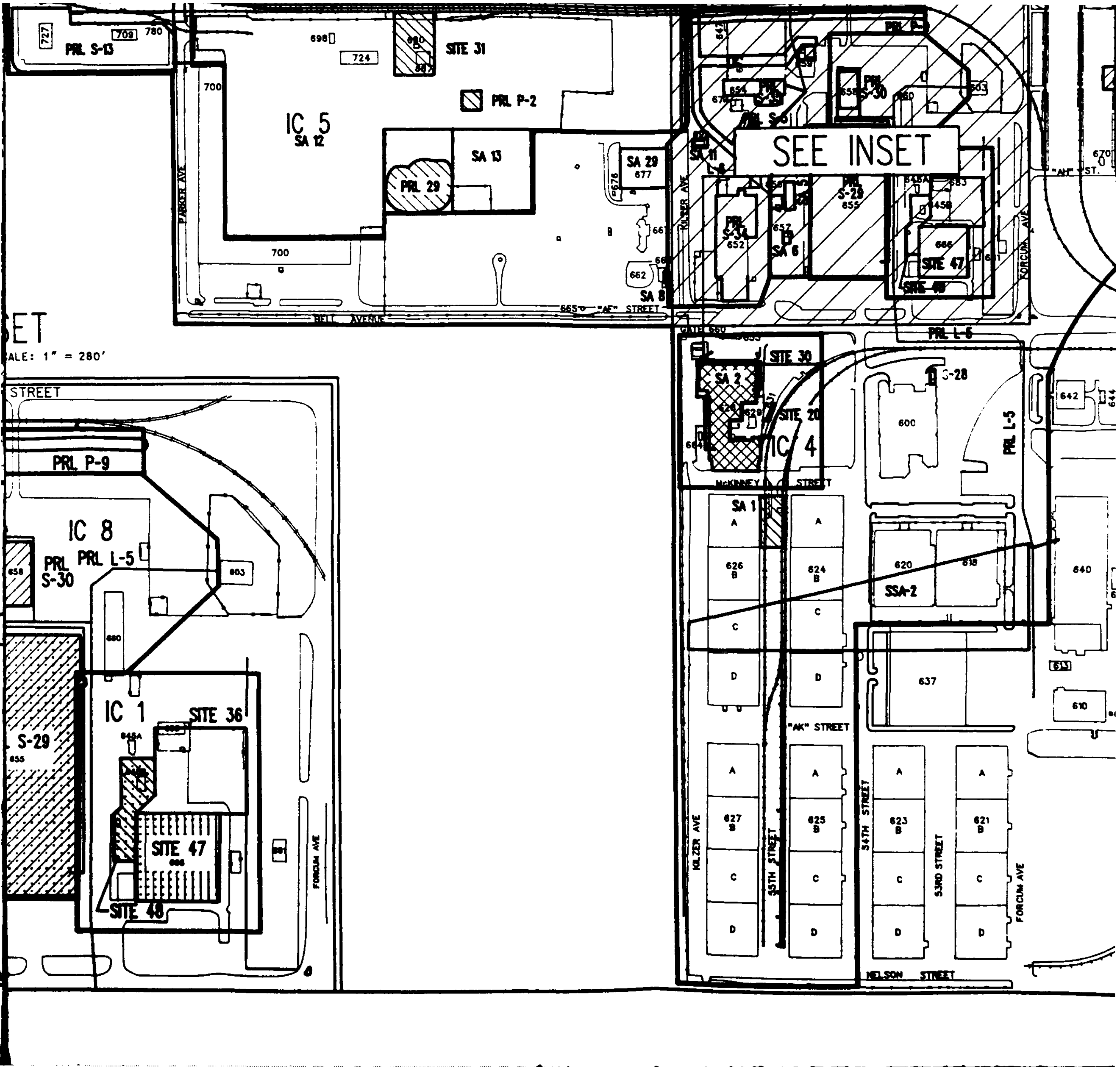
PRL S-13
727
709
780
698
724
SITE 31
PRL P-2
700
IC 5
SA 12
SA 13
PRL 29
SA 29
677
676
PARKER AVE
700
662
SA 8
665 "AE" STREET
BELL AVENUE
SEE INSET
PRL P
PRL S-30
PRL S-3
SA 11
PRL S-34
652
657
SA 6
PRL S-29
655
645A
583
645B
666
SITE 47
SITE 48
603
670
"AH" ST.
KILZER AVE
FORCUM AVE
ET
ALE: 1" = 280'
STREET
PRL P-9
IC 8
PRL L-5
658
PRL S-30
603
680
S-29
655
IC 1
SITE 36
645A
SITE 47
686
SITE 48
FORCUM AVE
GATE 660
653
SITE 30
SA 2
628
629
SITE 20
664
IC 4
McKINNEY STREET
SA 1
PRL L-6
S-28
600
642
644
PRL L-5
A
626 B
C
D
A
624 B
C
D
620
618
SSA-2
640
637
613
610
"AK" STREET
A
627 B
C
D
A
625 B
C
D
A
623 B
C
D
A
621 B
C
D
KILZER AVE
55TH STREET
54TH STREET
53RD STREET
FORCUM AVE
NELSON STREET

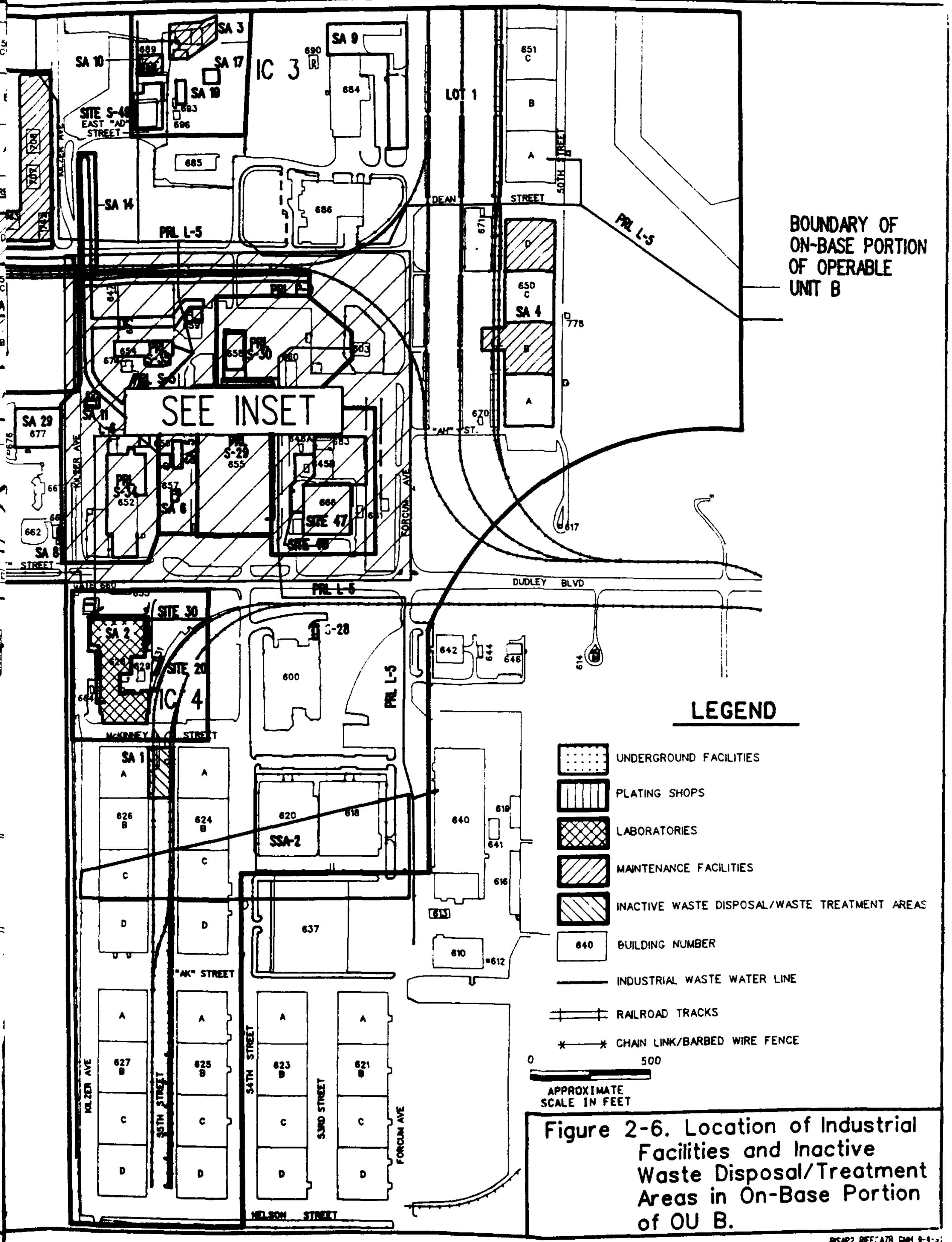

Figure 2-6. Location of Industrial Facilities and Inactive Waste Disposal/Treatment Areas in On-Base Portion of OU B.

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The warehouses and open storage areas of OU B are served by an extensive network of roads and railroad tracks. Major on-base access to OU B is via Dudley Boulevard (Figure 2-4), which connects the southwestern, southern, and eastern sides of McClellan AFB. Off-base access to OU B is via Gate 660 at Bell Avenue (Figure 2-4).

2.2 Site Topography and Surface Features

The land surface of McClellan AFB is a relatively level plain, which slopes gently to the west. Elevations range from 80 feet above mean sea level (msl) on the east side to approximately 50 feet above msl on the west side, a drop of 30 feet in elevation over approximately 2 miles (Figure 2-7). The major drainages in the vicinity are the Sacramento River, located approximately 6 miles west of McClellan AFB, and the American River, located approximately 4 miles to the south (Figure 2-8).

The major surface features at McClellan AFB include the north-south runway, taxiways, paved aircraft parking areas, aircraft maintenance hangers, and warehouses. Approximately forty percent of the surface of McClellan AFB is covered by building foundations, parking areas, runways, roads, and other paving; the remainder of the surfaces consists of grassy fields or soils with little or no vegetation. A system of open drainage ditches and covered storm drains direct runoff from the paved and unpaved areas to natural and man-made drainage channels.

Land elevation in OU B ranges from about 65 feet at the eastern boundary to about 50 feet at the western boundary. Approximately 60 percent of OU B is covered by building foundations and paving. Surface water runoff in the northwestern part of OU B flows into the Magpie Creek channel, which drains off-base to the west. Runoff from the southeastern part of OU B flows to Arcade Creek through artificial drainage ditches. Principal drainage areas are discussed in Section 2.4.

2.3 Soils

Soil types in the vicinity of McClellan AFB are extremely variable. The surface soils (less than five feet deep) have formed from mixed alluvium derived from stream erosion of granitic rocks in the Sierra Nevada. A silica-cemented hardpan has developed over large areas at 20 to 40 inches below the ground surface. Surface textures are predominantly loams and sandy loams which are underlain by finer-textured loam and sandy clay loam horizons above the hardpan (U.S. Department of Agriculture,

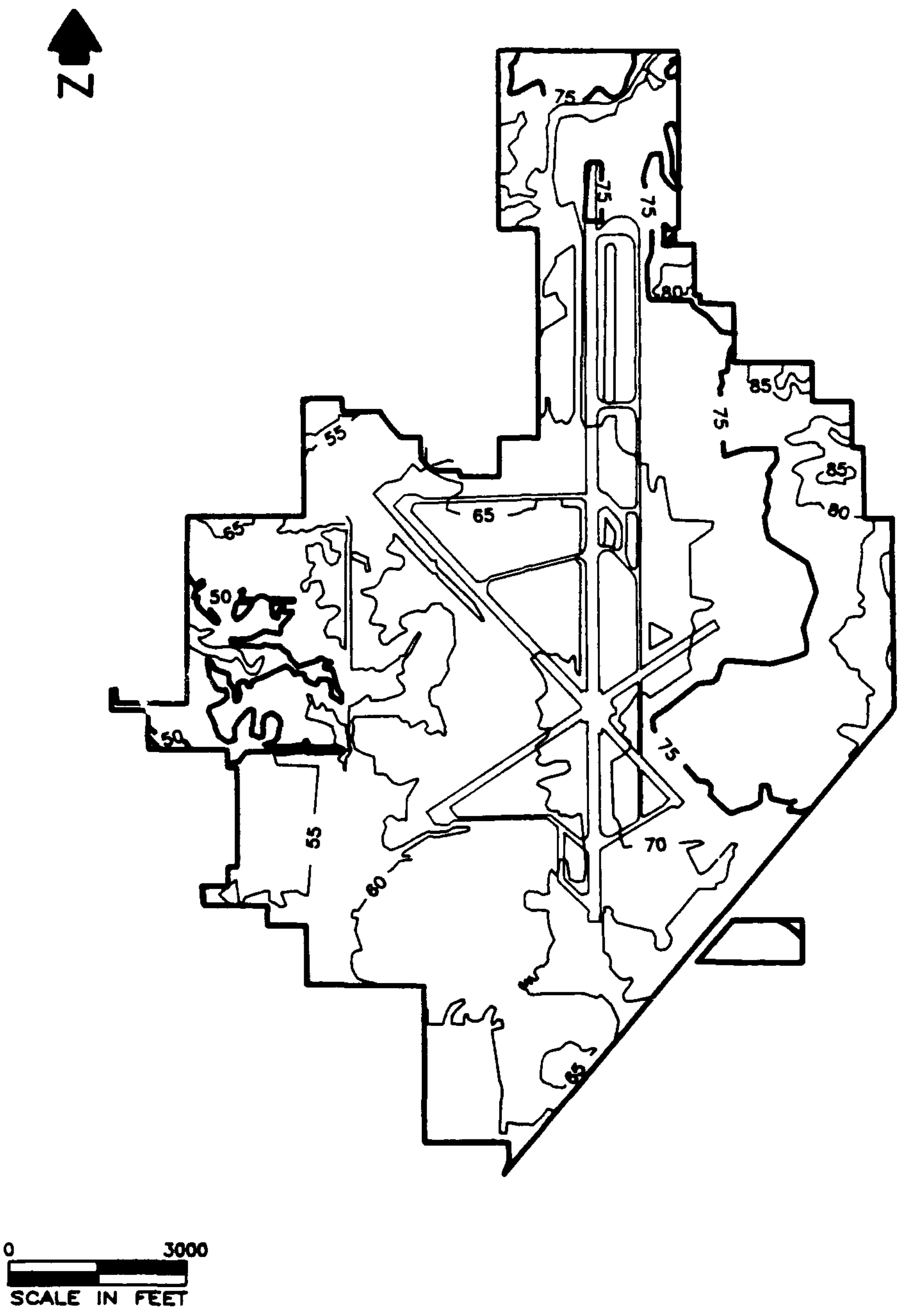

Figure 2–7. Topographic Map of McClellan AFB

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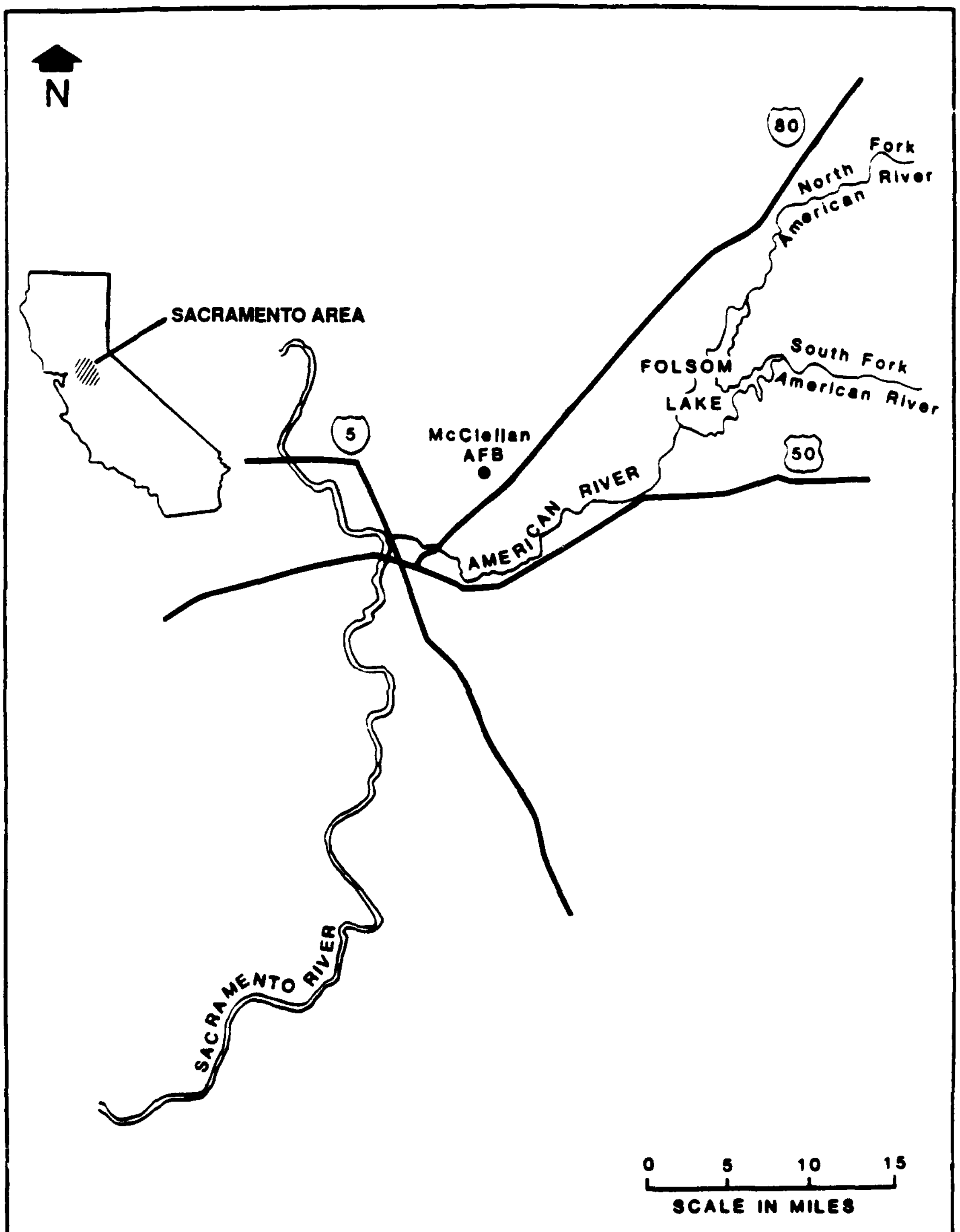

Figure 2-8. Major Drainages in the Vicinity of McClellan AFB.

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1990). Soils on McClellan AFB may not have the natural textures or layering of the original soils because of excavation and disturbance from development or covering by concrete and asphalt. Where soils are relatively undisturbed, permeabilities range from 0.6 to 2.6 inches per hour, depending on local amounts of clay and hardpan. The local soils are classified as San Joaquin fine sandy loam, Fiddyment fine sandy loam, or San Joaquin-Xeralfic Arents complex (U.S. Department of Agriculture, 1990). These soils have a low shrink-swell potential, a slight erosion potential, and a very low available water capacity of approximately 0.10 to 0.14 inches of water per inch of soil. These soils are primarily used for pasture; their agricultural capabilities are reported to range from fair to poor (McClellan AFB, 1987).

The primary surface soil types in OU B are urban land, Durixeralfs, San Joaquin sandy loams, and xeralific arents, as shown on the OU B agricultural soils classification map (Figure 2-9). Physical properties of the soils are shown on Table 2-1. Urban land soils, which are indicated as mapping unit "A" on Figure 2-9, are those which have been covered by paving, buildings, or are otherwise obscured. Xeralfic arents are soils that have been mixed by plowing, spading, or other human activities and, therefore, do not contain their natural soil horizons.

2.4 Surface Water

Surface water from McClellan AFB drains toward and is discharged primarily into four small creeks: Robla, Don Julio, Magpie, and Arcade. These creeks are fed by the McClellan AFB storm drainage system, which is a network of underground pipes, culverts, and open drainage ditches that collect storm runoff from streets and other paved areas. Two of these creeks, Robla and Magpie, originate off-base to the east, and convey surface water onto the base from the east. The drainage patterns and the courses of Robla, Don Julio, and Magpie Creeks have been modified on McClellan AFB for building, runway, and road construction. The most southerly creek, Arcade, does not cross McClellan AFB.

Because of surficial topography, McClellan AFB is divided into four drainage areas, each of which runs from east to west (Figure 2-10). Surface water originating in each area is channeled into the nearest creek draining that area and is discharged from the base to the west (Robla and Magpie) or to the south (Arcade). All four creeks flow into the Natomas East Drainage Canal southwest of McClellan AFB. The canal flows south and west until it discharges into the American River.

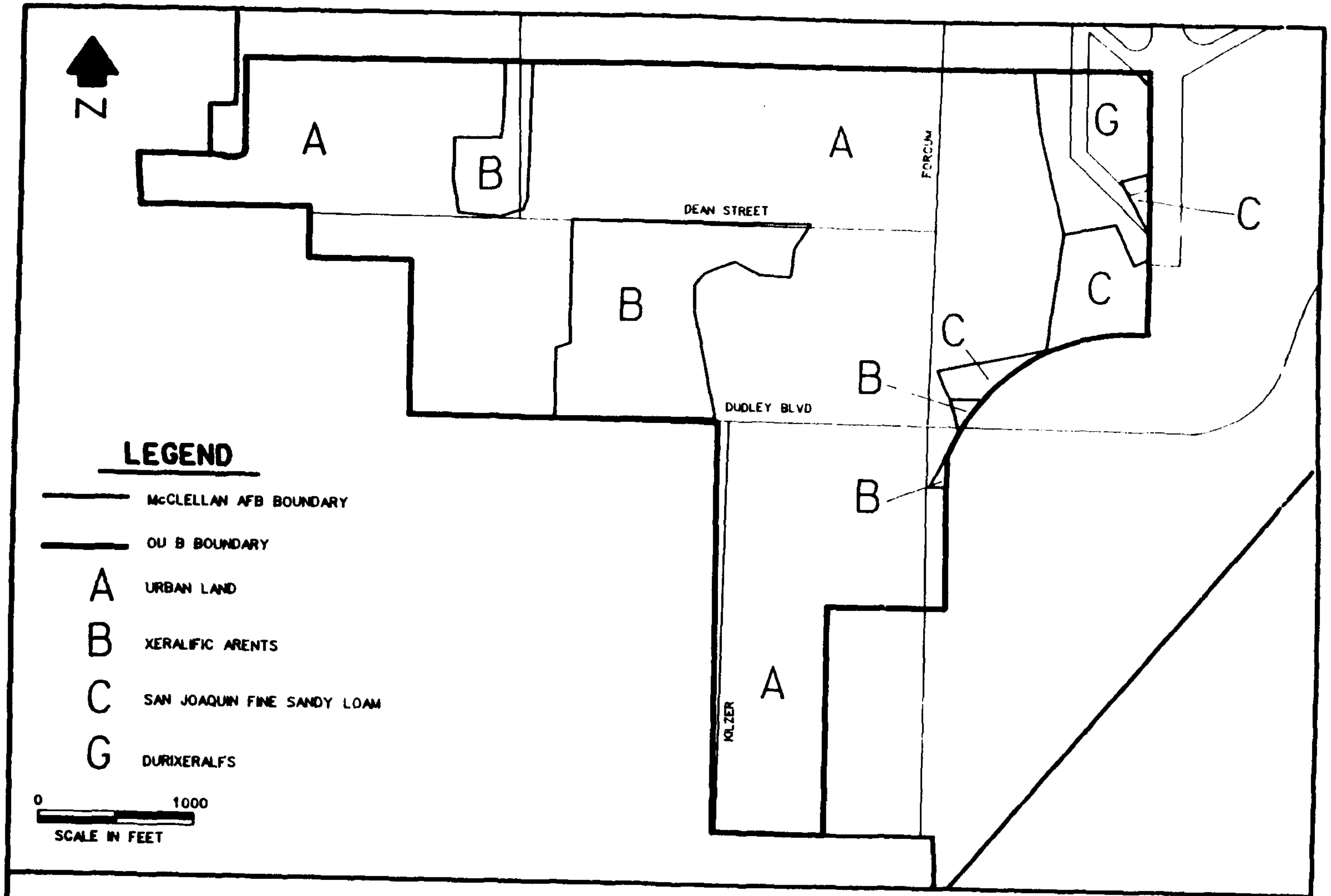

Figure 2-9. Soils Classifications in OU B at McClellan AFB.

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TABLE 2-1. PHYSICAL PROPERTIES OF SOILS IN OU B AT McCLELLAN AFB

Soil Name	Soil Type (Material)	Permeability	Available Water Capacity	Depth to Hard Pan	Shrink-Swell Potential	Runoff	Erosion Potential	Use
Urban land (A)	**Altered or disturbed soils**	--	--	--	--	--	--	Urban land
Xeralific Arents (B)	**Loamy sand to sandy loam**	Moderate to very slow	Moderate to high	35" - 60"	Low to high	Very slow to slow	Slight	Urban development
San Joaquin fine sandy loam (C)	**Fine sandy loam**	Very slow	Low	23" - 40"	High	Very slow to slow	Slight	Urban development or pasture
Durixeralfs (G)	**Clay loam to sandy clay loam**	Slow to very slow	Very low to low	10 - 30"	--	Very slow	None to slight	Irrigated crops

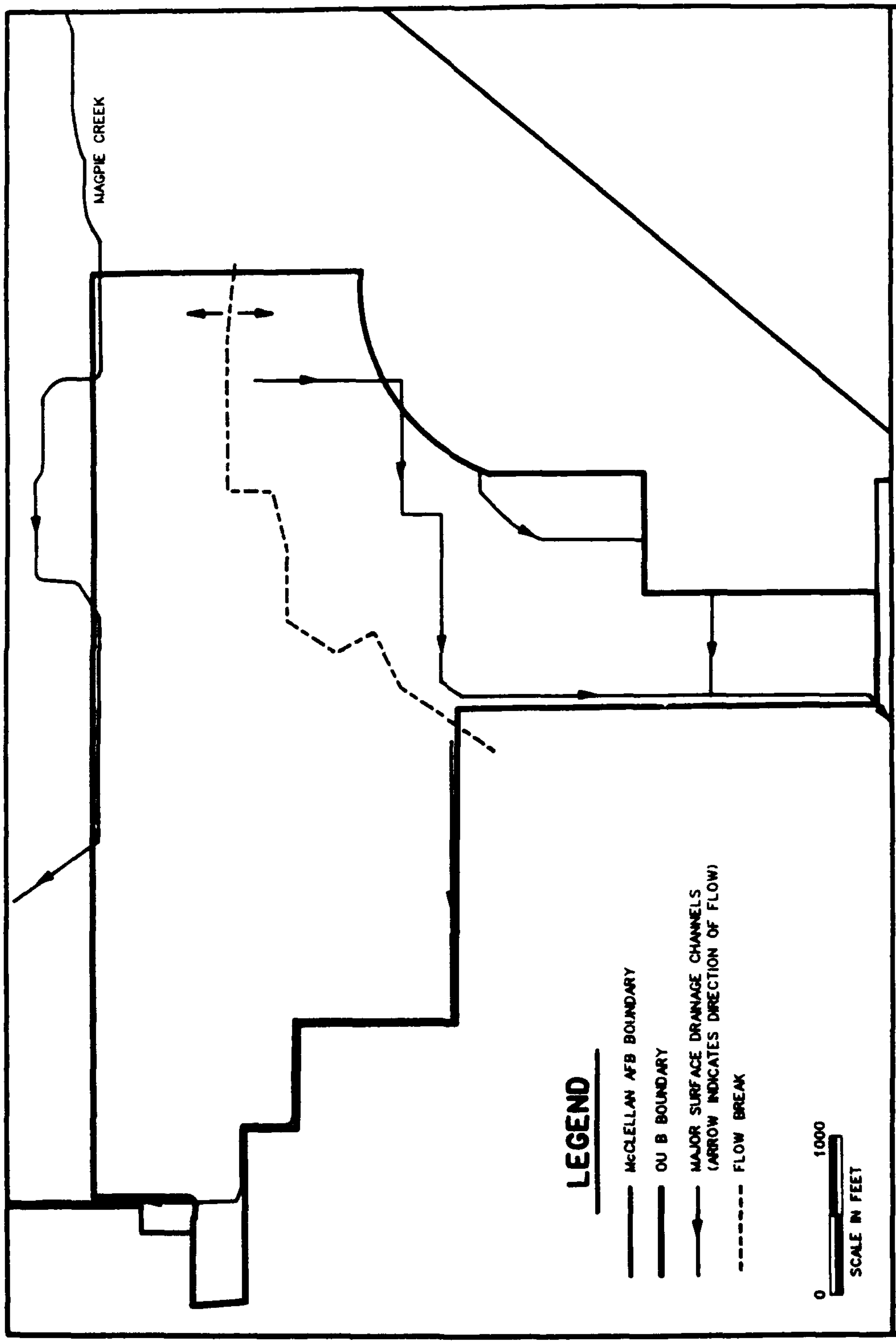

Figure 2-10. Surface Drainages in OU B at McClellan AFB.

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Magpie Creek enters the southeast side of the base near Myrtle Avenue and flows generally to the west across the base. Most of Magpie Creek has been channelized and a portion of it has been routed underground beneath the southern end of the runway. Magpie Creek is unpaved west of Patrol Road and the creek exits the base approximately 650 feet east of Raley Boulevard. Magpie Creek handles 38 percent of the drainage on the base (McClellan AFB, 1987). The 100-year flood plain map (Figure 2-11) indicates that Magpie Creek, as well as Robla and a portion of Don Julio creeks, will flood during the 100-year storm event.

Because of extensive paving and storm drain installation, recharge of groundwater by surficial water at McClellan AFB is extremely limited. Recharge is also restricted by the impermeable hardpan layers that are common in McClellan AFB soils. The most significant recharge source on the base is probably infiltration through unpaved stream channels and drainage ditches. Discharge of groundwater onto the surface at the base is precluded by the depth to groundwater, which is typically about 90 to 100 feet below the ground surface.

Operable Unit B is split into two drainage areas by a slight topographic high that trends from southwest to northeast through the middle of the operable unit. Surface water north of this dividing line flows into Magpie Creek, and surface water south of this line is discharged into Arcade Creek. The 100-year flood plain map indicates that the part of northern section of OU B along the course of Magpie Creek will be flooded during the 100-year storm event (Figure 2-11).

2.5 Groundwater

Beneath McClellan AFB and adjacent areas, groundwater migrates through the pores of unconsolidated sediments deposited by runoff from the Sierra Nevada. Groundwater flows beneath McClellan AFB from the east and is drawn toward depressions in the groundwater surface created by well pumping. The entry and spread of contaminant compounds has locally affected the quality of groundwater and has brought about groundwater investigations and remedial actions.

2.5.1 Groundwater Hydrology

In the vicinity of McClellan AFB, fresh groundwater may occur in deposits from depths of approximately 90 to 1400 feet, but water is withdrawn primarily from production wells screened from approximately 145 to 400 feet below ground surface

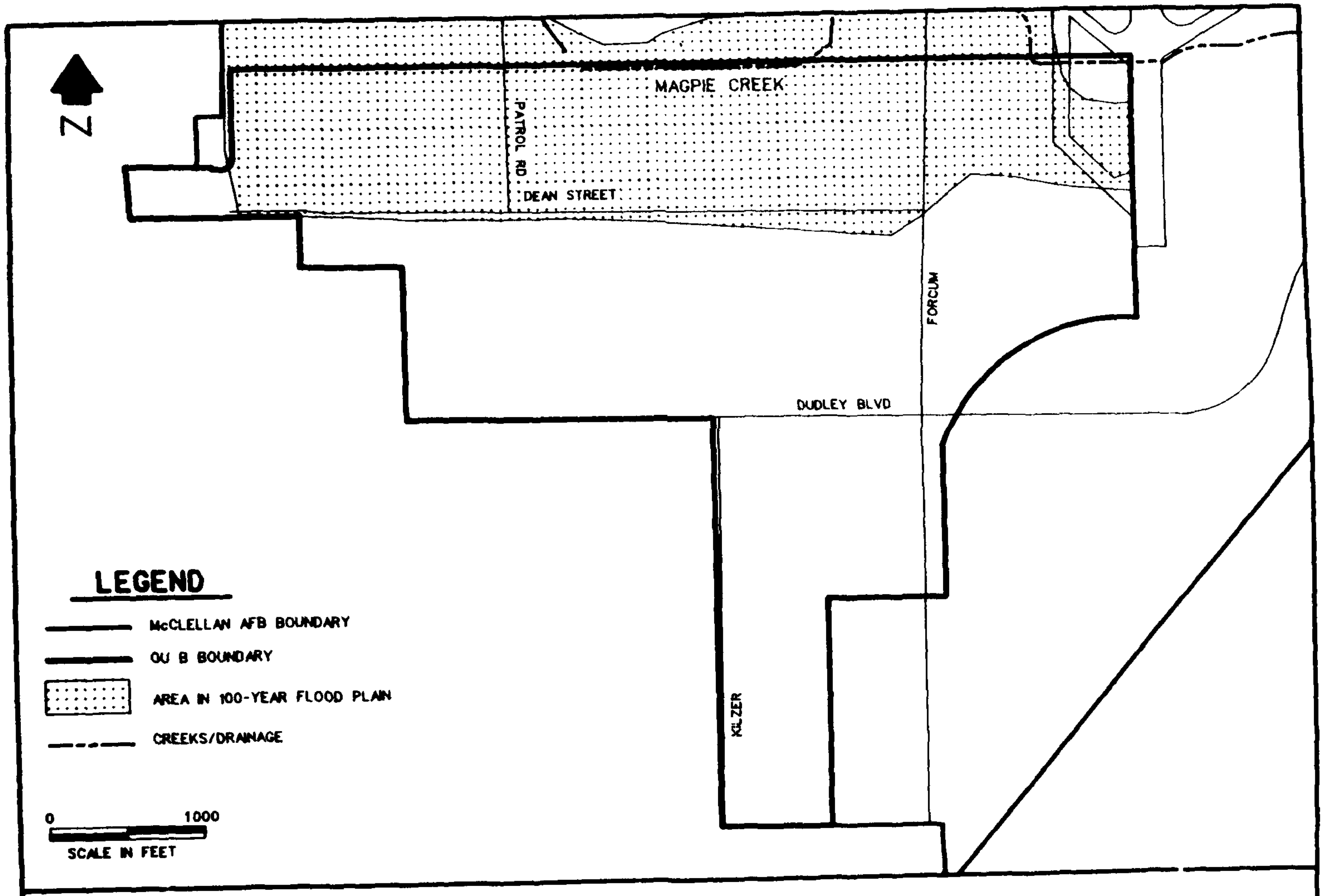

Figure 2-11. 100 Year Flood Plain in OU B at McClellan AFB.

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(BGS). Groundwater recharge in the eastern portion of the Sacramento Valley occurs as a result of leakage from streams and rivers, percolation of precipitation and irrigation water through soils, and migration of runoff along fracture zones and formation contacts in the foothills of the Sierra Nevada. The upper waterbearing zone in the Sacramento Valley is recharged predominantly through percolation of water from the ground surface. This process is generally inhibited by the presence of a hardpan layer. Therefore, groundwater recharge to the upper zone occurs predominantly through past and present stream channels where they penetrate the hardpan. These channels consist of permeable sands and gravels that allow percolation of surface waters into the saturated zone. The permeable buried stream channels interlayed with less permeable sediments has resulted in a network of tabular, shallow aquifers throughout Sacramento County (CDWR, 1974).

A large portion of groundwater discharge in the Sacramento Valley is attributable to water supply well withdrawals. Since the turn of the century, the extraction of groundwater for irrigation, industrial, municipal, and domestic uses has substantially lowered groundwater levels. In the vicinity of Sacramento, groundwater flows toward two groundwater depressions (Figure 2-12). One of the depressions is centered just south of McClellan AFB, and the second is centered south of Sacramento approximately 15 miles south of McClellan AFB. These depressions are caused by the pumping of municipal and private wells. When McClellan AFB base wells are inactive, the regional groundwater flow beneath the base, and specifically beneath OU B, is to the south/southwest. Municipal wells located south of McClellan AFB that lie within the northern groundwater depression and cause southerly flow are shown in Figure 2-13. However, when base wells are pumping, groundwater flow under the base is strongly affected by the withdrawal of groundwater. Groundwater withdrawals at a principal McClellan AFB supply well in OU B cause groundwater at depths of 100 to 350 feet beneath OU B to flow toward the well from on-base areas to the northwest, northeast, and southeast and from off-base areas to the southwest of the well.

2.5.2 Geology

Investigations of geology and groundwater, conducted since 1980 at McClellan AFB, have been focused on soils and groundwater affected by contaminants. The greatest amount of information has been obtained from surface to a depth of approximately 430 feet. Groundwater and contaminant migration beneath McClellan AFB is controlled and influenced by geologic and hydrologic variability. The subsurface deposits beneath OU B and much of McClellan AFB to a depth of 430 feet are sands,

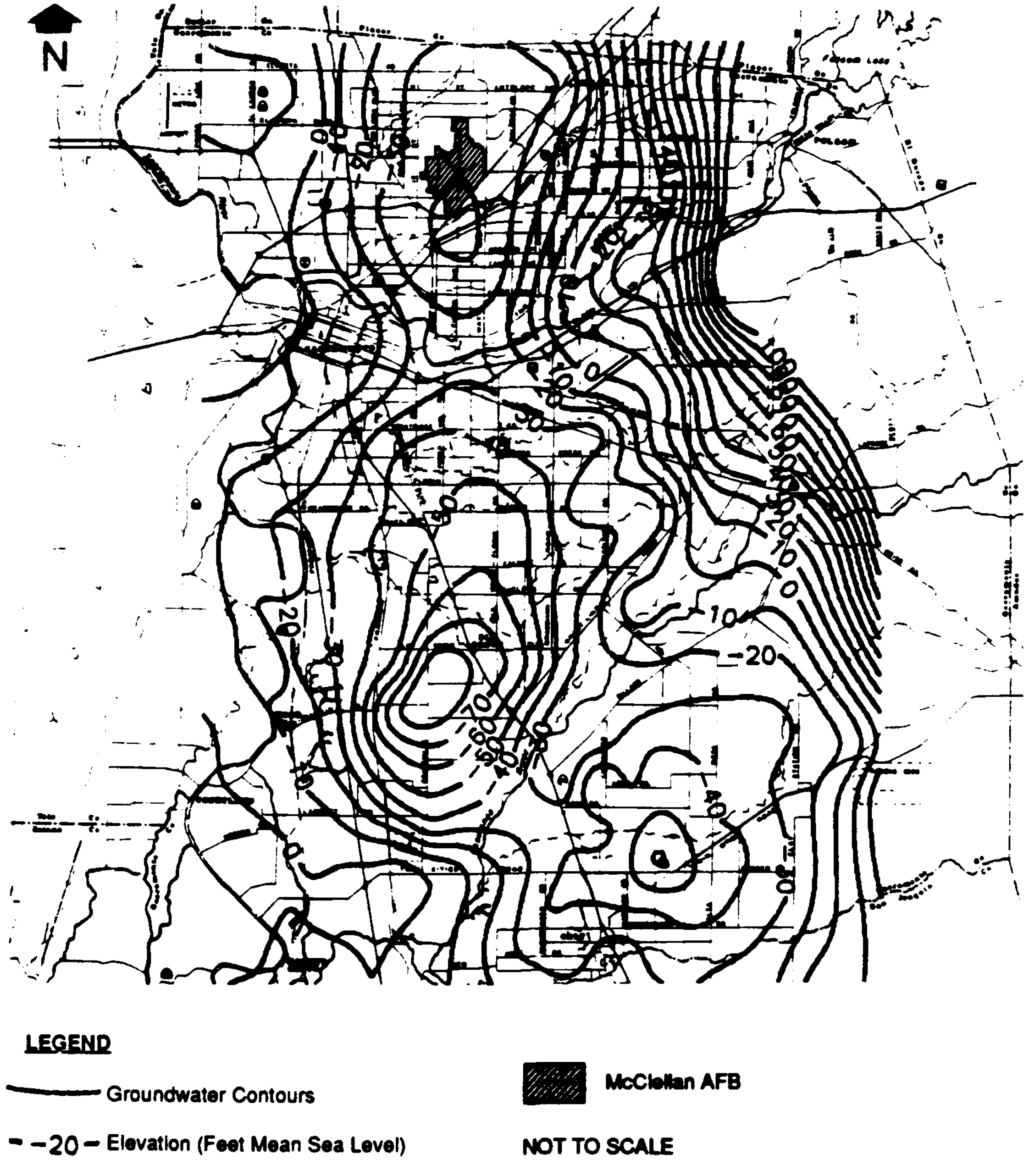

Figure 2-12. Groundwater Depressions Beneath Sacramento County Created by Supply Well Pumping, Fall 1989.

SOURCE: County of Sacramento Department of Public Works
Water Resources Division, 1989

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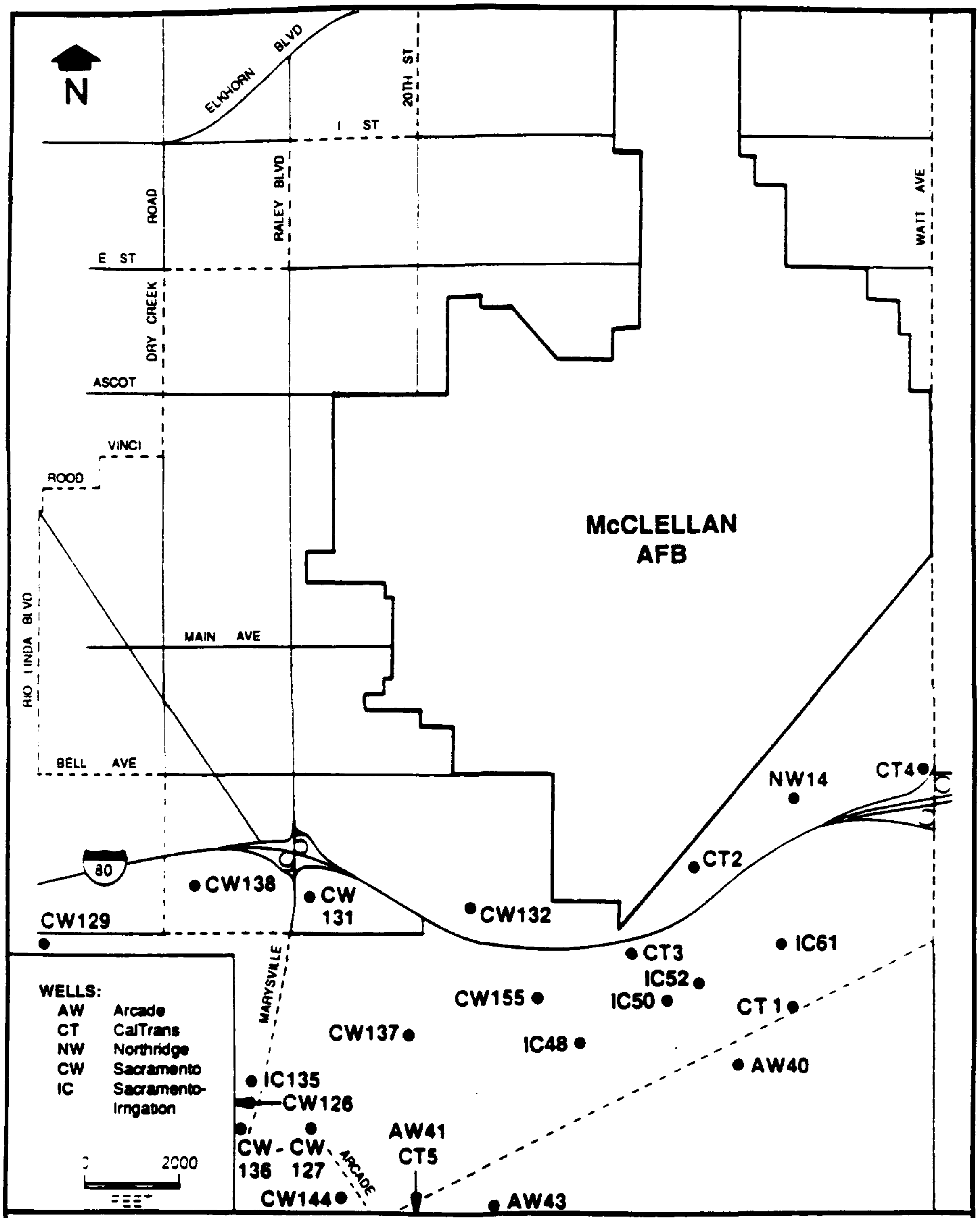

Figure 2-13. Location of Municipal Wells in or Near OU B.

1290-075-10

gravels, silts, and clays that were deposited by streams and floods flowing down from the Sierra Nevada over the last two million years. Evidence from the subsurface deposits of OU B and other areas of McClellan AFB suggests that streams active in the Pleistocene and Holocene epochs flowed from east to west, or northeast to southwest, through McClellan AFB and OU B. Stream deposits have great length along their downgradient course but are narrow in width and shallow in depth. Deposits consisting of one lithologic type, therefore, are limited in horizontal and vertical extent. Changes in the courses of streams over time cause the relative location and thickness of the coarsest stream bed sands and gravels and overbank silts and muds to vary. As a result of stream deposition and migration, characteristics of the deposits that affect groundwater flow (e.g., the horizontal and vertical permeability and thickness of deposits) vary widely with location and depth beneath McClellan AFB. Sand and gravel deposits occurring in or near former stream channels have the greatest permeability. However, stream channel deposits at depths of 100 to 430 feet are relatively narrow, widely spaced, and frequently separated from sands and gravels above and below by less permeable silt and clay deposits. The hydraulic properties of the deposits beneath McClellan AFB cannot be generalized because they vary from location to location.

The geology of deposits beneath OU B is similar to the remainder of McClellan AFB. Coarse sands and gravels deposited by streams lie 190 to 430 feet BGS in the central part of OU B. Data from deeper deposits is limited, and so knowledge of the deeper geology is also limited. To the north and south and at depths less than 190 feet BGS, deposits consist of fine sands, silts, and clays. The finer deposits have lower permeabilities and slow the movement of groundwater and any contaminants that are present.

2.5.3 Hydrogeology

The water table beneath McClellan AFB is typically 90 to 110 feet BGS and varies locally because of topography and the locations of cones of depression created by water supply wells. Beneath the water table are deeper waterbearing zones that are hydrologically separated over large areas but are locally interconnected where continuous fine-grained deposits are absent. Where they are present, fine-grained deposits, such as silts and clays, have the ability to restrict vertical movement of groundwater. Much of the groundwater flows horizontally through the coarser deposits in several groundwater zones. Because of local changes in the thickness or grain size of deposits, groundwater may move vertically between shallow and deeper groundwater zones.

To evaluate the movement of groundwater and contaminants beneath McClellan AFB, the subsurface from the water table to a depth of 430 feet BGS has been divided into six monitoring zones using geologic and hydrologic criteria. Each monitoring zone consists of a high to moderate permeability zone of sands or gravels and an underlying low permeability zone of silts or clays which creates a lithologic boundary. Locally, low permeability zones may be confining layers; however, in most locations, the boundary layers allow groundwater movement between zones. The monitoring zone designations are from shallowest to deepest, A (100 to 137 feet BGS), B (137 to 201 feet BGS), C (201 to 279 feet BGS), D (279 to 356 feet BGS), E (356 to 413 feet BGS), and F (deeper than 413 feet BGS). No wells have been completed in the F zone in OU B, and hydraulic conditions in this zone have not been evaluated. Beneath OU B, groundwater in each of the zones may move at a greater velocity or in a slightly different direction than in the zone above or below because of differences in permeability and hydraulic effects between zones.

2.5.4 Groundwater Flow

When McClellan AFB water supply wells are inactive, groundwater in the A, B, C, D, and E monitoring zones beneath OU B flows to the south or southwest, toward the large groundwater depression created by municipal well pumping for the City of Sacramento. However, when BW-18 is pumping, groundwater flow under OU B is strongly affected by the withdrawal of groundwater. The effects of pumping BW-18 on groundwater in the A, B, and C zones are reflected in the potentiometric surface maps in Figures 2-14, 2-15, and 2-16. During much of 1989 and early 1990, BW-18, the principal supply well for McClellan AFB, was pumped at a rate of approximately 1140 gallons per minute (gpm) (dry season) and 930 gpm (wet season), 20 to 24 hours a day, seven days a week. Hydrologic data collected during 1989 and 1990 indicate that BW-18 significantly alters groundwater flow within all zones and affects both vertical and horizontal gradients within each zone beneath OU B. Under the 1989 daily rate of discharge, a large portion of flow through the A, B, C, and D zones beneath OU B is captured by BW-18. The effects of pumping by BW-18 differ within each zone and the hydraulic response by each zone is dependent upon hydraulic separation between zones, permeability, depth, recharge from surface waters, and the depth of screen intervals in BW-18.

In general, the cone of depression created by pumping BW-18 within OU B is elliptical and trends northeast to southwest. The effects on water levels of pumping BW-18 decreases with distance from the well; that distance varies between zones. Base Well 18 has four screened intervals occurring from 169 to 185 feet (B zone), 210 to 260

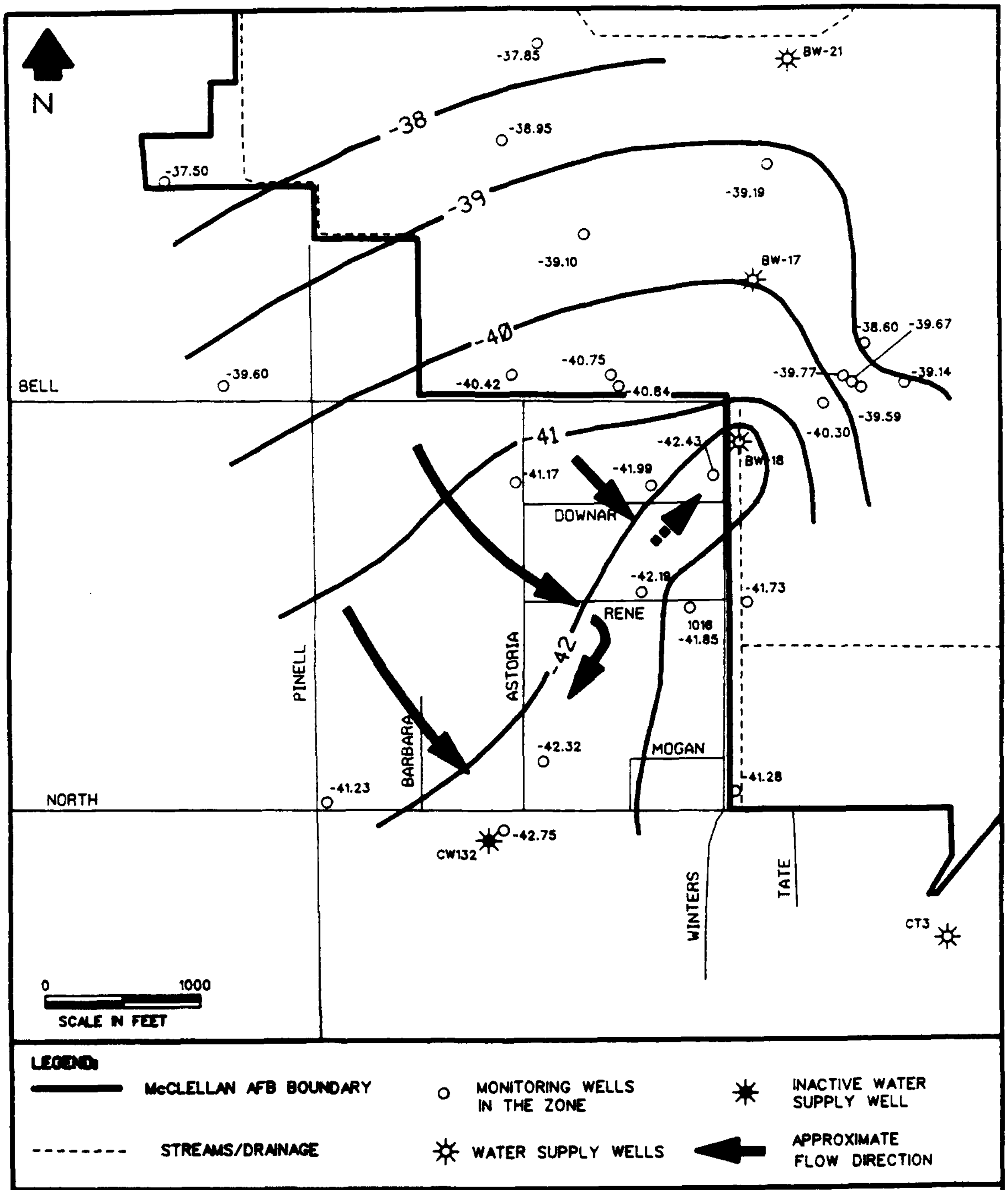

Figure 2-14. Potentiometric Surface Map for A Geohydrologic Zone With BW-18 Pumping, Operable Unit B April 1990.

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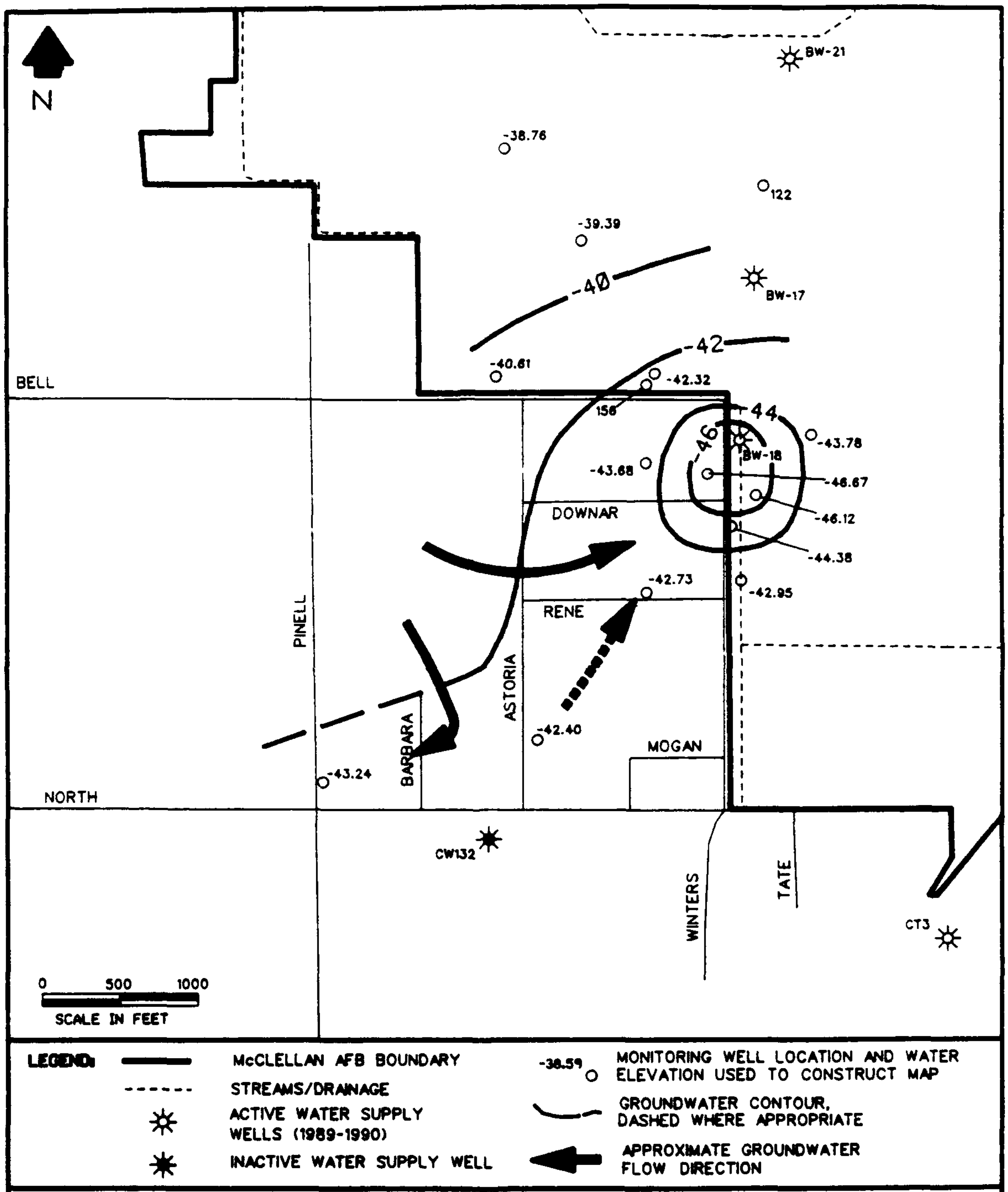

Figure 2-15. Potentiometric Surface Map for B Geohydrologic Zone, With BW-18 Pumping in Operable Unit B, April 1990.

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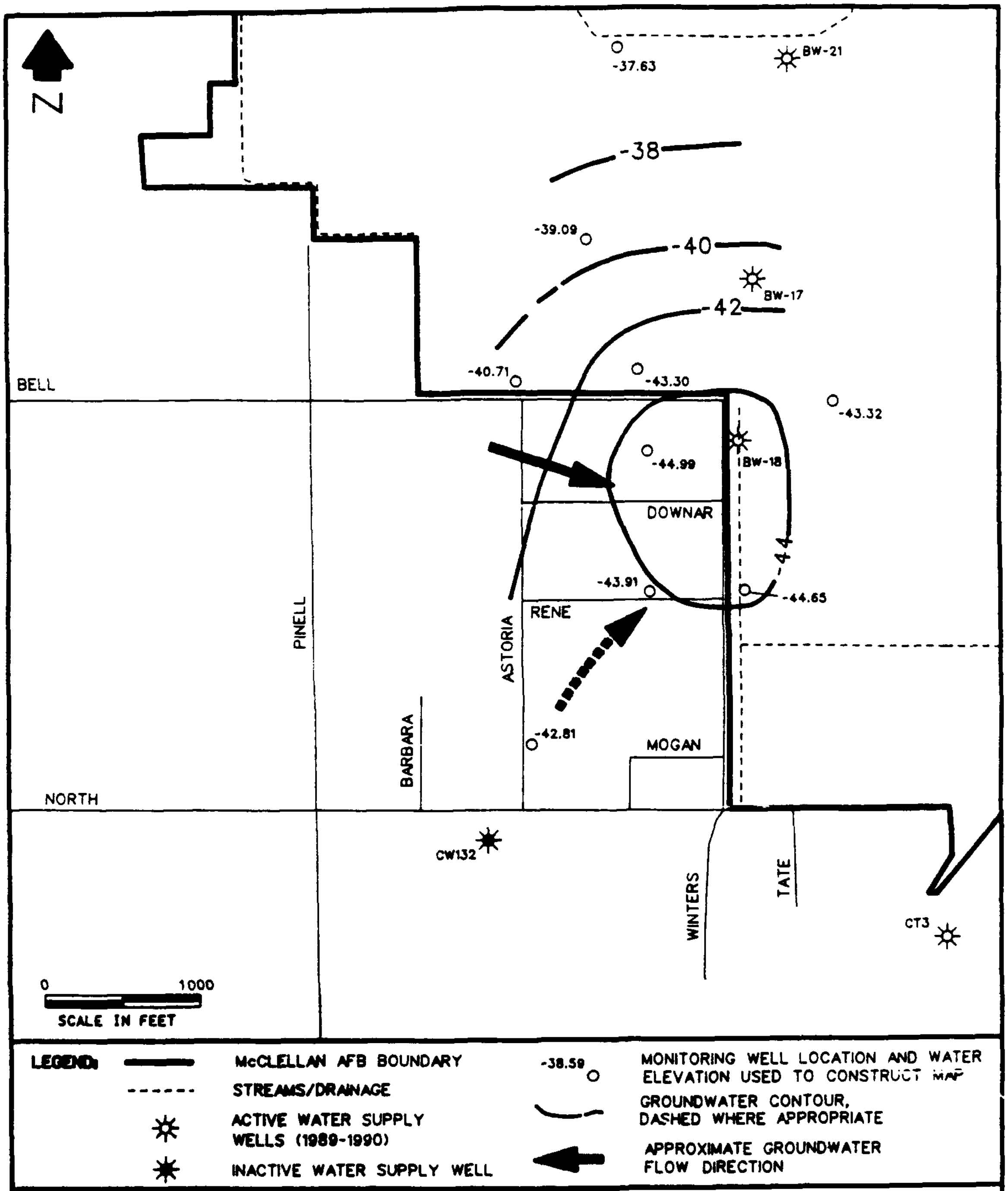

Figure 2-16. Potentiometric Surface Map for C Geohydrologic Zone, With Base Well-18 Pumping, Operable Unit B, April 1990.

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feet (C zone), 304 to 349 (D zone), and 378 to 387 feet (E zone) BGS. In general, the water-level data show that the C monitoring zone is the most strongly affected by BW-18 because the zone experiences the largest and most widespread difference in water levels between pumping and non-pumping conditions. The C zone is the most affected because the largest screened interval (50 feet) of BW-18 and the most permeable deposits occur in this zone. The B zone, however, is also strongly influenced near BW-18 although the supply well is only screened over 16 feet in this zone. Lower permeability deposits in the B zone and partial hydraulic connection with the C zone may contribute to BW-18's strong effect on the zone. The hydraulic impacts of BW-18 are less in the D zone and are least, but still important to groundwater flow, in the E and A zones. Pumping of BW-18 alters both vertical and horizontal hydraulic gradients in all zones. Vertical gradients between zones which are upward when BW-18 is not pumping, are downward from A to B and B to C zones when the base well is pumping. Base Well 18, however, did not have the same impact in the past that it currently has because it was pumped much less frequently from 1978 to 1989. It was shut down entirely from 1981 to 1985 when contaminants were detected in its discharge and it could not be used for McClellan AFB water supply until a wellhead treatment system was installed.

In addition to BW-18, CW-132, which is located approximately 3,000 feet southwest of BW-18 (Figure 2-14), was actively pumped at approximately 700 gpm, averaging 700 hours per month until June 1989 when pumping was stopped. Analysis of the hydrologic data indicates that CW-132 alone had a lesser effect on groundwater flow under OU B than BW-18. The city well has a screen only in the C zone, and water levels measured in monitoring wells near the well did not reflect widespread decreases when CW-132 was pumping. When BW-18 was off and CW-132 was pumping, groundwater flow beneath OU B was not strongly influenced by the city well; however, groundwater flows southwesterly toward CW-132 as it is drawn into the large, pumping-induced groundwater depression created by the City of Sacramento well field.

2.5.5 Groundwater Quality Beneath OU B

Volatile organic compounds have been detected in groundwater samples from five monitoring zones in the depth interval 100 to 390 feet BGS beneath McClellan AFB. Beneath off-base areas, three geohydrologic zones, A, B, and C (100 to 260 feet BGS) are known to contain VOCs. The distribution of contaminants in on-base and off-base areas are shown in Figures 2-17, 2-18, 2-19, and 2-20. The contaminant distribution in groundwater indicates that concentrations of VOCs in the A or shallowest

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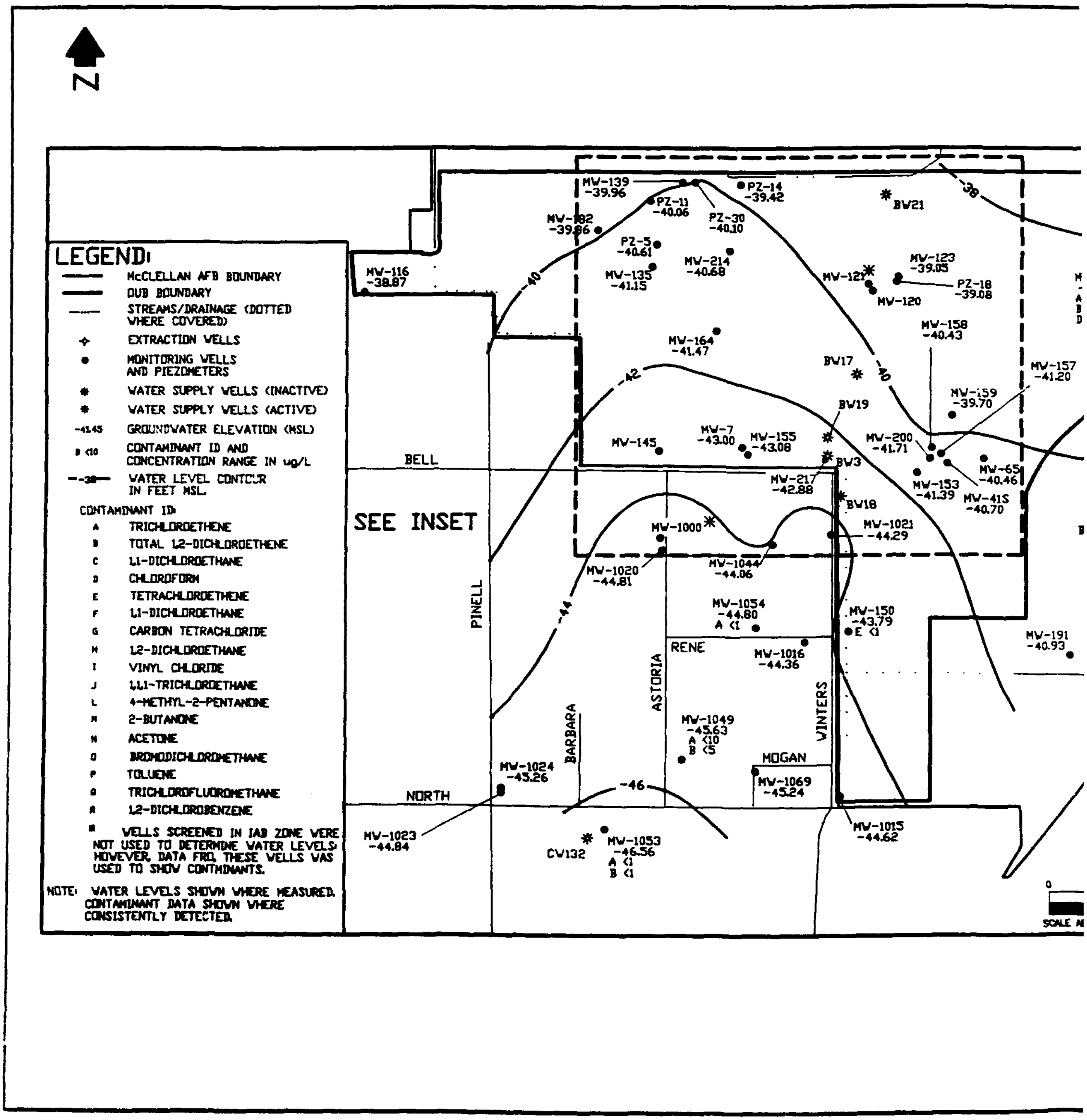

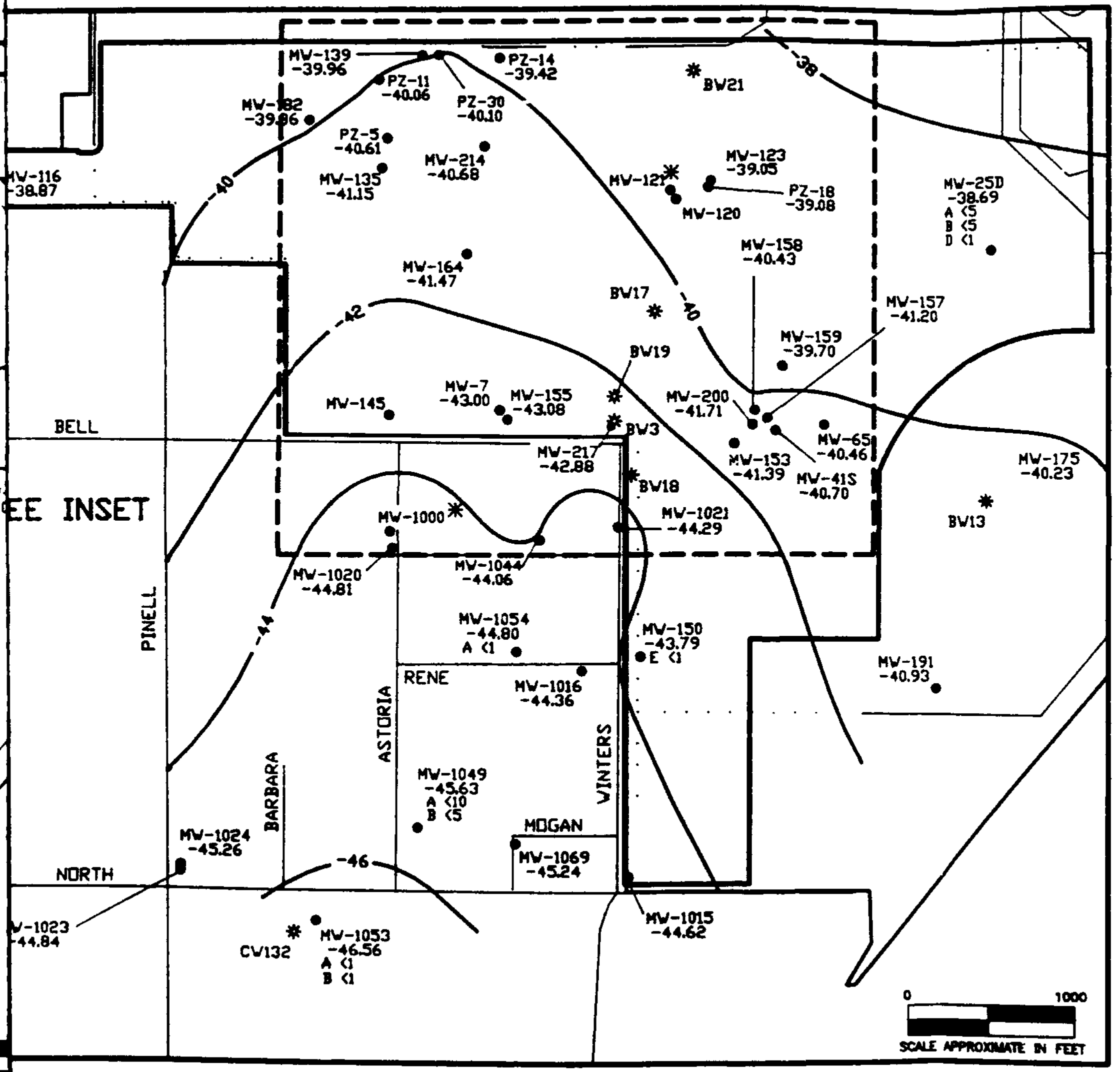

MW-139
-39.96
PZ-14
-39.42
BW21
-38
PZ-11
-40.06
MW-182
-39.86
PZ-30
-40.10
PZ-5
-40.61
MW-214
-40.68
MW-123
-39.05
MW-135
-41.15
MW-121
PZ-18
-39.08
MW-120
MW-116
-38.87
40
MW-25D
-38.69
A <5
B <5
D <1
MW-158
-40.43
MW-164
-41.47
BW17
40
MW-157
-41.20
-42
MW-159
-39.70
BW19
MW-7
-43.00
MW-155
-43.08
MW-200
-41.71
MW-145
BELL
BW3
MW-65
-40.46
MW-217
-42.88
MW-153
-41.39
MW-41S
-40.70
MW-175
-40.23
BW18
EE INSET
MW-1000
MW-1021
-44.29
BW13
MW-1020
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MW-1044
-44.06
PINELL
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MW-1054
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RENE
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ASTORIA
WINTERS
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A <10
B <5
BARBARA
MW-1024
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MOGAN
MW-1069
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NORTH
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MW-1023
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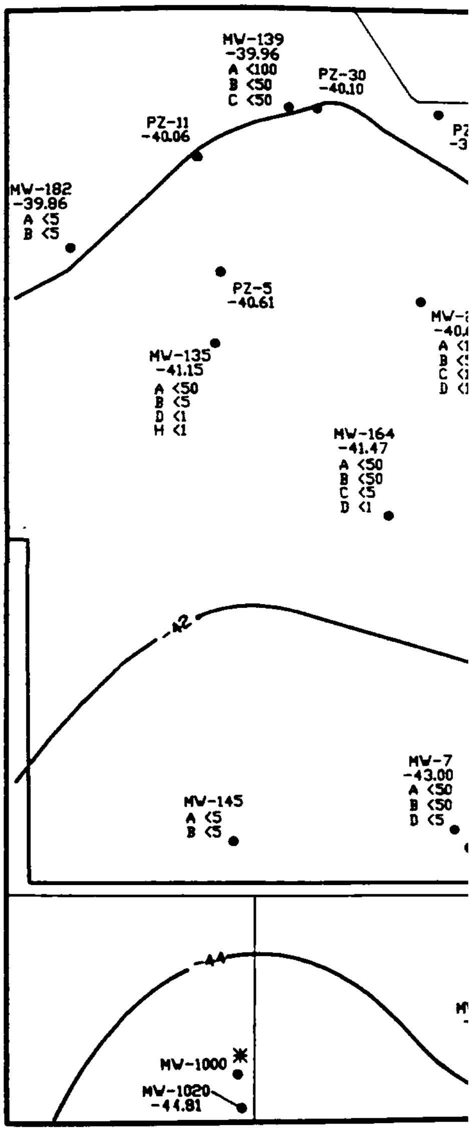
SCALE APPROXIMATE IN FEET



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B <50
C <50
PZ-30
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PZ-11
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B <5
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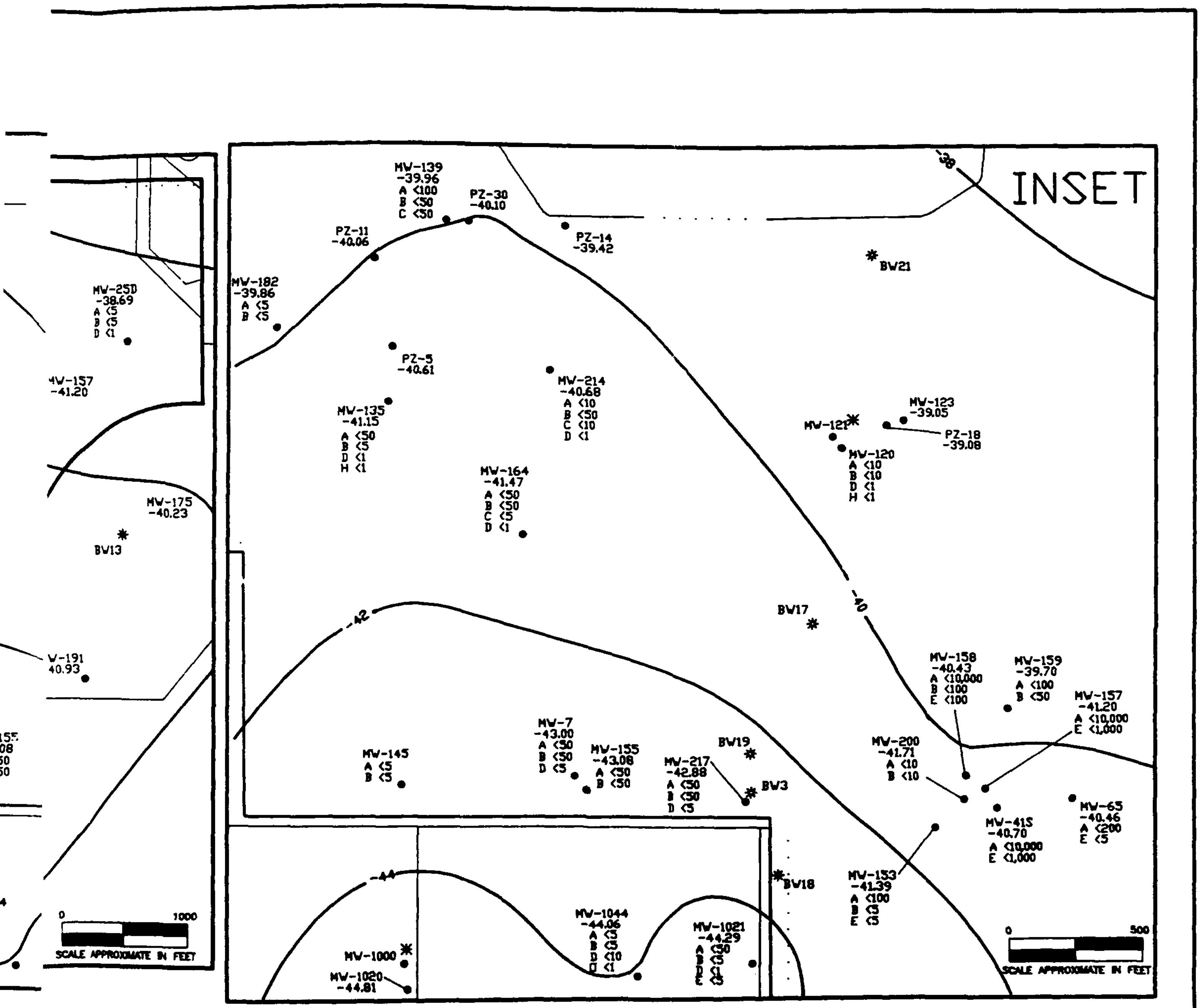

Figure 2-17. Distribution of Contaminants Within the A Monitoring Zone Through the Fourth Quarter 1990 in Operable Unit B at McClellan AFB.

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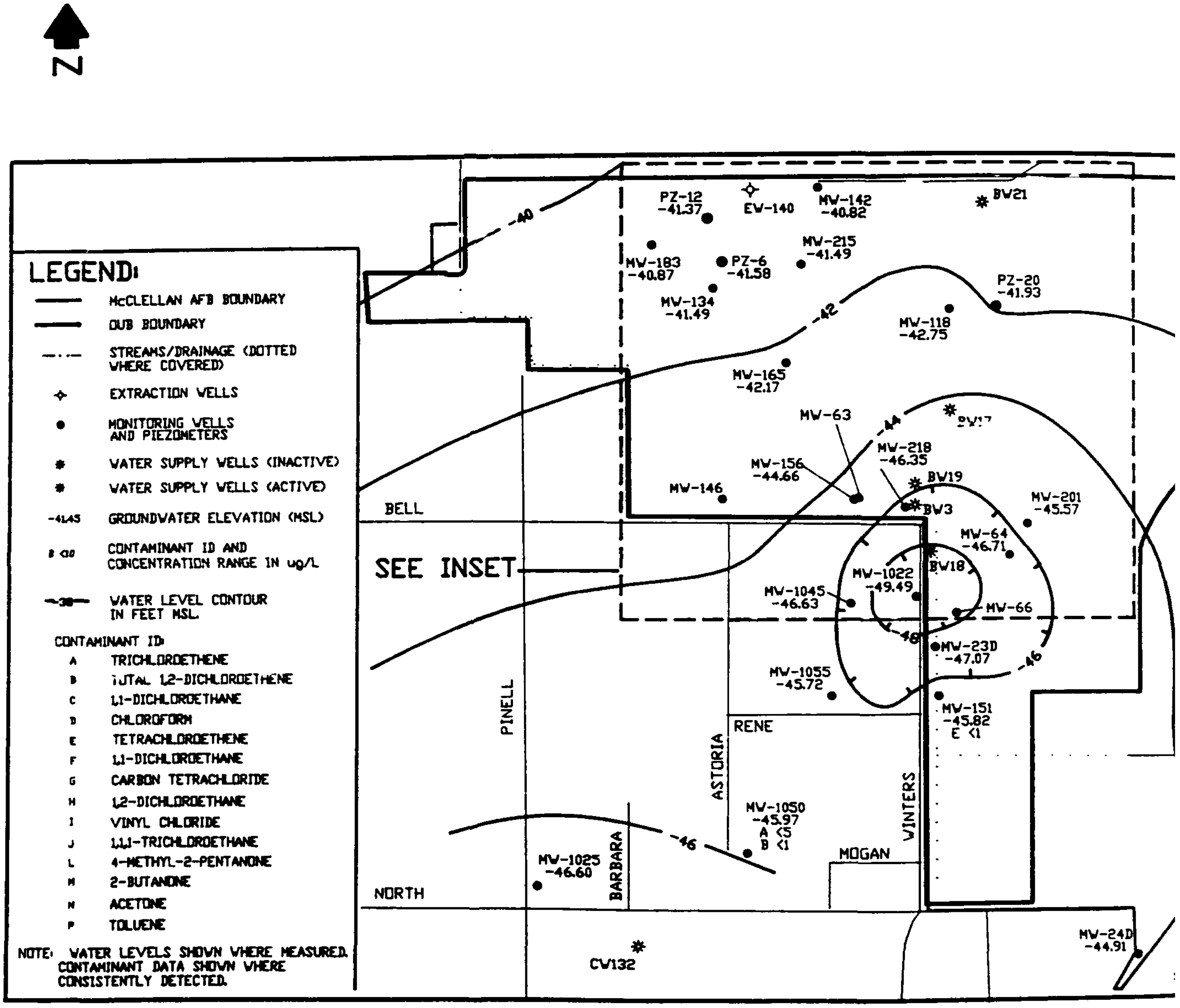

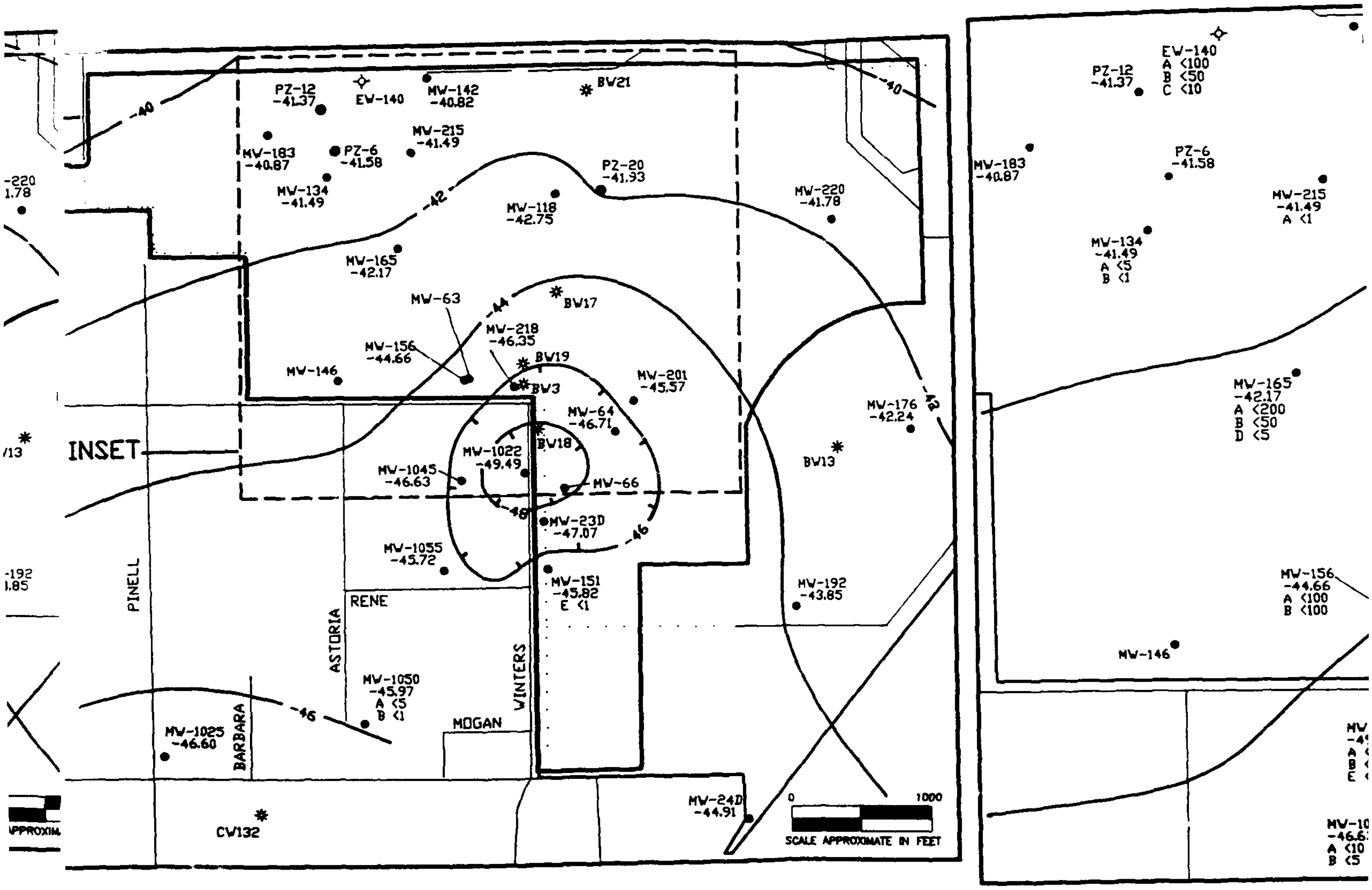
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-40
PZ-12
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EW-140
MW-142
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BW21
MW-215
-41.49
MW-183
-40.87
PZ-6
-41.58
PZ-20
-41.93
MW-134
-41.49
42
MW-118
-42.75
MW-220
-41.78
-220
1.78
MW-165
-42.17
MW-63
44
BW17
MW-218
-46.35
MW-156
-44.66
BW19
MW-146
MW-201
-45.57
BW3
MW-64
-46.71
MW-176
-42.24
42
BW18
/13
INSET
MW-1022
-49.49
BW13
MW-1045
-46.63
MW-66
48
MW-23D
-47.07
46
MW-1055
-45.72
MW-151
-45.82
E <1
MW-192
-43.85
-192
1.85
PINELL
RENE
ASTORIA
WINTERS
MW-1050
-45.97
A <5
B <1
46
MOGAN
MW-1025
-46.60
BARBARA
MW-24D
-44.91
0
1000
SCALE APPROXIMATE IN FEET
CW132
APPROXIM.
EW-140
A <100
B <50
C <10
PZ-12
-41.37
MW-183
-40.87
PZ-6
-41.58
MW-215
-41.49
A <1
MW-134
-41.49
A <5
B <1
MW-165
-42.17
A <200
B <50
D <5
MW-156
-44.66
A <100
B <100
MW-146
MW-10
-46.6
A <10
B <5

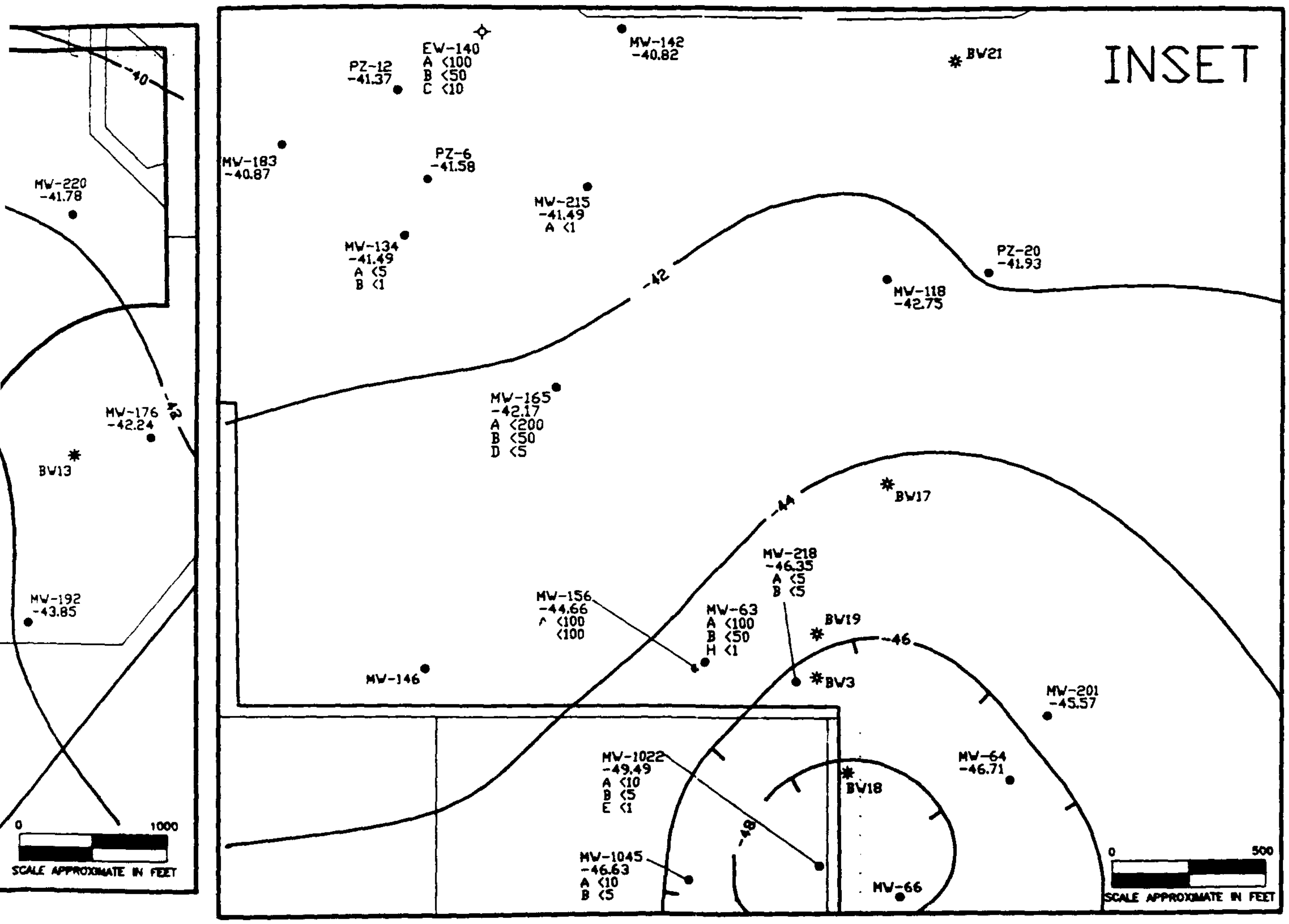

Figure 2-18. Distribution of Contaminants Within the B Monitoring Zone Through the Fourth Quarter 1990 in Operable Unit B at McClellan AFB.

OUBRI/4Q90BB-1/DMR/8-9

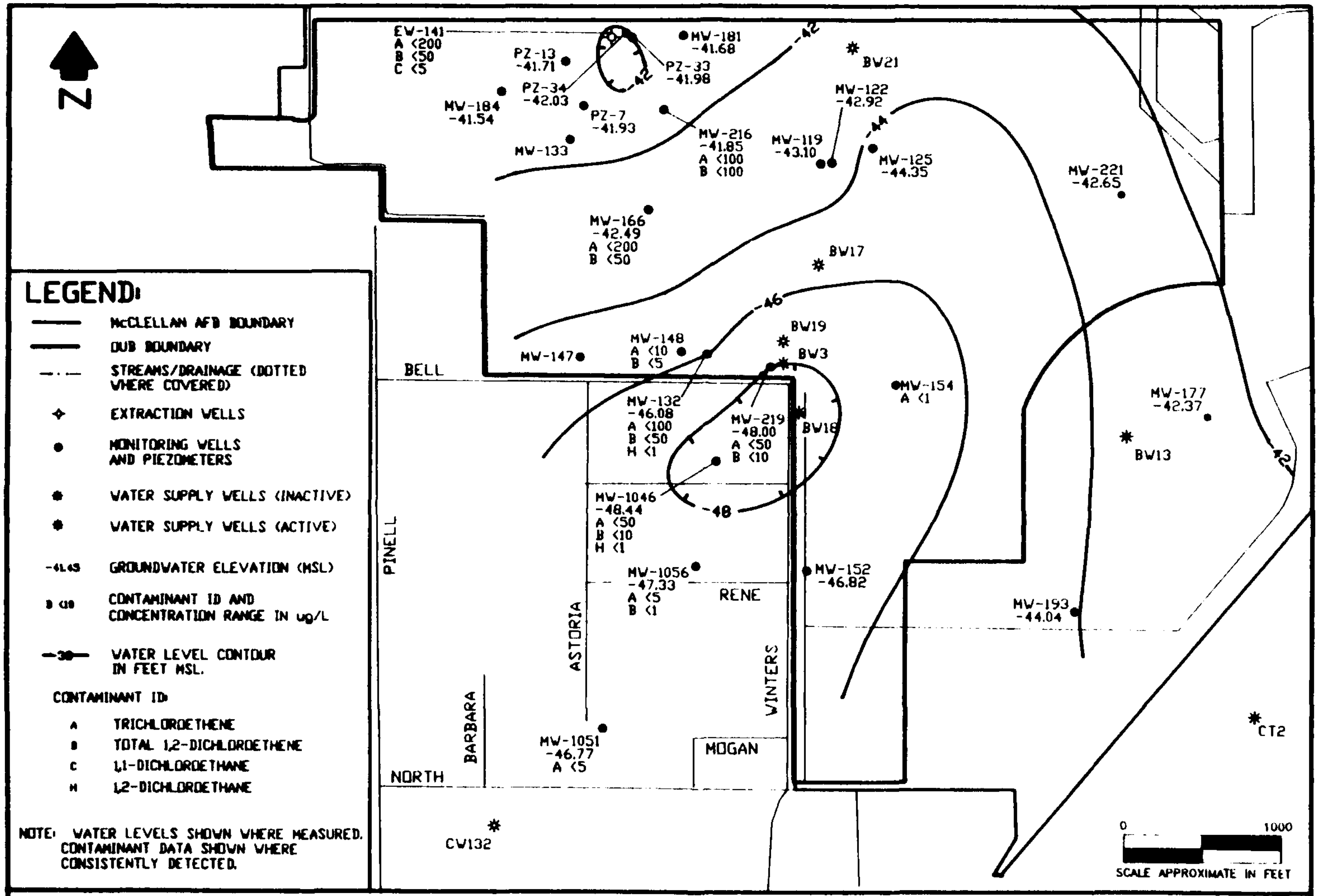

Figure 2-19. Distribution of Contaminants Within the C Monitoring Zone Through the Fourth Quarter 1990 in Operable Unit B at McClellan AFB.

OUBRI/4Q90CB-1

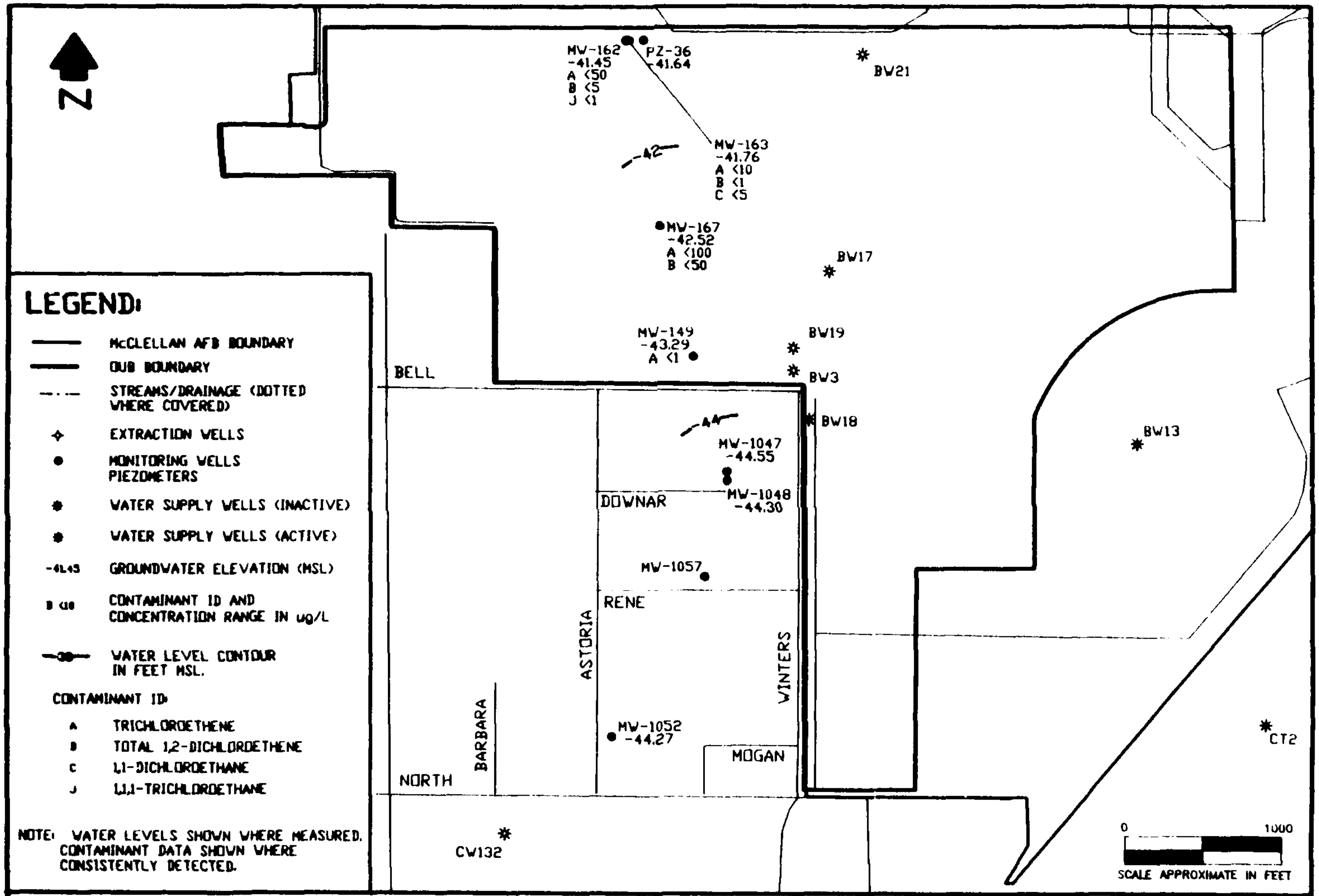

Figure 2-20. Distribution of Contaminants Within the D Monitoring Zone Through the Fourth Quarter 1990 in Operable Unit B at McClellan AFB.

OUBRI/4Q90DB-1

groundwater zone are the highest and exceed U.S. Environmental Protection Agency and California Maximum Contaminant Levels (MCLs) for drinking water. Concentrations of VOCs in the B, C, and D monitoring zones also exceed MCLs in OU B.

The distribution of VOCs in the plume and historical, regional groundwater flow directions lead to the conclusion that the contaminants have migrated from source areas on McClellan AFB. Potential sources of the contaminants in groundwater are sites in OU B (for example, Building 666, a former plating shop) and OU C.

In addition to organic compounds, metal ions have been detected in groundwater samples from both on- and off-base monitoring wells of OU B. A number of metal ions detected in the wells result from dissolution of naturally occurring minerals as groundwater migrates through rocks and sediments. The metal ions calcium, sodium, magnesium, silicon, and iron are the dissolved metals occurring most commonly and in the greatest concentration in groundwater. This is typical of groundwater quality in general. Other metals may also occur in groundwater in smaller or "trace" concentrations as a result of mineral dissolution or near-surface contamination. The trace metals arsenic, boron, chromium, cadmium, copper, lead, mercury, nickel, vanadium, and zinc are metals that have been detected historically in monitoring wells on McClellan AFB in OU B. Not all of the metals have been detected in any one well, and concentrations of the metals in samples from any of the monitoring wells have fluctuated between sampling events performed since 1982.

Trace metals ions detected in on-base monitoring wells have also been detected in analyses of samples from six off-base monitoring wells located within or near OU B. Concentrations of metal ions detected in the off-base groundwater samples are equal to or less than the lowest concentrations detected in samples from on-base monitoring wells. In analyses of samples from several off-base and on-base monitoring wells, the concentrations of several metals (chromium, lead, cadmium, selenium) have been detected at levels exceeding MCLs for drinking water. However, detection of these metals above MCL concentrations has not been consistent. Samples collected from the well in the sampling events following the detection of metals above MCLs yielded concentrations well below the MCLs.

The suite of trace metals occurring in groundwater in the off-base monitoring wells of the OU B are the same as those occurring in samples from wells on McClellan AFB and near the McClellan AFB boundary. This suggests that the metals are migrating with groundwater beneath the McClellan AFB boundaries. However, it cannot be determined with available data if the metals originate from dissolution of naturally occurring minerals in deposits beneath or upgradient from McClellan AFB or if the metals have entered the groundwater from a near-surface discharge source on McClellan AFB. Unlike VOCs, dissolved metals, including the trace metals discussed in this section, may have originated from the dissolution of the soil solid phase by natural processes. At the relatively low concentrations of trace metals which occur in OU B groundwater, the origin of the dissolved metals cannot be clearly determined with available data.

2.5.6 Groundwater Use

The communities in the vicinity of McClellan AFB receive water from private and municipal wells. Most of the water supply for North Highlands is supplied by the Arcade Water District. The Rio Linda Water District and the Northridge Water District also supply water to the North Highlands community. North Sacramento receives water from the City of Sacramento Water Department. Private wells are still in use in the area north of El Camino Boulevard in North Sacramento. In the area adjacent to McClellan AFB, on the west and southwest, private supply wells are used only for irrigation. Rio Linda and Elverta receive water from the Rio Linda Water District and from private wells.

McClellan AFB obtains water from on-base groundwater wells. Four are currently in use; the principal supply well is BW-18 located within OU B. The Northridge Water District also supplies water to McClellan AFB from an off-base well (NW-14, Figure 2-13) when the four base wells cannot meet demand.

Volatile organic compounds were detected in groundwater migrating beneath McClellan AFB and adjacent areas to the west and southwest during sampling from 1981 to 1985. The pumping of domestic, municipal, or McClellan AFB wells for water supplies creates the potential for contaminants to migrate toward the wells. In 1986, the Air Force provided connections to the municipal water supplies for approximately 550 Rio Linda, Elverta, and North Sacramento residences in an area west and southwest of McClellan AFB. The residents in this area previously used private wells for their domestic water needs. As a result of contaminants having been detected in samples collected from each, eight base supply wells, two City of Sacramento wells, and one private well have been taken out of operation.

2.6 Site Background

Removal actions have been evaluated and proposed for OU B and other parts of McClellan AFB because contaminant concentrations are present in groundwater beneath those areas and are migrating toward water supply wells. Contaminants discharged to the soils on McClellan AFB have apparently penetrated to the groundwater surface as a result of activities occurring on the ground surface from approximately 1936 to the mid-1970s. The activities that resulted in the discharges were, at the time, considered prudent, economic, and necessary to the aircraft repair and maintenance operations at McClellan AFB. In this section of the OU B RI SAP, the historical activities that lead to the contamination of soils and groundwater and the actions taken to investigate and correct historical errors are described.

2.6.1 Site History

Prior to the development of McClellan AFB, the land within and adjacent to its boundaries was occupied by rural residences, farms, and pasture land. The Sacramento Air Depot was established by Congressional authority in 1936. The air base was renamed McClellan AFB in 1939. Through World War II and the Korean War, McClellan AFB was a maintenance depot for bomber aircraft. In the 1950s, maintenance responsibilities were shifted to fighter aircraft and worldwide logistical support. Since the 1960s, McClellan AFB has continued in the role of jet fighter repair and maintenance facility. McClellan AFB is one of five Air Force Logistics Command Centers in the United States. In addition to aircraft maintenance, such activities as equipment repair, automotive maintenance, construction of aircraft ground support facilities, laboratory testing, and parts storage are conducted at McClellan AFB. Within OU B, the principal activities have been maintenance, storage, electronic equipment repair and testing, and preparation of ground support equipment. Three facilities that were a small part of the activities in OU B, but may have had a larger impact on the discharge of contaminants were the former plating shop at Building 666, and the former IWTP No. 4, adjacent to Building 666, the former research laboratory in Building 628, and the segment of the IWL conveying wastewater from the laboratory.

As a result of the activities conducted in OU B from 1940 to the present, toxic and hazardous materials have been used, stored, and locally disposed. The types of materials include: industrial solvents (VOCs), caustic cleaners, electroplating wastes (metals, arsenic, and cyanide compounds), oils contaminated with polychlorinated biphenyls (PCBs), contaminated jet fuels, automotive fuels, oils and lubricants, and radionuclides. A number of these materials have been detected in soils, and VOCs and metals have been detected in groundwater beneath OU B.

2.6.2 Use, Storage, and Disposal of Chemicals

The current and historical use, storage, and disposal of chemicals in OU B is specified by location in Table 2-2. These locations, shown in Figure 2-21, include Sites, PRLs, and Study Areas (SAs). The materials handled, stored, or disposed at each location and facility are categorized by type of chemical (e.g., acids and bases, fuels and oils, PCBs). The use or storage of these materials at these locations does not necessarily indicate that these chemicals have been released into the environment.

Fuels, oils, and solvents are the principal types of chemicals handled historically or currently within the various facilities. While acids and bases were in widespread use historically, they are currently used in only a few facilities (see Table 2-1). Metals were historically used at 12 facilities and are currently used or stored in three: Building 677 (SA 29), Building 781 (Site 23), and Lot 3 (PRL S-13). Polychlorinated biphenyls historically were used or handled at five locations and facilities; currently, PCBs are handled at PRL S-12 (Buildings 624C and D), PRL S-13 (Storage Lot 3), and SA 12 in Building 724. Historically, burn residues were generated or stored in four areas located near Building 700 (SA 12). No burn residues are currently generated in OU B. Cyanide compounds were historically used in the Building 666 plating shop (Site 47) and adjacent areas (the old storage area, Site 36, and the old IWTP, Site 48). With the exception of the hazardous materials storage lot (PRL S-13) in the western portion of OU B, there is no known use of cyanide compounds in OU B.

The locations of confirmed hazardous materials storage is shown in Figure 2-5. Prominent locations include Site 23, the site of a former burial pit that is currently the location of Building 781. Building 781 has been the primary chemical storage and distribution facility for McClellan AFB since 1971.

Three historical waste disposal areas and three historical waste treatment areas were located in OU B, and are shown on Figure 2-6. The burial pit (Site 23) located along the western edge of McClellan AFB operated between 1957 and 1971. Site 30 (east of the Building 628 laboratory) was used as a disposal area for laboratory

TABLE 2-2. CHEMICALS HANDLED AT SITES, LOCATIONS, AND STUDY AREAS IN OU B

Site/PRL/SA No.	Fuels and Oils	Solvents/ Paints	Acids/ Bases	Heavy Metals	PCBs	Radionu- clides	Burn Residues	Cyanide Compounds
Site 23	C	C	C	C			H	
Site 30		C	C			H		
Site 31							H	
Site 36		H	H	H				H
Site 47	H	H	H	H				H
Site 48		H	H	H				H
Site S-49	H	H		H	H		H	
PRL 29							H	
PRL 35[1]								
PRl B-1[2]								
PRL B-9[2]								
PRL L-5	C	C	C	H				
PRL L-6		H		H		H		
PRL P-2[2]								
PRL P-9		H	H	H				H
PRL S-5	H	H		H	C			
PRL S-12				C	C			
PRL S-13	C	C	C					C
PRL S-28	H	H						
PRL S-29	H	C			H			
PRL S-30	H	C	H					
PRL S-33	H	H	H					
PRL S-34	H	H						
PRL S-35	C	C						
PRL S-41	C							
PRL T-8	C							
PRL T-45	H							
PRL T-46	H	H						
PRL T-48	C							
PRL T-60	H							
SA 1	C	C	C					
SA 2	H	H	H	H		H		
SA 3[2]								
SA 4[3]	H	C						
SA 5	C	C						
SA 6	C							

(Continued)

TABLE 2-2. (Continued)

Site/PRL/SA No.	Fuels and Oils	Solvents/ Paints	Acids/ Bases	Heavy Metals	PCBs	Radionu- clides	Burn Residues	Cyanide Compounds
SA 7	H	C						
SA 8	C							
SA 9	C	C	C					
SA 10[4]								
SA 11	H							
SA 12	H	H			C		H	
SA 13					H			
SA 14	H	H		H				
SA 15		H						
SA 16	C							
SA 17	H							
SA 18	H							
SA 19[2]								
SA 20		C						
SA 21	C	C						
SA 22[2]								
SA 23		C	C					
SA 24[2]								
SA 25[1]								
SA 26[1]								
SA 27[1]								
SA 28[2]								
SA 29	C	C		C		C		
SA 30	H	H						
SA 31		C						
SA 33[2]								

[1] No hazardous materials handled.
[2] Materials handled unknown.
[3] Pesticides and herbicides historically stored.
[4] Pesticides and herbicides currently stored.

NOTES: H = Materials that were only handled historically.
C = Materials which continue to be handled.
PRL = Potential Release Location
SA = Study Area

Source: Radian, 1990a

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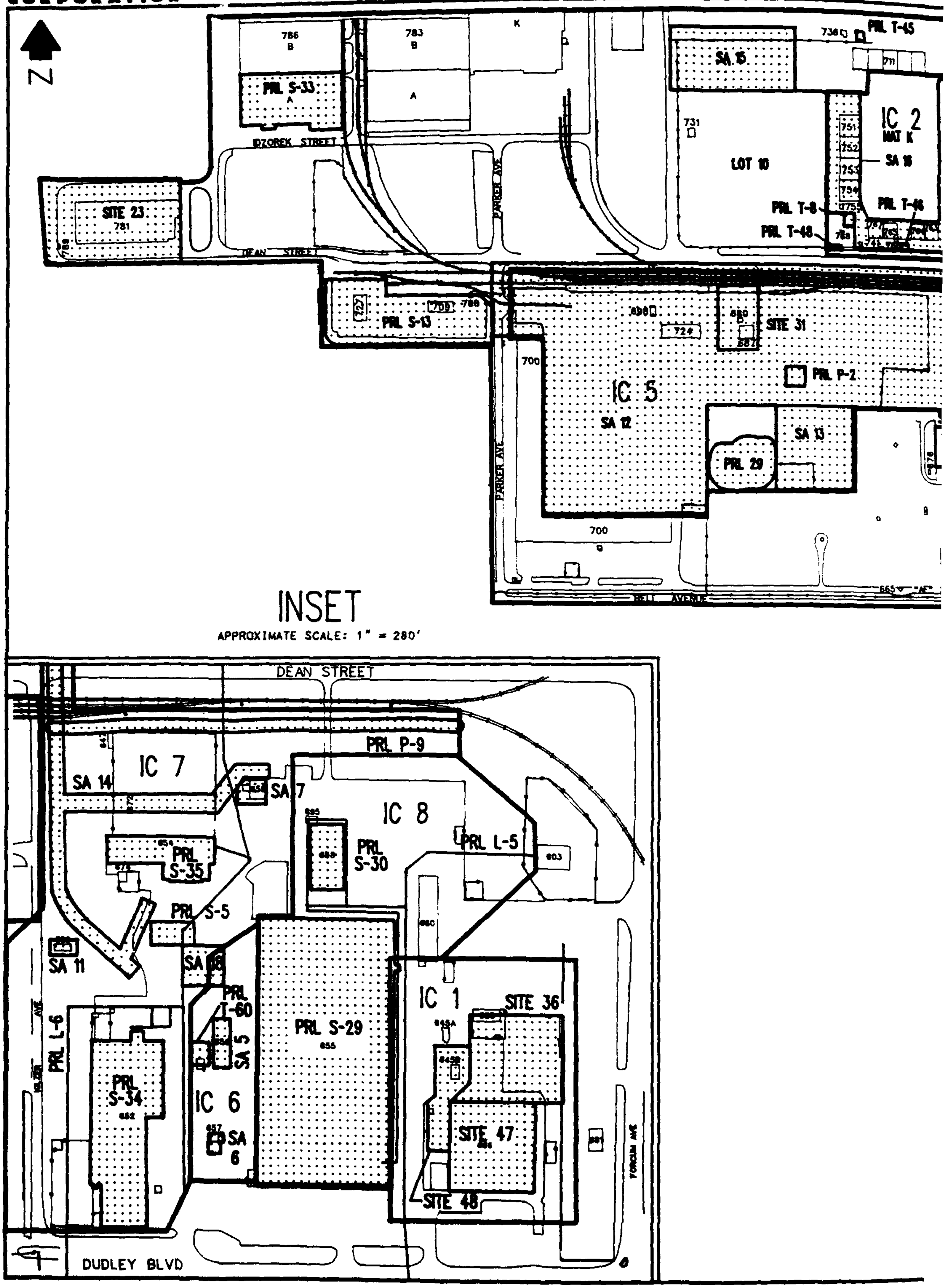
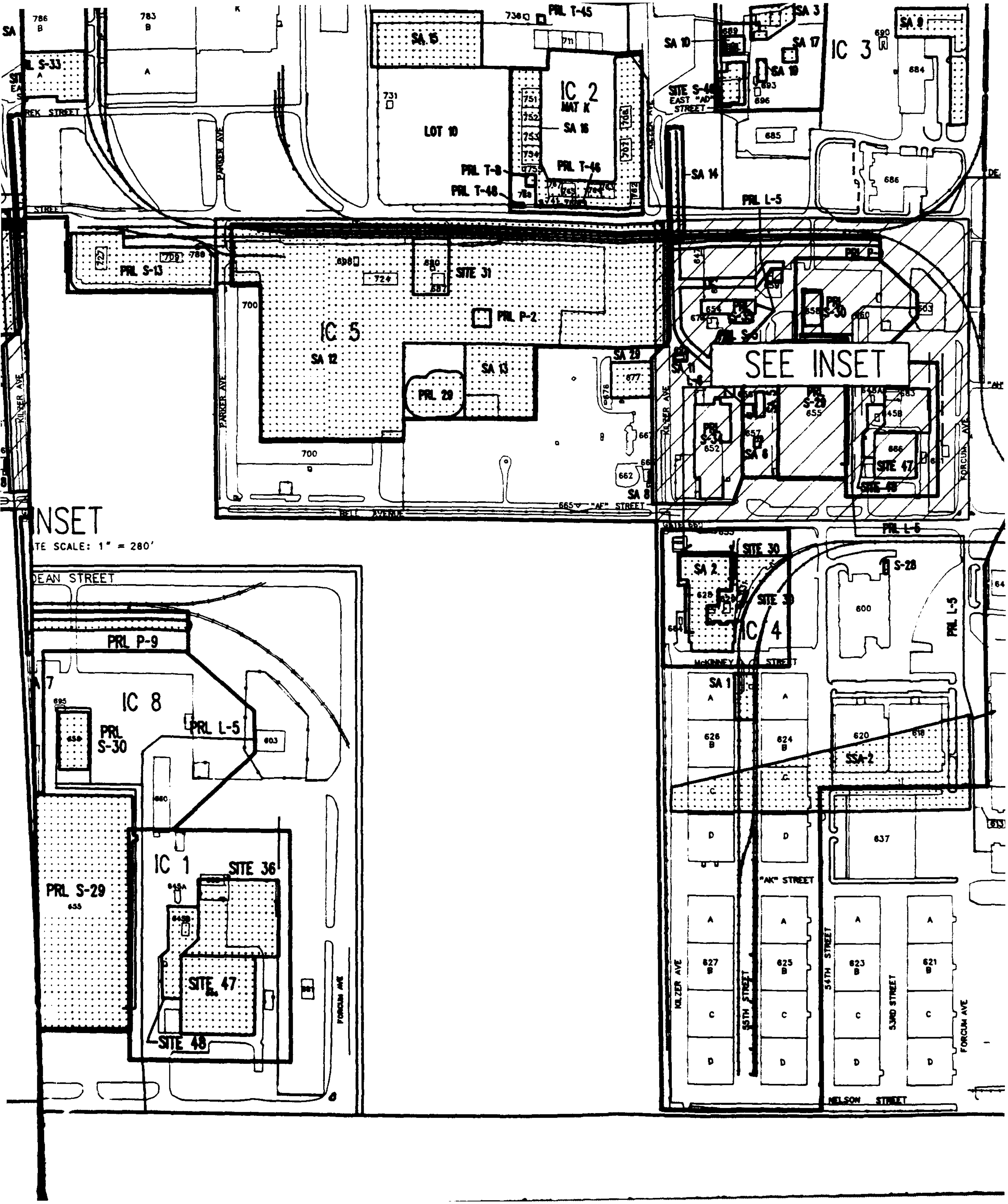
CORPORATION




IC 2
MAT K
SA 16
PRL T-46
PRL T-8
PRL T-48
PRL T-45
SA 15
LOT 10
IC 3
SA 3
SA 9
SA 10
SA 17
SA 19
SITE S-46
EAST "AD" STREET
SA 14
PRL L-5
PRL S-33
PRL S-13
PRL P-2
SITE 31
IC 5
SA 12
SA 13
PRL 29
SA 29
SA 11
SA 8
SEE INSET
PRL P-1
PRL S-30
PRL S-29
PRL S-31
SA 6
SITE 47
SITE 48
PARKER AVE
KILZER AVE
FORCUM AVE
BELL AVENUE
"AF" STREET
"AH" STREET
INSET
TE SCALE: 1" = 280'
DEAN STREET
PRL P-9
IC 8
PRL S-30
PRL L-5
IC 1
SITE 36
PRL S-29
SITE 47
SITE 48
SITE 30
SA 2
SITE 39
IC 4
McKINNEY STREET
S-28
PRL L-5
SA 1
SSA-2
PRL L-6
"AK" STREET
NELSON STREET
KILZER AVE
55TH STREET
54TH STREET
53RD STREET
FORCUM AVE
700
724
709
727
788
686
685
684
690
689
693
696
731
751
752
753
754
711
600
603
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623
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645A
645B
650
655
656
661
A
B
C
D

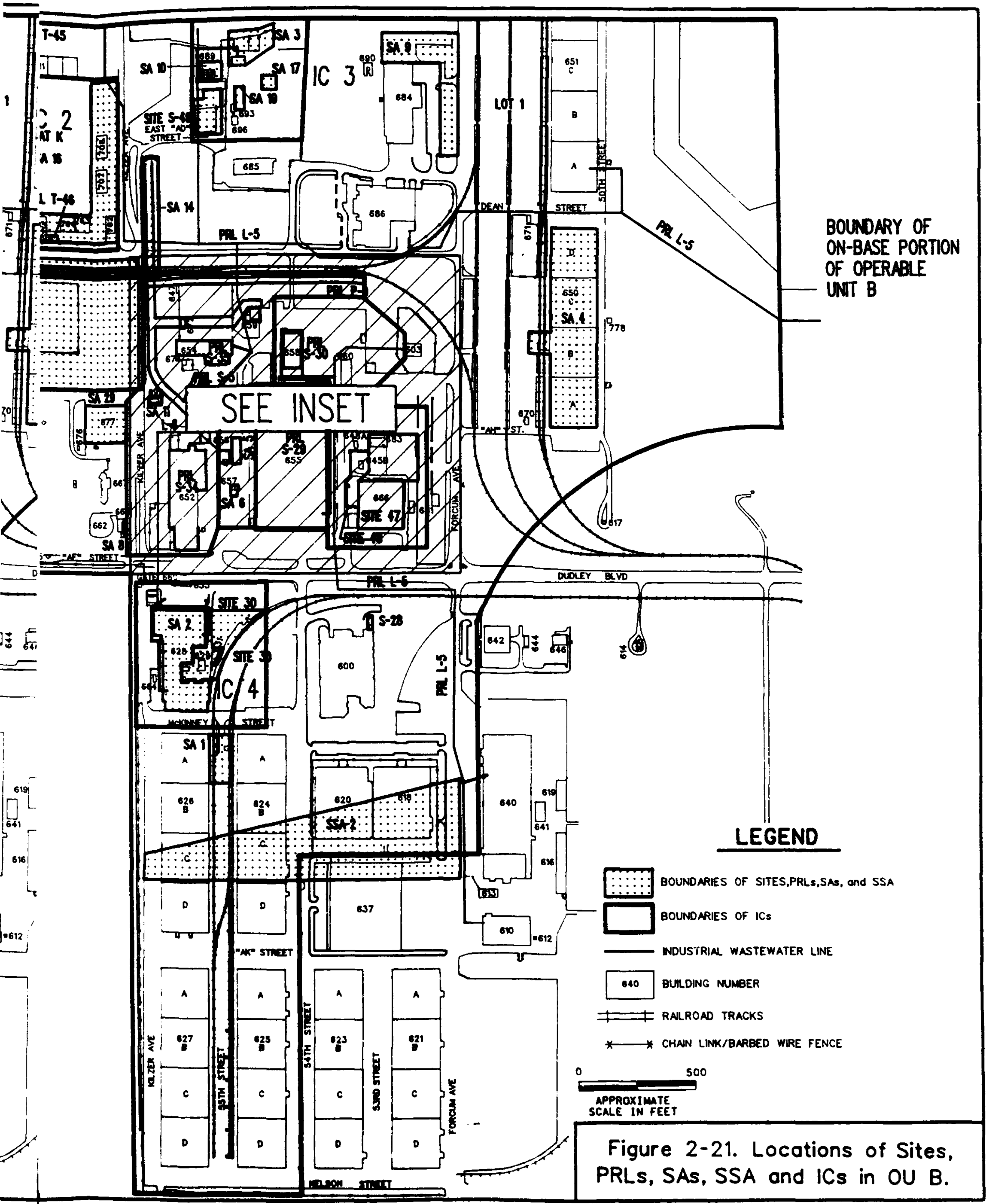

Figure 2-21. Locations of Sites, PRLs, SAs, SSA and ICs in OU B.

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chemicals between approximately 1960 and 1971. Potential Release Location 29 was reportedly used to bury aircraft generators, and PRL P-2 was reportedly used to dispose of oil; however, these reports have not been confirmed.

A refuse incinerator (Site 31) adjacent to Building 687 operated between 1963 and 1968. Industrial Wastewater Treatment Plant No. 2 (PRL S-5) and IWTP No. 4 (Site 48) operated in OU B until they were dismantled in 1976 and 1980, respectively. Industrial Wastewater Treatment Plant No. 2 treated wastewater generated in the vicinity of Building 655 (i.e., Buildings 652, 655, and 658). Industrial Wastewater Treatment Plant No. 4 treated wastewater generated in the Building 666 plating shop.

Historical disposal practices included the proper collection, treatment, and disposal of waste chemicals, but also included practices such as dumping solvents onto the ground (west of Building 628) and onto asphalt pavement where the solvents were allowed to evaporate (SA 1, PRL-30). Industrial wastewater generated by the washdown of floors in Building 666 was directed in part into trenches that drained into IWTP No. 4, and in part onto the dirt outside the building (Radian, 1990a).

Current disposal methods include containerization and transport of chemical wastes off-base to an appropriate disposal area. There are no currently operating waste disposal or treatment facilities in OU B. Industrial wastewater, such as that created by washrack use, or by the washdown of floors onto which chemicals have been spilled, is directed into drains that are connected to the IWL. The IWL runs through the central portion of OU B, and carries the wastewater from OU B to an on-base treatment facility where it is treated and discharged for subsequent treatment at the Sacramento County Regional County Sanitation District treatment facility. Industrial wastewater sludge is transported off-base for disposal at a Class I landfill.

2.6.3 Potential and Known Discharges

Sites, PRLs, and SAs in OU B that have documented releases of contaminants are Sites 23, 30, 31, 36, 47, and 48, PRL S-13, and SAs 9 and 12 (Radian, 1990a). Soil contamination has been confirmed at Sites 23, 30, 31, 36, 47, 48, and S-49, and SAs 3, 9, and 12. There is the potential that soil contamination will be found at some of the 46 locations within OU B where chemicals have been used, stored, or disposed. These 46 locations have been recommended for investigation in the OU B RI and are listed in Table 2-3.

TABLE 2-3. SITES, PRLs, SAs, and SSAs RECOMMENDED FOR FURTHER INVESTIGATION

Site/PRL/SA/SSA	Rationale for Recommendations
Site 23	Contamination detected in soil. Additional data needed to characterize.
Site 30	Contamination detected in soil. Additional data needed to characterize.
Site 31	Burn residues from former refuse incinerator are a potential contaminant source.
Site 36	Contamination detected in soil. Additional data needed to characterize.
Site 47	Contamination detected in soil. Additional data needed to characterize.
Site 48	Contamination detected in soil. Additional data needed to characterize.
Site S-49	Contamination detected in soil. Additional data needed to characterize.
PRL 29	Reported burn pit or transformer storage area may be a contaminant source.
PRL L-5	Confirmed damage to IWL; suspected contaminant sources.
PRL L-6	Confirmed damage to IWL; suspected contaminant sources.
PRL P-2	Possible former waste pit may be a contaminant source.
PRL P-9	Ditch that collected waste from IWTP is a suspected contaminant source.
PRL S-5	Former IWTP is a suspected contaminant source.
PRL S-13	Documented releases of hazardous materials. Suspected contaminant source.
PRL S-28	Former paint and oil storage facility is a potential contaminant source.
PRL S-29	Underground piping may have leaked. Potential contaminant source.
PRL S-30	Trench, catch basin, and pipes which transport wastes may have leaked. Potential contaminant source.
PRL S-33	Former chemical storage facility is a potential contaminant source.

(Continued)

TABLE 2-3. (Continued)

Site/PRL/SA/SSA	Rationale for Recommendations
PRL S-34	Pits, sumps, trenches, and pipelines may have leaked. Potential contaminant source.
PRL S-35	Trench, underground drain, and piping which transport wastes may have leaked. Potential contaminant source.
PRL T-8	Documented fuel spills. Underground fuel storage tanks may have leaked in the past. Suspected contaminant source.
PRL T-45	Abandoned tank and piping may have leaked. Potential contaminant source.
PRL T-46	Abandoned tank and piping may have leaked. Potential contaminant source.
PRL T-48	Abandoned tank and piping may have leaked. Potential contaminant source.
PRL T-60	Underground storage tank may have leaked. Potential contaminant source.
SA 1	Freon® waste reportedly dumped outside building. Potential contaminant source.
SA 2	Laboratory and former outdoor radioactive storage areas are potential contaminant sources
SA 3	Contamination detected in soil. Additional data needed to characterize.
SA 4	Large quantities of paints and solvents handled. Potential contaminant source.
SA 5	Fuels, oils, and paints are potential contaminants. Further investigation necessary.
SA 6	Underground fuel storage tanks may have leaked. Potential contaminant source.
SA 7	Previously analyzed soil data unavailable. Further investigation of Underground Storage Tanks is necessary.
SA 8	Underground storage tanks may have leaked. Potential contaminant source.
SA 9	Contamination detected in soil. Additional data needed to characterize.

Continued)

TABLE 2-3. (Continued)

Site/PRL/SA/SSA	Rationale for Recommendations
SA 10	Concrete wastewater sump may have leaked. Potential contaminant source.
SA 11	Underground storage tank and associated piping may have leaked. Potential contaminant source.
SA 12	Contamination detected in soil. Additional data needed to characterize.
SA 13	Open storage of hazardous matcrials. Suspected contaminant source.
SA 14	Ditch transported wastewater. Suspected contaminant source.
SA 15	Contaminants potentially released during fire in a chemical storage area.
SA 16	Underground tanks and piping may have leaked. Potential contaminant source.
SA 17	Open storage of hazardous materials. Suspected contaminant source.
SA 18	Open storage of hazardous materials. Suspected contaminant source.
SA 19	Former spray booth is a suspected contaminant source.
SA 29	Underground storage tanks may havc leaded. Potential contaminant source.
SSA 2	VOCs detected in soil gas above detection levels.
SSA 3	Magpie Creek drainages off base may have received contaminants in surface runoff.

PRL = Potential Release Location
SA = Study Area
SSA = Special Study Area
IWL = Industrial Wastewater Line
IWTP = Industrial Wastewater Treatment Plant

SOURCE: Radian, 1990a.

Contaminants discharged onto the soil in OU B include VOCs, semivolatile organic compounds, metals, PCBs, cyanide compounds, and oil and grease (Radian, 1990a). Documented discharges of chemicals to the soil in OU B have resulted in the past from the burial of waste material, leakage from underground storage tanks, leakage from the IWL, and spills in storage lots resulting from operational practices. In addition, undocumented releases have occurred as a result of spills of liquid or powdered chemicals onto dirt or pavement. For example, spills that occurred inside Building 666 were periodically washed from the interior floor with high pressure hoses and directed out through the door on the north side of the building onto the soil at Site 36 (Radian, 1990a).

Available information (Radian, 1990a) indicates that the largest documented contaminant releases in OU B are:

- A number of confirmed leaks in the underground IWL (PRLs L-5 and L-6). (This pipeline has transported industrial wastewater for approximately 30 years.)

- Reported spills in PRL S-13, a hazardous materials storage lot that has been in operation since 1955. (Stored materials include fuels, oils, acids, bases, solvents, and PCBs.)

Releases of contaminants into surface water are believed to have occurred at PRL T-45 and SA 14, and possibly at other locations where drainage ditches collected runoff from contaminated soil or pavement. Potential Release Location T-45 is an abandoned concrete oil-water separator tank located adjacent to Magpie Creek. Supernatant liquids from the oil-water separator are reported to have been discharged into Magpie Creek. Study Area 14 is a drainage ditch that received wastewater and spilled fuel from several sources. This drainage ditch discharged its effluent into Magpie Creek.

Releases of contaminants into groundwater from locations within OU B have not been confirmed. However, several locations with confirmed or suspected soil contamination (e.g., Sites 36, 47, and 48) are strongly suspected of being sources of groundwater contamination.

Data from four groundwater monitoring wells (MW-41S, MW-153, MW-157, and MW-158) located downgradient from Sites 36, 47, and 48 indicate that many of the contaminants in the soil are also found in the groundwater. These compounds include TCE, 1,2-DCE, chloroform, PCE, and 1,1,1-trichloroethane. Although additional site characterization and evaluation of the vadose zone will be required to specifically identify the source(s) of groundwater contaminants, one or more of these sites is a likely source of local groundwater contamination.

2.6.4 Previous Remedial Investigations

The major soil contamination investigation of OU B was conducted in 1985 and 1986. Additional soil borings, soil sample analyses, and other soil-related investigations in OU B including testing and evaluation of underground storage tanks and the Industrial Wastewater Line (IWL) have been compiled and presented in site-specific Technical Memorandums and Preliminary Assessments (Radian, 1990a).

The major groundwater remedial investigation of OU B, formerly called the Area B Groundwater Operable Unit Remedial Investigation, or ABGOURI (Radian, 1990d), consisted of drilling and groundwater sampling program that was conducted to determine the on-base and off-base extent of groundwater contamination, the presence of which was known from the quarterly sampling and analysis of OU B groundwater wells prior to 1989. This investigation is now referred to as the Operable Unit B Groundwater Remedial Investigation (OUBGRI).

Soil Contamination Investigations

Beginning in 1984, site characterization investigations were conducted at 56 sites within OUs A, B, C, and D, and other OUs on base. These investigations included waste, soil, and groundwater testing. More than 700 soil borings were drilled, and soil samples collected from the borings analyzed. In addition, a total of 86 additional potential sites were identified. The investigations were conducted throughout 1985 and 1986, and results were documented in a series of reports and technical memorandums, including the Final Basewide Report on Contamination (McLaren, 1986b).

Within OU B, soil borings were drilled at Sites 23, 30, 31, 36, 47, and 48, PRLs 29, 35, T-60, and SAs 3, 9, 12, 20, and 32. Samples from selected soil borings were analyzed for VOCs, semivolatile organic compounds, pesticides, PCBs, metals and inorganic compounds, and oil and grease. Quality assurance/quality control (QA/QC) information available for these analyses is generally limited to sample detection limits and some duplicate results. The results of these analyses are summarized in Section 2.6.5.

Soil borings also have been drilled at PRL T-60 and SAs 2, 9, 12, and 32. The exact location of each boring is uncertain due to a lack of adequate documentation (Radian, 1990d). However, analytical results are available for many of the samples from these borings, and are summarized in Section 2.6.5.

Groundwater Contamination Investigation

The first monitoring well in OU B was constructed in 1980. Twenty-eight additional wells were constructed during investigations conducted from 1982 to 1986. The wells were incorporated into the McClellan AFB monitoring well network in 1986. Reported results from quarterly sampling and analysis of these monitoring wells indicated the presence of dissolved VOCs and metals contamination in these wells. The purpose of the OUBGRI was to define the nature and extent of the contamination plumes, and to provide additional information on the subsurface geology and hydrology.

The OUBGRI field investigation was conducted from March through December 1989. During that period, three pilot holes and 14 monitoring wells were placed off base; three pilot holes and 15 monitoring wells were installed on base. From January to May 1990, an additional pilot hole and 11 monitoring wells were installed on McClellan AFB in OU B under the Preliminary Groundwater Operable Unit Remedial Investigation (PGOURI) program. Pilot holes 10, 11, 12, 13 17, and 21 and monitoring well locations 200, 201, 214 through 219, 145 through 159, 162 through 168, 181 through 184, 220 and 221, 1044 through 1057, and 1069, completed under the OUBGRI and the PGOURI programs, are shown in Figure 2-22. Of the 50 groundwater monitoring wells, 16 were screened in the A monitoring zone, 12 in the B, 12 in the C, 8 in the D, and 2 in the E. These groundwater zones are defined in Section 2.5. The specific results of the investigation are summarized below.

2.6.5 Contamination Distribution

Contaminants have been detected in the soils and the groundwater in OU B. Distribution of the contaminants is discussed below.

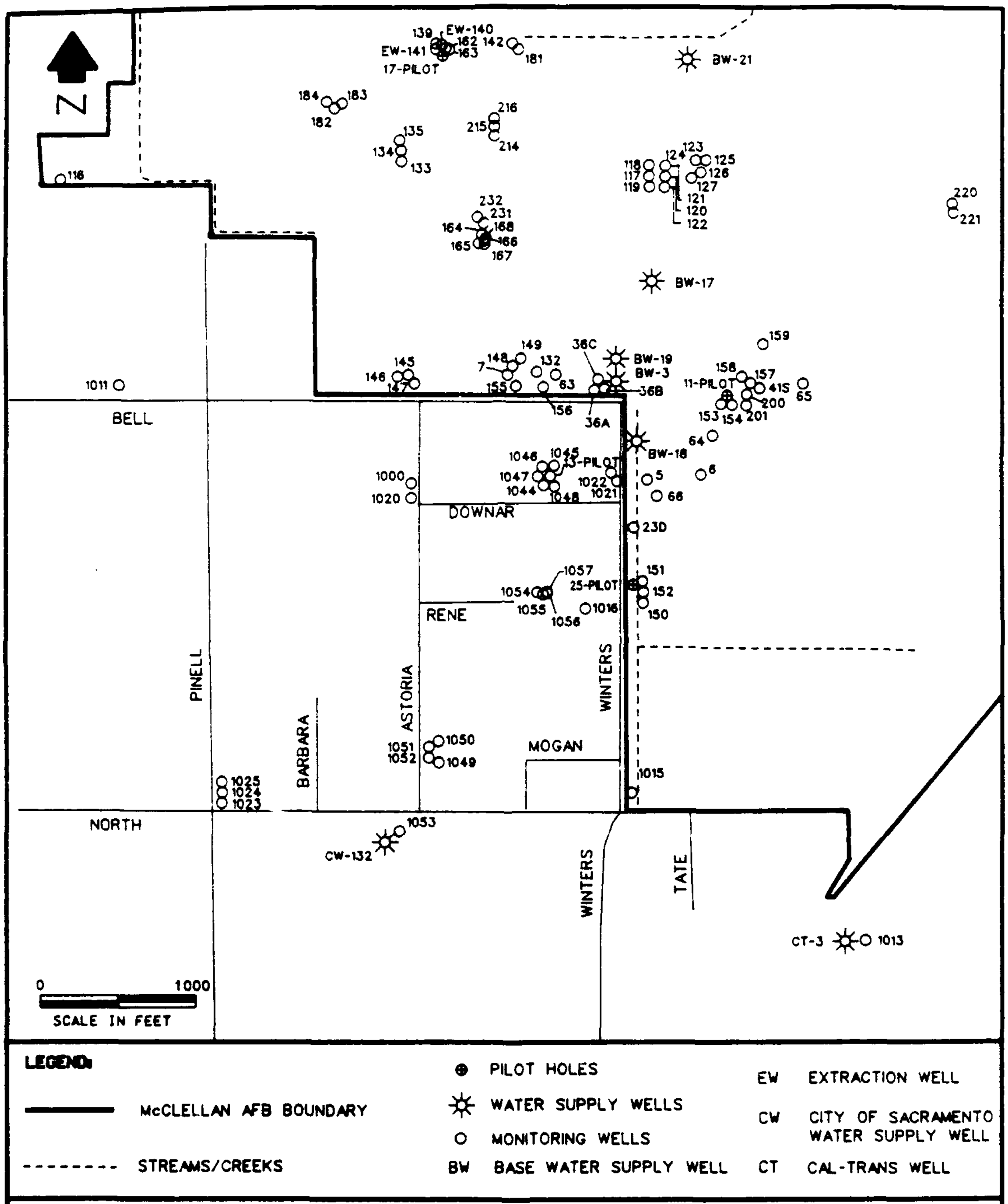

Figure 2-22. Location of Monitoring Well Clusters and Water Supply Wells In and Near OU B.

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Soil Contamination

As noted in Section 2.6.3, soil contamination has been confirmed at Sites 23, 30, 31, 36, 47, and 48, and SAs 3, 9, and 12 (Table 2-4). In addition, reported chemical disposal, spills, or leaks have created the potential that 35 additional sites are contaminated. A complete list of contaminated and potentially contaminated locations in OU B is presented in Table 2-3 (Section 2.6.3) and the locations are shown on the OU B site map (Figure 2-21, Section 2.6.2.).

A complete list of contaminants detected in the soil at each site is presented in the OU B Preliminary Assessment Summary Report (Radian, 1990a), along with maps showing specific soil boring locations at each site (if known). The areas of highest levels of confirmed soil contamination are:

- Building 666 (the old plating shop [Site 47]) and adjacent areas (the old IWTP No. 4 [Site 48] and a storage area [Site 36]) where 10 different VOCs were detected in soil samples from depths ranging from 9.5 to 80 feet BGS;
- The former landfill along the western base boundary (Site 23) where 10 VOCs and 4 semivolatile organic compounds were detected in soil samples from depths ranging from 24 to 60 feet BGS;
- The Building 628 research laboratory and the open lot east of the laboratory (Site 30), where six VOCs were detected in soil samples from depths ranging from 24 to 60 feet BGS; and
- The Building 700 storage area (SA 12) where PCB contamination was detected in soils from depths ranging from 0 to 10 inches BGS.

Of the fourteen locations in which soil borings were drilled, soil contamination was detected at all locations except PRLs 29, 35, and T-60, and SA-20.

Volatile organic compounds detected in the soil at OU B include TCE, PCE, acetone, toluene, methylene chloride, xylenes, 1,1,1-trichloroethane, chloroform, 2-butanone, 2-hexanone, benzene, ethylbenzene, 4-methyl-2-pentanone, trichloro-

TABLE 2-4. SITES AND STUDY AREAS WITH CONFIRMED SOIL CONTAMINATION

Site/PRL/SA	VOCs	Semivolatile Organic Compounds	PCBs	Cyanide	Oil and Grease
Site 23	✓	✓			✓
Site 30	✓	✓			✓
Site 31					✓
Site 36	✓	✓		✓	✓
Site 47	✓	✓			✓
Site 48	✓	✓		✓	
Site S-49	✓	✓	✓		✓
SA 3	✓	✓			
SA 9	✓				
SA 12	✓	✓	✓		

SA = Study Area

SOURCE: Radian, 1990a.

fluoromethane, and trans-1,2-dichloroethene. Semivolatile organic compounds detected in the soil at OU B include 2-methylnaphthalene, N-nitrosodiphenylamine, pentachlorophenol, phenanthrene, 1,2,4-trichlorobenzene, benzo[a]pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, ideno(1,2,3-c,d)pyrene, benzo(k)fluoranthene, and chrysene.

Metals identified in the soil at OU B include arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, and vanadium. These metals are not necessarily present in hazardous quantities; they are trace substances that are also natural constituents of soil and rock.

Groundwater Contamination

Groundwater contamination consisting of dissolved VOCs has been detected in samples from monitoring and supply wells throughout OU B. The contaminants have been detected in monitoring wells with screen intervals in the A, B, C, D, and E monitoring zones. The deepest known contaminated groundwater on McClellan AFB was detected in a sample from a depth of 390 feet BGS in MW-231 (Figure 2-22). The highest concentrations of VOCs, approximately 10,000 $\mu g/L$ in OU B, were detected in the A monitoring zone at MW-157 (Figure 2-17). However, VOC concentrations exceeding federal and state MCLs for drinking water have also been detected in the B, C, and D zones in OU B (Figures 2-18, 2-19, and 2-20). In several sampling events since 1982, samples from monitoring wells in OU B have had dissolved inorganic species detected at concentrations above federal MCLs. However, for each of the wells at which MCLs were exceeded, the inorganic species concentrations were well below MCLs in the following sampling and analysis events. Therefore, inorganic species are not "contaminants of concern" in the groundwater beneath OU B.

The VOCs which have been the most frequently detected contaminants in groundwater beneath OU B are TCE and 1,2-DCE. Trichloroethene (TCE) occurs in all monitoring zones. In addition to TCE and 1,2-DCE, six other VOCs (1,1-dichloroethane, chloroform, tetrachloroethene, 1,2-dichloroethane, bromodichloromethane, and 1,1,1-trichloroethane) have been consistently detected in groundwater samples. However, no monitoring wells have yielded samples with all of the VOCs, and the presence of compounds other than TCE and 1,2-DCE varies with the location and depth of the monitoring well.

The most diverse suite of VOCs has been detected in the A monitoring zone. Seven VOCs have been detected in groundwater of the A zone (Figure 2-17). The compound PCE occurs with TCE and 1,2-DCE in samples from wells located to the northeast and south of BW 18. Chloroform and 1,1-DCA occur in samples from wells located to the west and northwest from BW 18, but not in every monitoring well in those areas. Bromodichloromethane and 1,2-DCA have been detected consistently in samples from widely spaced monitoring wells.

In the B monitoring zone, TCE and 1,2-DCE are detected in samples from most wells, and in most locations at concentrations less than in the A zone (Figure 2-18). Chloroform, PCE, and 1,2-DCA have been detected in samples from a few widely spaced wells.

Trichloroethene (TCE) has been detected in samples from all C zone wells that contain contaminants (Figure 2-19); 1,2-DCE occurs with TCE in the C zone wells located to the northwest, west, and southwest of BW 18. The only other VOC detected in the C zone is 1,2-DCA in samples from two monitoring wells.

In the D monitoring zone, TCE and 1,2-DCE are detected together in samples from three monitoring wells (Figure 2-20). One of the wells yields samples containing concentrations of 1,1-trichloroethane; another has 1,1-DCA. Samples from the fourth D zone well has had only TCE consistently detected.

Of the two monitoring wells completed in the E zone in the northern portion of OU B, one, MW-231, has had TCE detected at 1 μg/L. The second E zone well, with a deeper screen interval, has had no VOCs detected in samples.

Analytical data for VOC concentrations in groundwater from OU B indicate widespread contamination from sources containing TCE. The presence of 1,2-DCE along with TCE in groundwater may be attributable to degradation of TCE or contamination of the TCE before it was discharged. From the distribution of TCE and 1,2-DCE in the groundwater of the A through D zones, it can be concluded that TCE, or both compounds, entered groundwater from a number of widespread source areas in or outside of OU B and have been migrating in groundwater for 20 years or more.

The less frequent and widely spaced occurrences of other VOCs throughout OU B support the hypothesis that a number of VOC sources have caused groundwater contamination in OU B. The presence of additional VOCs along with the more common TCE and 1,2-DCE indicates that different sources, at which different suites of VOCs were discharged, have resulted in contamination of the groundwater beneath OU B.

Surface Water

A limited investigation of contaminants in surface waters on McClellan AFB was conducted in 1989 (Radian, 1990b). Samples of surface waters standing on or flowing across the McClellan AFB were taken at 24 locations. The purpose of the investigation was to determine if contaminants were present in surface waters entering, flowing across, or exiting McClellan AFB. Only one of the sampling points occurred within OU B because the major on-base drainages occur north of OU B. The sampling point in OU B was a storm drainage ditch in western OU B along a short segment of the east-west boundary of McClellan AFB. Acetone was the only VOC detected, at 16 μg/L in the sample from the sampling point. No semivolatile organic compounds were detected. Analyses for 27 metals were conducted on the sample. Twenty-five metals, including commonly occurring (sodium, calcium, magnesium) and trace metals (chromium, copper, zinc), were detected. However, none of the concentrations of metals detected in the sample from OU B exceeded established MCLs for drinking water.

2.6.6 Soil Gas Results

An investigation of VOC contaminants in soil gas was conducted in the period from September to December 1990. Sampling and analysis of soil gas was conducted at 41 of the sites that will be investigated in the OU B Remedial Investigation (RI). Samples of soil gas present in soils from 4 to 6 feet below surface were collected in approximately 750 locations. A minimum of 1 and a maximum of 134 sampling probes were driven at each site. Fifty soil gas samples were collected in ten subsurface borings to depths of seventy-five feet to evaluate the vertical distribution of VOCs in soil gas at two sites. All soil gas samples were analyzed for groups of five halogenated VOCs (TCE, PCE, 1,2-DCE, 1,1,1-TCA, and chloroform) and 3 aromatic VOCs (benzene, toluene, and total xylenes) by gas chromatograph. Unknown VOC compounds were also detected and measured for relative concentrations but could not be identified with the instruments. Details of the sampling and analysis procedures are described in Sections 5.0 and 6.0.

The purpose of the soil gas investigation was to screen the sites for the presence and relative concentrations of VOCs in the vapor phase. Because the sources and distribution of VOCs in the soils beneath many of the sites in OU B have not been identified, the investigation was intended to provide target areas on those sites where liquid VOCs had been released and were presently adsorbed on soil particles. The target areas determined by the greatest concentration of VOCs will be the focus of soil sampling in the OU B RI to confirm the concentration of contaminants and volume of contaminated soil. Isopleths of VOC concentrations in soil gas are one of the methods by which soil sample locations were selected for specific sites (Sections 3.1 to 3.22).

A limited validation study was conducted at two sites during the OU B Soil Gas Investigation. Soil samples were collected from several depths in ten borings and were analyzed for VOCs and other potential contaminants. Results of the soil gas validation study indicated that concentrations of VOCs on soil particles were detected in samples collected in two of the four borings drilled in soil gas targets with concentrations greater than 1,000 parts per billion by volume (ppbv) total VOCs. The study also indicated that soil samples collected beneath locations with soil gas concentrations of 150 ppbv or less total halogenated VOCs had no VOCs detected on soil particles. A full discussion of the soil gas validation study is presented in Section A2.6, Appendix A.

2.6.7 Previous Removal Actions

Results of groundwater sampling and analysis and soil boring sampling and analysis conducted prior to the OUBGRI indicated the presence of contaminants in soil and groundwater beneath OU B (Section 2.6.5). On the basis of the results of the earlier investigations, the Air Force implemented removal actions to decrease the potential for contaminant migration. A removal action addressed groundwater contamination in the off-base portion of OU B, and another addressed soil contamination on base in OU B.

The removal action addressing groundwater contamination in off-base areas was begun in the spring of 1986 when McClellan AFB announced a plan to provide municipal drinking water to approximately 550 residences in the area west of the base that used private wells for drinking water supplies. The area in which water connections were made is shown in Figure 2-23. The area included the off-base areas beneath which groundwater contamination has been detected that may be attributed to sources within McClellan AFB. The southern part of the area includes all of the off-base portion of OU B. Water connections were completed in August 1987. This removal action was taken to decrease the potential for migration of contaminants in groundwater into the deposits near private water wells. In providing the water connections to the residences in OU B and off-base areas to the north, the need to use groundwater for potable water supply was eliminated. Private wells were maintained and operated for other uses, but water supplies for drinking, bathing, dishwashing, and other domestic uses were provided by the connections. Residential wells within the northern portion of the removal action area are in use for irrigation and livestock watering. Within OU B, residential wells are no longer in use, and the County of Sacramento has prohibited the installation of any additional potable water supply wells in the off-base area, shown in Figure 2-23.

The second removal action undertaken in OU B was completed in March 1988. A former electroplating facility at Building 666 (Site 47) was dismantled. The building was used from 1957 to 1980 as an electroplating shop and from 1980 to 1982 for hazardous waste storage space. Demolition also included the affiliated industrial wastewater treatment facility (IWTP No. 4, Site 48). Contractors covered all doors and windows, removed all material and debris inside and surrounding the building, and vacuumed the floors, trenches, and pits. Piping, valves, pumps, tanks, and other interior aboveground components were dismantled and disposed, while maintaining the facilities' structural integrity and washing air pump discharge to make sure airborne particulate could not escape. The walls and roof of the facility were removed intact. Trenches and floor drains were filled with concrete. Sumps were covered with metal caps to prevent entry of surface water (Figure 2-24). The concrete pads for the buildings were left in place.

The removal action at Building 666 was taken to prevent migration of contaminants in the soil to groundwater. Soil borings sampled around the foundation of Building 666 and IWTP No. 4 (McLaren, 1986b) indicated that concentrations of contaminants had migrated to 80 feet BGS. The activities conducted in Building 666 during its operating life are suspected of being the source for the TCE/PCE plume migrating southwest of the building's foundation. The soils beneath the foundation of Building 666 and adjacent areas (IWTP No. 4) will be investigated to determine sources of soil contamination and to evaluate remedial action alternatives in the comprehensive OU B RI.

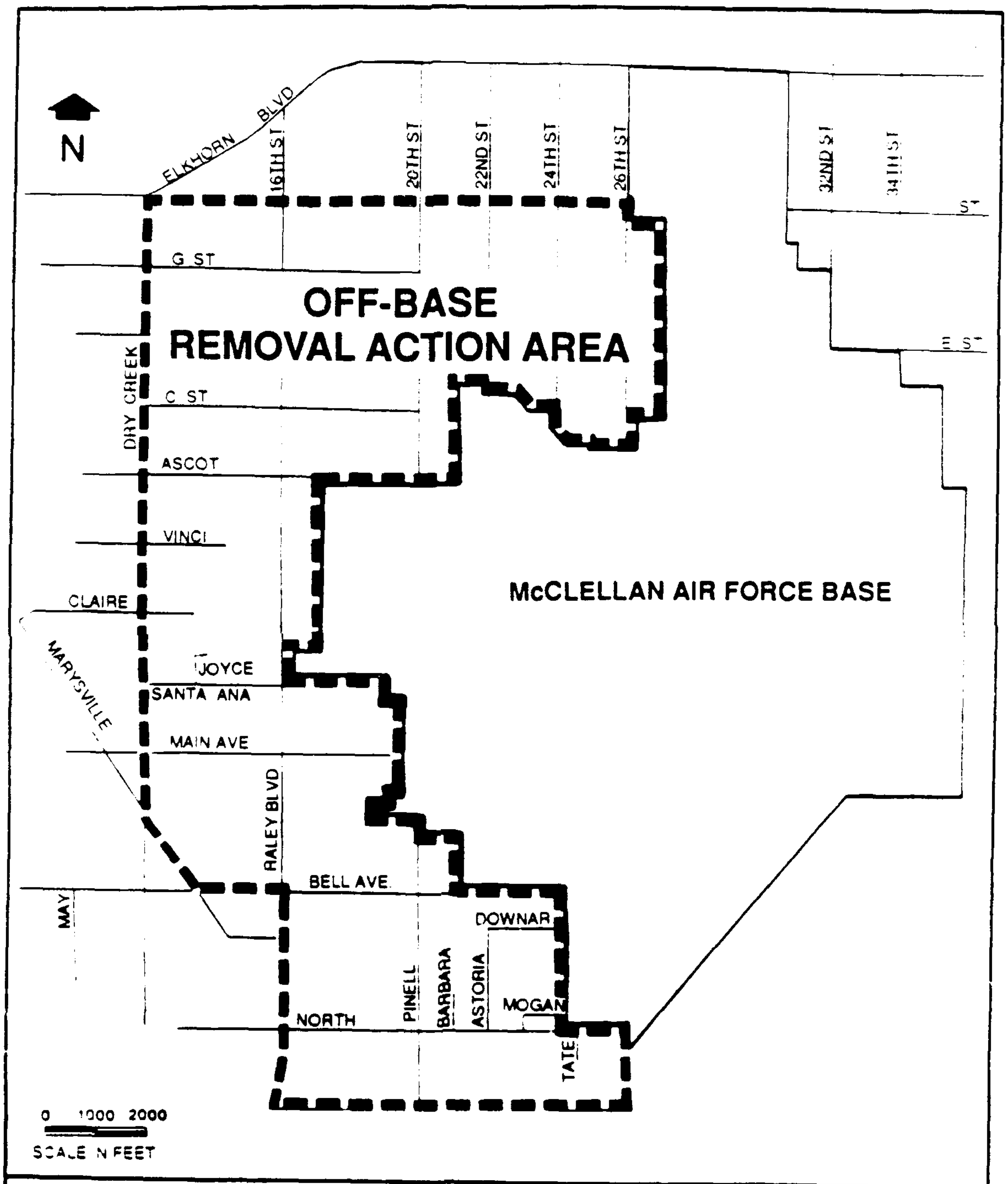

Figure 2-23. Off-Base Remedial Action Area.

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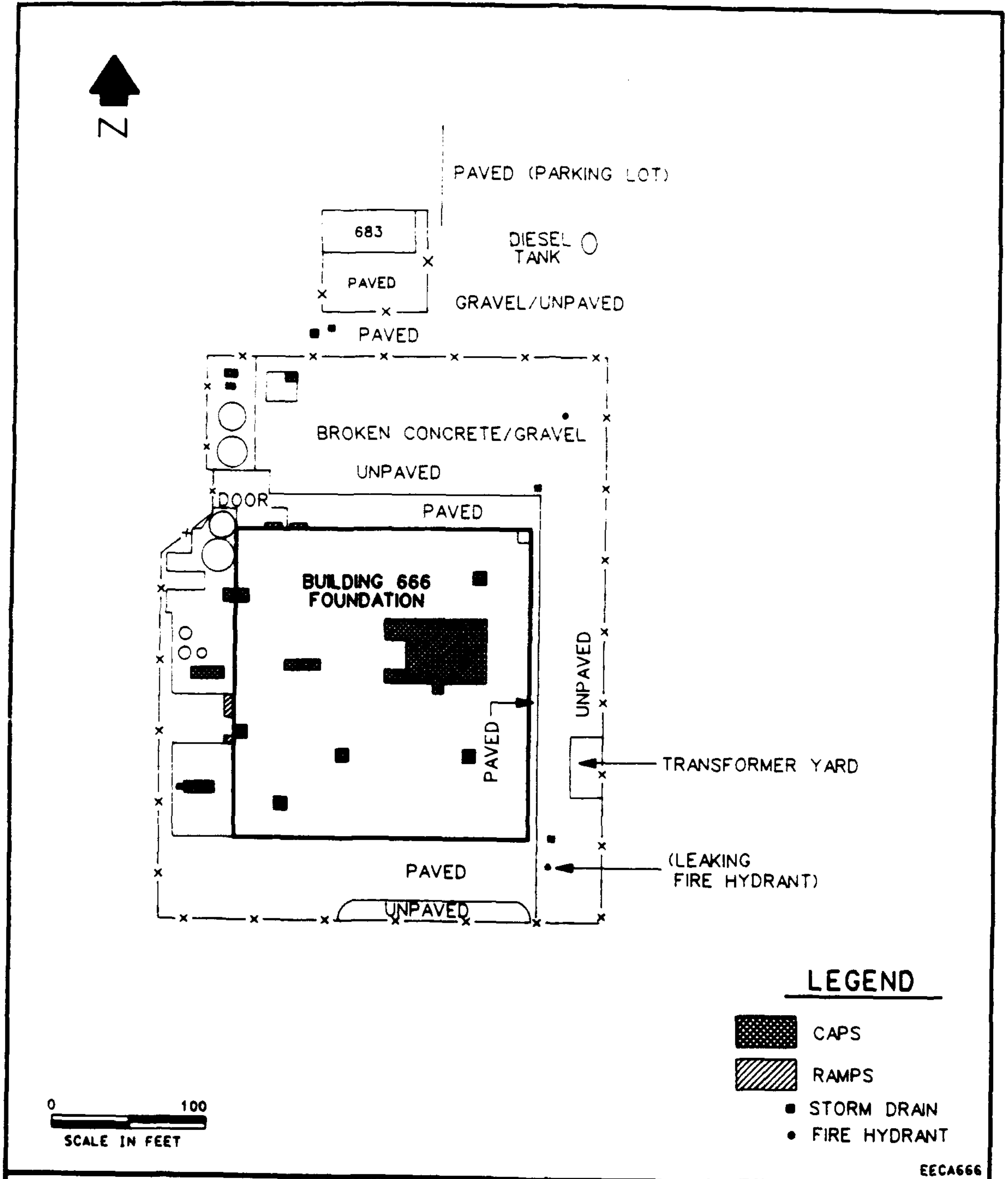


Figure 2-24. Foundation of Building 666.

An additional removal action was considered in the OU B Engineering Evaluation/Cost Analysis-Environmental Assessment (EE/CA-EA) conducted in 1990 (Radian, 1990e). The purpose of the OU B EE/CA-EA was to consider what action should be taken to mitigate the VOCs present and migrating in groundwater toward water supply wells in OU B (Figures 2-17 through 2-20). As a result of the OU B EE/CA-EA, several interrelated measures will be taken in a removal action for contaminants in groundwater. Each of the measures is intended to control, remove, and abate a portion of the groundwater containing contaminants beneath OU B. The measures will consist of: extraction and treatment of contaminants in two plumes; control of contaminant migration in each of three plumes through the continued pumping of McClellan AFB water supply well (BW) 18; and monitoring and further investigation of contaminant sources and migration in the plumes.

The specific measures planned in the OU B removal action are:

- For the TCE-PCE plume, construction of 2 extraction wells, a local treatment plant, and a treated water disposal pipeline in an Expedited Response Action (the wells, treatment plant, and pipeline have already been constructed);
- For the TCE-1,2-DCE plume, construction of 3 extraction wells, six monitoring wells, a pipeline to convey the extracted groundwater to the Groundwater Treatment Plant; and abandonment of five unused supply wells in OU B;
- For the PCE plume, investigation of soil gas, soil boring sampling, and monitoring well construction to determine its source, extent, and migration direction; and
- For all contaminant plumes in OU B, continued operation of BW-18 to control the flow of groundwater containing contaminants beneath on- and off-base areas.

The measures undertaken in the OU B groundwater removal action are considered interim actions that will become components of the remedial action in OU B. However, the removal action mitigates only a portion of the contaminants that have entered the environment from sources on McClellan AFB and are migrating beneath OU B. To achieve full remediation of contaminants that have been released to the environment in OU B, the OU B RI will proceed beyond the previous groundwater, soil, soil gas, and surface water investigations. Until the OU B RI has provided the data to determine the sources, extent, and movement of contaminants, the long-term effectiveness of removal actions taken cannot be evaluated. Additional mitigative actions for soil, soil gas, and groundwater contaminants are likely to be indicated by the results of the OU B RI.

2.7 Conceptual Model for OU B

The purpose of the conceptual model for OU B is to provide a framework of the remedial investigation site to characterize contaminants, sources, migration pathways, and potential risks to human health and the environment. The framework is the outline of understanding about a site to which details are added as the investigation proceeds. Missing details in the outline are identified as data gaps to be filled before the model is completed and presented in the Remedial Investigation/Feasibility Study (RI/FS) report.

The conceptual model for OU B will be large and complex because it must incorporate approximately 600 acres, including off-base areas underlain by contaminated groundwater, and 53 sites on McClellan AFB. Soil contamination has been detected at depths from less than 10 inches to 80 feet BGS. Soil gas contamination has been detected from 3 feet to 78 feet BGS. Groundwater contamination has been detected at depth intervals of 100 feet to 390 feet BGS. Although preliminary assessments/site inspections, groundwater sampling and analysis, soils remedial investigations, and groundwater remedial investigations have been conducted since 1981, a number of data gaps remain in the framework of the conceptual model. The physical and chemical data available for the conceptual model were presented in Sections 2.1 to 2.6 and will be summarized here in the context of the model.

The principal components of the OU B Conceptual Model are:

- Discharge points and source media;
- Contaminants;
- Transport Pathways and Exposure Routes; and
- Potential Receptors and Concentrations.

The framework of the model is illustrated in Figure 2-25. The information available from OU B for the conceptual model are summarized in the following sections.

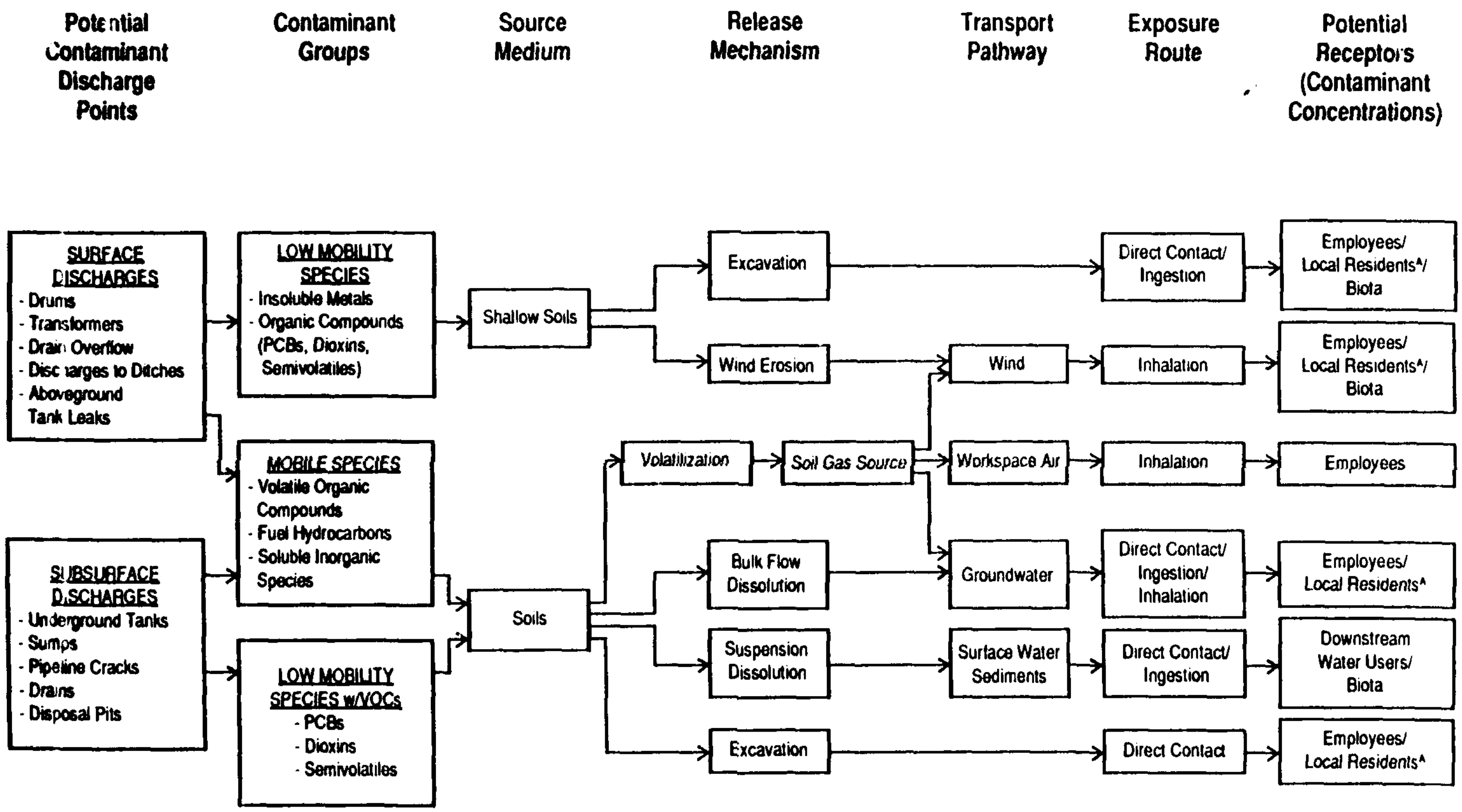
2.7.1 Discharge Points and Source Media

Potential and known discharge points in OU B were described in Sections 2.6.2 and 2.6.3; they consist of both surface and subsurface facilities in which storage, use, or disposal of chemicals and fuels have occurred. Locations at which contaminants may have been discharged in a number of small volume spills are the large chemical drum and transformer storage area, aboveground tanks, the areas surrounding washracks, and drainage ditches. Streams that received a portion of their flow from drainage ditches near surface discharges may be secondary discharge points.

Surface discharges were reportedly intermittent or accidental events in OU B; therefore, the potential sources of contaminants that can be identified in the RI are the shallow soils on which the contaminants discharged or the deep soils into which they may have been transported by infiltration. Depending on the volume and mobility of the contaminant discharged and the permeability of surface soils, contaminants discharged at the surface may have a source in shallow soils (0 to 1 foot BGS) or deeper soils (1 foot or greater BGS). In OU B, sources in shallow soils will be investigated in the transformer storage and handling areas (e.g., SA 12, SA 13, PRL 29) in which small volumes (5 to 50 gallons) of low mobility PCB-containing oils may have been discharged onto low to moderate permeability surface soils (Xeralific Arents). Deeper soils may be sources beneath surface discharges that contained 500 to 1,000 gallons of wastewater with VOCs from a washrack (SA 3) or from a drainage ditch (SA 14).

Subsurface discharges of mobile species (e.g., VOCs, cyanide, soluble metals) are known to have resulted in sources in deeper soils at sumps located in Site 23 and Site 47. Underground fuel tank leakage has resulted in a deep soil contamination source at SA 6. Potential deep soil contamination, containing VOCs, soluble metals, PCBs, and semivolatile organic compounds, may occur at a number of identified cracks in the Industrial Wastewater Line (PRL L-5 and PRL L-6). Low mobility species, PCBs or dioxins, may occur in deep soils beneath disposal/burn pits (Site 23) in which PCB and dioxin compounds may have been mobilized by discharged solvents or rainwater runoff.

In addition to shallow and deep soils, soil gas may be a source of VOCs, as well as a contaminant pathway. Beneath locations where VOCs have penetrated to



[A] Local residents include current military personnel and potential future domestic residents on or outside McClellan AFB

Figure 2-25. Conceptual Model Framework.

deeper soils, VOCs have entered soil gas. The detection of VOC concentrations of 50,000 to 1,000,000 ppbv in the soil gas beneath OU B (e.g., PRL L-5B, PRL L-6, and SA 16) indicates the presence of soil gas contamination. The potential for VOCs to migrate into soils, groundwater, or air from soil gas suggest that it is a source of contaminants beneath portions of OU B.

2.7.2 Contaminants

Seventy-eight contaminants are of concern in OU B either because they have been previously detected in soils or because they have been formed by incomplete combustion (dioxin and furan compounds) or degradation (vinyl chloride) of precursor compounds (Section 4.0). The contaminants of concern may be divided into groups of species categorized by their general mobility in water or VOC liquids (Figure 2-25).

Low mobility species occur in two groups. Some organic compounds are listed in both groups because they increase in mobility if solvent compounds are present in high concentrations. The large molecular weight, halogenated organic compounds, PCBs, dioxins, furans, and a group of semivolatile compounds (e.g., phenanthrene, benzo[a]pyrene, and chrysene), will remain in shallow soils at surface discharge sites if concentrated VOCs have not been discharged in the same location. The low mobility compounds may be carried to deeper soils if VOC liquids were also discharged and there was adequate vertical force and soil permeability to allow penetration. Semivolatile compounds have been detected in soils between 7 and 24 feet BGS at Site 23 in OU B. Dioxin and furan compounds have been detected in soils at 15.5 and 43.5 feet BGS, and several semivolatile compounds were detected in soils between 8.5 and 18 feet BGS at Site 24 located 1,500 feet east of OU B. Low mobility PCBs were detected in only shallow soils (0 to 10 inches BGS) in SA 12.

Other species in the low mobility group that would occur only in shallow soils are metal compounds. A wide range of metal compounds are virtually insoluble in shallow soils under normal pH conditions of 5 to 9. Metal oxide and hydroxide compounds are commonly insoluble under the conditions prevailing in surface soils unless acidic or basic solutions are discharged at the same location.

Low mobility species that are discharged to the surface soils are strongly attracted to soil particles. Unless concentrated solvents (VOCs), acidic, or basic liquids are discharged at the same location, the mobility species will remain adsorbed to the soil particles. Near surface soils with adsorbed low mobility species may be mobilized into the air pathway by excavation or wind erosion of the soil surface.

The group of mobile contaminant species identified in OU B include VOCs, lighter fuel hydrocarbons (e.g., gasoline, diesel, or jet fuel), and soluble inorganic species (e.g., cyanide, arsenic, metals). The members of this group may penetrate to deeper soil sources or, for VOCs and fuels, in soil gas. They may also occur in surface soils for periods of time after discharge; however, the ability of VOCs and fuels to volatilize and the ability of cyanide and soluble metals to dissolve in infiltrating water reduces the potential of the mobile species remaining in surface soils. Mobile species in shallow soils may be released by dissolution or particle suspension to enter surface water runoff.

Beneath OU B, VOCs have been detected in deep soils at depths of 60 to 80 feet BGS (Sites 30 and 47). Cyanide, arsenic, and zinc have been detected in the depth interval between 24 and 59 feet BGS.

From deep soil sources, mobile species may continue to migrate vertically to groundwater if conditions of hydraulic force and soil permeability are adequate. Mobile VOCs and fuel hydrocarbons may volatilize and migrate in soil gas.

2.7.3 Transport Pathways and Exposure Routes

After contaminants have entered the source media from discharge points in OU B, they may migrate to human or ecologic receptors if they are released into an open transport pathway. There are five transport pathways into which contaminants from OU B sources may be transported to receptors (Figure 2-25). The pathway is determined by the source of contaminant and the release mechanism. The form of the contaminant may be altered from that in which it was discharged.

Release mechanisms for the contaminants that are present in OU B are determined by the physical and chemical properties of the contaminant in the source medium. Low mobility species adsorbed to shallow soil particles may be released by excavation (or any disturbance of the surface resulting in dermal contact or ingestion) or wind erosion. More mobile species may be released from soils by volatilization to the vapor phase, bulk flow or dissolution in liquid, suspension or dissolution in surface water, and excavation. After release, the contaminant is available for migration in the particulate, vapor, or liquid state in which it left the source medium. The potential for migration of the released form of the contaminant is determined by physical conditions between the source and potential receptors.

Potential transport pathways for contaminants present in OU B are wind, workspace air, groundwater, surface water, and stream sediments. Although contaminants in shallow and deeper soils have a release mechanism, there is no transport pathway to receptors who may come in direct contact or ingest contaminants adsorbed on soil particles. The contaminants adsorbed on the soils present a risk to employees or residents because the soils are present within their working or living area. The soils would present a risk if they were excavated or ingested; they would not present a risk if they were covered and the exposure route was cut off.

All transport pathways shown in Figure 2-25, with the exception of workspace air, are known to be "open" to transport. Workspace air would be open as a transport pathway for VOCs in soil gas if a work space with vapor-permeable walls or floor had been constructed over or adjacent to a soil gas source containing VOCs. A poorly ventilated basement office or aboveground office with a broken floor in the area of VOC source would be a likely location for this transport pathway. No location fitting this description has been identified in OU B.

The wind pathway is open for transport of contaminated soil particles that may be found in OU B. There is potential for transport of particulates and potential for exposure through inhalation for McClellan AFB employees in OU B. There may also be potential for inhalation of particulates in off-base or on-base residential areas; however, the strength and direction of winds must be determined to evaluate risks to potential receptors if shallow soil particles are found to be contaminated.

There is potential for transport of contaminants through surface water and stream sediments. Drainage ditches throughout OU B receive storm runoff from sites that have potentially had discharges of mobile contaminants to shallow soils. The storm runoff from OU B flows northward toward Magpie Creek or southward toward Arcade Creek (Section 2.4).

If contaminants were released from contaminated soils in OU B by suspension or dissolution, the contaminants may be carried to exposure routes of downstream residents or biota. One VOC, acetone, and twenty-five metals were detected in a water sample collected in OU B in a previous investigation (Section 2.6.5). None of the concentrations of analytes detected exceeded Maximum Contaminant Levels

(MCLs) for drinking water. Sampling of surface water and stream sediments in drainages as well as surface soils that would provide runoff to drainages will be conducted in the OU B RI to determine if surface waters and sediments are now or will in the future be a transport pathway. Samples will be collected along drainages in OU B and in Magpie Creek downstream in the off-base area west of McClellan AFB. Potential receptors and exposure routes will be evaluated if contaminants occur in the surface water or stream sediment pathways.

Groundwater is a contaminant transport pathway in OU B. Volatile organic compounds (VOCs) are the only contaminants that have been consistently detected in samples from monitoring wells (Section 2.6.5). The lateral distributions of contaminants in monitoring zones A through D are illustrated in Figures 2-17 through 2-20. Concentrations of VOCs in groundwater exceed MCLs and may pose health risks to McClellan AFB employees and current residents as well as future on-base or off-base residents if the water were not treated prior to use.

Although the groundwater transport pathway exists in OU B, there is uncertainty regarding the sources of the VOCs in the pathway and additional potential sources that have not been identified. Geologic cross sections that parallel two transport pathways have been prepared for the conceptual model of the groundwater pathway. Figure 2-26 depicts the legend of lithologic units used on four cross sections. Cross section A-A' shows the estimated premeabilities of lithologic units penetrated between BW 18 and MW-159 (Figure 2-27). Along this section, groundwater flows from northeast to southwest. The patterns of estimated permeability indicate that the vadose and A monitoring zones contain the lowest permeability deposits along this section. Deposits in the B, C, and D zones have a greater average grain size and higher estimated permeability than the vadose and A zones. The greatest thickness of low permeability deposits occurs in the vadose and A zones between MW-200 and MW-159. These monitoring wells are located downgradient from a group of three sites (Site 47, Site 48, and Site 36) where VOCs have been detected in soils to a depth of 80 feet BGS.

In Figure 2-28, the vertical distribution of VOCs in groundwater along cross section A-A' is shown. The greatest concentrations and most diverse suite of VOCs occur at MW-158 and MW-159. Concentrations decrease downward in the B and C zones at MW-201 and MW-154 and downgradient in MW-153. Greater concentrations of TCE and PCE occur at MW-157 which is located to the southeast of the A-A' line of section. The vertical distribution of VOCs in Figure 2-28 and the

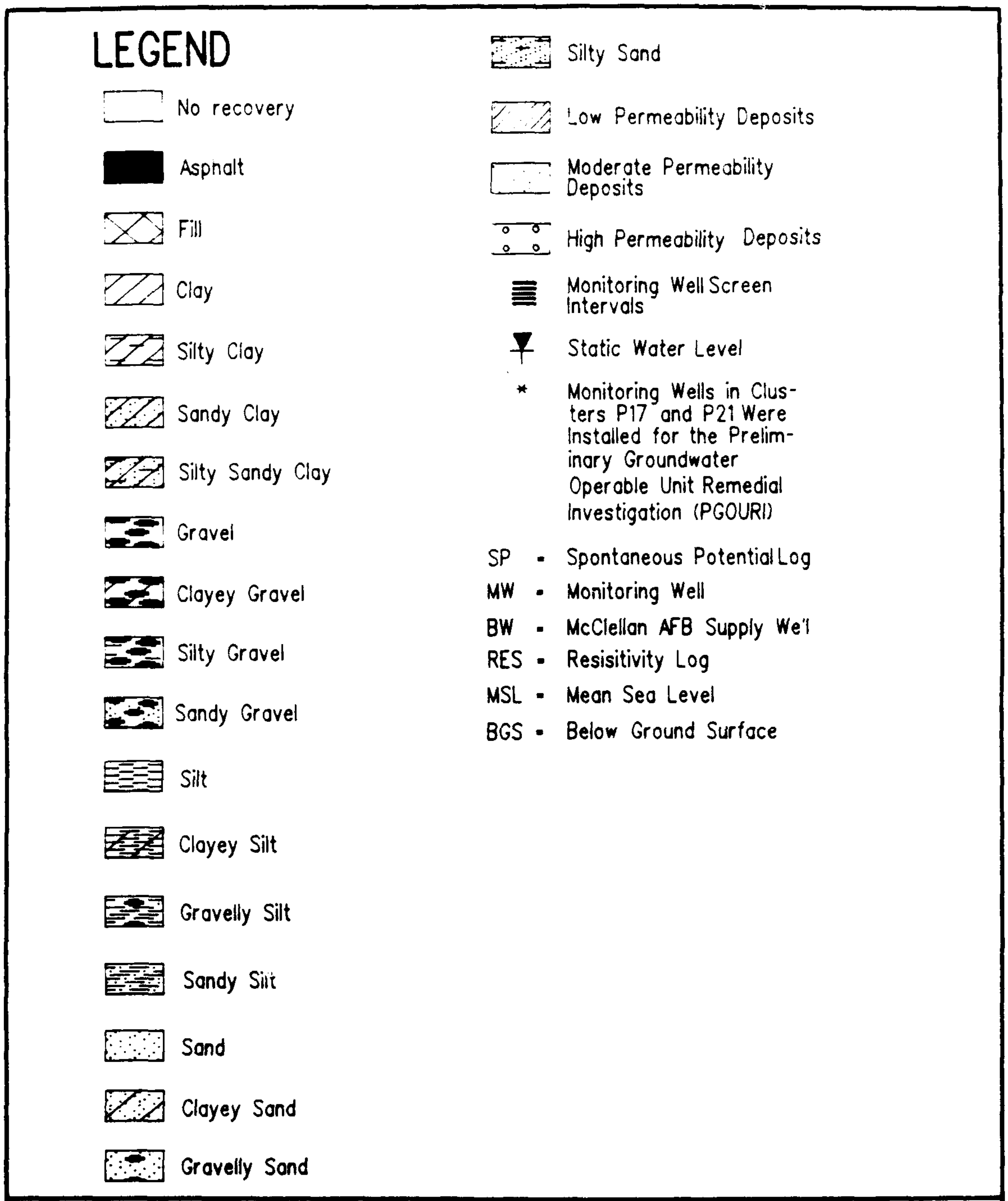


Figure 2-26. Legend of Lithologic Symbols Used in Figures 2-27 through 2-30.

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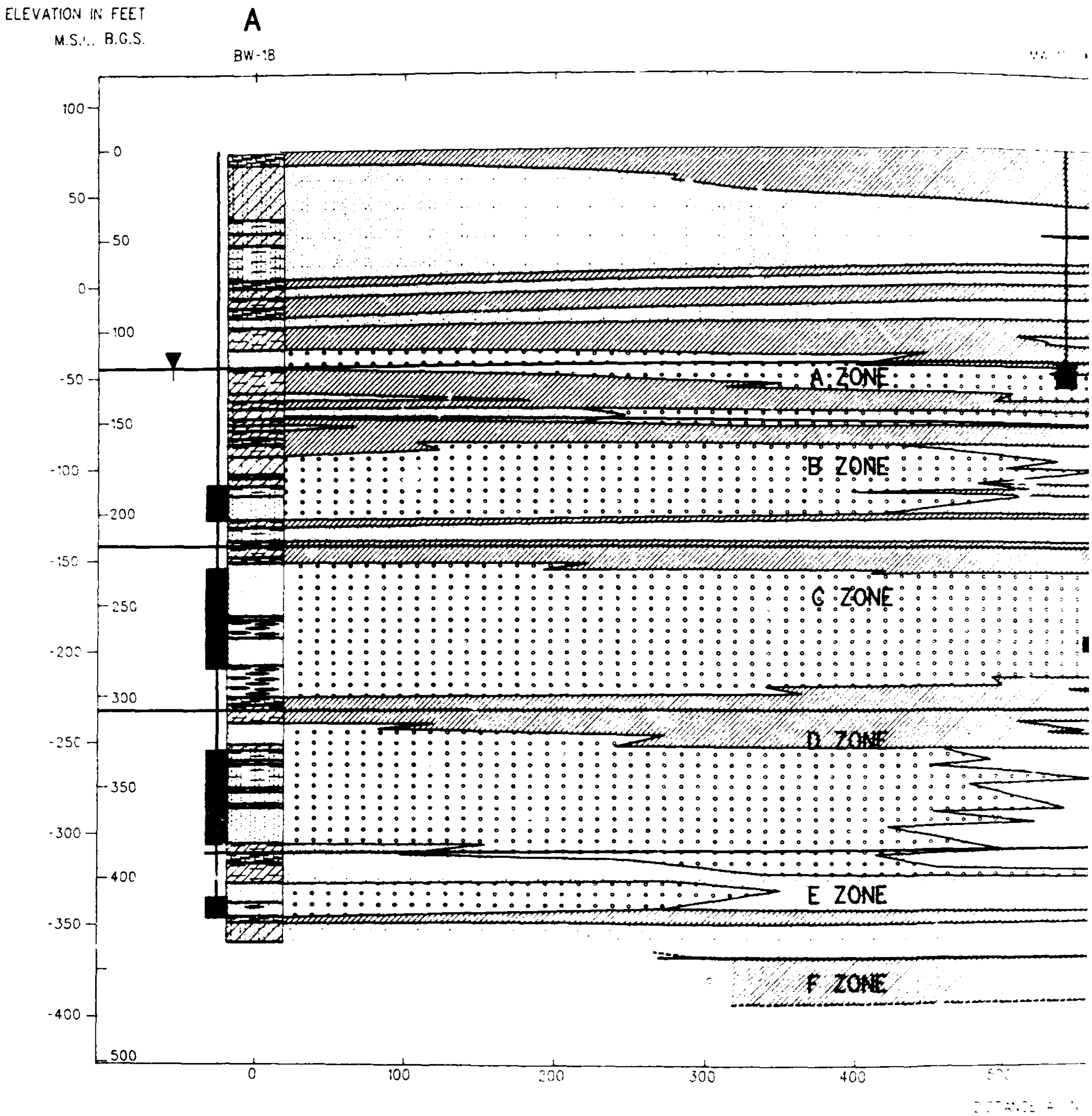
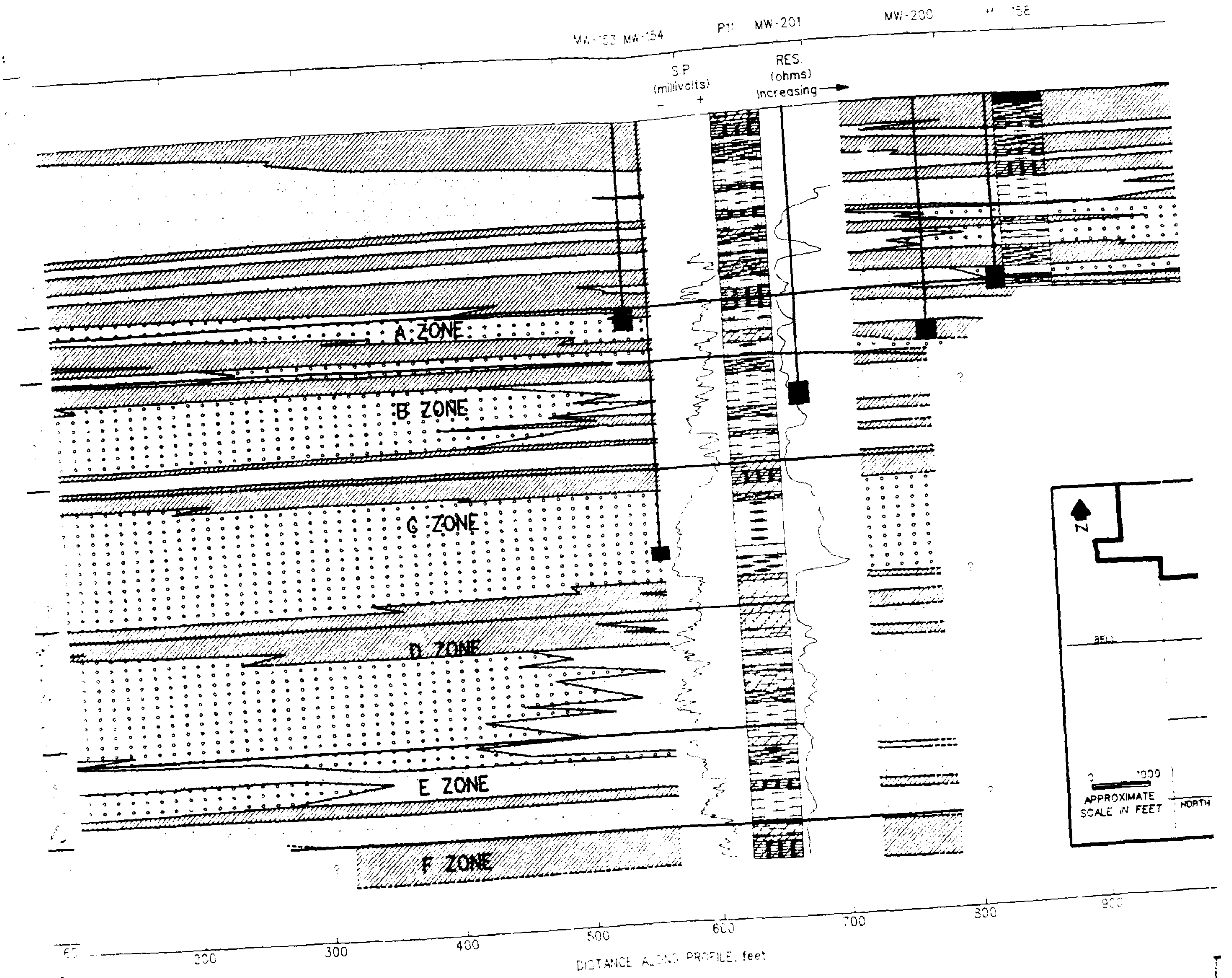

ELEVATION IN FEET
M.S.L. B.G.S.
A
BW-18
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
0
50
100
150
200
250
300
350
400
500
A ZONE
B ZONE
C ZONE
D ZONE
E ZONE
F ZONE
0
100
200
300
400


MW-153 MW-154
P11
MW-201
MW-200
158
S.P (millivolts)
–
+
RES. (ohms) increasing
A ZONE
B ZONE
C ZONE
D ZONE
E ZONE
F ZONE
?
N
BELL
0
1000
APPROXIMATE SCALE IN FEET
NORTH
200
300
400
500
600
700
800
900
DISTANCE ALONG PROFILE, feet

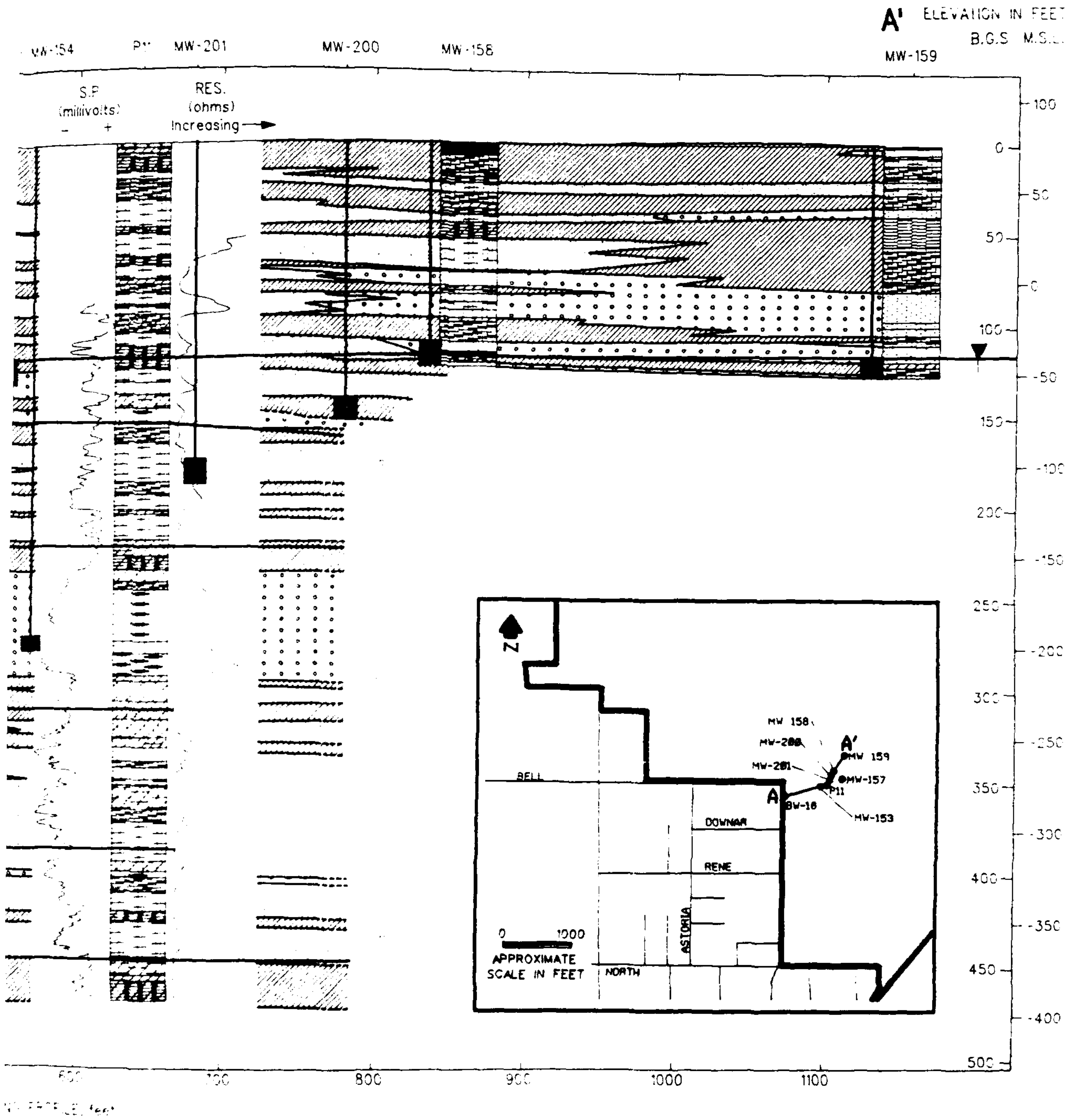
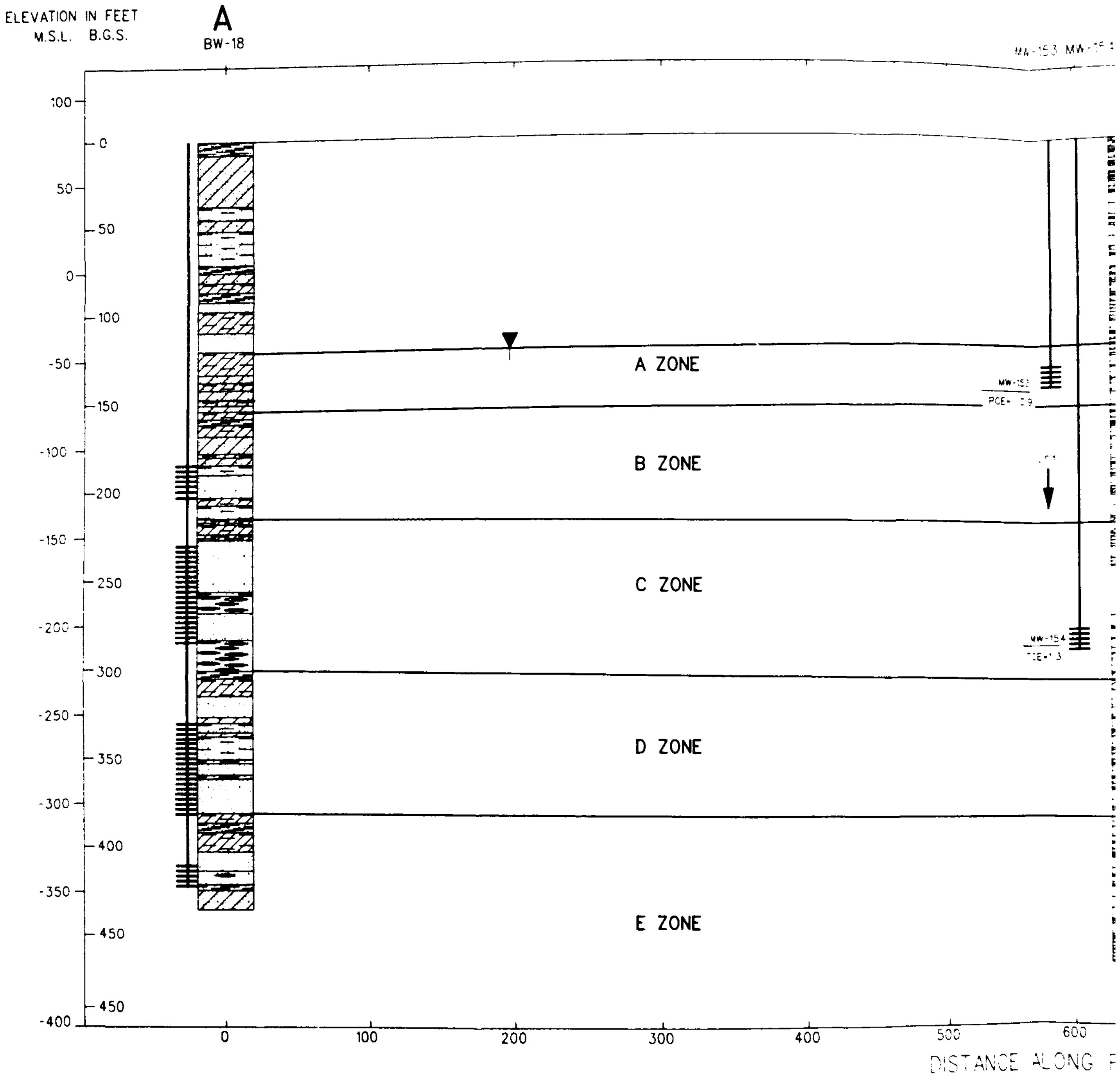


Figure 2-27.
Geologic Cross Section A-A'
Through Central Operable Unit B

McClellan AFB
Operable Unit B Remedial Investigation
Sampling & Analysis Plan (OU B RI SAP)

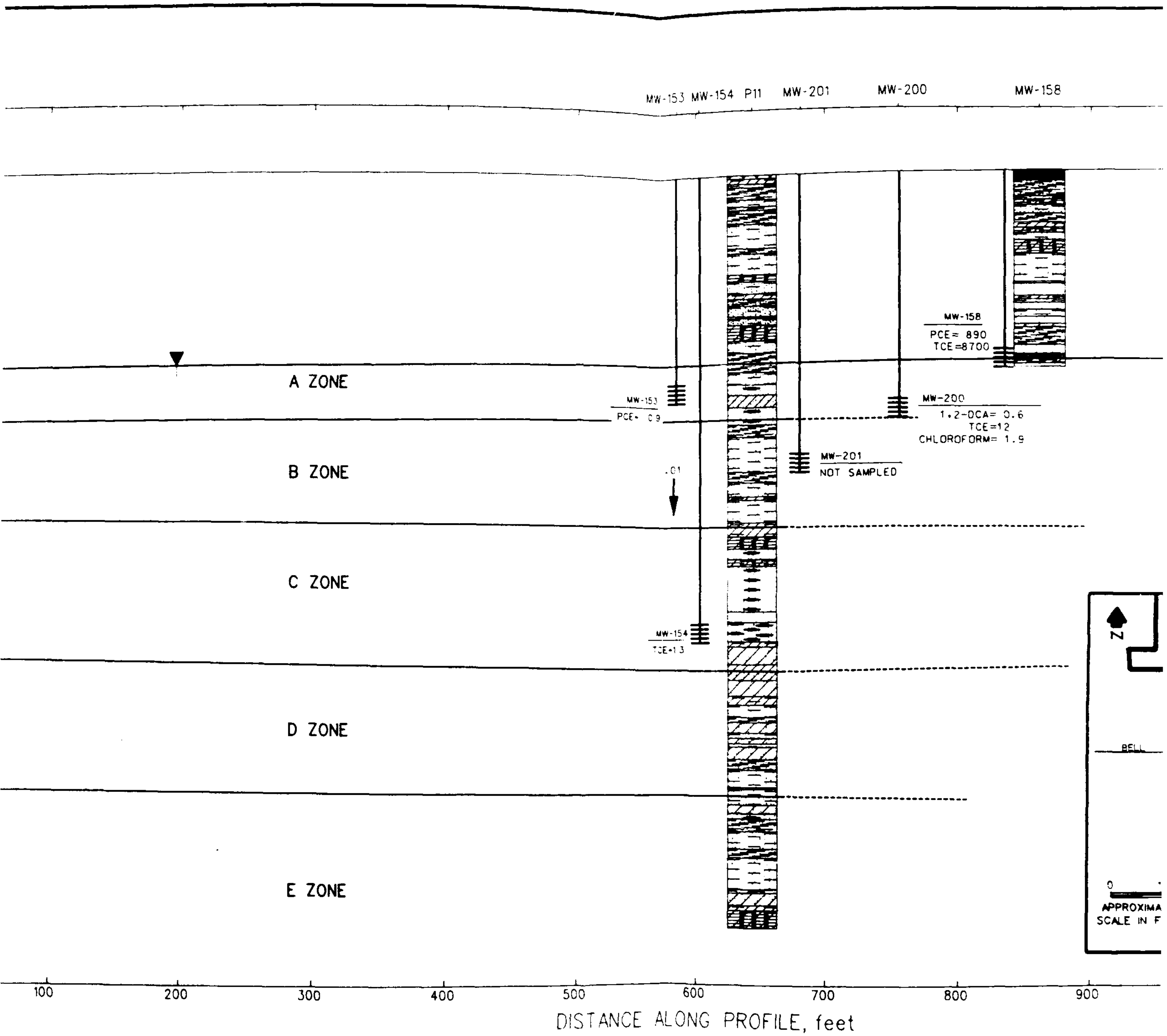
RADIAN
CORPORATION



LEGEND

TCE- 23 CONTAMINANT DETECTED, CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED SECOND QUARTER, 1991

.01 ↓ VERTICAL GRADIENT MAGNITUDE AND DIRECTION



CONCENTRATION IN

ER, 1991

NITUDE

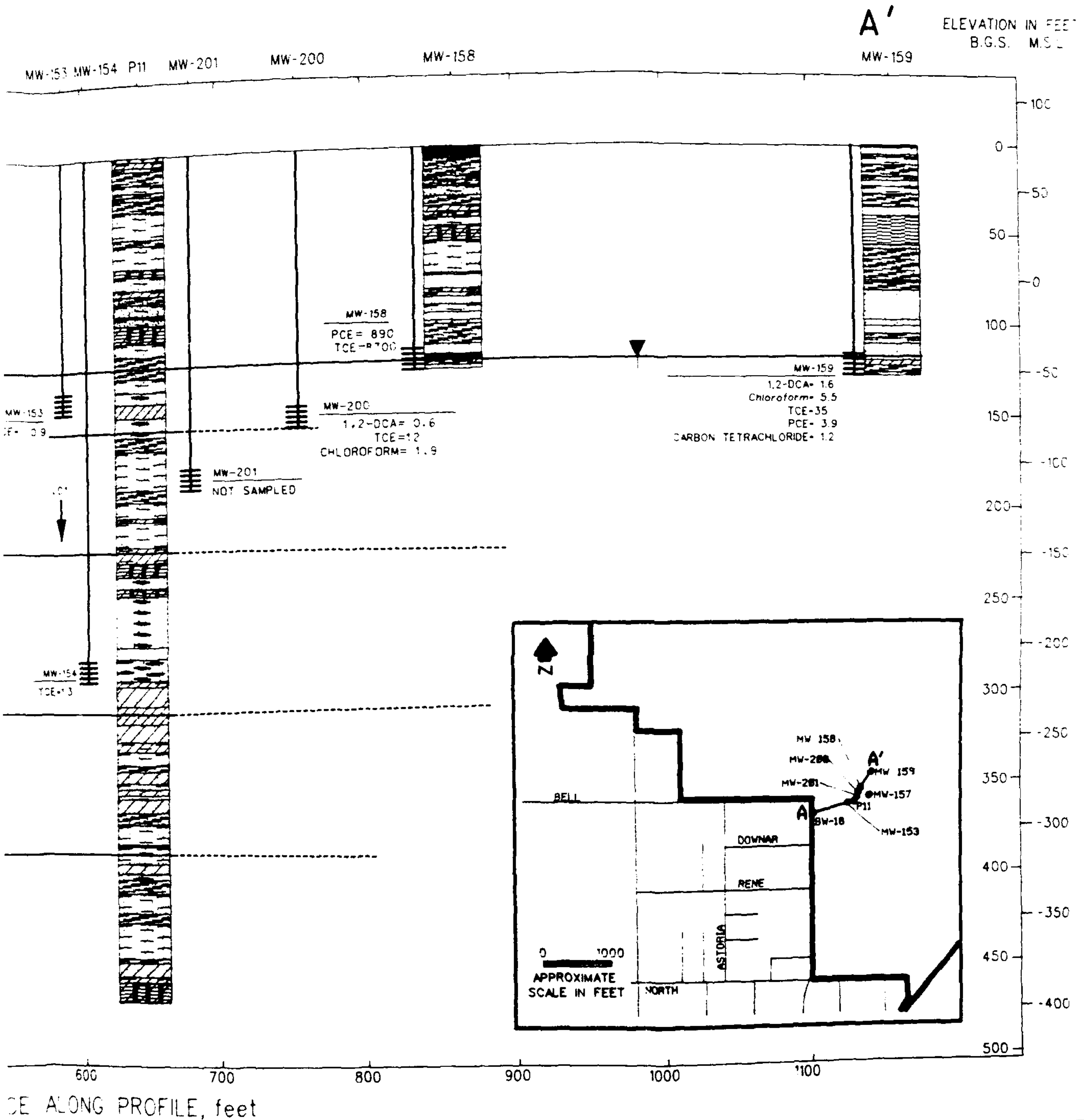


Figure 2-28.
Vertical Distribution of Volatile Organic Compounds in Groundwater Cross Section A-A'

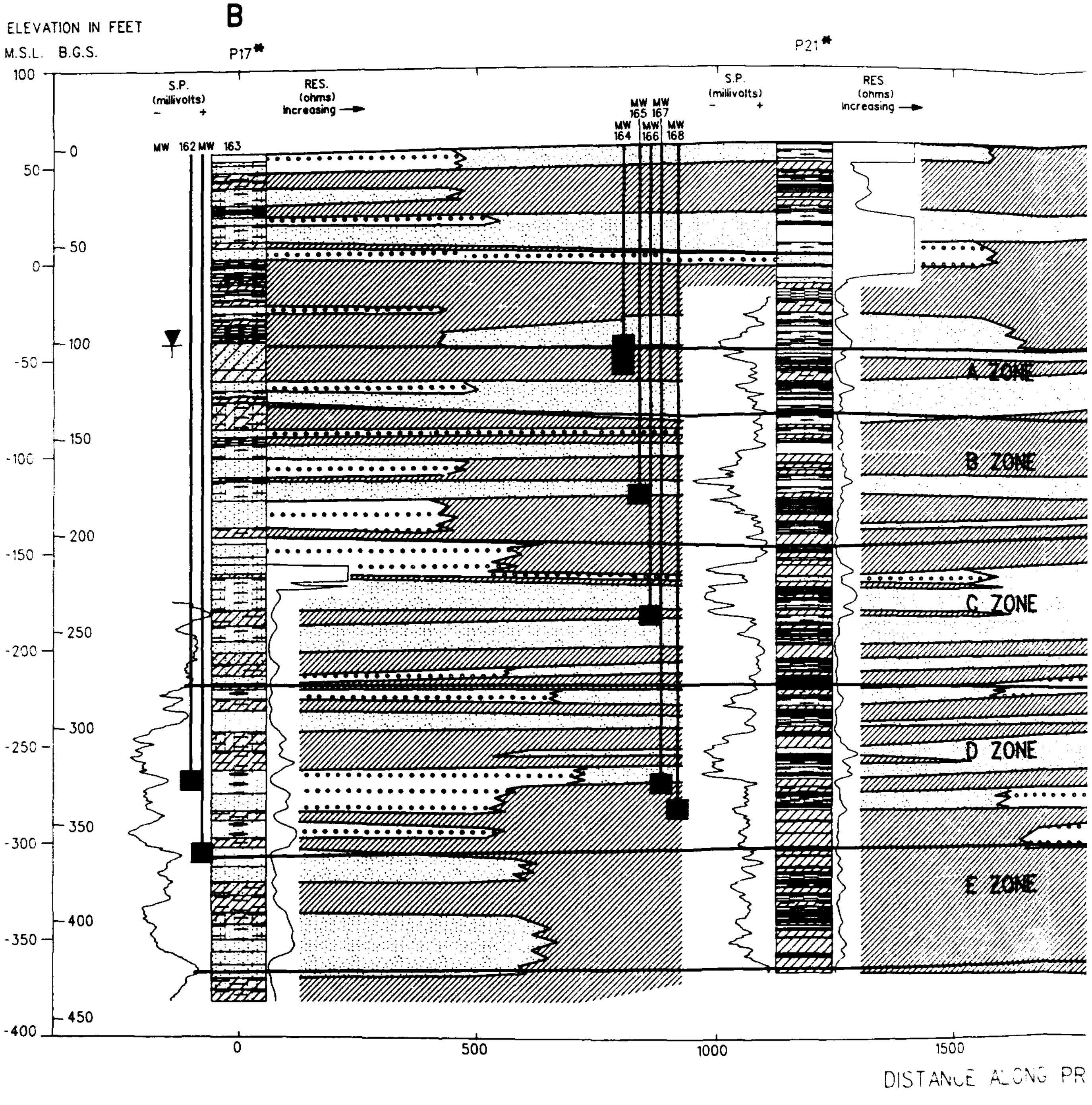
McClellan AFB
Operable Unit B Remedial Investigation
Sampling & Analysis Plan (OU B RI SAP)

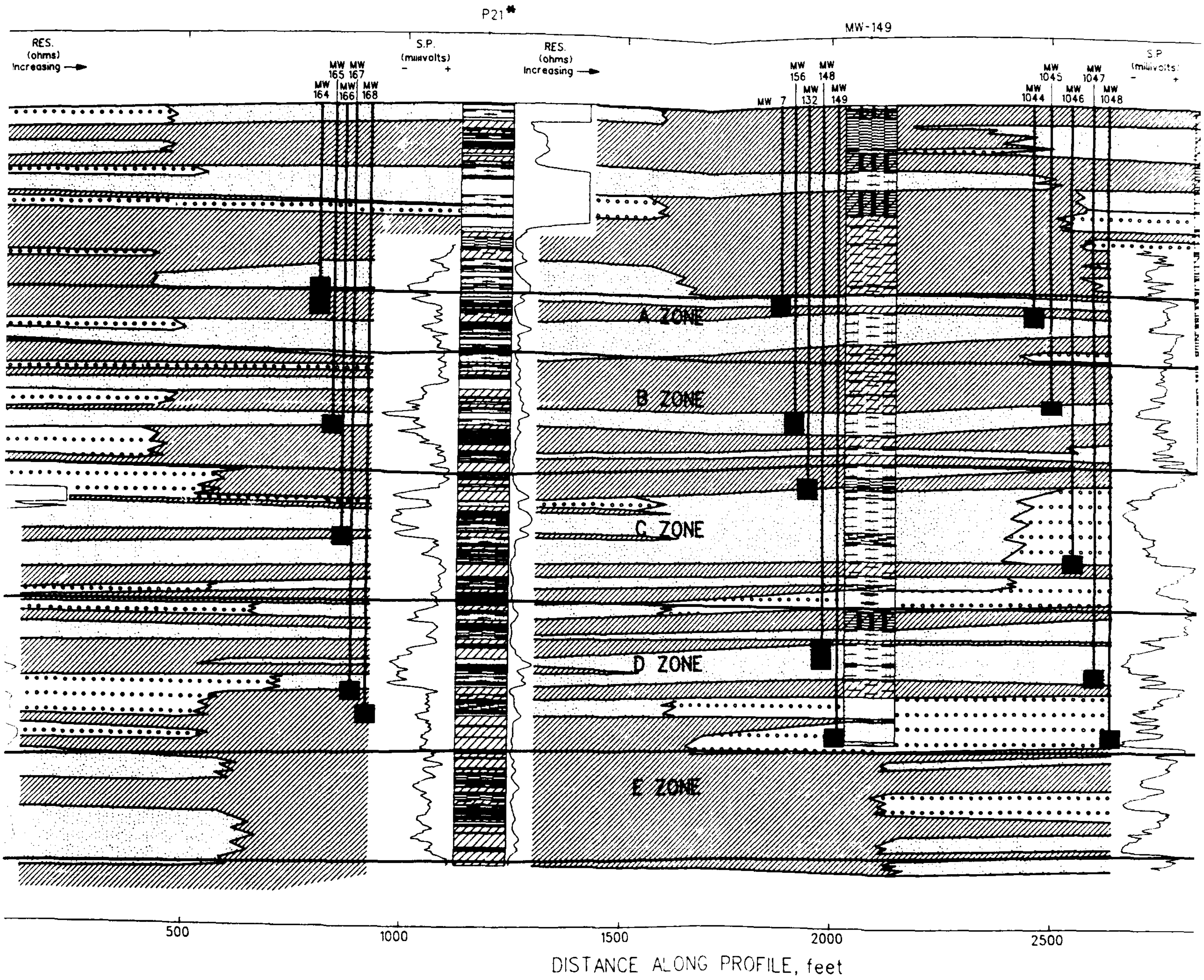
detection of TCE and PCE in soils at 60 feet BGS at Site 47 suggests that the site contains a source of VOCs. The VOCs from the source area migrated vertically through approximately 80 feet of low permeability deposits to enter the groundwater transport pathway near, but to the southeast of, MW-159.

Cross section B-B′ generally parallels the north to south groundwater flow direction that prevailed in this area from approximately 1955 to 1989 (Figure 2-29). Since 1989, groundwater in the A through D zones has flowed more southeasterly because of the hydraulic influence of BW 18 (see Figures 2-14 through 2-16). Along this cross section, the vadose and A monitoring zones contain greater thicknesses of low permeability deposits than deeper ones within the exception of the E zone. However, there are thicker moderate and high permeability layers in the shallow zones here than were present in cross section A-A′. Comparison of lithologic distributions and estimated permeabilities on the two sections indicates that the vadose zone and A monitoring zone through much of OU B contain finer-grained and lower permeability deposits than the deeper saturated zones. This distribution of lithologies is likely to have slowed the migration of contaminants from sources in OU B to the groundwater pathway.

Figure 2-30 shows the vertical distribution of VOCs in groundwater along cross section B-B′. Concentrations of VOCs in the B and C monitoring zones are greater than in the A zone. With the exception of TCE and 1,2-DCE, the contaminant suites differ in each zone and between wells in the same zone (see Figures 2-17 through 2-20). The diversity of contaminants detected along cross section B-B′ suggests that several sources of contaminants are released as VOCs to the groundwater pathway in the northern portion of OU B. The depth of contamination along the cross section (350 feet BGS at MW-149) indicates that VOCs occurring in the C, D, and E zones entered the groundwater at a source or sources north of MW-162 in OU C.

The identification and characterization of VOC contaminant sources in OU B will be an important portion of the OU B RI because VOCs are the contaminants detected in the only transport pathway known in OU B. The conceptual model for the groundwater pathway will be more fully developed following further characterization and modeling of transport through the vadose zone.


B
ELEVATION IN FEET
M.S.L.
B.G.S.
P17*
P21*
S.P. (millivolts) − +
RES. (ohms) Increasing →
MW 162
MW 163
MW 164
MW 165
MW 166
MW 167
MW 168
A ZONE
B ZONE
C ZONE
D ZONE
E ZONE
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
0
50
100
150
200
250
300
350
400
450
0
500
1000
1500
DISTANCE ALONG PR


P21*
MW-149
RES. (ohms) Increasing →
MW 165
MW 167
MW 164
MW 166
MW 168
S.P. (millivolts) − +
RES. (ohms) Increasing →
MW 156
MW 148
MW 7
MW 132
MW 149
MW 1045
MW 1047
MW 1044
MW 1046
MW 1048
S.P. (millivolts) − +
A ZONE
B ZONE
C ZONE
D ZONE
E ZONE
500
1000
1500
2000
2500
DISTANCE ALONG PROFILE, feet

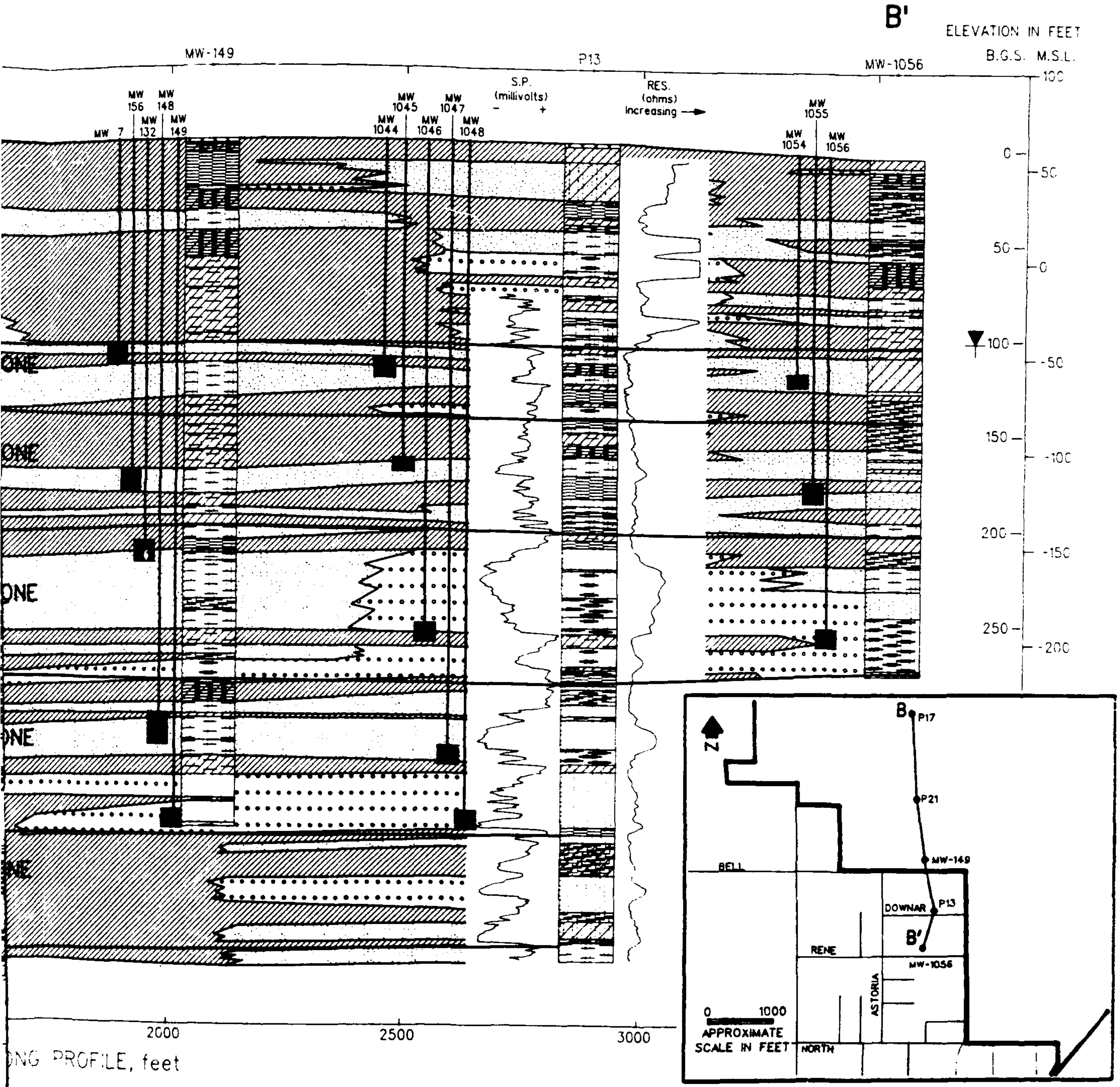
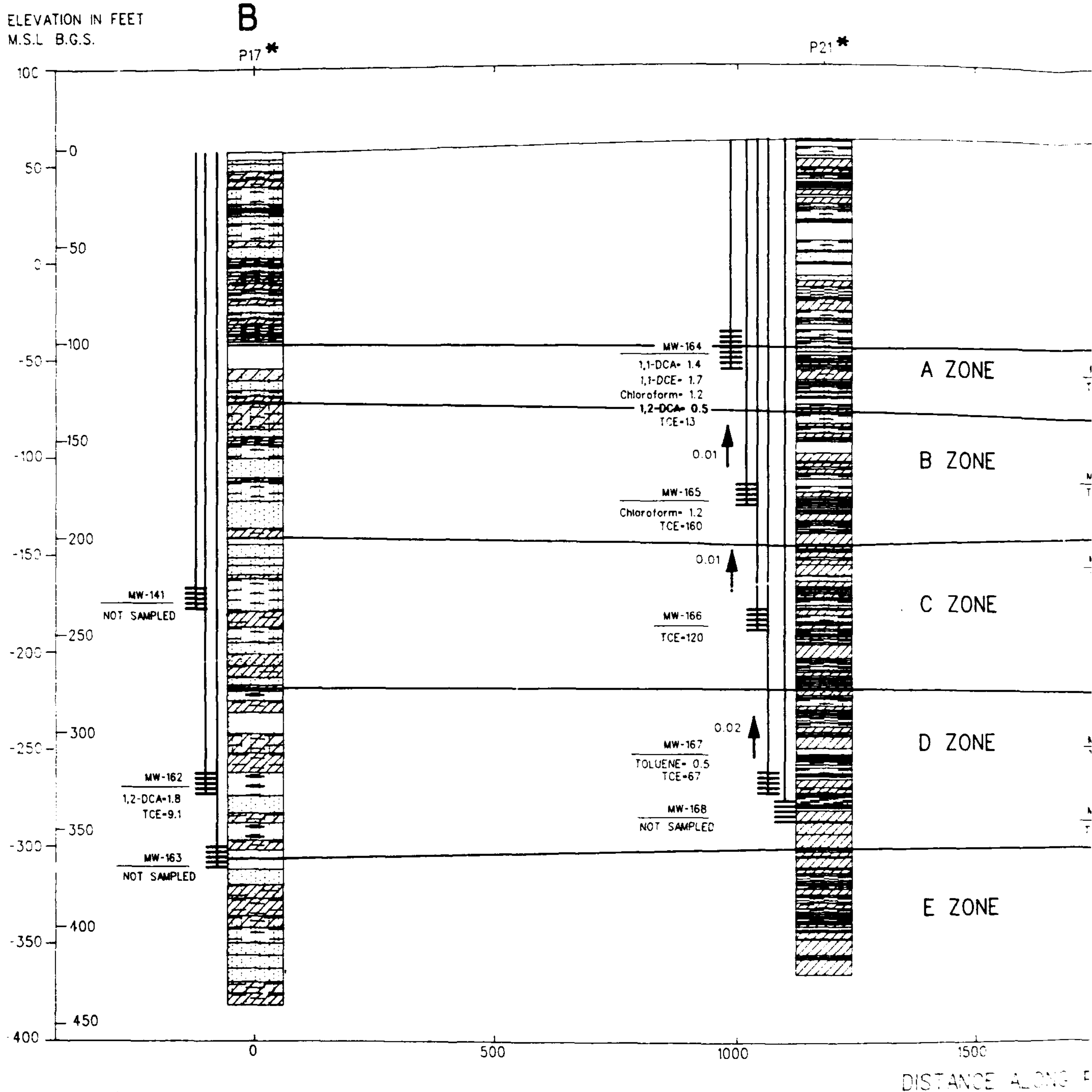


Figure 2-29.
Geologic Cross Section B-B'
Through West Central Operable Unit B

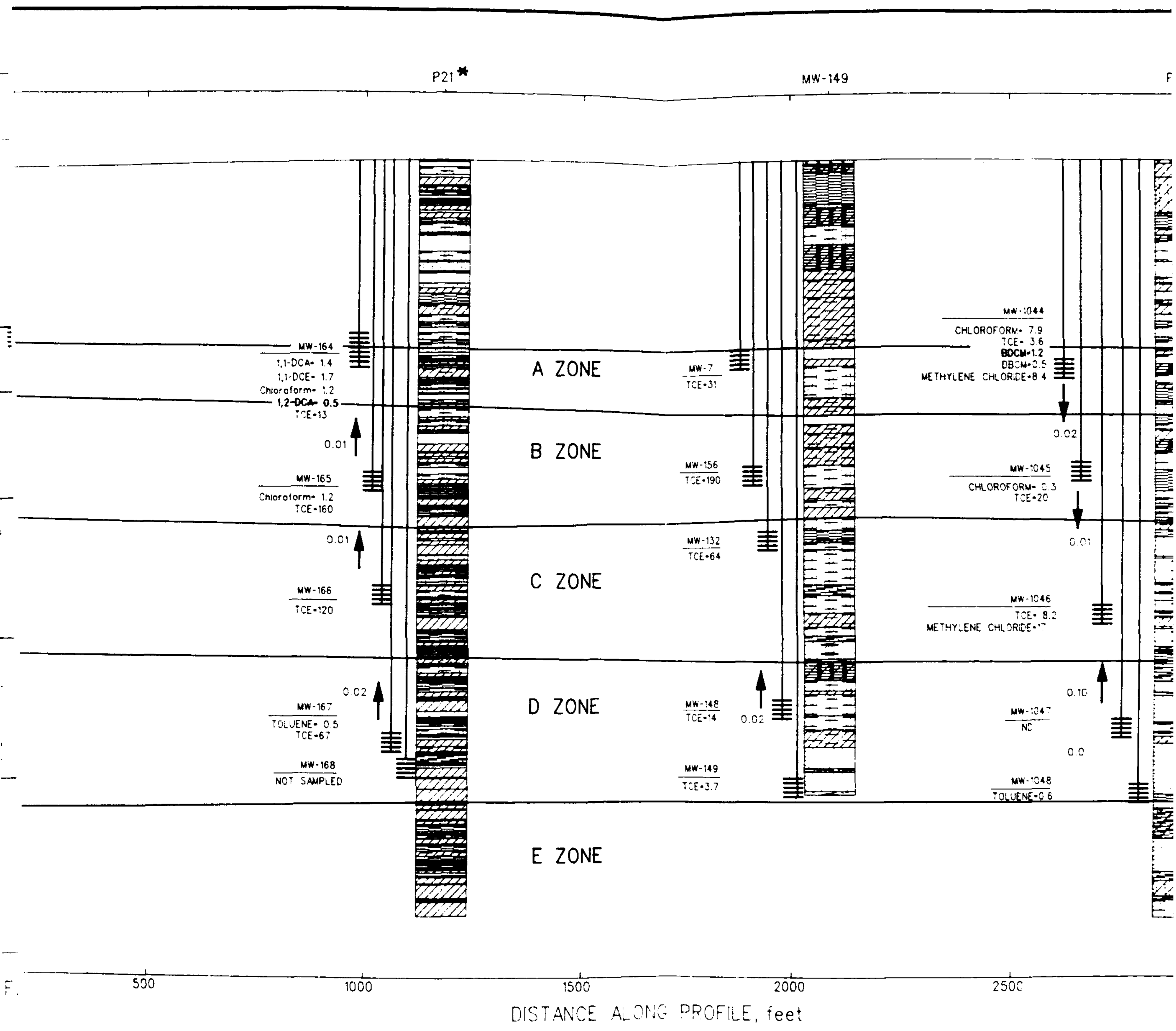
McClellan AFB
Operable Unit B Remedial Investigation
Sampling & Analysis Plan (OU B RI SAP)

RADIAN
CORPORATION



LEGEND

TCE- 31	CONTAMINANT DETECTED, CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED SECOND QUARTER, 1991
.01 ↓	VERTICAL GRADIENT MAGNITUDE AND DIRECTION
BDCM	BROMODICHLOROMETHANE
DBCM	DIBROMODICHLOROMETHANE
ND	NOT DETECTED


P21*
MW-149
MW-164
1,1-DCA= 1.4
1,1-DCE= 1.7
Chloroform= 1.2
1,2-DCA= 0.5
TCE=13
0.01
MW-165
Chloroform= 1.2
TCE=160
0.01
MW-166
TCE=120
0.02
MW-167
TOLUENE= 0.5
TCE=67
MW-168
NOT SAMPLED
A ZONE
B ZONE
C ZONE
D ZONE
E ZONE
MW-7
TCE=31
MW-156
TCE=190
MW-132
TCE=64
MW-148
TCE=14
0.02
MW-149
TCE=3.7
MW-1044
CHLOROFORM= 7.9
TCE= 3.6
BDCM=1.2
DBCM=0.5
METHYLENE CHLORIDE=8.4
0.02
MW-1045
CHLOROFORM= 0.3
TCE=20
0.01
MW-1046
TCE= 8.2
METHYLENE CHLORIDE=17
0.10
MW-1047
ND
0.0
MW-1048
TOLUENE=0.6
500
1000
1500
2000
2500
DISTANCE ALONG PROFILE, feet

IN

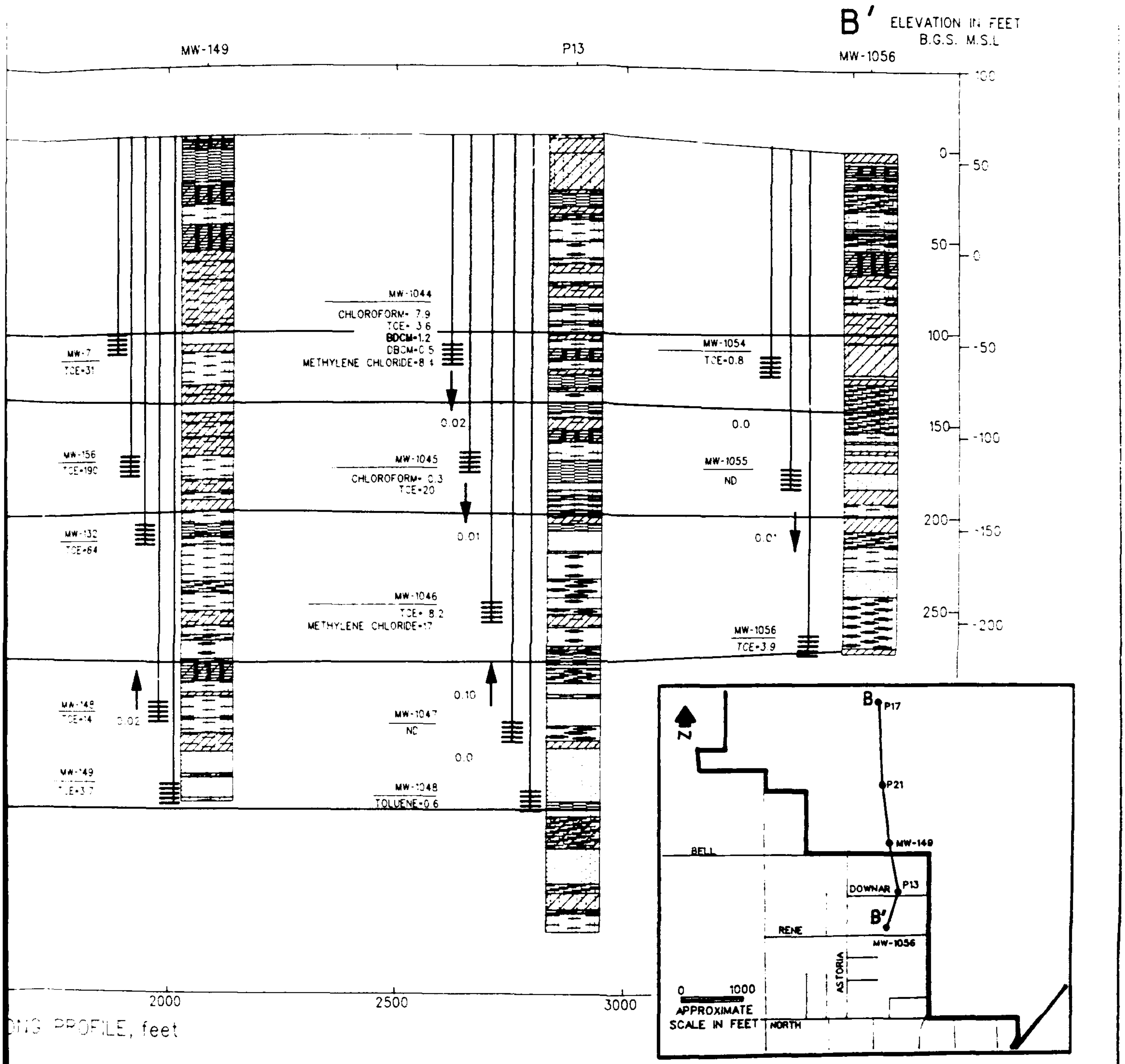


Figure 2-30.
Vertical Distribution of Volatile Organic Compounds in Groundwater Cross Section B-B'

McClellan AFB
Operable Unit B Remedial Investigation
Sampling & Analysis Plan (OU B RI SAP)

2.7.4 Model Development

As data are collected in the OU B RI, the conceptual model will be updated with additional details. There are evident data gaps within the model framework. Along with analytical data for contaminants at identified sources, other data for the wind, surface water, sediment, and groundwater will be obtained to evaluate the concentration of contaminants during transport through each pathway. The presence or absence of the work space area pathway will be determined. Previously unidentified release mechanisms, transport pathways, and exposure routes will be added to the model if they occur.

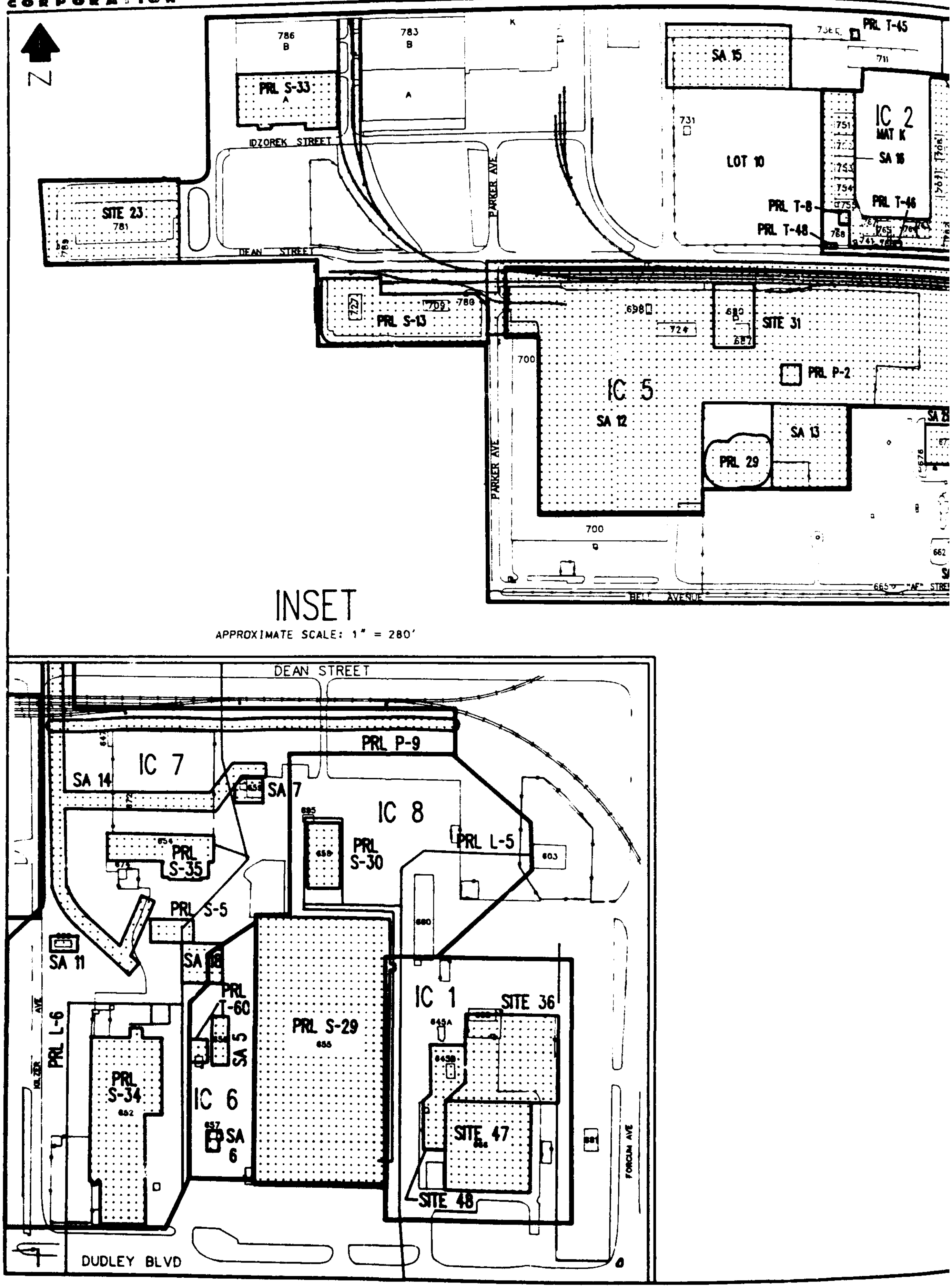
Physical parameters, meteorological data, demographic data, and ecologic information will be used in mathematical modeling to calculate health and environmental risks that may be posed by contaminants in any of the pathways. While the RI field work is being performed, the physical and chemical data compiled in the conceptual model may be used to develop "action levels," contaminant concentrations that indicate a remedial action is needed at a source. In preparation of the RI/FS report, the conceptual model and calculations will be used to complete the baseline risk assessment for sources identified OU B.

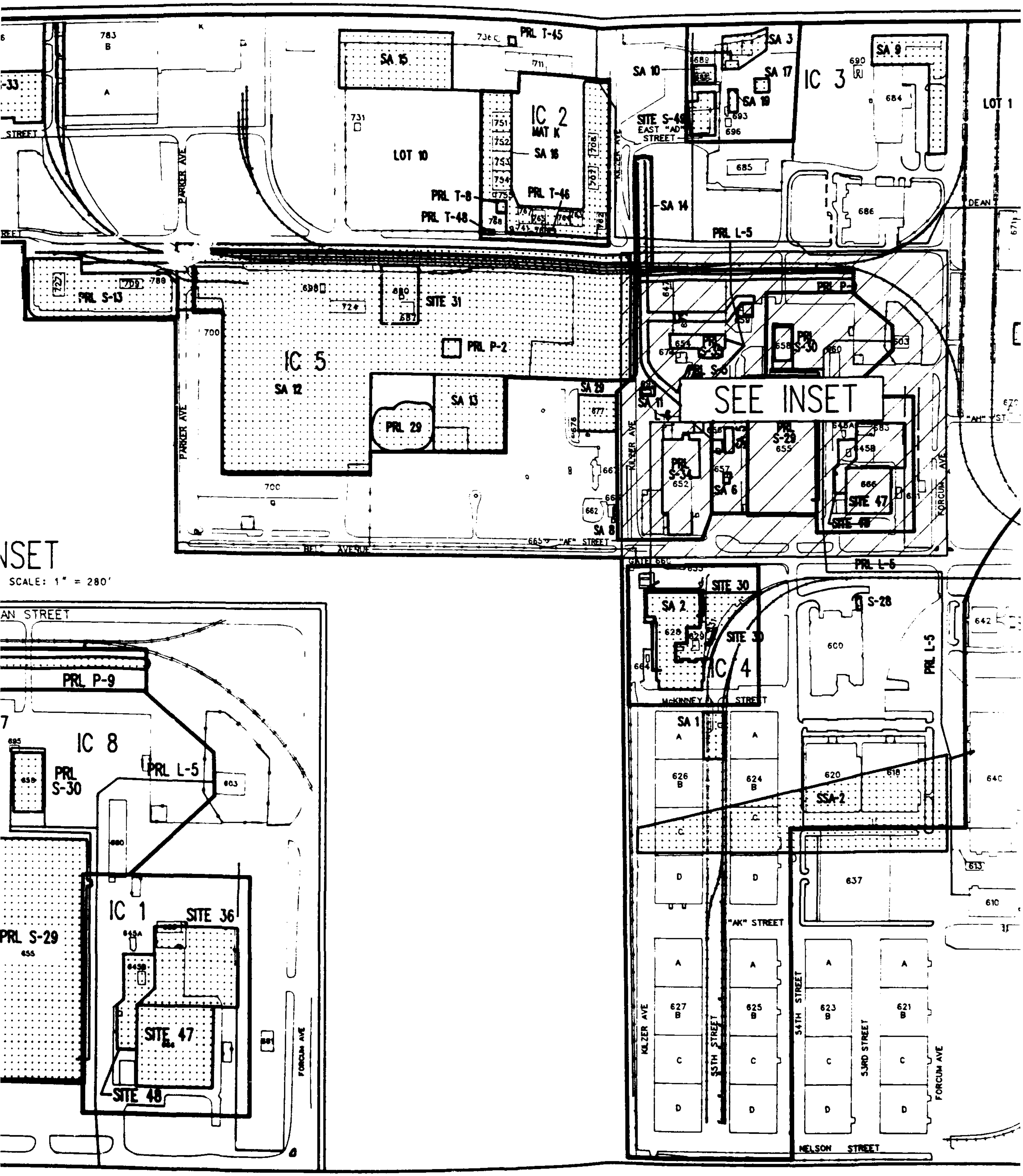
3.0 SITE-SPECIFIC SAMPLING PLANS

The Remedial Investigation (RI) in Operable Unit (OU) B of McClellan Air Force Base (AFB) will be conducted in three phases and will culminate with the preparation of a Remedial Investigation/Feasibility Study (RI/FS) report. The OU B RI comprises the major portion of the process leading to selection of remedies and cleanup of contamination in OU B. Fifty-three individual sites distributed over 340 acres (Figure 3.0-1), surface water drainages, and contaminants migrating in groundwater will be investigated. The sites to be investigated are grouped in three categories: Sites, where the presence of contaminants in soil was confirmed in previous investigations; Potential Release Locations (PRLs), where the presence of contaminants in soil is suspected but has not been confirmed; and Study Areas (SAs), where historical or ongoing operations or practices pose the potential for contaminant release to the environment. Two Special Study Areas (SSAs) are a subset of SAs in which there have been no operations or practices that would result in contamination, but in which potential for contamination exists. Among the sites are facilities of various types that include: former disposal and burn pits; wastewater treatment facilities; underground storage tanks; waste sumps, drains, and pipelines that are in use; and large open unpaved storage areas.

The sampling plans for each site in OU B were developed with all data that were available for the site, including recently obtained soil gas analyses, and the preliminary conceptual model applicable to sites in OU B. The data available for most sites consist of documented, aerial photographs, and interview records of historical operations and chemical handling. A few sites have had a number of borings drilled with some sampling and analysis. The preliminary conceptual model for sites in OU B (Section 2.7) was developed from descriptions on soil boring and monitoring well drilling logs and from groundwater analyses. Data available for historical operations or previous soil, soil gas, and groundwater sampling in OU B indicated the types of analyses that are needed to evaluate discharges at potential contaminant sources. The preliminary conceptual model, based on lithologic descriptions of the vadose and saturated zones and on the types of potential discharges, indicated the depths of sampling needed to characterize a contaminant discharge or its extent of migration.

The sampling plans are designed to provide data for decision making for sites in OU B. An RI Decision Process provides the framework for reaching decisions


N
786 B
783 B
K
A
PRL S-33 A
PRL T-45
SA 15
711
731
LOT 10
IC 2
MAT K
SA 16
751
753
754
755
PRL T-8
PRL T-46
PRL T-48
788
IDZOREK STREET
PARKER AVE
DEAN STREET
SITE 23
781
727
709
780
PRL S-13
698
724
680
687
SITE 31
700
IC 5
SA 12
PRL P-2
SA 13
PRL 29
SA 21
676
662
BELL AVENUE
665
"AF" STREET
INSET
APPROXIMATE SCALE: 1" = 280'
DEAN STREET
PRL P-9
IC 7
SA 14
SA 7
IC 8
PRL S-30
PRL L-5
603
PRL S-35
PRL S-5
SA 11
SA 8
PRL T-60
SA 5
PRL L-6
KILZER AVE
PRL S-34
652
IC 6
657
SA 6
PRL S-29
655
IC 1
SITE 36
645A
645B
SITE 47
SITE 48
FORUM AVE
DUDLEY BLVD


783
B
A
STREET
PARKER AVE
SA 15
736 C
PRL T-45
711
731
LOT 10
IC 2
MAT K
751
752
753
754
755
SA 16
PRL T-8
PRL T-46
PRL T-48
788
708
SA 10
SA 3
SA 17
689
SA 19
693
696
SITE S-49
EAST "AD" STREET
IC 3
690
SA 9
684
LOT 1
KILZER AVE
685
SA 14
686
DEAN
PRL L-5
722
709
789
PRL S-13
698
724
680
SITE 31
682
700
PRL P-2
IC 5
SA 12
SA 13
PRL 29
SA 29
677
676
SA 11
PRL P
654
PRL S-35
658
PRL S-30
660
663
SEE INSET
PRL S-29
655
645A
683
645B
PRL S-34
652
657
SA 6
666
SITE 47
SITE 48
FORCUM AVE
700
662
SA 8
665
"AF" STREET
BELL AVENUE
"AH" ST
GATE 660
SITE 30
S-28
SA 2
628
629
IC 4
600
642
PRL L-5
664
McKINNEY STREET
SA 1
A
626
B
624
B
620
618
SSA-2
640
C
C
D
D
637
613
610
"AK" STREET
A
627
B
C
D
A
625
B
C
D
35TH STREET
34TH STREET
A
623
B
C
D
53RD STREET
A
621
B
C
D
NELSON STREET
INSET
SCALE: 1" = 280'
AN STREET
PRL P-9
IC 8
695
659
PRL S-30
PRL L-5
603
680
IC 1
SITE 36
645A
645B
PRL S-29
655
SITE 47
686
681
SITE 48
FORCUM AVE

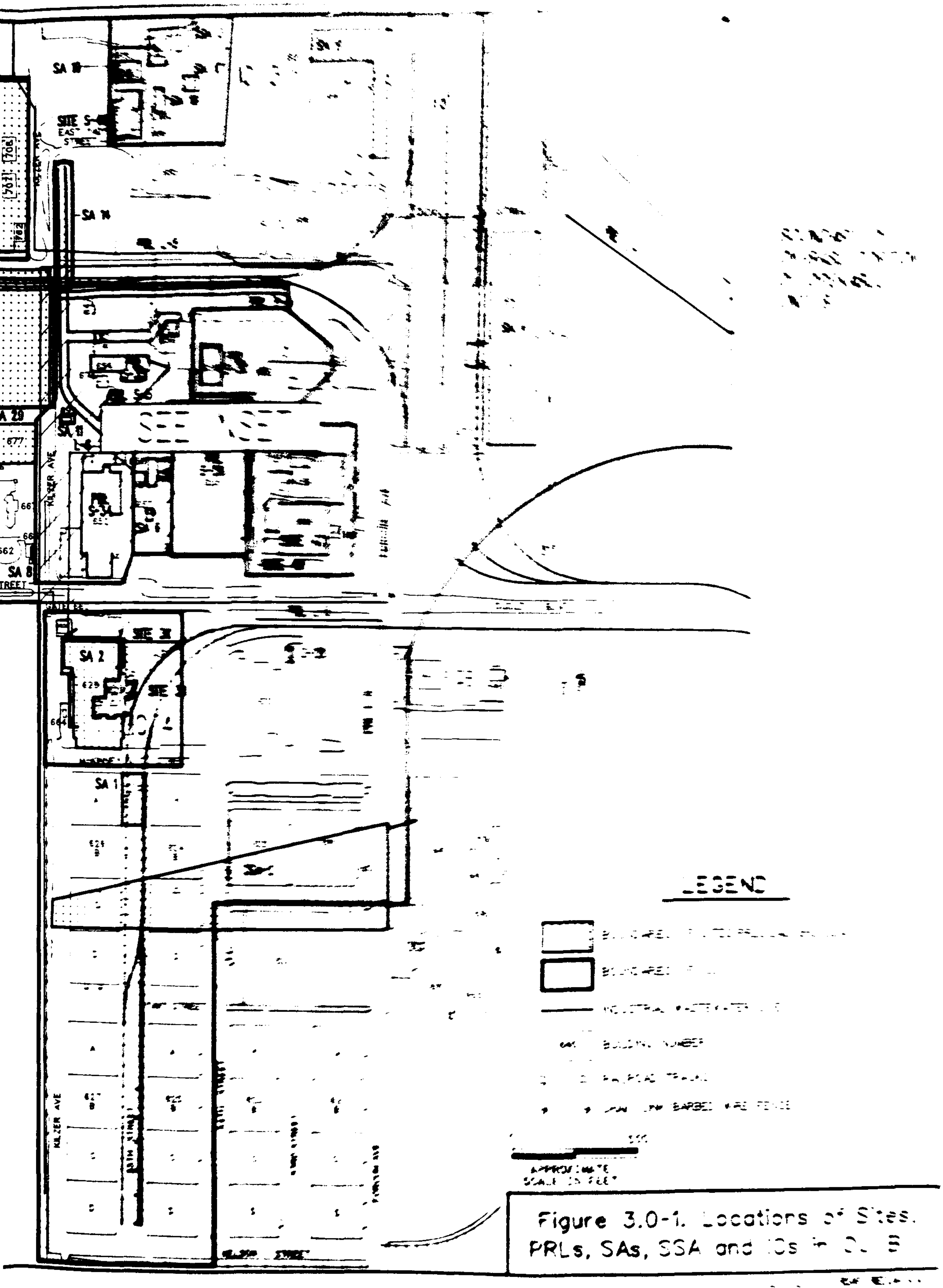


Figure 3.0-1. Locations of Sites, PRLs, SAs, SSA and ICs in OU B

regarding sampling, analysis, prioritization of activities, and preliminarily remedial actions.

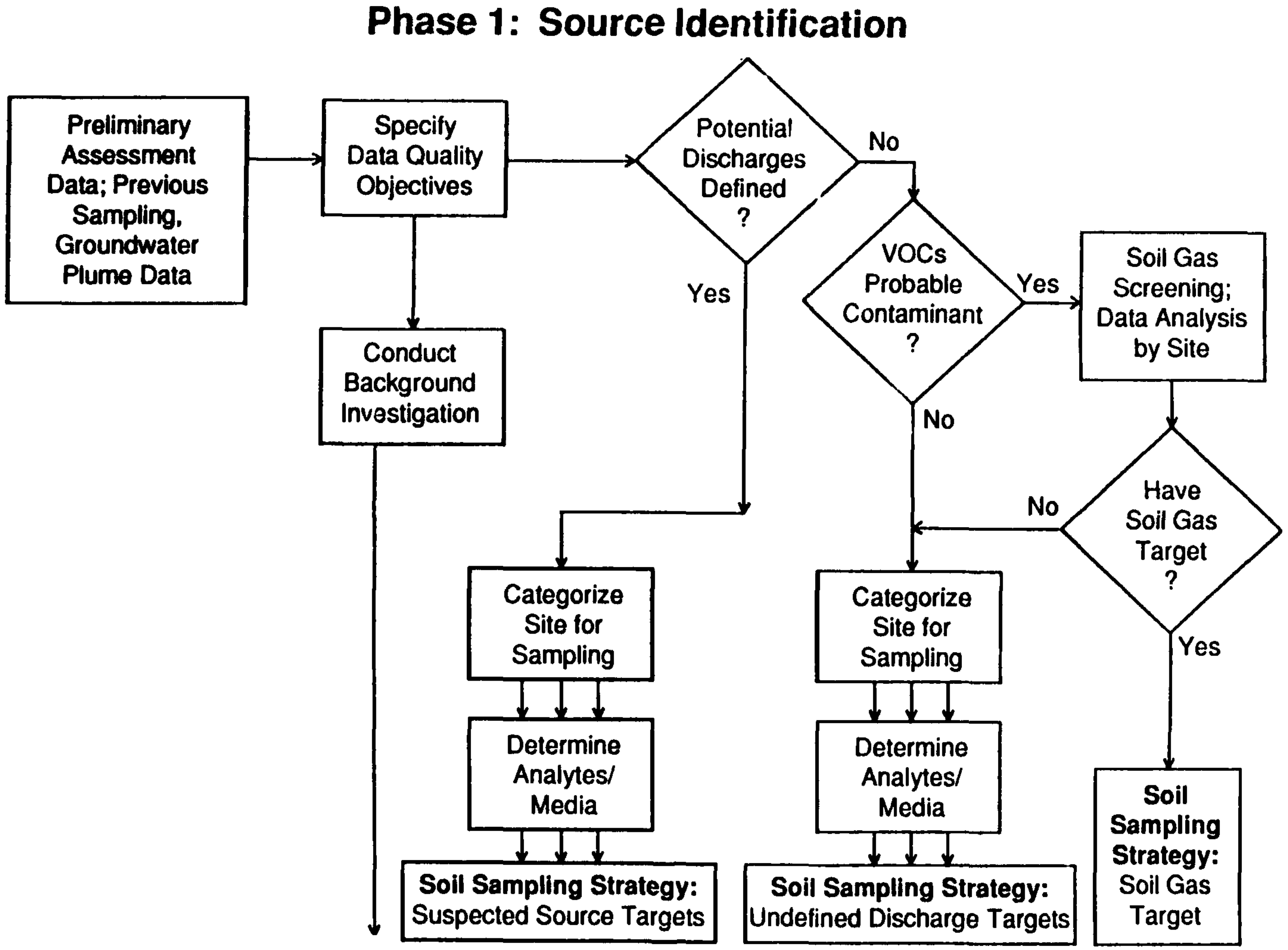
3.0.1 Remedial Investigation Decision Process

To effectively characterize the sites and, where necessary, screen and evaluate remedial alternatives during the course of the field investigation, an RI Decision Process has been developed for the OU B RI. Decisions will be required throughout the RI field investigation to:

- Determine if a site is a source of contaminants;
- Assess the extent of contamination and potential for migration through exposure pathways;
- Decide on the need for remediation on the basis of action levels for human health or environmental protection; and
- Evaluate appropriate methods to achieve the cleanup levels.

The RI Decision Process is intended to ease the transition between investigation phases and to prioritize activities throughout the RI. Criteria for sampling, analysis, and data handling are designed to organize and direct the flow of information from collection to decision making. The organized flow of data from collection to decision points will make the most effective use of labor, equipment, and supplies in an effort to find and remediate contaminants. The flow of information through the RI Decision Process is illustrated as a process diagram in Figures 3.0-2, 3.0-3, and 3.0-4. The RI Decision Process is described in detail in Appendix A of this Sampling and Analysis Plan.

The three phases of the OU B RI are: Phase 1 -- Source Identification; Phase 2 -- Extent Determination; and Phase 3 -- Remedial Alternative Evaluation. The development of Data Quality Objectives (DQOs) for each phase of the RI is described in Section 4.0. Detailed DQOs for Phase 1 are provided with each site-specific plan.



Phase 1: Source Identification

Figure 3.0-2. Remedial Investigation Decision Process Flow Diagram for Phase 1.

VMG 8/29/91

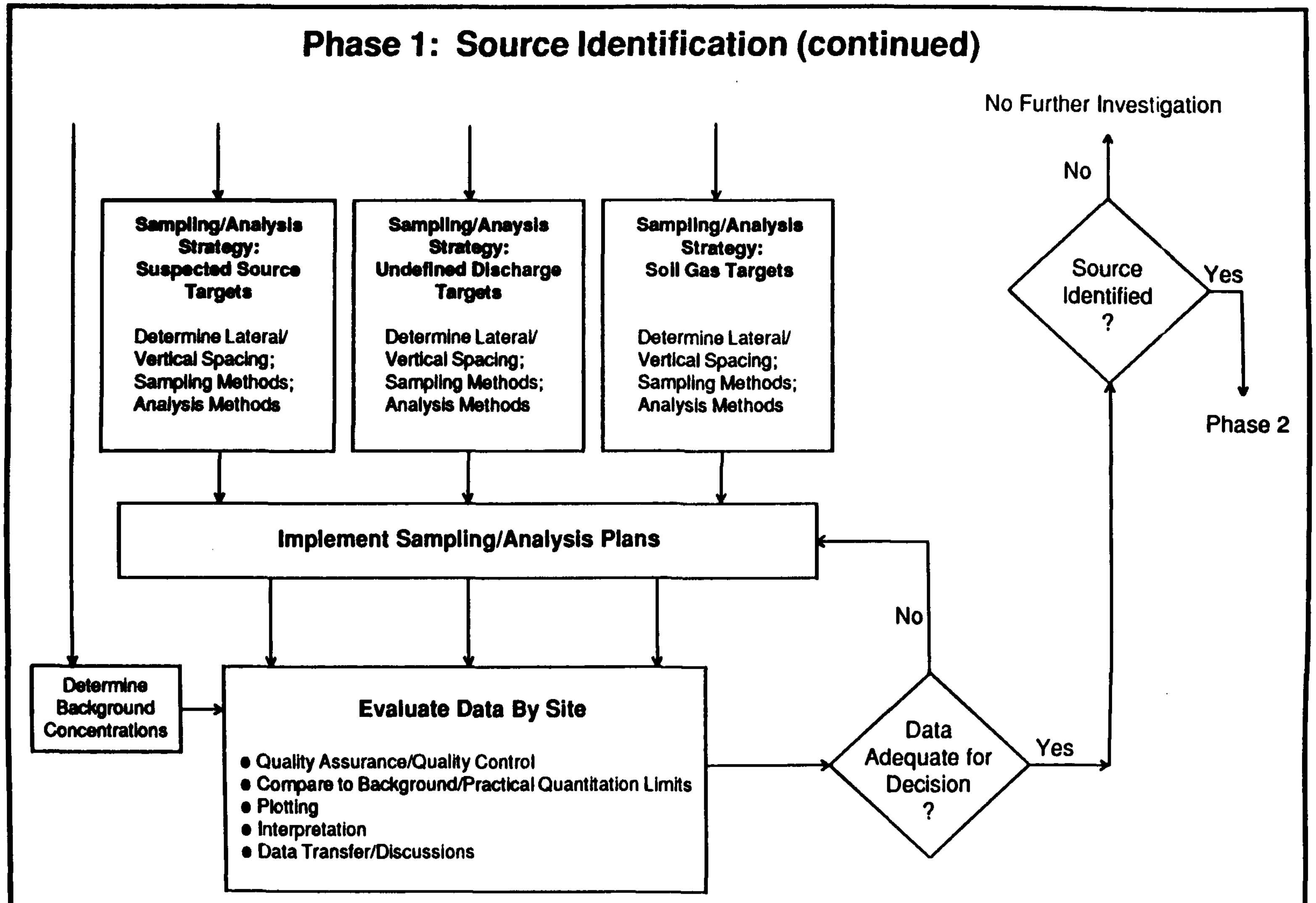

Phase 1: Source Identification (continued)

Figure 3.0-3. Remedial Investigation Decision Process Flow Diagram for Phase 1. (Continued)

VMG 8/29/91

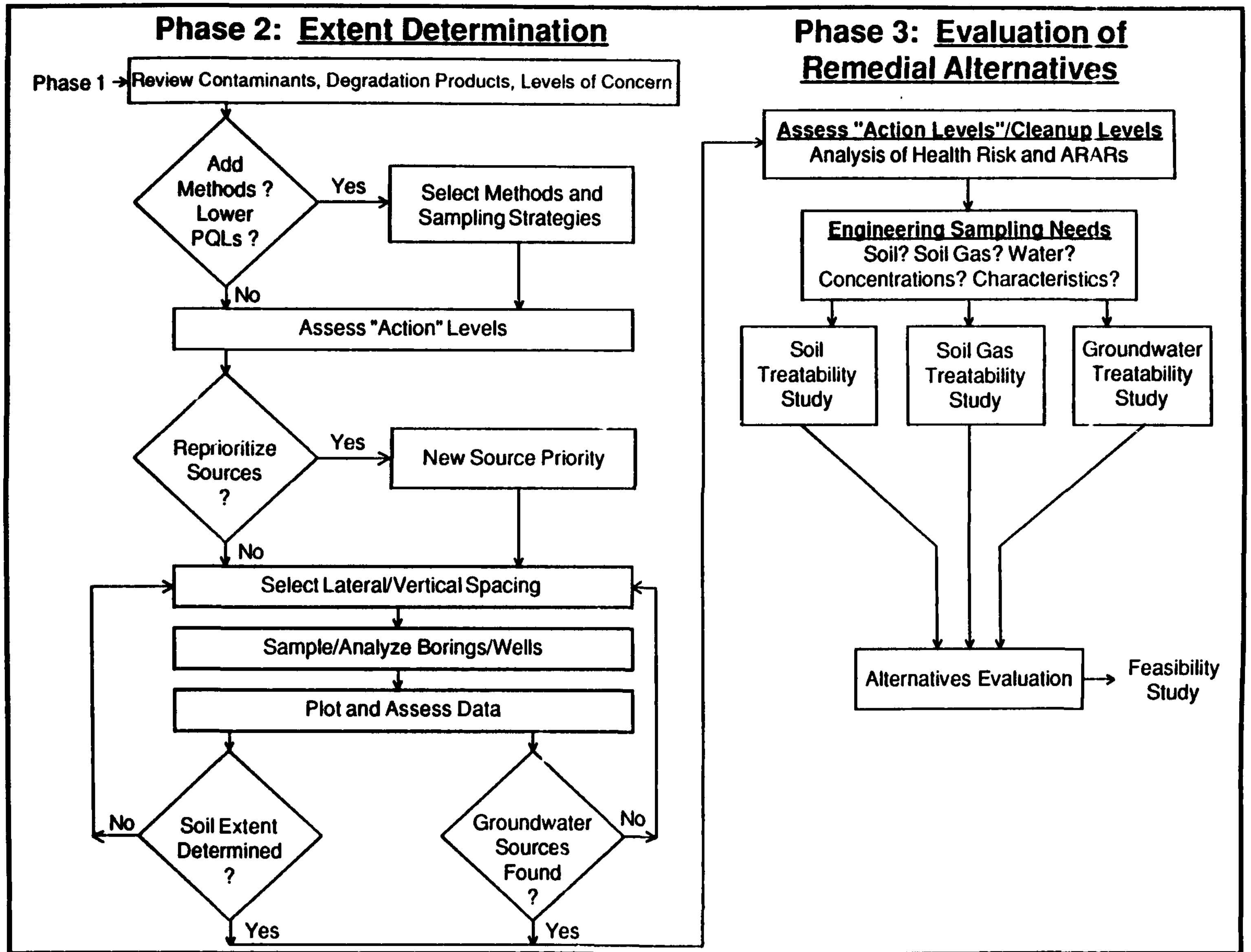


Figure 3.0-4. Remedial Investigation Decision Process Flow Diagram for Phase 2 and Phase 3.

3.0.2 Phase 1 -- Source Identification

In Phase 1, the presence and types of contamination at each site will be determined. An attempt will be made in this phase to identify the greatest concentrations of contaminants present on soil particles, in soil gas, in surface water or in groundwater in the areas of investigation and to determine the point(s) of contaminant discharge to the environment. The initial point of discharge may not be identifiable because it was not fixed (e.g., a temporarily stored drum or transformer) or was removed by subsequent construction or mitigative activities (e.g., tank removal). At some sites, historical points of discharge remain in place, but discharge of contaminants has ceased. Regardless of the current status of the initial discharge point, contaminants on soil particles or in soil gas may represent a "source" from which contaminants may migrate. Sources of contaminants will be the starting point for Phase 2 investigation. Identification of sources is the focus of Phase 1 because sources are the volumes of soil or soil gas from which contaminants are migrating or will migrate to receptors. Sources may also pose the greatest potential risk to human health or the environment because they contain the highest contaminant concentrations.

Use of Available Data

Part of the Phase 1 investigation has been conducted at a number of sites in OU B. A soil gas investigation was performed at 41 sites in the period of September through December 1990 (*Operable Unit B Soil Investigation Data Summary Report* December 1990, February 1991). Data from the soil gas investigation indicated areas of sites in which there are concentrations of volatile organic compounds (VOCs) in soil gas. Areas of a site where VOC concentrations exceeding 1,000 parts per billion by volume (ppbv) total VOCs, 100 ppbv of one halogenated VOC (HVOC) or unidentified VOC (UVOC), or 500 ppbv of one aromatic VOC (AVOC) were detected, meet the criteria for classification as Soil Gas Targets. Soil Gas Targets on specific sites are indicated in the figures that illustrate site-specific plans (Sections 3.1 to 3.24). The absence of a soil gas target on a portion of a site does not preclude the presence of VOCs in soils beneath that portion. Soil gas targets are used in Phase 1 to focus investigations in areas where the concentration of VOCs in soil gas indicates a greater potential for a VOC source.

Investigations to determine the presence and nature of contaminants were conducted at several sites in OU B prior to the soil gas investigation. Details of investigations performed by the Directorate of Environmental Management (EM), McClellan AFB, and other contractors have been presented in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Those data are presented in summary form within site-specific plans.

Data from the previous investigations have been reviewed and incorporated into the strategy for the OU B RI. The data indicate that contaminants are present at a number of sites in OU B; however, the soil gas and previous soil sampling investigations do not provide sufficient data to proceed to a decision on the need for remedial action, contaminant cleanup level determination, or evaluation of remedial alternatives. Data gaps, such as the location of contaminant sources, the points of contaminant discharge, and the potential for migration, exist in the information compiled from previous investigations. Therefore, the sites at which contaminants have been detected in soil or soil gas are retained in Phase 1 of the RI to fill those data gaps before proceeding to Phase 2.

Data from all previous investigations have been incorporated into the development of site-specific Phase 1 sampling and analysis plans. At sites where contaminants in soils and soil gas have been detected within OU B, Phase 1 sampling and analysis will be conducted to identify the locations of greatest concentrations or sources of contaminants. A number of the sites in OU B that will be investigated in Phase 1 are located within 300 feet of the boundaries of other sites. In some cases, soil gas targets cross the boundaries of adjacent sites. It would be inappropriate in the comprehensive OU B RI to ignore the relationship between closely spaced sites. Therefore, the Industrial Wastewater Line (IWL) segments, formerly designated PRL L-5 and PRL L-6, have been divided into nine individual sections (sites). Seven of the IWL sections and thirty-two other sites have been combined into 8 Investigation Clusters (ICs). The 8 ICs and 14 individual sites that will be investigated are identified in Figure 3.0-1. Tables 3.0-1 and 3.0-2 provide cross references between ICs and individual sites and list the section numbers in which Phase 1 sampling plans are presented. Locations to be sampled and analyses to be performed at sites or ICs during Phase 1 are shown in the site-specific plans (Sections 3.1 to 3.24). Phase 2 and, if required, Phase 3 sampling locations and analyses are not indicated for individual sites.

TABLE 3.0-1. CROSS REFERENCE BETWEEN ICs AND SITES

Section Number	IC Number	Site(s)
3.1	1	Site 36 Site 47 Site 48 PRL L-5D (West of Building 666)
3.2	2	PRL L-5A (next to Mat K) PRL T-8 PRL T-46 PRL T-48 SA 16
3.3	3	Site S-49 PRL L-5E (North of PRL L-5G) SA 3 SA 10 SA 17 SA 19
3.4	4	Site 30 PRL L-6 (Southern Section) SA 2
3.5	5	Site 31 PRL 29 PRL P-2 SA 12 SA 13
3.6	6	PRL T-60 SA 5 SA 6
3.7	7	PRL L-5B (West of PRL S-29) PRL L-6 (Northern Section) PRL P-9 PRL S-5 PRL S-34 PRL S-35 SA 7 SA 11 SA 14 SA 18

(Continued)

TABLE 3.0-1. (Continued)

Section Number	IC Number	Site(s)
3.8	8	PRL L-5C (MH-12B -- Northeast Corner of PRL S-29) PRL S-29 PRL S-30
3.9	--	Site 23
3.10	--	PRL L-5F (South of Building 666)
3.11	--	PRL L-5G (Between IC 2 and IC 3)
3.12	--	PRL S-13
3.13	--	PRL S-28
3.14	--	PRL S-33
3.15	--	PRL T-45
3.16	--	SA 1
3.17	--	SA 4
3.18	--	SA 8
3.19	--	SA 9
3.20	--	SA 15
3.21	--	SA 29
3.22	--	SSA 2
3.23	--	SSA 3
3.24	--	Background Investigation

-- = Not included in an Investigation Cluster
IC = Investigation Cluster
MH = Manhole
PRL = Potential Release Location
SA = Study Area
SSA = Special Study Area

TABLE 3.0-2. CROSS REFERENCE BETWEEN SITES AND ICs

Site	IC Number	Section Number
Site 23	--	3.9
Site 30	4	3.4
Site 31	5	3.5
Site 36	1	3.1
Site 47	1	3.1
Site 48	1	3.1
Site S-49	3	3.3
PRL 29	5	3.5
PRL L-5A (Next to Mat K)	2	3.2
PRL L-5B (West of PRL S-29)	7	3.7
PRL L-5C (MH-12B -- Northeast Corner of PRL S-29)	8	3.8
PRL L-5D (West of Building 666)	1	3.1
PRL L-5E (North of PRL L-5G)	3	3.3
PRL L-5F (South of Building 666)	--	3.10
PRL L-5G (Between IC 2 and IC 3)	--	3.11
PRL L-6 (Northern Section)	7	3.7
PRL L-6 (Southern Section)	4	3.4
PRL P-2	5	3.5
PRL P-9	7	3.7
PRL S-5	7	3.7
PRL S-13	--	3.12

(Continued)

TABLE 3.0-2. (Continued)

Site	IC Number	Section Number
PRL S-28	--	3.13
PRL S-29	8	3.8
PRL S-30	8	3.8
PRL S-33	--	3.14
PRL S-34	7	3.7
PRL S-35	7	3.7
PRL T-8	2	3.2
PRL T-45	--	3.15
PRL T-46	2	3.2
PRL T-48	2	3.2
PRL T-60	6	3.6
SA 1	--	3.16
SA 2	4	3.4
SA 3	3	3.3
SA 4	--	3.17
SA 5	6	3.6
SA 6	6	3.6
SA 7	7	3.7
SA 8	--	3.18
SA 9	--	3.19
SA 10	3	3.3
SA 11	7	3.7

(Continued)

TABLE 3.0-2. (Continued)

Site	IC Number	Section Number
SA 12	5	3.5
SA 13	5	3.5
SA 14	7	3.7
SA 15	--	3.20
SA 16	2	3.2
SA 17	3	3.3
SA 18	7	3.7
SA 19	3	3.3
SA 29	--	3.21
SSA 2	--	3.22
SSA 3	--	3.23

-- = Not included in an Investigation Cluster
IC = Investigation Cluster
MH = Manhole
PRL = Potential Release Location
SA = Study Area
SSA = Special Study Area

Sampling Strategies

The principal purpose of the Phase 1 investigation at each site is to decide if any sources of contaminants exist. If one or more sources of contaminants are identified, the site will advance to the Phase 2 investigation to determine the extent and potential for contaminant migration. With the purpose of Source Identification, the Phase 1 investigation is focused on areas of sites in which contaminant discharge is most likely to have occurred. To select the areas with the greatest potential for discharges, three types of targets are designated: Suspected Source Targets (such as sumps, tanks, leaks in the IWL, or locations where contaminants were previously detected), Soil Gas Targets, and Undefined Discharge Targets (such as chemical storage areas and surface drainages in which contaminants may have entered soils in one or more unspecified locations).

The sampling strategies used to initiate the Phase 1 investigation differ among the target types and are influenced by the type of potential discharge and the nature of the contaminants that may have been discharged. The sampling strategy for Suspected Source Targets are focused on a specific existing or historical point of discharge. Lateral distribution of sampling points is denser than at other targets because potential discharge points occur in a small area around the suspected source. The principal sampling method is the reconnaissance boring drilled to sample between the shallowest potential discharge depth and approximately 20 feet below ground surface (BGS). Borings at Suspected Source Targets may be sampled deeper than 20 feet BGS if there are indications of contaminant migration to greater depth. Deep borings, having a pre-selected depth of 95 feet BGS, may be drilled at Suspected Source Targets if there are previous data to indicate contaminants occur below 30 feet BGS or if lithologic data from the depth interval, 20 to 95 feet BGS are likely to be needed to evaluate migration from the source to groundwater. Analytical strategies for these targets are based on lower average mobility for metals and less volatile organic species and greater average mobility for VOCs. Therefore, VOC analyses are performed on samples from all depth intervals, and metal and less-volatile organic species analyses are performed on samples taken between the surface and 20 feet BGS in Phase 1.

Sampling strategies for Soil Gas Targets differ from strategies for other targets because the VOCs in soil gas cannot be related to a specific discharge point. With the soil gas screening data available, it is not possible to determine if the VOCs detected occur at the original point of discharge or if they have migrated laterally from the point of discharge. The sampling location at which the highest VOC concentrations were detected in soil gas may not be the location of the highest VOC concentration on soil particles. However, soil gas data provide an indication of VOCs present in soils. Soil gas targets include larger areas of site than Suspected Source Targets because VOC concentrations were detected in multiple sampling locations at a number of sites and specific discharge points cannot be identified. Therefore, soil gas targets will be evaluated with sampling locations distributed areally within each target and outward beyond the identifiable limits of the target area. Sampling locations within the target will be placed within a triangular grid with a spacing of 50 feet between locations. The rationale for this spacing is explained in Appendix A, Section A3.2. Sampling within soil gas targets will occur in reconnaissance borings drilled to approximately 20 feet BGS. The analysis strategy for Soil Gas Targets includes sampling of soils for VOCs at a minimum of 3 horizons and sampling of soil gas for VOC concentrations at the bottom of each boring. Analyses for other contaminants will be performed on samples collected within areal borings if the data for the site indicate other contaminants may have been discharged along with VOCs.

Undefined Discharge Targets will be evaluated with surface scrape and hand auger sampling at most sites where these targets have been identified. This target type includes areas of OU B in which contaminants of unknown volume may have been discharged to surface soil, or stream sediments, at a number of unspecified locations. Because the contaminant discharges are likely to have infiltrated exposed surface soils, sampling will begin at the surface for contaminants of low mobility, such as metals and polychlorinated biphenyls (PCBs), and 1 to 5 feet below surface for more mobile contaminants. The distribution of the surface scrapes and hand auger borings within most of these targets is determined by a statistically based grid spacing. The rationale and method for determined grid spacing are described in Appendix A, Section A3.2. Surface drainage sites included in Undefined Discharge Targets will be sampled at locations that are not based on a grid spacing.

Data Integration and Decision Making

The Phase 1 investigation will proceed in a sequence planned to provide the data needed to reach critical decisions for each site and for OU B as a whole. To fully evaluate the feasibility of remedial actions in the RI/FS report for OU B, data collected during the RI, which may include treatability study results, must be sufficient to evaluate "action levels" (contaminant concentrations that will require remedial action) and to assess appropriate remedial technologies. Phase 1 results may be sufficient to preliminarily evaluate action levels and to assess appropriate remedial technologies; if they are not sufficient, the data will be used to prioritize sites for Phase 2 sampling that will supply the necessary data.

Sites and ICs within OU B have been preliminarily prioritized to allow timely decision making on Phase 2 sampling. Sites to be investigated early in Phase 1 and those with the greatest potential for exceeding action levels or for requiring treatability studies are located along the main section of the IWL in northern OU B (e.g., PRL L-5G and sections adjacent to IC 2 and IC 3 in Figure 3.0-1). These locations will be sampled early in Phase 1 because they may have discharged significant volumes of wastewater containing a number of compounds to the soils from a number of identified cracks. Investigation Cluster 2, including several underground tank sites, fuel pipelines, high concentrations of VOCs in soil gas, and documented fuel spills, and IC 1, in which VOCs, metals, and cyanide have previously been detected in soils, will also be investigated early in Phase 1.

To reach decisions on the presence of sources and the need to prioritize Phase 2 activities, the data for each site and each IC should be complete. To assure that all Phase 1 data for a site or IC are complete for decision making, all boring sampling and analyses planned for the area will be completed prior to moving to another site for Phase 1 sampling.

As Phase 1 analytical and lithologic data are received, assessed for quality, and compiled, they will be assembled into graphical formats with horizontal and vertical views to illustrate contaminant concentrations for decision making. Contaminant concentration data for soils, soil gas, surface, and groundwater and lithologic data will be integrated into the conceptual model developed for OU B.

The principal decisions to be reached after Phase 1 will be:

- The site does (or does not) contain a contaminant source and will (or will not) advance to Phase 2; and

- The appropriate locations of Phase 2 sampling to determine the extent of contamination and potential migration pathways.

Additional decisions to be considered after Phase 1 will be:

- Soil or soil gas concentrations indicate the source is likely (or unlikely) to exceed action levels; and

- Treatability studies are (or are not) needed to assess remedial technologies for the source.

3.0.3 Phase 2 -- Extent Determination

In Phase 2, the extent of contamination (i.e., the volume of soil, soil gas, or groundwater affected by contaminants at a site) will be determined. The Phase 2 investigation will start at sources of contaminants identified in Phase 1 and step outward to define the extent of contamination. Migration pathways of contaminants from the source, fate and transport of contaminants, potential receptors, and contaminant exposure risk will be evaluated for soil, soil gas, and water. Action levels for contaminated media that were preliminarily assessed in Phase 1 will be more fully developed. On the basis of action levels and potential cleanup levels, remedial alternatives will be preliminarily assessed. Treatability studies for specific remedial problems that were not addressed during Phase 1 may be started on the basis of Phase 2 data.

Sampling Strategy

The sampling and analytical methods used in Phase 2 will differ to some degree from those used in Phase 1. There will be no reconnaissance borings drilled in Phase 2. All borings will be located to define the lateral or vertical extent of contaminants. Most borings will be located as stepouts at specific intervals from Phase 1 borings in which contaminants were detected. Phase 2 borings will obtain samples for physical parameter measurements to characterize migration pathways and contaminant transport in the vadose and saturated zones.

Analytical methods needed for samples in Phase 2 will be less extensive than in Phase 1 because the contaminants that occur in the soil, soil gas, and groundwater will be better defined. Some specialized analytical techniques for highly toxic compounds (such as dioxins, furans, and polyaromatic hydrocarbons) may be added locally to achieve lower practical quantitation levels.

Soil vapor flux measurements will be obtained at some source areas. The measurements will be taken at selected source areas with relatively high concentrations of VOCs near the soil-atmosphere interface. The flux of contaminants to the atmosphere from the soil will provide the data needed to evaluate the potential for contaminant migration through the air pathway.

The potential impact that contaminants from any source area have on groundwater will be evaluated in Phase 2. Previous investigations, the Operable Unit B Groundwater Remedial Investigation (OUBGRI) formerly called the Area B Groundwater Operable Unit Remedial Investigation (ABGOURI), the Preliminary Groundwater Operable Unit Remedial Investigation (PGOURI), and the Groundwater Sampling and Analysis Program (GSAP) have indicated the presence of contaminants in groundwater beneath OU B and have partially determined the extent of groundwater contamination. However, those investigations have not identified sources of the contaminants migrating in groundwater. After sources and types of contaminants at sites are determined in Phase 1, the vertical extent and migration pathways of contamination will be evaluated in Phase 2.

Specific single contaminants or groups of related contaminants that are detected in soil or soil gas samples from depths of 35 to 95 feet BGS will be identified as migration indicator contaminants (MICs). The MICs may include one or more of the contaminants detected beneath the source area as well as one or more compounds that could result from modification or degradation of the detected compounds over a period of time; for example, if tetrachloroethene (PCE) is detected in soil beneath a source area, the potential degradation products, trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE), or vinyl chloride, may be included in the MICs, along with PCE, for the source. The relative concentrations of detected contaminants will also be a factor in the MICs.

The MICs designated for a source will be compared to any contaminants and their concentrations detected in groundwater of the A Geohydrologic Zone upgradient or downgradient from the site. New monitoring wells may be constructed during Phase 2 to confirm the presence or absence of the MICs in groundwater if existing wells are not located along the principal groundwater flowpath downgradient or upgradient from a source. A correlation between the MICs in soil or soil gas for a source area and contaminants detected in groundwater migrating along the flowpath downgradient from a source area will be used to indicate the source area as the "tentative source of groundwater contaminants."

In the event that MICs for a site are identified in groundwater samples collected both downgradient and upgradient from a source area which is a tentative source of the groundwater contaminants, it may be necessary to continue the surface investigation in the upgradient direction along the groundwater flowpath. The continuation of the surface investigation of sources along the groundwater flowpath will consist of tracking contaminant concentrations in groundwater to a source at which MICs correlate with contaminants in groundwater and, thereby, indicate it is a tentative source. The tracking of groundwater contamination upgradient will be undertaken in the OU B RI only if there are data available to indicate that concentrations of specific contaminants or groups of contaminants detected in groundwater samples collected downgradient from a potential source increase in samples collected upgradient from the tentative source. If a trend of increasing concentrations of specific contaminants in groundwater continues upgradient and beyond potential sources in OU B, the investigation will continue toward and, if necessary, beyond the boundaries of OU B. Potential sources of groundwater contaminants migrating beneath OU B will be identified by tracking of concentrations upgradient, even though the sources are located within another operable unit or geographic area. It is anticipated that the tracking of contaminants in groundwater beneath the northern portion of OU B may lead to investigations for MICs and source identification at sites in OU C.

Decision Making

The principal decisions to be reached in Phase 2 will be:

- The source, or contaminated medium, is (or is not) likely to require remedial action because of human health risk or environmental degradation; and

- Additional sampling, analysis, or testing is (or is not) required to identify remedial alternatives.

Final decisions on remedial actions will not be secured until after the RI/FS report and a Proposed Plan have been prepared and approved. However, remedial alternatives for soil, soil gas, and groundwater should be evaluated in Phase 3 to provide adequate data for the OU B FS. To preliminarily decide on sources that are likely to require remediation, action levels will be more fully developed in Phase 2 through preliminary assessments of potential health risk or environmental degradation resulting from contaminant migration.

During Phase 2, potential action levels for groundwater will be either Maximum Contaminant Levels (MCLs) promulgated by the U.S. or California Environmental Protection Agencies, or Levels of Concern for Health Risk Assessment. Action levels for soil, soil gas, and air will be estimated from contaminant transport modeling and preliminary risk calculations incorporated into the conceptual model for OU B.

3.0.4 Phase 3 -- Remedial Alternative Evaluation

Data compiled in Phase 1 and Phase 2 will be used in the evaluation of remedial alternatives in Phase 3. The types, concentrations, and extent of contaminants from sources areas will be preliminarily evaluated for health risk and environmental degradation before remedial alternatives are fully evaluated. Potential cleanup levels for contaminants in soils and groundwater will be estimated from health risk assessments and Applicable or Relevant and Appropriate Requirements (ARARs). A group of remedial alternatives, which may achieve the potential cleanup levels, will be selected for evaluation. Treatability studies for contaminants in soil, soil gas, and groundwater may be necessary in Phase 3 to aid in the evaluation of remedial alternatives. Sampling and analyses during Phase 3 will be designed to provide data to evaluate cleanup levels, treatability, and remedial alternatives. The controlled pumping and monitoring of extraction wells and monitoring wells will be performed at selected locations in OU B to aid in the evaluation of remedial alternatives. The data compiled in Phase 1, Phase 2, and Phase 3 will be reported in the OU B RI/FS report, which will be the basis for selection of feasible remedies for contaminants requiring mitigation in OU B.

The site-specific plans for Phase 1 of the OU B RI are provided with the rationale and DQOs for the plans in Sections 3.1 to 3.24. Figures in each plan show the proposed locations of sampling points. Surface soil scrape locations are indicated by "SS" in these location designations. Hand auger boring locations have an "H" in the location designation, and reconnaissance and deep boring locations have a "B" designation. The distribution of all Phase 1 sampling locations proposed within the boundaries of OU B is shown in Plate 1. All sampling points shown in site-specific plan figures or Plate 1 are approximate. Sampling points will be placed as closely as possible to the locations shown; however, access to specific locations may be limited by working space, aboveground or belowground utilities, or Air Force activities and operations.

3.1 Investigation Cluster 1 (Sites 36, 47, and 48, and PRL L-5D)

Investigation Cluster 1 consists of Sites 36, 47, and 48, and PRL L-5D, the section of PRL L-5 extending from the southern edge of Building 660 to approximately the southern edge of Building 666, all of which are located in the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 1. Although each of these four sites have distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and related historical activities.

3.1.1 Site Descriptions

Site 36

Site 36 was an open storage yard that was used to store chemicals for the plating shop in Building 666 from 1958 to 1980. The foundation of Building 666 (Site 47) lies adjacent to the southern boundary of Site 36; the foundation of Industrial Wastewater Treatment Plant (IWTP) No. 4 lies adjacent and to the west of Site 36 (Figure 3.1-1). Aerial photographs show that the 30-foot wide strip of pavement around the perimeter of Building 666 was constructed at the same time as the plating shop. The remainder of Site 36 was not paved until sometime after 1971. Currently, the ground surface of Site 36 is covered by a combination of gravel, broken concrete, and intact concrete.

The type of chemicals most commonly stored at Site 36 were acids used in plating processes. Other stored chemicals included sodium hydroxide, sodium dichromate, TCE, and other solvents. These chemicals were normally transferred to Building 666 by pouring the chemical from the storage container into a smaller container for transfer to the plating shop. Any spills that occurred during this process would have fallen onto the bare soil of Site 36 prior to 1971 and onto pavement after 1971; portions of the unpaved soil are discolored in 1962 and 1965 aerial photographs. Any spills of liquids or powdered chemicals that may have occurred on the pavement strip surrounding Building 666 were reportedly washed into the soil of Site 36 with high-pressure hoses. Some of the washwater may have run off and may have been collected in a drain located in the southeast corner of Site 36. Spills that occurred inside Building 666 were also

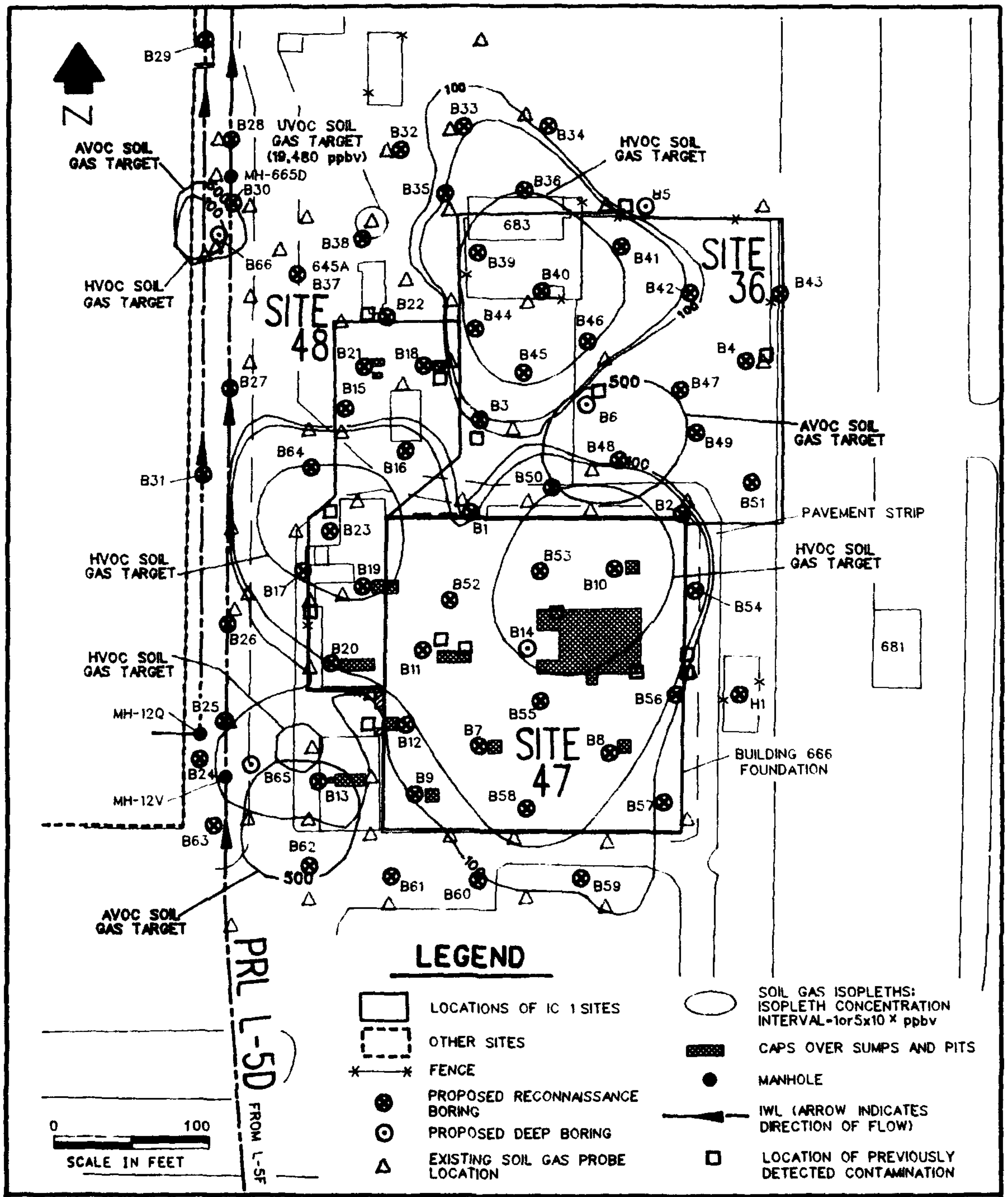


Figure 3.1-1. Site Features and Soil Boring Locations at IC 1 (Site 36, Site 47, Site 48, and PRL L-5D).

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periodically washed from the interior floor and out through a door on the building's north side, toward Site 36.

Site 47

Site 47 is the location of an electroplating facility that operated in Building 666 between 1957 and 1980 (Figure 3.1-1). During that time, Building 666 also contained a radiator repair shop in the northern portion of the building shown in Figure 3.1-1 and a sandblasting shop in the southwestern corner of the building. Figure 3.1-2 identifies locations of historical operations within Building 666. The chemicals used in the electroplating operations were stored in the open lot north of Building 666 as well as within the building. Wastewater generated in the electroplating operations was pretreated in IWTP No. 4 (Site 48), prior to its discharge to the IWL (PRL L-5). The potential sources of contamination from former operations at Building 666 include: the electroplating waste conveyance system; two degreasing pits; a hard chrome plating pit; floor drains in the testing lab; trenches and drains under the hazardous waste storage area; and the drain in the radiator shop (Figure 3.1-2), each of which is described in the OU B Preliminary Assessment Summary Report (Radian 1990a). Materials handled at Building 666 include acids, bases, cyanide compounds, metals, fuels, oils, and solvents.

In 1980, the plating operations at Building 666 were discontinued, and from 1980 to 1982, Building 666 was used to store hazardous wastes. In 1988, Building 666 was dismantled; its foundation was left in place. Trenches, drains, and other shallow floor penetrations were filled with concrete. Metal caps were constructed around and over the sumps and pits (Figure 3.1-1).

Site 48

Site 48 was the site of IWTP No. 4, which operated between 1957 and 1980 (Figure 3.1-1). The IWTP No. 4 was primarily a pretreatment facility for liquid wastes generated by the Building 666 (Site 47) plating operations, although it also received wastes from the McClellan AFB photography laboratory, x-ray shop, and various technical operations laboratories. Liquid wastes influent to the treatment plant contained metals, acids, bases, cyanide, and organic compounds. Effluent from the treatment plant discharged to the IWL (PRL L-5), approximately 50 feet west of Site 48.

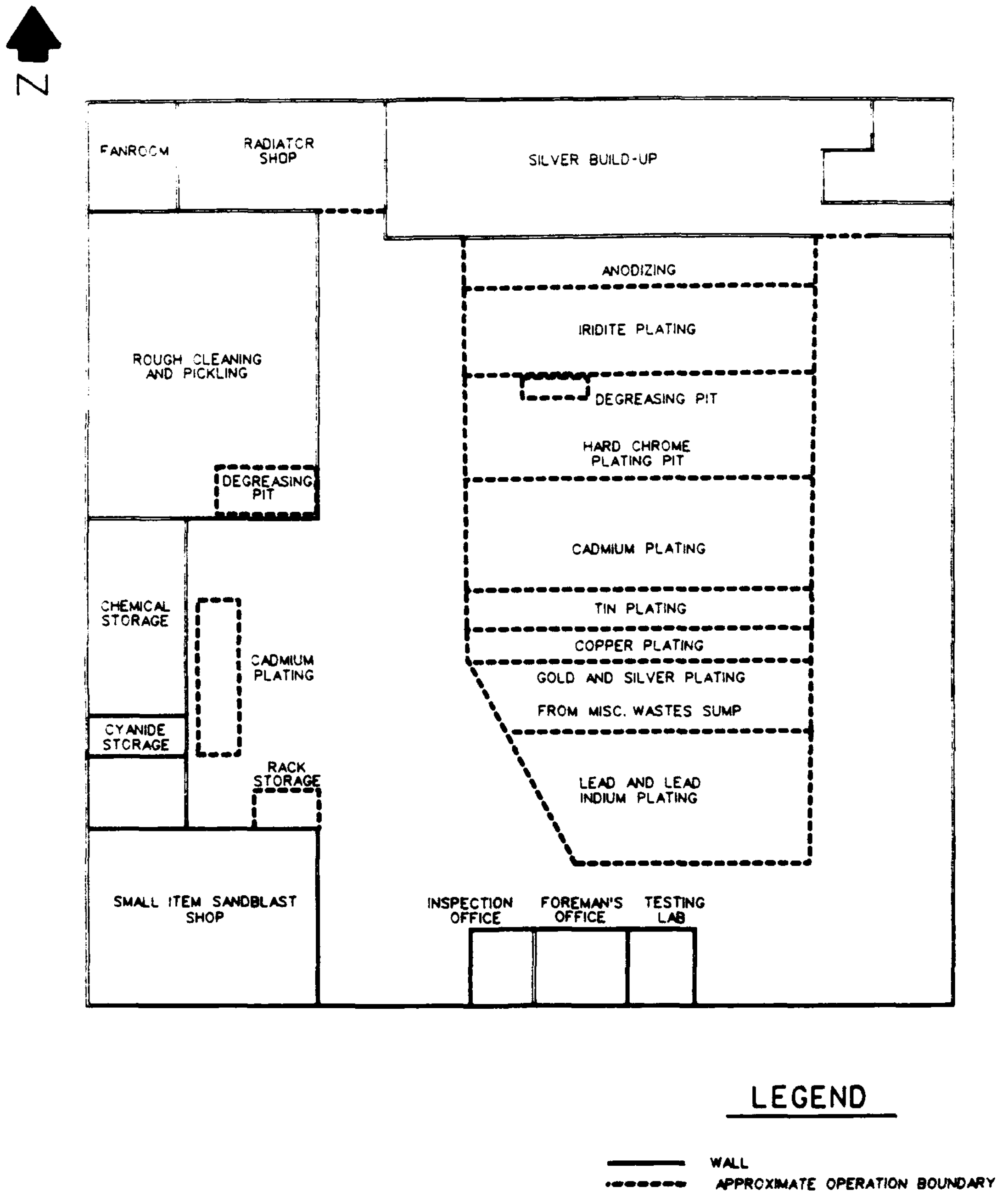

Figure 3.1-2. Historical Operations in Building 666.

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The facilities at Site 48 included a total of 38 aboveground tanks, two underground sumps, aboveground piping, and Building 645B, which were described previously in the OU B Preliminary Assessment Summary Report (Radian, 1990a). The treatment plant consisted of two sections (Figure 3.1-1): one adjacent to the west side of Building 666 (30 tanks) and the other 35 feet northwest of Building 666 (4 open-top tanks). All of the tanks were set on a 12-inch-thick concrete pad without secondary containment structures. The two sumps at Site 48 were underground and lined with concrete. Construction drawings indicate that the piping at Site 48 was aboveground. Building 645B was used to store dry chemicals; acids in glass carboys were stored east of the building. After IWTP No. 4 was decommissioned, Building 645B was used to store asbestos-containing insulation materials. Other unidentified hazardous materials were reportedly stored east of the building.

In 1988, IWTP No. 4 was dismantled. The only aboveground structure remaining at the facility is the concrete foundation. Impressions left by some of the larger tanks can still be seen in the foundation. The remaining foundation sumps and plant water reservoirs were reportedly cleaned, and metal caps were installed over the sumps to prevent inflow of surface water (Figure 3.1-1). An area in the northeast corner of the site is unpaved and consists of gravelly soil.

Potential Release Location L-5D

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the pipes. The IWL at PRL L-5 is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-5D is the section of PRL L-5 located south of Building 660 and west of the western edge of Building 666, and is approximately 538 feet long. Figure 3.1-1 shows the surface trace of PRL L-5D, locations of access covers, and soil gas probe locations. Most of the piping system is constructed of 8-inch vitrified clay pipe, but 4-, 8- and 10-inch asbestos-concrete, cast iron, and vitrified clay pipes are found in some sections of PRL L-5. Industrial activities at the facilities connected to PRL L-5 include maintenance, paint removal, painting, cleaning, industrial wastewater processing, and hazardous material storage described previously in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Table 3.1-1 summarizes the

TABLE 3.1-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED AT BUILDINGS CONTRIBUTING TO THE FLOW THROUGH THE IWL AT PRL L-5D (IC 1)

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL carrying wastewater from:		
Building 610: 6 VAN repair, maintenance	1953-Present	S
Building 613: washrack, electronics shop	1953-Present	NA
Building 640: electronics repair shop, paint shop, paint booth, and solvent booths (PRL T-7)	1953-Present	S, P
IWTP #4	1957-1980	A, B, C, M, S

PRL = Potential release location
NA = Not available
A = Acids
B = Bases
C = Cyanide
M = Metals
P = Paint
S = Solvents

available information concerning the historical operations performed and materials handled at buildings contributing to the flow through the IWL at PRL L-5D.

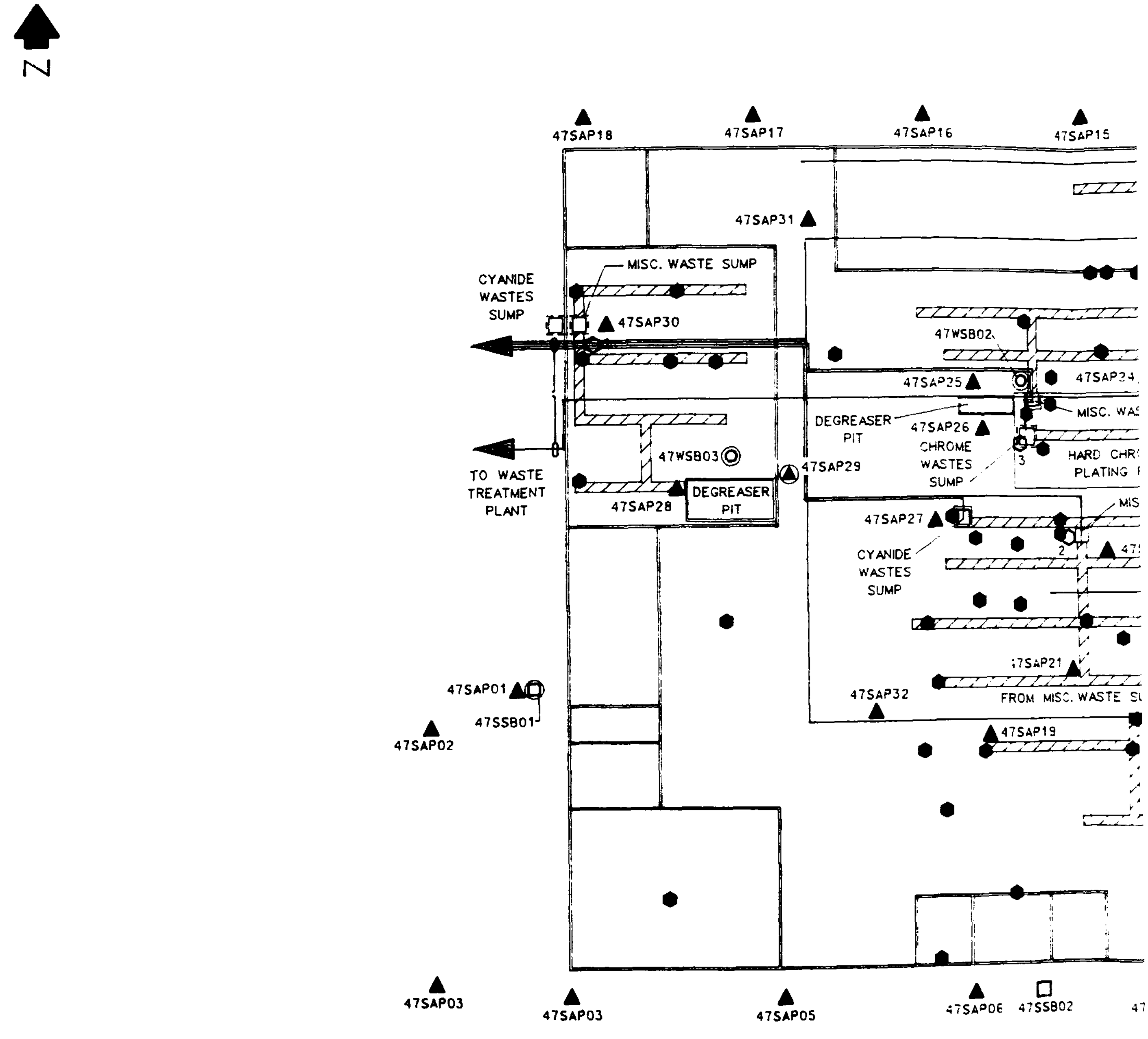
3.1.2 Previous Investigations

Two separate source investigations have confirmed the presence of soil contamination at IC 1: a Thomas J. Walker, Inc. in 1982 and an investigation by McLaren Environmental Engineering, Inc. in 1985. Results of these investigations have also been summarized in the OU B Preliminary Assessment Summary Report (Radian 1990a).

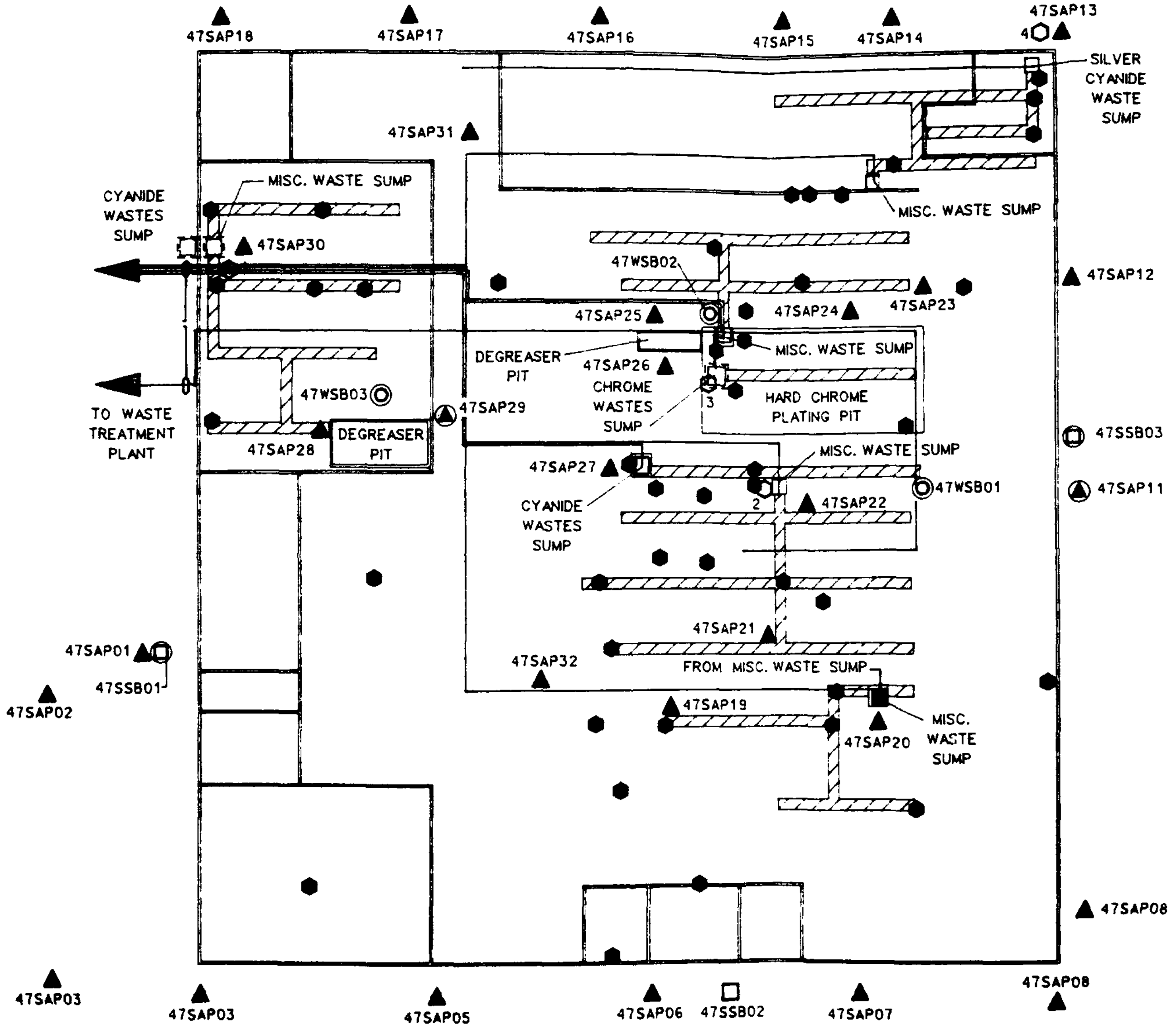
Thomas J. Walker, Inc. collected and analyzed a total of 75 samples from the interior of Building 666 in 1982 (Figure 3.1-3). The samples consisted of brick, mortar, and concrete samples; and wipings from ducts, walls, and floors. Analytical results indicated the presence of cadmium, chromium, copper, fluoride, nickel, and silver above Total Threshold Limit Concentration (TTLC) values.

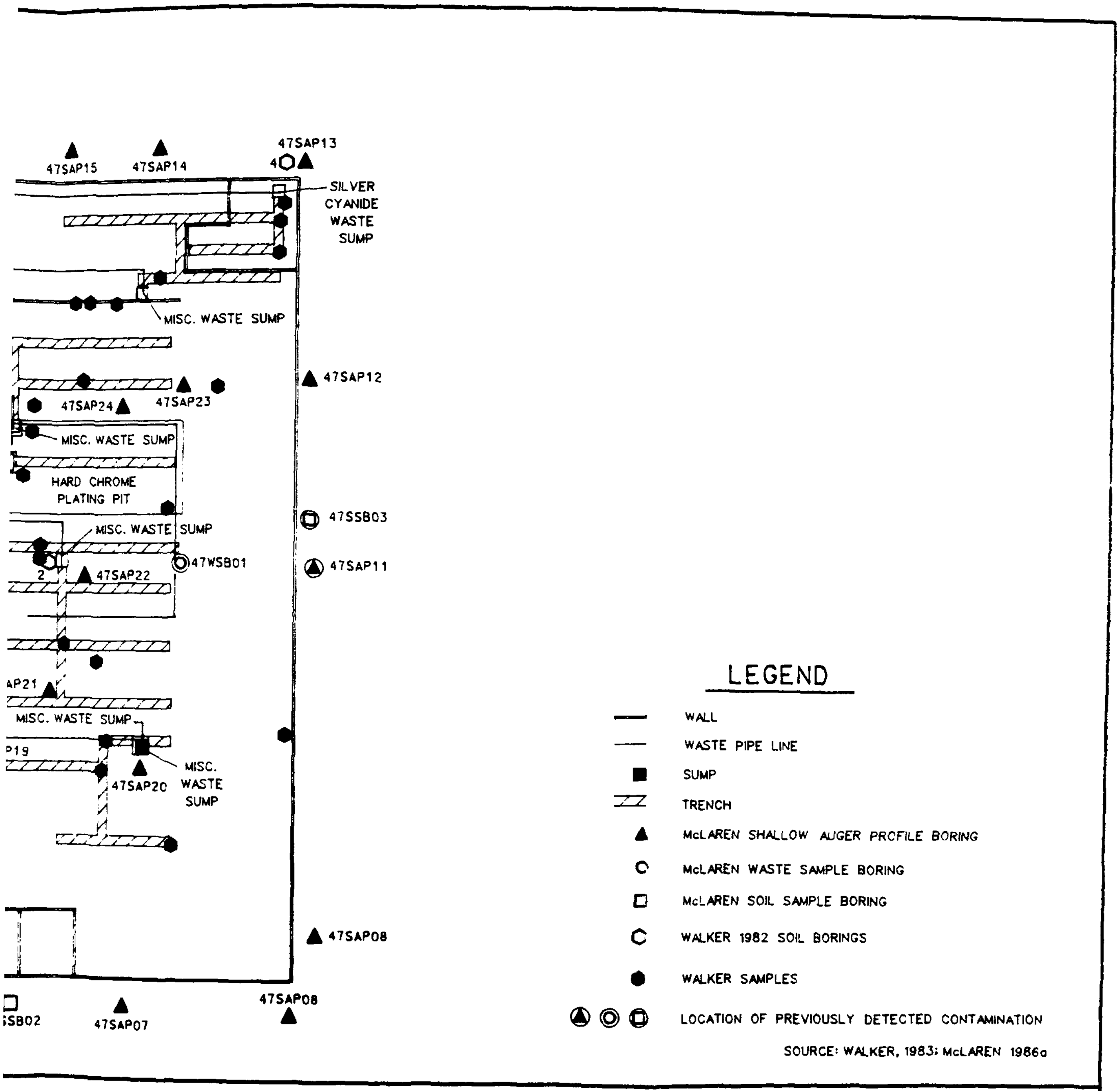
Additionally, four soil borings were also drilled as part of the Walker investigation (Figure 3.1-3). Four samples from each of the four borings were analyzed for total metal concentrations of cadmium, chromium, copper, nickel, and silver. All metal concentrations in the soils were below the applicable TTLCs, and all extractable concentrations were below the applicable Soluble Threshold Limit Concentrations (STLCs).

In 1985, McLaren investigated Sites 36, 47, and 48 (Radian, 1990a). Twenty-six shallow auger profile borings (identified as SAPs in Figure 3.1-4) were drilled in a 50-foot grid pattern across Site 36 and along the edges of Sites 47 and 48. McLaren recorded photoionization detector (PID) readings for each of the shallow auger profile borings on Site 36, but no soil samples were collected. Two waste sample borings (identified as WSBs in Figure 3.1-4) were drilled between the shallow auger borings that had the highest soil gas readings, and three soil sample borings (identified as SSBs in Figure 3.1-4) were drilled along the north, west, and east edges of Site 36; soil samples were generally collected at intervals between 15 and 30 feet BGS and from 60 to 70 feet BGS. Samples from two soil sample borings (36SSB01 and 36SSB02) had detectable concentrations of methyl ethyl ketone and oil and grease. The third (48SSB03) contained concentrations of acetone, chloroform, and 1,1,1-trichloroethane.


N
47SAP18
47SAP17
47SAP16
47SAP15
47SAP31
MISC. WASTE SUMP
CYANIDE WASTES SUMP
47SAP30
47WSB02
47SAP25
47SAP24
MISC. WAS
DEGREASER PIT
47SAP26
CHROME WASTES SUMP
3
HARD CHR
PLATING
47WSB03
47SAP29
TO WASTE TREATMENT PLANT
47SAP28
DEGREASER PIT
47SAP27
MIS
2
CYANIDE WASTES SUMP
47SAP21
FROM MISC. WASTE S
47SAP01
47SSB01
47SAP02
47SAP32
47SAP19
47SAP03
47SAP03
47SAP05
47SAP06
47SSB02

NOT TO SCALE


47SAP18
47SAP17
47SAP16
47SAP15
47SAP14
47SAP13
4
SILVER CYANIDE WASTE SUMP
47SAP31
MISC. WASTE SUMP
CYANIDE WASTES SUMP
MISC. WASTE SUMP
47SAP30
47WSB02
47SAP12
47SAP25
47SAP24
47SAP23
MISC. WASTE SUMP
DEGREASER PIT
47SAP26
CHROME WASTES SUMP
3
HARD CHROME PLATING PIT
47WSB03
TO WASTE TREATMENT PLANT
47SAP29
47SAP28
DEGREASER PIT
MISC. WASTE SUMP
47SSB03
47SAP27
47WSB01
47SAP11
CYANIDE WASTES SUMP
2
47SAP22
47SAP21
47SAP01
47SSB01
47SAP32
FROM MISC. WASTE SUMP
47SAP02
47SAP19
MISC. WASTE SUMP
47SAP20
47SAP08
47SAP03
47SAP03
47SAP05
47SAP06
47SSB02
47SAP07
47SAP08



SOURCE: WALKER, 1983; McLAREN 1986a

Figure 3.1-3. Previous Boring Locations for Site 47 and Vicinity.

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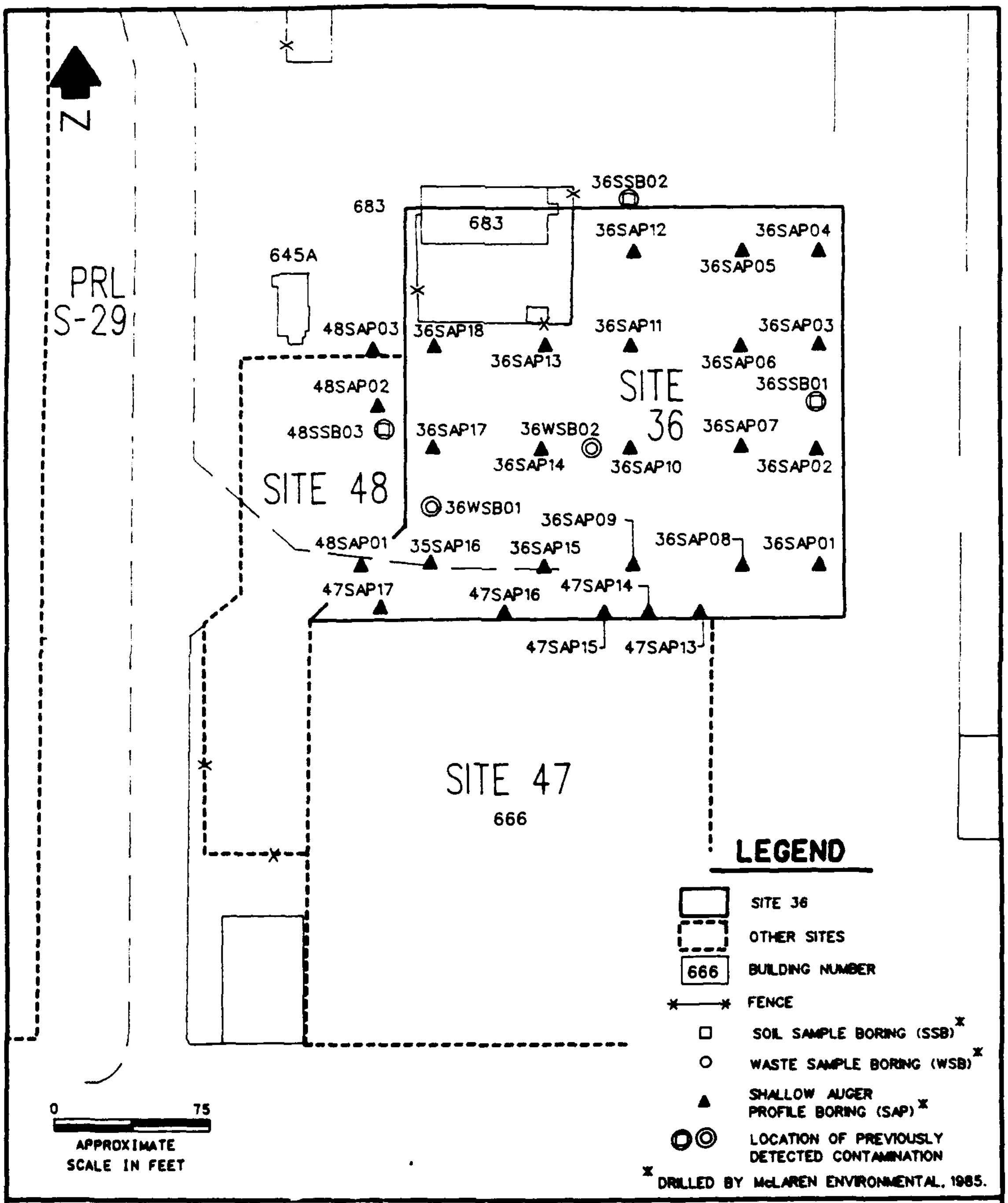

Figure 3.1-4. Previous Boring Locations at Site 36.

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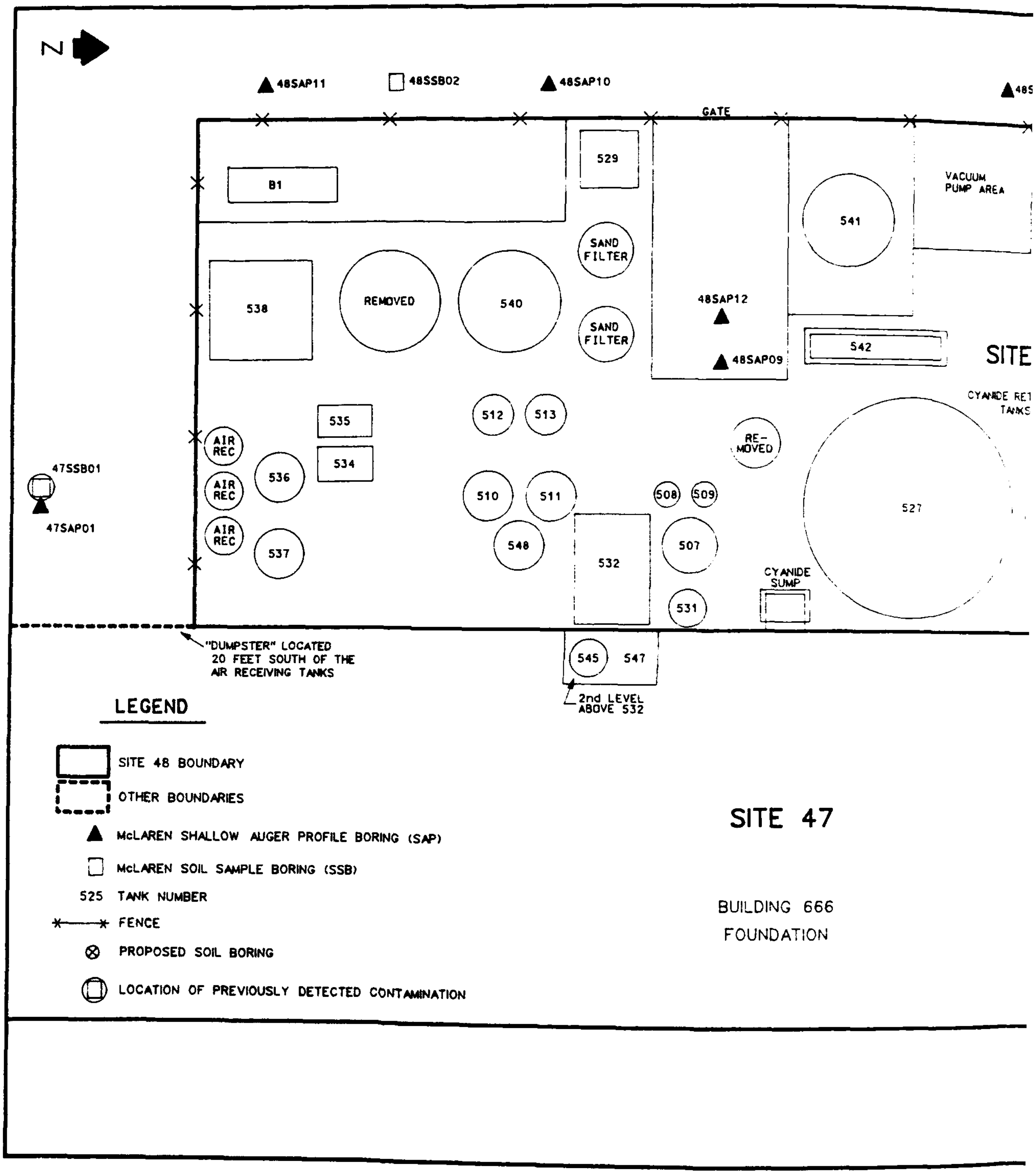
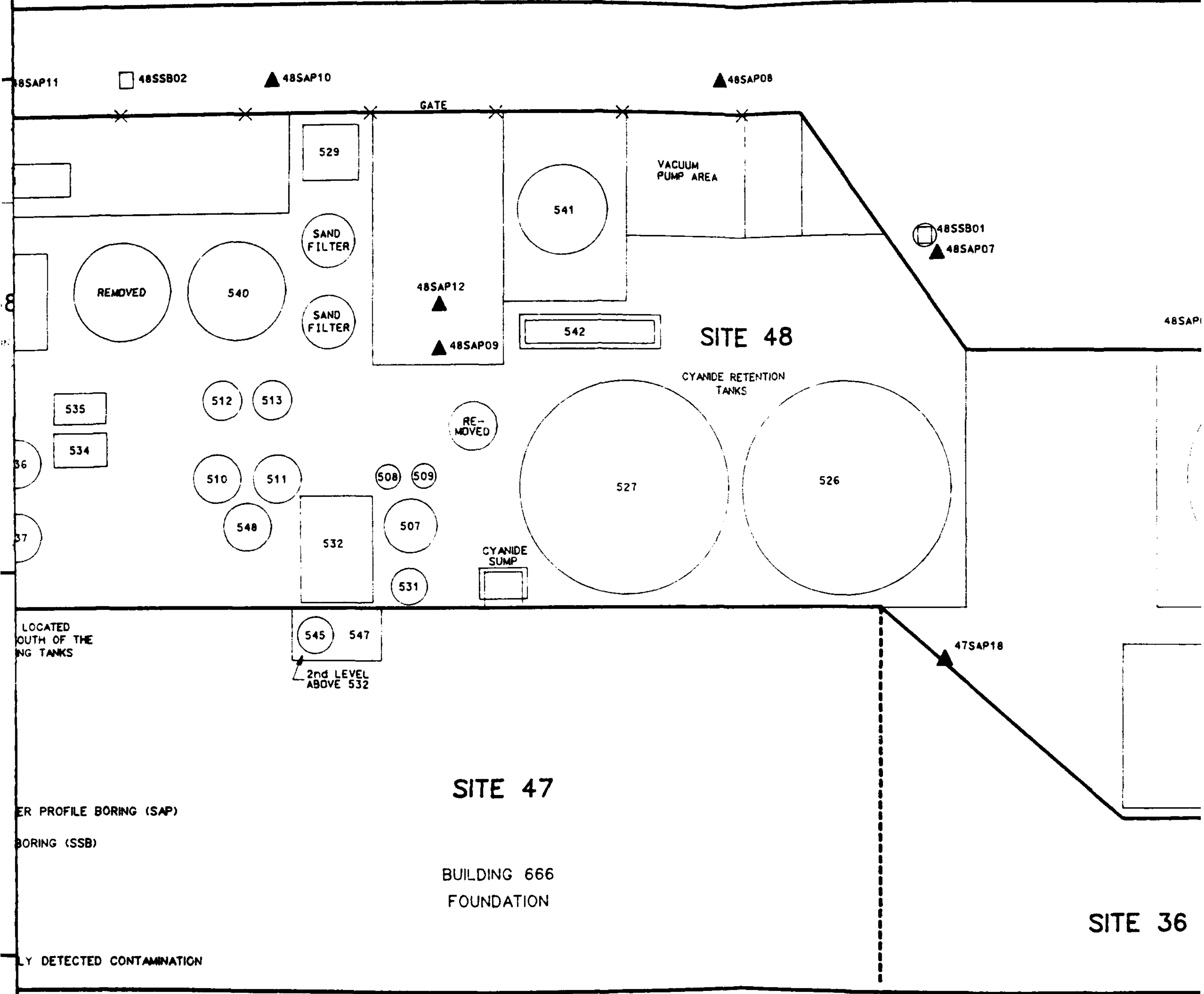
A total of 38 borings were drilled as part of the McLaren soil investigation of Site 47: 17 within the interior of Building 666 and 21 around the perimeter (Figure 3.1-3). Forty-five samples from the 38 borings were collected and analyzed for total concentrations of metals; 42 samples were analyzed for cyanide. From the six McLaren borings identified as WSBs and SSBs in Figure 3.1-3, 12 samples were analyzed for VOCs and 6 for semivolatile organic compounds. All total metal concentrations in samples from the borings were below the applicable TTLCs, and all extractable concentrations were below the applicable STLCs. Cyanide was detected in three samples. Ten different VOCs were detected in soil samples, at depths ranging from 15 to 80 feet BGS. At least one VOC was detected in each of the six borings designated as WSBs and SSBs. The only semivolatile organic contaminant detected in the soil was bis(2-ethylhexyl)phthalate, a common laboratory contaminant.

Eighteen borings were drilled by McLaren as part of the investigation of Site 48 along the perimeter of the concrete pad at the locations shown in Figure 3.1-5. Metals and cyanide analyses were performed on composite samples collected between 1 and 10 feet BGS from 14 shallow borings identified as SAPs in Figure 3.1-5. Four deeper borings, identified as SSBs in Figure 3.1-5, were also drilled around the perimeter of the concrete pad. Five different VOCs (acetone, chloroform, toluene, 1,1,1-trichloroethane, and TCE) were detected in the soils collected from the SSBs. The only semivolatile organic compound detected in the samples, bis(2-ethylhexyl)phthalate, is a common laboratory contaminant. All total and extractable metal concentrations detected in the samples were below the applicable TTLC and STLC. Cyanide was detected in Boring 48SSB01 at 335.2 mg/kg. Oil and grease compounds were detected at concentrations ranging from 59 to 1,000 mg/kg in the four SSB borings.

McLaren also collected residual water and solids samples from 20 tanks, the cyanide sump, and two bins at Site 48 on 27 November 1985 (McLaren, 1986a). Samples were analyzed for total heavy metals, cyanide, and pH. Solid residues were collected from Tank 525; all other tank samples collected were of residual water. The OU B Preliminary Assessment Summary Report summarizes sampling information and analytical results for these samples (Radian, 1990a). Results showed pH levels ranging from 1.6 to 10.4, cyanide concentrations up to 29 mg/kg, and levels of cadmium, total


N
48SAP11
48SSB02
48SAP10
48S
GATE
81
529
VACUUM PUMP AREA
541
SAND FILTER
538
REMOVED
540
SAND FILTER
48SAP12
48SAP09
542
SITE
CYANIDE RET TANKS
535
512
513
RE-MOVED
AIR REC
534
47SSB01
AIR REC
536
510
511
508
509
527
47SAP01
AIR REC
537
548
532
507
CYANIDE SUMP
531
"DUMPSTER" LOCATED 20 FEET SOUTH OF THE AIR RECEIVING TANKS
545
547
2nd LEVEL ABOVE 532
LEGEND
SITE 48 BOUNDARY
OTHER BOUNDARIES
McLAREN SHALLOW AUGER PROFILE BORING (SAP)
McLAREN SOIL SAMPLE BORING (SSB)
525 TANK NUMBER
FENCE
PROPOSED SOIL BORING
LOCATION OF PREVIOUSLY DETECTED CONTAMINATION
SITE 47
BUILDING 666
FOUNDATION



48SAP11
48SSB02
48SAP10
48SAP08
GATE
529
VACUUM PUMP AREA
541
48SSB01
48SAP07
SAND FILTER
SAND FILTER
REMOVED
540
48SAP12
48SAP09
542
SITE 48
48SAP
CYANIDE RETENTION TANKS
535
534
512
513
RE-MOVED
36
510
511
508
509
527
526
548
532
507
37
CYANIDE SUMP
531
545
547
2nd LEVEL ABOVE 532
LOCATED
OUTH OF THE
NG TANKS
47SAP18
SITE 47
ER PROFILE BORING (SAP)
BORING (SSB)
BUILDING 666 FOUNDATION
SITE 36
LY DETECTED CONTAMINATION

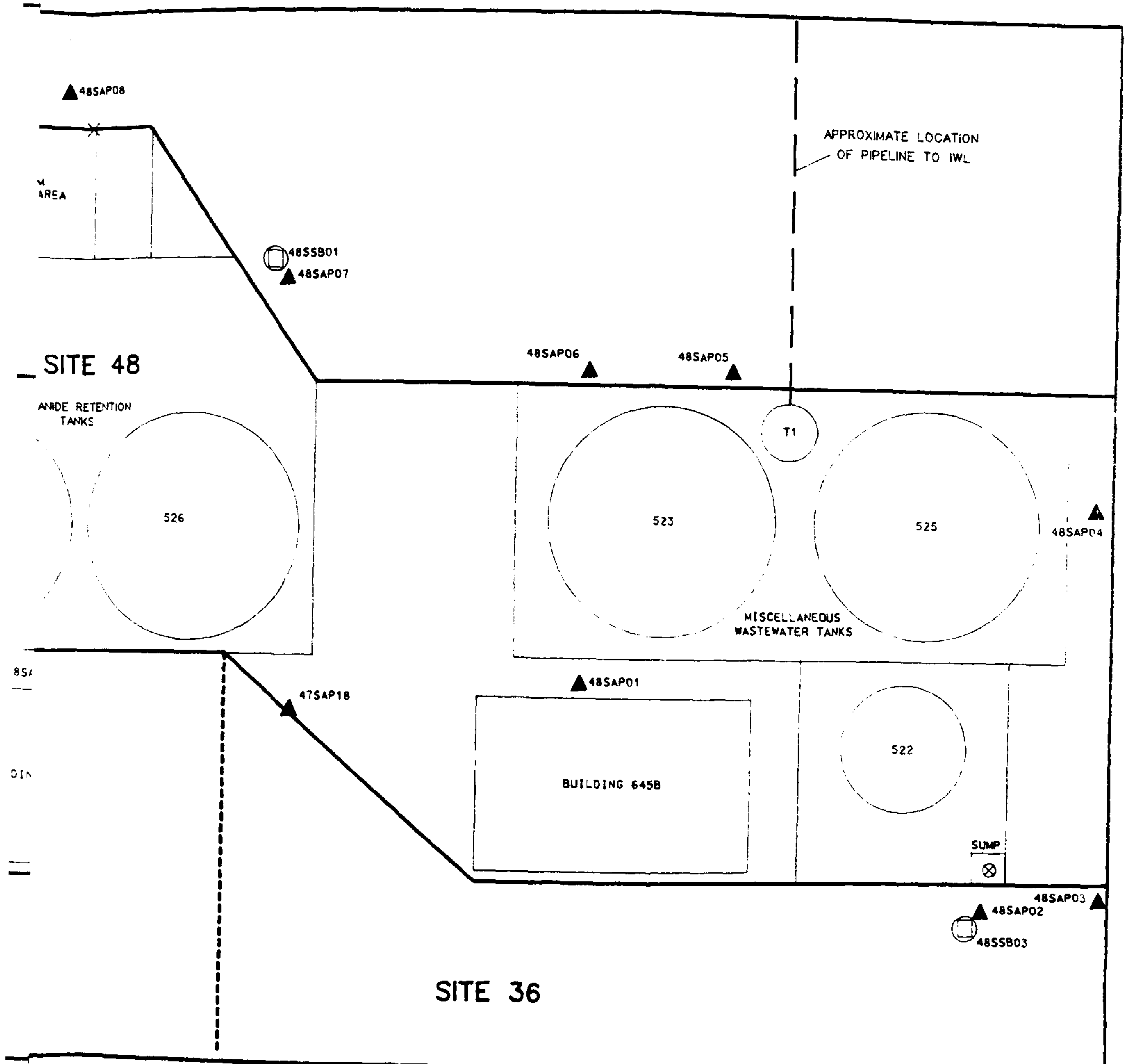


Figure 3.1-5. Historical Features and Boring Locations at Site 48.

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chromium, lead, nickel, silver, and zinc that exceeded TTLC and STLC values. Results of the tank sampling confirmed the presence of metals and cyanide, which are suspected of contributing to contamination at the site.

In 1988, EG&G Idaho, Inc. tested the integrity of the IWL at PRL L-5 and at Site 48. During the investigation, access ways were cleaned, and the pipe segments were observed either by direct or remote inspection and pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through the pipes. The section of pipe from Tank 1 to the IWL at Site 48, through which effluent was transported (Figure 3.1-5) and several sections of PRL L-5, reportedly contained cracked joints and areas of breakage.

Investigations of groundwater in the area of IC 1 have also confirmed the presence of contamination. In the quarterly GSAP at McClellan AFB, four VOCs detected in the soils at IC 1 have been detected in the groundwater of MWs 41S and 65 located immediately south of Site 47. Chloroform, PCE, and TCE have been detected in groundwater samples collected from MW-41S; toluene has been detected in samples collected from MW-65.

During the OUBGRI in 1989, the contaminants in the groundwater southwest of IC 1 were further characterized. Trichloroethene, 1,2-DCE, PCE, and chloroform were detected in MW-159, located 100 feet west of the western boundary of Site 47 at concentrations of 85 μg/L, 48 μg/L, 1.3 μg/L, and 3.9 μg/L, respectively. Volatile organic groundwater contamination detected in the area of Sites 36, 47, and 48 is described in the OU B Engineering Evaluation/Cost Analysis - Environmental Assessment (OU B EE/CA-EA) Report (Radian, 1990e), and appears to be migrating beneath IC 1 in a southwesterly direction (Figure 3.1-6). It is probable that the VOC contamination entered the groundwater from past operations at Building 666.

Construction of an Expedited Response Action (ERA), which was described in the OU B EE/CA-EA (Radian, 1990e), was implemented in October 1990 because of the potential threat that the plume poses for a principal McClellan AFB water supply well (BW-18) and groundwater resources beneath off-base areas beyond the base supply well. The ERA consists of two groundwater extraction wells, which remove contaminated groundwater and transport it to a nearby treatment facility (Figure 3.1-6). Treated water will be discharged to the McClellan AFB IWL.

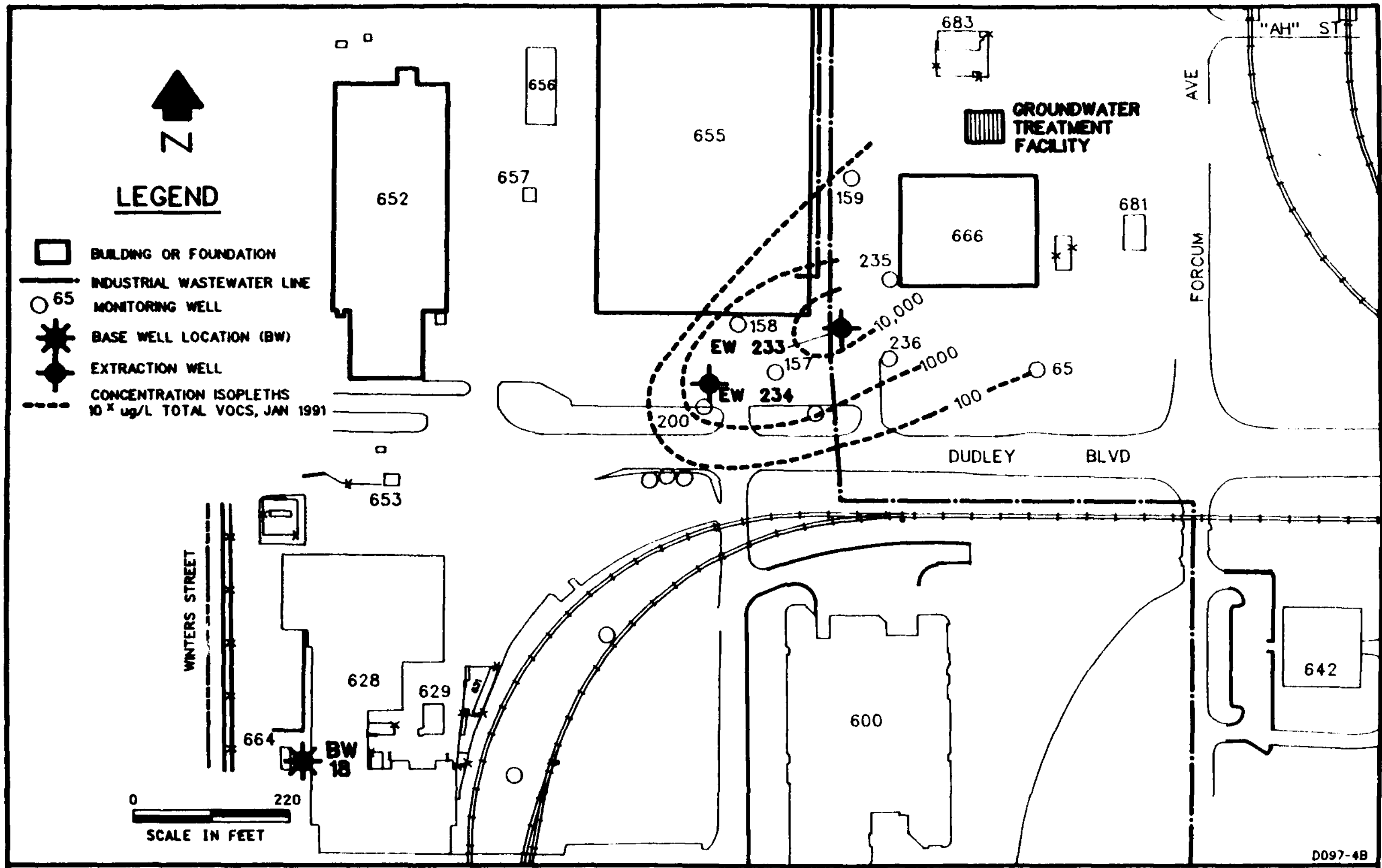

Figure 3.1-6. Location of Extraction Wells and Groundwater Treatment Facility for Expedited Removal Action, Operable Unit B, McClellan AFB.

A soil gas investigation of IC 1 was conducted by Radian Corporation in 1990 as part of the OU B Soil Gas Investigation. Fifty-eight soil gas probes were placed and sampled. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 14 of these 58 probes at concentrations that exceeded the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the 58 probes, ranged from 3.6 to 48,372 ppbv. Total AVOC concentrations, detected in 5 of the 58 probes, ranged from 139 to 2,084 ppbv. Total UVOC concentrations, detected in 2 of the 58 probes, were 19,480 and 1,936,040 ppbv.

Results of the soil gas investigation of IC 1 indicate 10 areas of contamination that exceed the criteria for soil gas targets. The targets are depicted in Figure 3.1-1. Four targets had soil gas concentrations exceeding 10,000 ppbv total HVOCs), and one target had a total 1,2-DCE concentration of 128 ppbv. Total AVOCs were greater than 1,000 ppbv in three targets. Two other areas were targets because total UVOCs were greater than 1,000 ppbv.

3.1.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 1 is to determine the presence of VOC or other contamination in the area. A total of 61 reconnaissance borings, 5 deep borings, and 1 hand auger boring will be placed at IC 1 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Site 36

Reconnaissance Borings. Two reconnaissance borings (B1 and B2) will be placed to determine the presence of contamination resulting from surface discharge at Site 36. One boring (B1) will be placed on the north side of Building 666 near the door where wastes were washed from the interior of the building. Another boring (B2) will be placed near the storm drain located at the southeast corner of Site 36 where washwater may have collected. Samples will be collected to a minimum depth of 20 feet

BGS. Contaminants of concern at this location include metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-2 presents DQOs for the surface discharge area at Site 36.

Two borings (B3 and B4) will be placed at Site 36 in locations of previously detected contamination. Samples will be collected to a minimum depth of 20 feet BGS.

Deep Borings. Two deep borings (B5 and B6) will be placed at Site 36 in locations of previously detected contamination. Samples will be collected to a depth of 95 feet BGS to confirm the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration.

Contaminants of concern at the borings placed in locations of previously detected contamination include metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-3 presents DQOs for the locations of previously detected soil contamination at Site 36.

Site 47

Reconnaissance Borings. Seven reconnaissance borings (B7 through B13) will be placed at Site 47 near the locations of formerly used electroplating operations, including waste sumps and plating and degreasing pits, which are currently covered with metal caps (Figure 3.1-1). Samples will be collected to a minimum depth of 20 feet BGS.

Deep Boring. One deep boring (B14) will be placed adjacent to a former hard chrome plating pit location. Samples will be collected to a depth of 95 feet BGS to confirm the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration.

Contaminants of concern at this location include metals, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-4 presents DQOs for the sumps and pits at Site 47.

TABLE 3.1-2. DQOs FOR THE SURFACE DISCHARGE AREA AT SITE 36

Objective:	To determine the presence of contamination from surface discharge and to identify the source(s) of the TCE/PCE plume.
Source Description	
Source Type:	Potential surface spill area
Area of Characterization:	4,750 square feet
Approximate Years of Operation:	1958-1980
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, and bases
Sampling Methodology	
Lateral Spacing Basis:	Boring placement adjacent to a suspected discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	B1: 5′ N, 145′ W (20 feet BGS)
	B2: 5′ N, 2′ W (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.1-3. DQOs FOR LOCATIONS OF PREVIOUSLY DETECTED SOIL CONTAMINATION AT SITE 36

Objective:	To confirm the presence of previously detected contamination.
Source Description	
Source Type:	Previously detected contamination
Area of Contamination:	200,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Appendix A guidelines for previously detected contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	B3: 65' N, 60' E (20 feet BGS) B4: 105' N, 245' E (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW7471, SW8270, SW9010, SW9045, FVOC, FGC
Deep Boring Locations and Depths:	B5: 195' N, 165' E (95 feet BGS) B6: 75' N, 125' E (95 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW7471, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.1-4. DQOs FOR SUMPS AND PITS AT SITE 47

Objectives:	To determine the presence of contamination potentially resulting from leakage of underground sumps, pits, and trenches and to identify the source(s) of the TCE/PCE plume.
Source Description	
Source Type:	Underground sumps, pits, and trenches
Area of Contamination:	38,483 square feet
Approximate Years of Operation:	1957-1980
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring at each sump and pit
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	B7: 55′ N, 60′ E (20 feet BGS) B8: 50′ N, 145′ E (20 feet BGS) B9: 25′ N, 20′ E (20 feet BGS) B10: 170′ N, 145′ E (20 feet BGS) B11: 115′ N, 25′ E (20 feet BGS) B12: 70′ N, 15′ E (20 feet BGS) B13: 30′ N, 40′ W (20 feet BGS)
Total Number of Locations:	7
Analytical Methods:	SW6010, SW8270, SW9010, SW9045, FVOC, FGC
Deep Boring Location and Depth:	B14: 115′ N, 95′ E (95 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

Hand Auger Boring. The location of a former transformer storage yard east of Building 666 will be investigated with hand auger H1 to determine the presence of PCB contamination. Samples will be collected to a depth of 5 feet for PCBs. Table 3.1-5 presents DQOs for the transformer storage yard east of Building 666 at Site 47.

Site 48

Reconnaissance Borings. Three reconnaissance borings (B15 through B17) will be placed at Site 48 to investigate operational spills or leaks from the aboveground tanks or from hazardous materials formerly stored east of Building 645B (Figure 3.1-1). Boring B15 will be placed in the soil to the west of the tank locations. Boring B16 will be drilled in the soil south of Building 645B and will aid in the characterization of contamination from Building 645B as well as from spillage or leakage from the tanks. Boring B17 will be drilled at the perimeter of the concrete pad west of Building 666 (Figure 3.1-1) to determine if any contamination is present in the southern portion of the IWTP. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-6 presents DQOs for the investigation of surface discharge from the former tanks at Site 48.

Four borings (B18 through B21) will be drilled adjacent to underground sumps or pits now covered by metal caps installed on the foundation of IWTP No. 4 (Figure 3.1-1) to determine the presence of contamination resulting from any leakage. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at these locations include metals, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-7 presents DQOs for the investigation of the former underground sumps and pits at Site 48.

Two borings (B22 and B23) will be placed near locations of previously detected contamination. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at these locations include metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-8 presents DQOs for the locations of previously detected soil contamination at Site 48.

TABLE 3.1-5. DQOs FOR THE TRANSFORMER STORAGE YARD EAST OF BUILDING 666 AT SITE 47

Objective:	To determine the presence of PCB contamination potentially resulting from storage of transformers.
Source Description	
Source Type:	Surface spill area
Area of Contamination:	487.5 square feet
Approximate Years of Operation:	1957-1980
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	PCBs
Sampling Methodology	
Lateral Spacing Basis:	Boring placement adjacent to a suspected discharge point
Drilling Method:	Hand auger
Reference Point:	Southeast corner of Building 666 foundation
Hand Auger Boring Location and Depth:	H1: 90′ N, 35′ E (5 feet BGS)
Total Number of Locations:	1
Analytical Method:	FPCB

FPCB = Field polychlorinated biphenyl screening.

TABLE 3.1-6. DQOs FOR SURFACE DISCHARGE FROM THE FORMER TANKS AT SITE 48

Objectives:	To determine the presence of contamination potentially resulting from discharge from aboveground tanks and to identify the source(s) of the TCE/PCE plume.
Source Description	
Source Type:	Surface spill
Area of Characterization:	8,754 square feet
Approximate Years of Operation:	1957-1980
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Boring placement adjacent to a suspected discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	B15: 70' N, 25' W (20 feet BGS) B16: 45' N, 15' E (20 feet BGS) B17: 35' S, 55' W (20 feet BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.1-7. DQOs FOR FORMER UNDERGROUND SUMPS AND PITS AT SITE 48

Objectives:	To determine the presence of contamination potentially resulting from leakage of underground sumps, pits, and trenches and to identify the source(s) of the TCE/PCE plume.
Source Description	
Source Type:	Underground sumps and pits
Area of Characterization:	40 square feet
Approximate Years of Operation:	1957-1980
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring at each sump and pit
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	B18: 100' N, 25' E (20 feet BGS) B19: 45' S, 15' W (20 feet BGS) B20: 95' S, 35' W (20 feet BGS) B21: 100' N, 15' W (20 feet BGS)
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.1-8. DQOs FOR LOCATIONS OF PREVIOUSLY DETECTED SOIL CONTAMINATION AT SITE 48

Objectives:	To confirm the presence of previously detected contamination.
Source Description	
Source Type:	Contaminant migration
Area of Contamination:	10,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Borings placed at locations of previously detected contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	B22: 130′ N (20 feet BGS) B23: 10′ S, 35′ W (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW7471, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

PRL L-5D

Reconnaissance Borings. Eight reconnaissance borings (B24 through B31) will be placed adjacent to each leak or break identified in IWL sections at PRL L-5D by the 1988 EG&G report (Figure 3.1-1). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, mercury, volatile and extractable petroleum hydrocarbons, PCBs, phenols, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-9 presents DQOs for locations of IWL leaks at PRL L-5D.

IC 1 Areal Borings

Reconnaissance Borings. Thirty-three reconnaissance borings (B32 through B64) will be located within a systematic triangular grid at IC 1. Locations within the grid will be spaced at 50-foot intervals within soil gas target areas. Samples will be collected to a minimum depth of 20 feet BGS.

Deep Borings. Two deep borings (B65 and B66) will also be placed within the triangular grid. Samples from these borings will be collected to a depth of 95 feet BGS. Boring B65 will confirm the presence of contaminants from potential leakage of the IWL. Boring B66 will assist in the evaluation of HVOC, AVOC, and UVOC soil gas target areas. Both borings will provide information on subsurface lithologic conditions that would affect migration of contaminants in IC 1.

Contaminants of concern in the soils of IC 1 include metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.1-10 presents DQOs for the areal borings at IC 1.

Table 3.1-11 presents the sampling analysis matrix for all sampling locations at IC 1.

TABLE 3.1-9. DQOs FOR LOCATIONS OF IWL LEAKS AT PRL L-5D

Objective: To determine the presence of contamination potentially resulting from leaks in the IWL.

Source Description

Source Type: Underground pipeline

Area of Characterization: 700 linear feet

Approximate Years of Operation: 1953-present

Phase: 1

Media to be Sampled: Soil/soil gas

Contaminants of Concern: Metals, mercury, volatile and extractable petroleum hydrocarbons, PCBs, phenols, VOCs, semivolatile organic compounds, cyanide, acids, bases

Sampling Methodology

Lateral Spacing Basis: Boring placed at each potential leak location

Drilling Method: Power assisted split-spoon sampler

Reference Point: Various, see below

Reconnaissance Boring Locations and Depths: (All borings to a depth of 20 feet BGS)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B24	10'S of MH-12Q	34,50	Cracked joint[b,d]
B25	40' N of MH-12V	34	Broken pipe, longitudinal and circumferential cracks[b]
B26	98' N of MH-12V	34	Cracked joint[b]
B27	257' N of MH-12V	34	Joint that failed leak testing[b]
B28	42' N of MH-665D	35	Cracked joint[c]
B29	563' N of MH-12Q	50	Offset joint[d]
B30	380' N of MH-12V	34	Longitudinal and circumferential cracks, offset joint[b]
B31	166' N of MH-12Q	50	Crushed pipe[d]

Total Number of Locations: 8

Analytical Methods: SW6010, SW7471, SW8015/3550, SW8040, SW8270, SW9010, SW9045, FVOC, FPCB, FGC

IR = Immediate Report referenced in EG&G (1988).

FVOC = Field volatile organic compound screening.

FPCB = Field polychlorinated biphenyl screening.

FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3E and 3H

[b] SWP-E-11(A)

[c] SWP-E-12(A)

[d] SWP-E-16(A)

TABLE 3.1-10 DQOs FOR AREAL BORINGS AT IC 1

Objective:	To determine if volatile organic or other contamination is present in the soils at IC 1.
Source Description	
Source Type:	Undetermined, as indicated by soil gas
Area of Contamination:	100,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling in nonuniform areas of contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 666 foundation
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B32: 240' N, 10' E
	B33: 250' N, 55' E
	B34: 250' N, 105' E
	B35: 210' N, 40' E
	B36: 210' N, 90' E
	B37: 160' N, 55' W
	B38: 180' N, 15' W
	B39: 170' N, 60' E
	B40: 145' N, 100' E
	B41: 175' N, 150' E
	B42: 145' N, 195' E
	B43: 150' N, 255' E
	B44: 125' N, 55' E
	B45: 95' N, 90' E
	B46: 120' N, 130' E
	B47: 80' N, 195' E
	B48: 40' N, 150' E
	B49: 55' N, 200' E

TABLE 3.1-10 (Continued)

Reconnaissance Boring Locations and Depths (Continued):	B50: 20′ N, 105′ E
	B51: 20′ N, 235′ E
	B52: 55′ S, 40′ E
	B53: 35′ S, 100′ E
	B54: 45′ S, 200′ E
	B55: 120′ S, 100′ E
	B56: 115′ S, 185′ E
	B57: 185′ S, 180′ E
	B58: 185′ S, 90′ E
	B59: 230′ S, 125′ E
	B60: 230′ S, 60′ E
	B61: 230′ S, 5′ E
	B62: 225′ S, 45′ W
	B63: 200′ S, 105′ W
	B64: 35′ N, 50′ W
Total Number of Locations:	33
Analytical Methods:	SW6010, SW7471, SW8015/3550, SW8270, SW9010, SW9045, FVOC, FGC
Deep Boring Locations and Depths:	B65: 155′ S, 85′ W (95 feet BGS)
	B66: 185′ N, 110′ W (95 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW7471, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.1-11. SAMPLING AND ANALYSIS MATRIX FOR IC 1

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval						
Depth Interval (feet BGS)	Sample Horizon[a]	Reconnaissance Borings B1, B2[b]	Reconnaissance Borings B3, B4[c], B22, B23[d], B32-B64[e]	Deep Borings B5, B6[c], B65, B66[e]	Reconnaissance Borings B7-B13[f], B15-B21[g,h]	Deep Boring B14[f]	Reconnaissance Borings B24 - B31[i]	Hand Auger Boring H1[j]
0-20	1	SW6010 SW8015/3550 SW8270 SW9010 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8270 SW9010 SW9045 FVOC	SW6010 SW8015/3550 SW7471 SW8270 SW9010 SW9045 FVOC	SW6010 SW8270 SW9010 SW9045 FVOC	SW6010 SW8270 SW9010 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8040 SW8270 SW9010 SW9045 FPCB FVOC	FPCB
0-20	2	SW6010 SW8015/3550 SW8270 SW9010 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8270 SW9010 SW9045 FVOC	SW6010 SW8015/3550 SW7471 SW8270 SW9010 SW9045 FVOC	SW6010 SW8270 SW9010 SW9045	SW6010 SW8270 SW9010 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8040 SW8270 SW9010 SW9045 FVOC	NS
0-20	3	SW8015/3550 SW9045 FVOC FGC	SW8015/3550 SW9045 FVOC FGC	SW8015/3550 SW9045 FVOC FGC	SW9045 FVOC FGC	SW9045 FVOC FGC	SW8015/3550 SW8040 SW9045 FVOC FGC	NS
20-95	4	NS	NS	SW8015/3550 SW9045 FVOC FGC	NS	SW9045 FVOC FGC	NS	NS
20-95	5	NS	NS	SW8015/3550 SW9045 FVOC FGC	NS	SW9045 FVOC FGC	NS	NS
20-95	6	NS	NS	SW8015/3550 SW9045 FVOC FGC	NS	SW9045 FVOC FGC	NS	NS
20-95	7	NS	NS	SW8015/3550 SW9045 FVOC FGC	NS	SW9045 FVOC FGC	NS	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of the boring.

[b] Boring locations for the surface discharge area at Site 36.

[c] Borings for locations of previously detected soil contamination at Site 36.

[d] Borings for locations of previously detected soil contamination at Site 48.

[e] Locations of areal borings at IC 1.

[f] Boring locations for sumps and pits at Site 47.

[g] Boring locations for surface discharge from the former tanks at Site 48.

(footnotes continued on next page)

[h] Boring locations for former underground sumps and pits at Site 48.

[i] Borings for locations of IWL leaks at PRL L-5D.

[j] Boring location for the transformer storage yard east of Building 666 at Site 47 (to a depth of 5 feet).

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples from each site will be sent to off-site laboratory for SW8240 analysis to confirm screening results.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues from 20 feet depth, or below depth of previous sample for hand auger samples.

FPCB = Screening analysis of soils for 7 PCB compounds by field gas chromatograph; samples with detectable concentrations will be sent to off-site laboratory for SW8080 analysis.

3.2 Investigation Cluster 2 (PRL L-5A, PRL T-8, PRL T-46, PRL T-48, and SA 16)

Investigation Cluster 2 consists of PRL L-5A, PRL T-8, PRL T-46, PRL T-48, and SA 16, located in the northern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 2. Although each of these five sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

3.2.1 Site Descriptions

Potential Release Location L-5A

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP located in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the line. The IWL at PRL L-5A is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-5A is approximately 2,100 feet long, and it parallels the outer west, south, and east sides of Mat K (Figure 3.2-1). The principal flow line or "main line" of the IWL includes the section of PRL L-5A paralleling the east side of Mat K between manhole (MH) 10 and the north end of Mat K. Wastewater that has flowed through IWL segments from OU A and much of OU B enters PRL L-5A at MH-10. Also entering the main line section of PRL L-5A at MH-10 is the flow from a branch line that originates on the west side of Building 751 and is included in PRL L-5G. Wastewater entering PRL L-5A from Building 751 and buildings to the south of it flows southward to the oil/water separator at PRL T-48 and from there, eastward toward MH-10, gaining additional flows from Buildings 764, 765, and 767 that pass through the oil/water separator at PRL T-46. The surface trace of PRL L-5A and locations of manholes along its course are shown in Figure 3.2-1. Since 1953, wastewater from industrial operations throughout OU A, the southern portion of OU B (PRLs L-5B through L-5G), and the branch line included in PRL L-5G have flowed through the main line section of PRL L-5G. Industrial operations in the facilities

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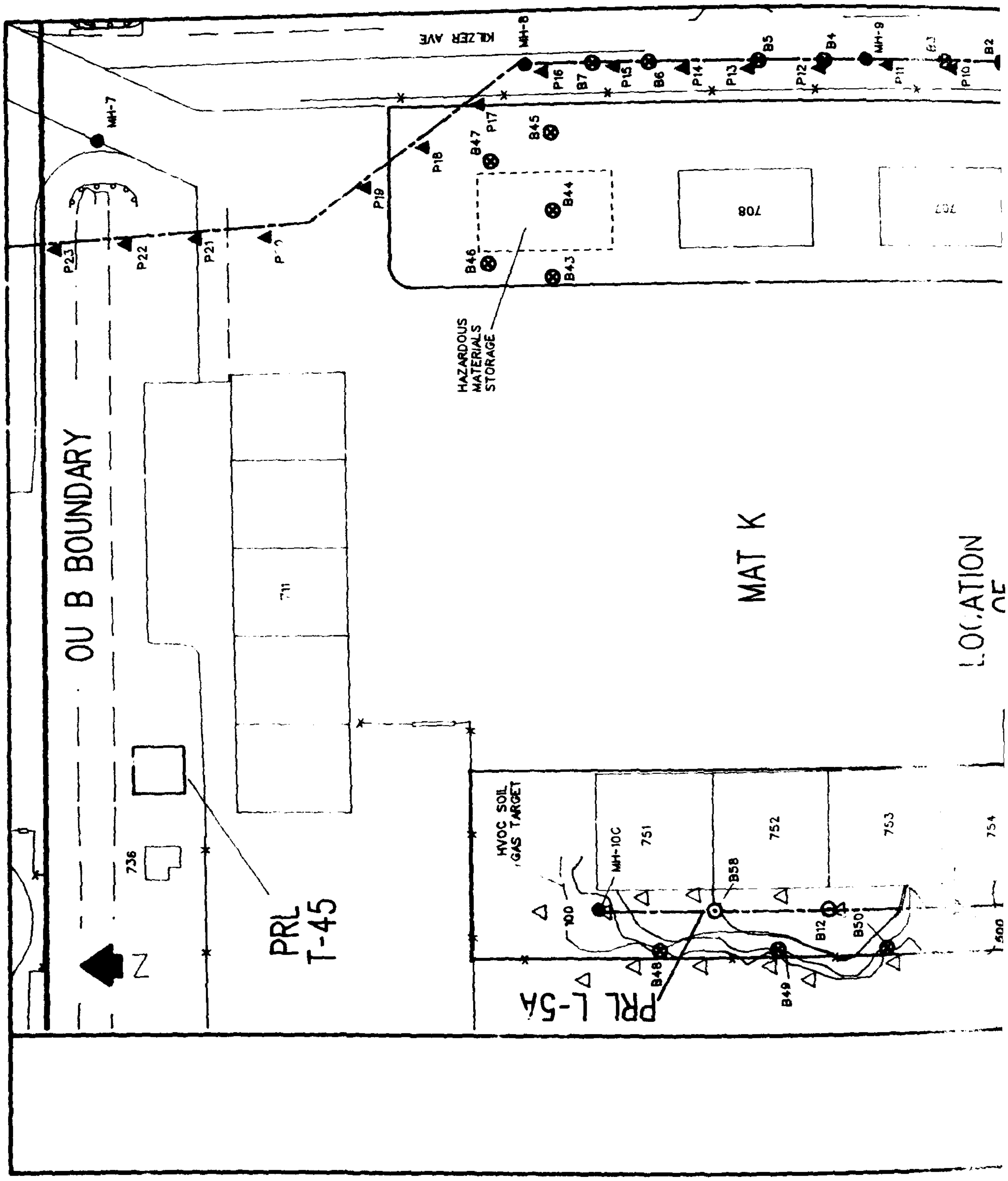

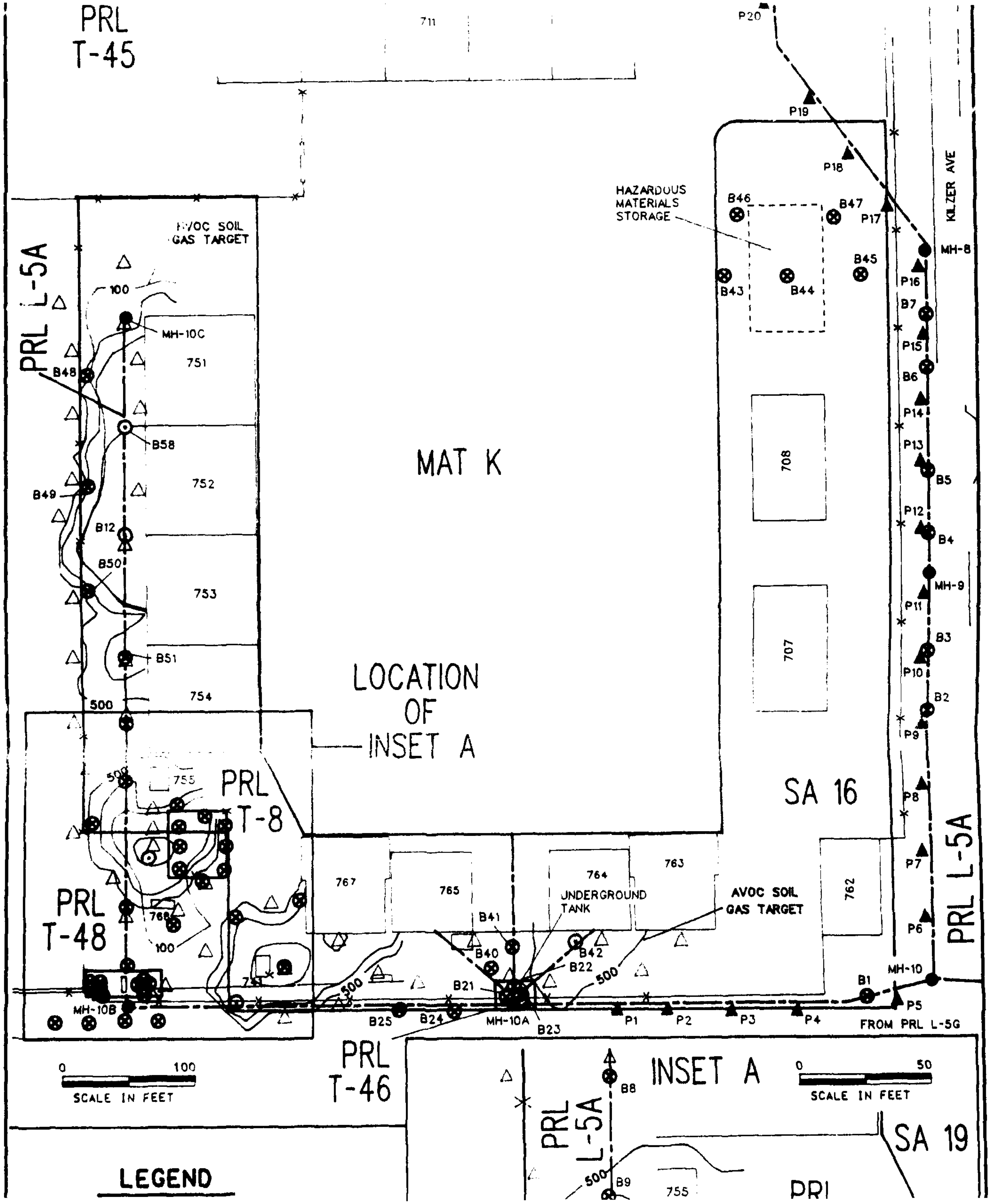
PRL T-45
711
P20
P19
P18
KILZER AVE
HAZARDOUS MATERIALS STORAGE
B46
B47
P17
MH-8
B45
B43
B44
P16
B7
P15
B6
P14
P13
B5
P12
B4
MH-9
P11
B3
P10
B2
P9
P8
P7
P6
AVOC SOIL GAS TARGET
PRL L-5A
100
MH-10C
751
B48
B58
752
B49
B12
B50
753
B51
754
500
MAT K
708
707
LOCATION OF INSET A
SA 16
755
PRL T-8
PRL T-48
768
767
765
764
763
762
UNDERGROUND TANK
AVOC SOIL GAS TARGET
B41
B42
B40
B22
B21
MH-10A
B23
B25
B24
MH-10B
MH-10
B1
P5
P1
P2
P3
P4
FROM PRL L-5G
PRL T-46
0
100
SCALE IN FEET
INSET A
B8
0
50
SCALE IN FEET
SA 19
PRL L-5A
B9
755
PRI
LEGEND

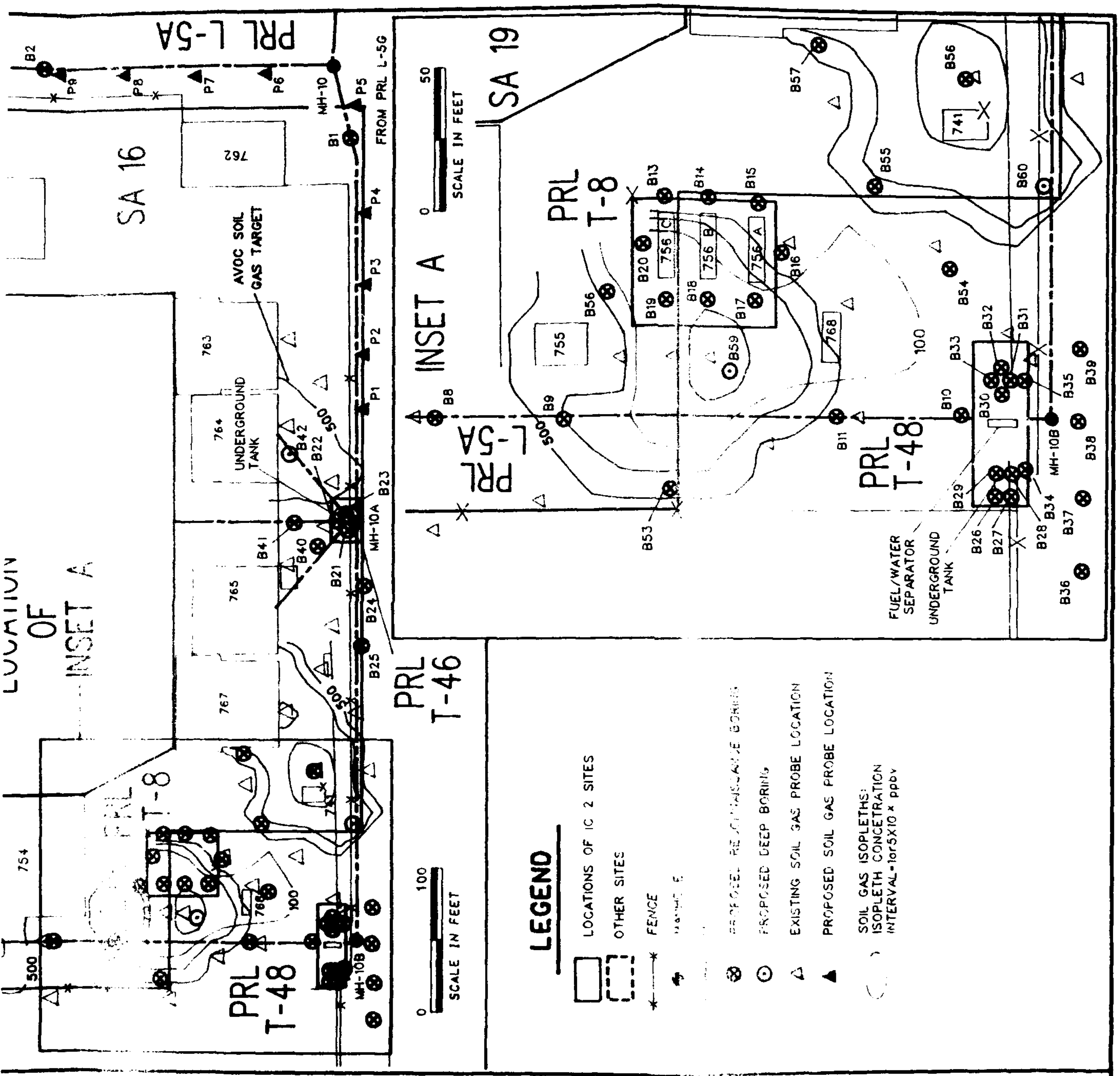

Figure 3.2-1. Site Features and Soil Boring Locations at IC 2 (PRL L-5A, PRL T-8, PRL T-46, PRL T-48, and SA 16).

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connected to PRL L-5 in OU B include maintenance, paint removal, painting, cleaning, industrial wastewater processing, aircraft fueling and defueling operations, and hazardous material storage as described in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Table 3.2-1 summarizes the information available for historical operations performed and materials handled at buildings contributing to the flow through the IWL at PRL L-5A. Operations in OU A that generated wastewater which passed through the main line of PRL L-5A are similar to those listed in Table 3.2-1; however, a detailed listing of those operations is not presented.

Potential Release Location T-8

Potential Release Location T-8 contains three underground fuel storage tanks and an aboveground oil/water separator located southwest of Mat K (Figure 3.2-1). The two northern tanks, both 15,000-gallon tanks (Tanks 756B and 756C), contain JP-4 and JP-5 jet fuel; the southernmost 20,000-gallon tank, Tank 756A, contains waste fuel, oil, and solvents. The underground tanks were installed in 1968 and are also connected by underground pipes to buildings located on the south and west sides of Mat K. All four tanks are still in operation; the surface area of this location is paved with asphalt.

Potential Release Location T-46

Potential Release Location T-46 is situated south of Mat K. An underground oil/water separator tank, which was built before 1968 and removed in November 1990, was located at PRL T-46. The tank had a capacity of 2,000 gallons and was 6 feet wide and 11 feet deep.

An area approximately 16 to 18 feet wide and 15 feet deep was excavated during removal of the tank. According to recent information obtained from McClellan AFB EMR staff, approximately 400 gallons of fuel and wastewater spilled into the pit during the tank removal process. McClellan AFB EMR staff collected soil samples from the bottom of the pit; however, analytical results are not yet available. The surface area of the location is unpaved.

Drain lines from Hangars 764 and 765 and a refueling slab on the south side of Mat K are connected to the separator tank (Figure 3.2-1). Hangars 764 and 765

TABLE 3.2-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED AT BUILDINGS CONTRIBUTING TO THE FLOW AT PRL L-5A (IC 2)

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL Carrying Wastewater From:		
Building 610: 6 VAN repair, maintenance	1953 - Present	S
Building 613: washrack, electronics shop	1953 - Present	NA
Building 640: electronics repair shop, paint shop, paint booth, and solvent booths (PRL T-7)	1953 - Present	S, P
Building 603: oil separator	1953 - Present	F
IWTP No. 4: pretreatment of plating shop wastes, now removed (Site 48)	1957 - 1980	A, B, C, M
Building 655: fuel-tanker servicing, aircraft/vehicle painting, PCB storage, and van repair (PRL S-29)	1953 - Present	A, F, P, S
Building 658: washrack, solvent/steam cleaning, and paint stripping (PRL S-30)	1953-Present	A, F, P, S
Building 654: ground power equipment repair (PRL S-35)	1953 - Present	S, F
Building 659: washrack fueling area, and staging area (SA 7)	1951 - Present	F, S
Buildings 751-754, 763-767: aircraft fuel systems repair and maintenance	NA	F

A = Acids
B = Bases
C = Cyanide compound
F = Fuels and oils
M = Metals listed in California Code of Regulations, Title 22
NA = Not available
P = Paint
PCB = Polychlorinated biphenyls
S = Solvents

are used for the fueling, defueling, and repair of aircraft and discharged two types of aircraft fuels (JP-4 and JP-5), 10/10 slushing oil, and wastewater to this separator. The disposal method for the wastes that collected in the separator was not determined. However, the IWL is located immediately south of PRL T-46 and may have received water or wastes from the separator. The oil/water separator was investigated by EG&G Idaho, Inc., in 1986. Only the contents of the oil/water separator were sampled. The oil/water separator was emptied in 1987 and removed in the fall of 1990. Soil samples were collected from beneath the former tank. All pipelines were capped or sealed. A sample of the tank contents was analyzed and found to contain semivolatile and aromatic compounds and metals.

Potential Release Location T-48

Potential Release Location T-48 is situated southwest of Mat K. Two underground tanks and one aboveground tank are located at PRL T-48 (Figure 3.2-1). The two underground tanks were installed in 1968; one tank may have been an oil/water separator and the other a lift station holding tank for the discharged wastewater. Two types of aircraft fuel (JP-4 and JP-5) and 10/10 slushing oil were used in the aircraft hangars and may have drained to the oil/water separator as a result of spills during fueling or defueling aircraft. The lift station pumped the wastewater from the separator tank to storm drains located west of PRL T-48. An unlined ditch, running east to west, lies to the south of the location (Figure 3.2-1).

In 1979, an aboveground fuel/water separator was installed between the two underground tanks. The two underground tanks presently collect wastewater produced in the hangars and surface water that drains from Mat K. The wastewater drains to the fuel/water separator. From the separator, wastewater is transferred to the IWL. The waste fuel in the separator is piped to a contaminated fuel tank north of PRL T-48. A concrete pad covers the ground surface surrounding the separator and underground tanks. The surface areas around the two underground tanks are enclosed by separate concrete berms.

Study Area 16

Study Area 16 consists of the aircraft hangars, underground fuel tanks, and fuel pipelines surrounding Mat K (Figure 3.2-1). The potential contaminant sources at

SA 16 include pipelines containing jet fuel, contaminated fuel, slushing (10/10) oil, and waste oil that may have leaked and contaminated the soil. In addition to these potential contaminant sources, a documented 3,000-gallon fuel spill (Radian, 1990a) occurred immediately north of PRL T-48 on the asphalt paving southwest of Mat K. An unlined ditch located south of SA 16 has been included in the Phase 1 investigation, because surface water that may have contained spilled fuel or oil from part of SA 16 flows into it.

The jet fuel stored in underground tanks at PRL T-8 (Tanks 756B and 756C) adjacent to SA 16 is piped to the hangars on the south and west sides of Mat K. Contaminated fuel taken from planes in those hangars is piped to another underground tank (Tank 756A) located at PRL T-8. Any fuel spilled in the hangars flows to drains located at the back of each hangar. The spilled fuel was previously conveyed by underground pipelines to an underground oil/water separator at PRL T-46 until it ceased operations, and now it is piped to the aboveground fuel/water separator that is operating at PRL T-48 (Figure 3.2-1). Slushing oil tanks, containing 10/10 oil for rinsing aircraft fuel tanks, are located south of Hangar 765; underground pipelines run from the tanks to Hangars 763 and 767. Used oil is piped back to these tanks for reuse. Underground pipelines from Hangars 764 and 765 and from a now unused refueling slab at the southern end of Mat K historically transferred waste oil and fuel to an oil/water separator located at PRL T-46. Semivolatile organic compounds and aromatic hydrocarbons were detected in samples of the contents of the separator at PRL T-46 in 1986.

Buildings 707 and 708 are storage areas for non-hazardous materials including aircraft packing foam and hoses. Two portable trailers are located north of Building 708 and are used to store solvents.

The hazardous materials holding area is located north of the portable trailers and consists of a concrete pad, enclosed by an asphalt berm. Cracks in the pad were observed (Radian, 1989b).

3.2.2 Previous Investigations

Testing of Tanks 756B and 756C at PRL T-8 in 1986 indicated that both tanks were leaking. Both tanks were subsequently repaired. It is standard procedure at McClellan AFB to retest underground storage tanks (USTs) after they have been repaired; however, no information is available documenting testing after the repair. Because of its size, Tank 756A could not be adequately tested.

EG&G tested the integrity of the IWL at PRL L-5 (EG&G, 1988). During the investigation, access ways were cleaned, and the pipe segments were observed either by direct or remote inspection and were pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through the pipes. All of the pipeline sections were compatible with wastewater passing through them. EG&G tested all sections of the IWL at PRL L-5A, except the section between MH-10B and MH-10C (Figure 3.2-1). Leaks or cracks were identified in the sections of the IWL between MH-10A and MH-8. These were subsequently repaired by grouting. Sampling locations and analytical methods presented here are based on the results of the EG&G investigation.

A soil gas investigation of IC 2 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Forty-four soil gas probes were placed and sampled for the soil gas investigation of IC 2. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 10 of these probes at concentrations that exceeded the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the 42 probes, ranged from 1.9 to 992.3 ppbv. Total AVOC concentrations, detected in 12 of the 44 probes, ranged from 388.0 to 238,000 ppbv. Total UVOC concentration, detected in 14 of the 44 probes, ranged from 373.0 to 957,000 ppbv. In all but two of the probes, UVOC concentrations were detected in samples with AVOCs at concentrations of similar magnitude.

Results of the soil gas investigation indicate the presence of six areas of soil gas contamination that require further investigation during the OU B RI; these are depicted in Figure 3.2-1. The two soil gas targets shown on the west side of Mat K contain total AVOCs and UVOCs at concentrations exceeding 1,000 ppbv and single HVOC analytes exceeding 100 ppbv. Two soil gas targets, identified southwest of Mat K in the vicinity of PRLs T-8 and T-48, consist of a total AVOC target exceeding 1,000 ppbv and a single HVOC analyte exceeding 100 ppbv. The two soil gas targets located south of Mat K are based on concentrations of total AVOCs and UVOCs exceeding 1,000 ppbv.

3.2.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 2 is to determine the presence of VOC or other contamination in the area. A total of 58 reconnaissance borings, 2 deep borings, and 23 soil gas probes wil be placed at IC 2. The soil gas probes will initially be placed along the IWL, PRL L-5A, to screen soil gas for the presence of VOC concentrations. Borings have initially been selected at IC 2 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. Additional Phase 1 reconnaissance borings will be placed along the IWL if VOC concentrations in soil gas indicate the presence of soil gas targets. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Potential Release Location L-5A

Soil Gas Investigation. Soil gas samples will initially be collected from 23 locations (P1 through P23) along the IWL in IC 2. The IWL segments in PRL L-5A were tested, had cracks, but have not previously been sampled for VOCs in soil gas. Samples will initially be collected from probes driven to 6 feet BGS and spaced 50 feet apart along the length of the IWL (Figure 3.2-1). On the basis of concentrations detected in the initial soil gas samples, stepout probes will be placed along the IWL segments at distances of 25 feet from any initial probe with a total VOC concentration of 100 ppbv total HVOCs or UVOCs, or 500 ppbv total AVOCs. Soil gas samples collected in the probes will be analyzed for HVOCs and AVOCs in the field with a gas chromatograph (GC). Table 3.2-2 presents the DQOs for soil gas probe locations of IWL leaks and uninvestigated portions of PRL L-5A.

After the initial and stepout probes are sampled, reconnaissance or deep soil borings will be placed along the IWL to determine if VOCs are present on soil particles. Locations of the reconnaissance borings have been based on previous evidence of cracks or damage to the IWL. Additional reconnaissance boring locations will be determined by the distribution of VOCs in soil gas, as determined from probe sample analyses.

TABLE 3.2-2. DQOs FOR THE LOCATIONS OF POTENTIAL IWL LEAKAGE AT PRL L-5A

Objective:	To determine the presence of soil gas contamination resulting from potential leakage of the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	1,180 linear feet
Phase:	1
Medium to be Sampled:	Soil gas
Contaminants of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source areas
Drilling Method:	Soil gas probe driver
Reference Point:	MH-10
Boring Locations and Depths:	(All probes to a depth of 4 to 6 feet BGS) P1 - P23: Probes placed at approximately 50-foot intervals beginning at reference point
Total Number of Locations:	23
Analytical Method:	FGC

FGC = Field gas chromatograph screening of soil gas.

Reconnaissance Borings. Seven reconnaissance borings (B1 through B7) will be placed adjacent to leaks or breaks identified by the 1988 EG&G report (Figures 3.2-1). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern along PRL L-5A that may have been transported in wastewater from operations along upstream sections in OU A or southern OU B include metals, VOCs, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds, herbicides, pesticides, phenols, acids, bases, radionuclides, and cyanide. Table 3.2-3 presents DQOs for locations of IWL leaks at PRL L-5A.

Reconnaissance borings (B8 through B11) will be placed to determine if leakage from the IWL between MH-10B and MH-10C has occurred. The integrity of this section of the IWL was not determined previously by EG&G. These borings will also serve to identify potential releases from various facilities adjacent to PRL L-5A where wastes are initially discharged to the IWL (Figure 3.2-1).

Deep Boring. One deep boring (B12) will be placed adjacent to PRL L-5A (Figure 3.2-1) between MH-10B and MH-10C to determine subsurface lithology that would affect the migration of contaminants from leaks from the IWL. Samples will be collected to a depth of 95 feet BGS. Table 3.2-4 presents DQOs for the uninvestigated portion of the IWL at PRL L-5A.

Potential Release Location T-8

Reconnaissance Borings. Eight reconnaissance borings (B13 through B20) will be placed within the site boundaries of PRL T-8 to determine whether the fuels and solvents stored in the tanks have contaminated the soil. Prior to collecting soil samples, ground penetrating radar and magnetometer surveys will be conducted to determine the exact locations, dimensions, and depths of the underground tanks and pipes. Precise boring locations will be determined from the results of these tests. In accordance with the criteria in Appendix A for underground tanks, one boring will be placed at the ends of each of the three tanks, and on each side of the two outer tanks. Borings are not proposed between tanks because of their close proximity to each other and limited access. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern include metals, VOCs, and volatile and extractable petroleum hydrocarbons. In addition, samples collected from borings within the 100 ppbv isopleth (B17 through B20)

TABLE 3.2-3. DQOs FOR LOCATIONS OF IWL LEAKS AT PRL L-5A

Objective:	To determine the presence of contamination resulting from leaks in the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	6,000 square feet
Approximate Years of Operation:	1953-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, herbicides, pesticides, VOCs, semivolatile organic compounds, acids, bases, radionuclides, cyanide
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at each potential leak location
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B1	263′ E of MH-10A	64	Circumferential cracks[b]
B2	230′ N of MH-10	85	Leaking joints[c]
B3	284′ N of MH-10	85	Leaking joints[c]
B4	44′ N of MH-9	86	Leaking joints[d]
B5	86′ N of MH-9	86	Leaking joints[d]
B6	164′ N of MH-9	86	Leaking joints[d]
B7	200′ N of MH-9	86	Leaking joints[d]

Total Number of Locations:	7
Analytical Methods:	SW6010, SW7471, SW8010/3550, SW8010/5030, SW8040, SW8080, SW8140, SW8150, SW8270, SW9045, SW9310, SW9010, U.S. EPA 901.1, FVOC, FGC

IR = Immediate Report referenced in EG&G (1988).
FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3F and 3H

[b] SWP-F-03-A

[c] SWP-F-01-A

[d] SWP-F-04-A

TABLE 3.2-4. DQOs FOR THE UNINVESTIGATED PORTION OF THE IWL AT PRL L-5A

Objective:	To determine the presence of contamination from the IWL between MH-10B and MH-10C.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	500 linear feet
Approximate Years of Operation:	1953-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at each discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Hangar 754
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)

Boring	Location	EG&G (1988)[a] Boring Placement Rationale
B8	25' N, 10' W	Previously untested[b]
B9	25' S, 10' W	Previously untested[b]
B10	175' S, 10' W	Previously untested[b]
B11	125' S, 10' W	Previously untested[b]

Total Number of Locations:	4
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC
Deep Boring Location and Depth:	(Boring to a depth of 95 feet BGS)

Boring	Location	EG&G (1988)[a] Boring Placement Rationale
B12	170' N, 10' W	Previously untested[b]

Total Number of Locations:	1
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

[a] Informal Report, Volume I, page 3-45

[b] No EG&G ID number

will be analyzed for HVOCs. Tables 3.2-5 presents the DQOs for the underground storage tanks at PRL T-8.

Potential Release Location T-46

Reconnaissance Borings. Three reconnaissance borings (B21 through B23) will be drilled at the bottom of the pit at PRL T-46 to determine if the tank and/or drain line connections have leaked (Figure 3.2-1). Two borings (B24 and B25) will be drilled in the ditch that is located south of PRL T-46 to determine if any wastewater overflowed from the tank to the ditch and will also serve to assess if the IWL (PRL L-5A) has leaked at these locations (Figure 3.2-1). Contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, and semivolatile organic compounds. Tables 3.2-6 and 3.2-7 present the DQOs for the underground oil/water separator tank and drainage ditch south of PRL T-46.

Metals, petroleum hydrocarbons, and semivolatile organic compounds were detected in samples of the tank contents analyzed in the 1986 investigation as summarized in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Therefore, contaminants of concern will include these compounds. However, the list of contaminants of concern may be reevaluated based on the results of analyses on soil samples to be collected by McClellan AFB at PRL T-46.

Potential Release Location T-48

Reconnaissance Borings. Ten reconnaissance borings (B26 through B35) will be drilled adjacent to the two underground tanks and within the bermed areas of PRL T-48 to determine whether the soils around PRL T-48 have become contaminated. Borings (B34 and B35) will be located in the drainage ditch located just south of the aboveground fuel/water separator, since any spillage from the separator would flow south to the ditch. Because the dimensions and depths of the tanks are unknown, ground penetrating radar, a magnetometer, and/or field observations will be used to accurately place the borings and determine the initial sampling depth. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, and semivolatile organic compounds that have been detected in the contents of other oil/water separators receiving

TABLE 3.2-5. DQOs FOR THE UNDERGROUND STORAGE TANKS AT PRL T-8

Objective:	To determine if fuel and solvent leakage has contaminated the soil.
Source Description	
Source Type:	Underground storage tank
Area of Characterization:	2020 square feet
Approximate Years of Operation:	1968 to unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwestern corner of Building 767
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B13 - B15 and B17 - B19: One at each end of the three underground storage tanks B16 and B20: One on each side of the two outside underground storage tanks
Total Number of Locations:	8
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-6. DQOs FOR THE UNDERGROUND OIL/WATER SEPARATOR TANK AT PRL T-46

Objective:	To determine whether any contaminants from the oil/water separator tank have been released to the soil.
Source Description	
Source Type:	Underground tank
Area of Characterization:	750 square feet
Approximate Years of Operation:	1968-unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northernmost pit point (23' S, 32' E of Building 766)
Reconnaissance Boring Locations and Depths:	B21: 2.5' S (20 feet BGS) B22: 15' S, 5' W (20 feet BGS) B23: 15' S, 5' E (20 feet BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-7. DQOs FOR THE DRAINAGE DITCH SOUTH OF PRL T-46

Objective:	To determine whether any contaminants from the drain lines have been released to the soil.
Source Description	
Source Type:	Surface drainage area
Approximate Years of Operation:	1968-unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southeast corner of Building 766
Reconnaissance Boring Locations and Depths:	B24: 45′ S, 13.5′ W (20 feet BGS) B25: 45′ S, 55′ W (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

wastewater from Mat K. Tables 3.2-8 and 3.2-9 present the DQOs for the underground storage tanks and the aboveground fuel/water separator at PRL T-48.

Borings B36 through B39 will be used to assess contaminants in soil resulting from the fuel spill that occurred north of PRL T-48. The spilled fuel may have flowed south to the unpaved drainage ditch in SA 16. Four reconnaissance borings will be placed in the bottom of the ditch at 20-foot intervals. Contaminants of concern are volatile and extractable petroleum hydrocarbons. Tables 3.2-10 presents the DQOs for a spill area at SA 16.

SA 16

Reconnaissance Borings. Leaks in the fuel distribution pipelines at SA 16 are potential sources of contamination. The precise locations of these pipelines will be determined following ground penetrating radar and magnetometer surveys. The location of three pipelines located at the southern end of Mat K are currently known. Two additional reconnaissance borings (B40 and B41) will be placed at two of the three pipelines leading from the southern portion of Mat K and Building 765. Samples will be collected to a minimum depth of 20 feet BGS. Additional borings to assess leakage from other pipelines in SA 16 will be placed and sampled following the results of surface geophysical surveys to determine their locations.

Deep Boring. One deep boring (B42) will be placed to assess an AVOC soil gas target in the area and to assess the pipeline from Building 765. The deep soil boring will be placed to determine subsurface lithologic information from IC 2, and sampled to 95 feet BGS. Contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, and semivolatile organic compounds. The DQOs for the pipelines at SA 16 are presented in Table 3.2-11.

Hazardous Material Holding Area

Reconnaissance Borings. Five reconnaissance borings (B43 through B47) will be placed in the area of two portable trailers used to store solvents and a hazardous materials holding area north of Building 708 in IC 2. Reconnaissance boring locations have been selected on a triangular 50-foot grid spacing. The borings will be used to

TABLE 3.2-8. DQOs FOR THE UNDERGROUND STORAGE TANKS AT PRL T-48

Objective:	To determine whether the soils around the tanks have become contaminated.
Source Description	
Source Type:	Two underground tanks
Area of Characterization:	900 square feet
Approximate Years of Operation:	1968 - 1979
Phase:	1
Media To Be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Corners of concrete berm
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B26:Northwest of and adjacent to underground western tank, inside bermed area. B27: Southwest of and adjacent to underground western tank, inside bermed area. B28: Southeast of and adjacent to underground western tank, inside bermed area. B29: Northeast of and adjacent to underground western tank, inside bermed area. B30: West of and adjacent to underground eastern tank, inside bermed area. B31: South of and adjacent to underground eastern tank, inside bermed area. B32: East of and adjacent to underground eastern tank, inside bermed area. B33: North of and adjacent to underground eastern tank, inside bermed area.
Total Number of Locations:	8
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-9. DQOs FOR ABOVEGROUND FUEL/WATER SEPARATOR AT PRL T-48

Objective:	To determine whether the soils around the separator have become contaminated.
Source Description	
Source Type:	Aboveground tank
Area of Characterization:	200 square feet
Approximate Years of Operation:	1979 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Location adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Aboveground separator
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B34: South of western underground storage tank within drainage ditch B35: South of eastern underground storage tank within drainage ditch
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-10. DQOs FOR THE SURFACE SPILL AREA AT SA 16

Objective:	To determine the extent of contamination in soils from a documented spill at SA 16.
Source Description	
Source Type:	Surface spill
Area of Characterization:	200 square feet
Approximate Years of Operation:	1963 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid spacing for statistical sampling of soil gas targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Hangar 754
Reconnaissance Boring Locations and Depths:	B36: 210' S, 75' W (20 feet BGS) B37: 210' S, 55' W (20 feet BGS) B38: 210' S, 35' W (20 feet BGS) B39: 210' S, 15' W (20 feet BGS)
Total Number of Locations:	4
Analytical Methods:	SW8015/3550, SW8015/5030, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-11. DQOs FOR THE PIPELINES AT SA 16

Objective:	To determine if contamination is present in soils beneath pipelines at SA 16.
Source Description	
Source Type:	Pipelines
Area of Characterization:	2,000 linear feet
Approximate Years of Operation:	1953 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Hangar 754
Reconnaissance Boring Locations and Depths:	B40: 172.5' S, 255' E (20 feet BGS) B41: 150' S, 275' E (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC
Deep Boring Location and Depth:	B42: 150' S, 322.5' E (95 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

assess any soil contamination that may have resulted from leaks or spills that may have occurred during the storage of solvents or other hazardous materials in the area. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.2-12 contains the DQOs for the hazardous material holding area north of Building 708 and solvent storage trailers.

IC 2 Areal Borings

Reconnaissance Borings. Ten reconnaissance borings (B48 through B57) will be placed in the areas of VOC contamination detected during the soil gas investigation (Figure 3.2-1). Because the AVOC/UVOC and HVOC targets on the west and southwest portions of IC 2 are coincident, reconnaissance borings placed in each will evaluate both types of targets. In addition to investigating soil gas targets, these borings will also be used to identify leaks in PRL L-5A west of the hangars and one of the three pipelines located south of Mat K leading to the oil/water separator of PRL T-46 (Figure 3.2-1). Samples will be collected to a minimum depth of 20 feet BGS.

Deep Borings. Three deep borings (B58 through B60) will be placed adjacent to PRL L-5A and will evaluate soil gas targets and determine subsurface lithology for IC 2. Soil samples will be collected to a depth of 95 feet.

Contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.2-13 presents the DQOs for areal borings at IC 2.

Table 3.2-14 presents the sampling and analysis matrix for all sampling locations at IC 2.

TABLE 3.2-12. DQOs FOR THE HAZARDOUS MATERIAL HOLDING AREA NORTH OF BUILDING 708 AND SOLVENT STORAGE TRAILERS

Objective:	To determine if contamination is present in soils in the vicinity of solvent storage trailers and the hazardous material holding area.
Source Description	
Source Type:	Solvent storage trailers and hazardous material holding area
Area of Characterization:	6,000 square feet
Approximate Years of Operation:	Unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular, 50-foot grid
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 708
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B43: 44' N, 37' E B44: 44' N, 14' E B45: 44' N, 15' W B46: 67' N, 31' E B47: 67' N, 6' W
Total Number of Locations:	5
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-13. DQOs FOR AREAL BORINGS AT IC 2

Objective:	To determine if VOCs and other contaminants are present in soils at IC 2.
Source Description	
Source Type:	Soil gas targets
Area of Characterization:	209,000 square feet
Approximate Years of Operation:	1963 - present
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Appendix A guidelines for soil gas targets
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Hangar 754
<u>Reconnaissance Boring Locations and Depths</u>:	(All borings to a depth of 20 feet BGS) B48: 290' N, 43' E B49: 200' N, 43' E B50: 122' N, 23' E B51: 169' N, 16' E
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC
Reference Point:	Northwest corner of Building 741
<u>Reconnaissance Boring Locations and Depths</u>:	(All borings to a depth of 20 feet BGS) B52: 117' N, 53' W B53: 96' N, 122' W B54: 3' S, 29' W B55: 23' N, 15' W

(Continued)

TABLE 3.2-13. (Continued)

Reconnaissance Boring Locations and Depths (Continued):	B56: 8' S, 23' E
	B57: 42' N, 33' E
Total Number of Locations:	6
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC
Reference Point:	Southwest corner of Hangar 754
Deep Boring Location and Depth:	B58: 250' N, 16' E (95 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC
Reference Point:	Northwest corner of Building 741
Deep Boring Locations and Depths:	B59: 75' N, 81' W (95 feet BGS)
	B60: 35' S, 15' W (95 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.2-14. SAMPLING AND ANALYSIS MATRIX AT IC 2

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval				
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B7[b]	Reconnaissance Borings B8 - B11[c]	Deep Boring B12[c]	Reconnaissance Borings B13 - B20[d]	Reconnaissance Borings B21 - B23[e]
0 - 20	1	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8080 SW8140 SW8150 SW8270 SW9010 SW9045 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC
0 - 20	2	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8080 SW8140 SW8150 SW8270 SW9010 SW9045 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC
0 - 20	3	SW8015/3550 SW8015/5030 SW8080 SW8140 SW8150 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC
20 - 95	4	NS	NS	SW8015/3550 FVOC FGC	NS	NS
20 - 95	5	NS	NS	SW8015/3550 FVOC FGC	NS	NS
20 - 95	6	NS	NS	SW8015/3550 FVOC FGC	NS	NS
20 - 95	7	NS	NS	SW8015/3550 FVOC FGC	NS	NS

(Continued)

TABLE 3.2-14. (Continued)

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval				
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B24 - B25[f]	Reconnaissance Borings B26 - B33[g]	Reconnaissance Boring B34 - B35[h]	Reconnaissance Borings B36 - B39[i]	Reconnaissance Borings B40 - B41[j]
0 - 20	1	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW8015/3550 SW8015/5030 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC
0 - 20	2	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW8015/3550 SW8015/5030 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC
0 - 20	3	SW8015/3550 SW8015/5030 FVOC FGC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 FVOC FGC	SW8015/3550 SW8015/5030 FVOC FGC
20 - 95	4	NS	SW8015/3550 SW8015/5030 FGC		SW8015/3550 SW8015/5030 FGC	
20 - 95	5	NS	NS	NS	NS	NS
20 - 95	6	NS	NS	NS	NS	NS
20 - 95	7	NS	NS	NS	NS	NS

(Continued)

TABLE 3.2-14. (Continued)

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval				
Depth Interval (ft BGS)	Sample Horizon[a]	Deep Borings B42[j]	Reconnaissance Borings B43 - B47[k]	Reconnaissance Boring B48 - B57[l]	Reconnaissance Borings B58 - B60[l]	Probes P1 - P23[m]
0 - 20	1	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	FGC
0 - 20	2	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	NS
0 - 20	3	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	SW8015/3550 SW8015/5030 SW8270 FVOC FGC	NS
20 - 95	4	NS	NS	NS	SW8015/3550 SW8015/5030 FGC	NS
20 - 95	5	NS	NS	NS	SW8015/5030 FVOC FGC	NS
20 - 95	6	NS	NS	NS	SW8015/5030 FVOC FGC	NS
20 - 95	7	NS	NS	NS	SW8015/5030 FVOC FGC	NS

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[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations of IWL leaks at PRL L-5A.

[c] Boring locations of IWL leaks at the uninvestigated portion of the IWL at PRL L-5A.

[d] Boring locations for the underground storage tank at PRL T-8.

[e] Boring locations for the underground oil/water separator tank at PRL T-46.

[f] Boring locations for the drainage ditch south of PRL T-46.

[g] Boring lcoations for the underground storage tanks at PRL T-48.

[h] Boring locations for the aboveground oil/water separator at PRL T-48.

[i] Boring lcoations for the surface spill area at SA 16.

[j] Boring locations for the pipelines at SA 16.

[footnotes continued on following page]

TABLE 3.2-14. (Continued)

[k] Boring locations for the hazardous materials holding area north of Building 708 and solvent storage trailers.

[l] Areal boring locations at IC 2.

[m] Probes for locations of potential IWL leakage at PRL L-5A.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Reconnaissance borings not sampled unless contamination continues from 20 feet depth; soil gas probes not sampled below 4 to 6 feet BGS.

3.3 Investigation Cluster 3 (Site S-49, PRL L-5E, SA 3, SA 10, SA 17, and SA 19)

Investigation Cluster 3 consists of Site S-49, PRL L-5E, SA 3, SA 10, SA 17, and SA 19 is located in the northern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology for the Phase 1 remedial investigation of IC 3. Although each of these six sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

3.3.1 Site Descriptions

Site S-49

Site S-49 is the former location of a base maintenance facility in use from the late 1970s to 1990 (Figure 3.3-1). The facility consisted of a temporary shed structure that was dismantled in 1990 and existing asphalt lot located south of the structure, concurrently used as an equipment and material staging area. The substances handled at this facility include pesticides, herbicides, motor oil, fuels, and solvents.

Potential Release Location L-5E

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the pipes. The IWL at PRL L-5 is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-5E is the section of PRL L-5 extending from East AD Street to 200 feet north of the northern OU B boundary and is approximately a total of 900 feet. Figure 3.3-1 shows the surface trace of PRL L-5E. Most of the piping system is constructed of 8-inch vitrified clay pipe, but 4-, 8-, and 10-inch asbestos-concrete, cast iron, and vitrified clay pipes are found in some sections of PRL L-5. Industrial activities at the facilities connected to PRL L-5 include maintenance, paint removal, painting, cleaning industrial wastewater processing, and hazardous material storage described previously in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Table 3.3-1 summarizes the available information

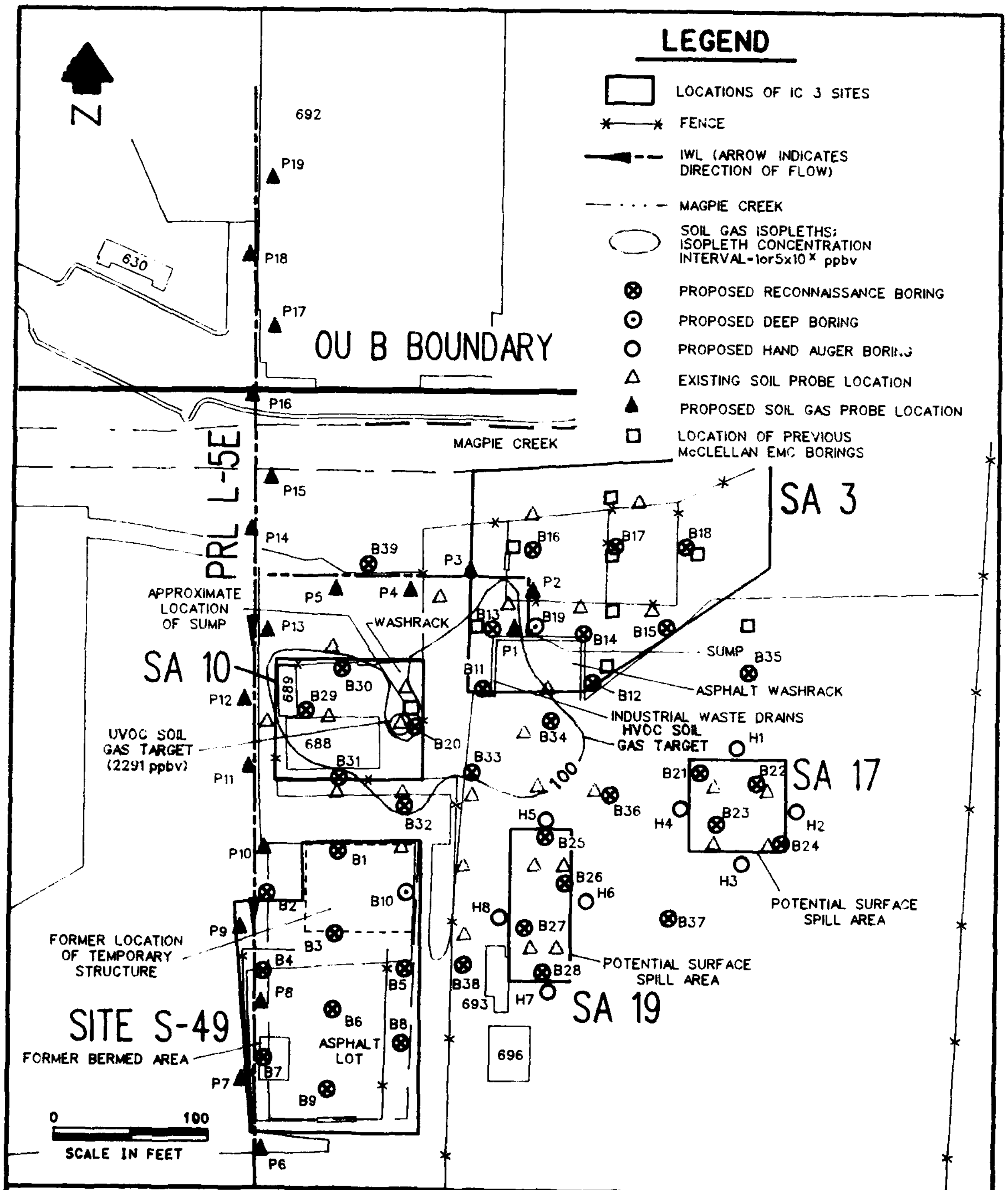

Figure 3.3-1. Site Features and Soil Boring Locations at IC 3 (Site S-49, PRL L-5E, SA 3, SA 10, SA 17 and SA 19).

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TABLE 3.3-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED AT BUILDINGS CONTRIBUTING TO THE FLOW THROUGH THE IWL AT PRL L-5E (IC 3)

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL carrying wastewater from:		
Buildings 688, 689 Entomology Unit	1980-Present	H, M, P, Pe, S
Asphalt washrack at SA 3	1955-Present	NA

H = Herbicides
M = Metals listed in the California Code of Regulations, Title 22
NA = Not available
P = Paint
Pe = Pesticides
S = Solvents

concerning the historical operations performed and materials handled at buildings contributing to the flow through the IWL at PRL L-5E.

Study Area 3

Study Area 3 consists of a 50-foot by 50-foot washrack connected by underlying drains and an overflow sump to the McClellan AFB IWL and the overflow area between the washrack and Magpie Creek (Figure 3.3-1). The washrack has been used by base personnel and subcontractors to dispose of wastewater sediment, and washwater from cleaning of vehicles from 1966 to the present. Aerial photographs and personnel interviews indicate that the washwater from the washrack overflows onto the adjacent soil and also into Magpie Creek.

Study Area 10

Study Area 10 boundaries surround Buildings 688 and 689, which have housed the Entomology Unit since the buildings were constructed in 1980 (Figure 3.3-1). The Entomology Unit is responsible for weed and pest control at McClellan AFB. Herbicides, pesticides, and various solvents have been stored in Building 688. The building was designed for this purpose and is not considered a likely source of contamination. However, a sump connected to Building 688 on the east is considered a possible source of contamination.

Wastewater contaminated with pesticides and herbicides drains from Building 688 and the adjacent washrack into the sump. The sump was constructed by placing a concrete cylinder, 6 feet in diameter and 6 feet deep, on top of a 7-inch thick concrete slab. The connection between the cylinder and the slab was sealed with a narrow strip of mortar. The mortar is not considered an impervious seal, and contaminated wastewater may have leaked to soils through the seal. Wastewater is periodically pumped from the sump into portable tanks for disposal into the IWTP.

Additionally, Building 688 may be connected to the base IWL at PRL L-5F, according to a report by EG&G Idaho (1988); however, this cannot be verified based on a review of other available information including McClellan AFB composite utilities maps. Leakage of this section of pipeline or its connection to Building 688 or the base IWL are potential contaminant sources.

Study Area 17

Study Area 17 was used as an oil storage yard from approximately 1955 to 1974, according to McClellan AFB CE drawings and aerial photographs (Radian, 1990a). The boundary for SA 17 is delineated by the fence line that once surrounded the storage yard (Figure 3.3-1). Drums that may have leaked oil during storage are a potential source of contamination. Whereas asphalt pavement now covers the area, it has not been determined whether the area was paved when it was used for storage.

Study Area 19

Study Area 19 was the location of Temporary Building 690 from approximately 1951 to 1974 (Figure 3.3-1). Temporary Building 690 was used as a spray booth; little other historical information about the building is available. The specific materials used in operations at the spray booth are not known; however, paints and solvents were probably used. Therefore, the spray booth may be a potential source of contamination. Aerial photographs taken in 1965 and 1966 show an area of surface discoloration south of Building 690. This area may also be a potential source of contamination. The area is currently covered with asphalt, but whether the area was paved when the discoloration occurred is not known.

3.3.2 Previous Investigations

In October 1987, McClellan AFB EM drilled nine soil borings at SA 3 (Figure 3.3-1), as described in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Exact boring locations are not known. Analyses were performed on 24 samples. Five VOCs ranging in concentration from 1 to 57 ppb were detected in the samples. Four semivolatile organic compounds with concentrations ranging from 13 to 1800 ppb were detected. Metals were also detected in samples; beryllium was detected at the highest concentration of 162 ppm.

Following the dismantling of the temporary structure at Site S-49 in 1990, visible contamination was noted on the ground under and adjacent to the building location. Thirty-eight samples were collected from 30 locations (Figure 3.3-2) at the facility. Metals, oil and grease, total petroleum hydrocarbons, motor and diesel oil

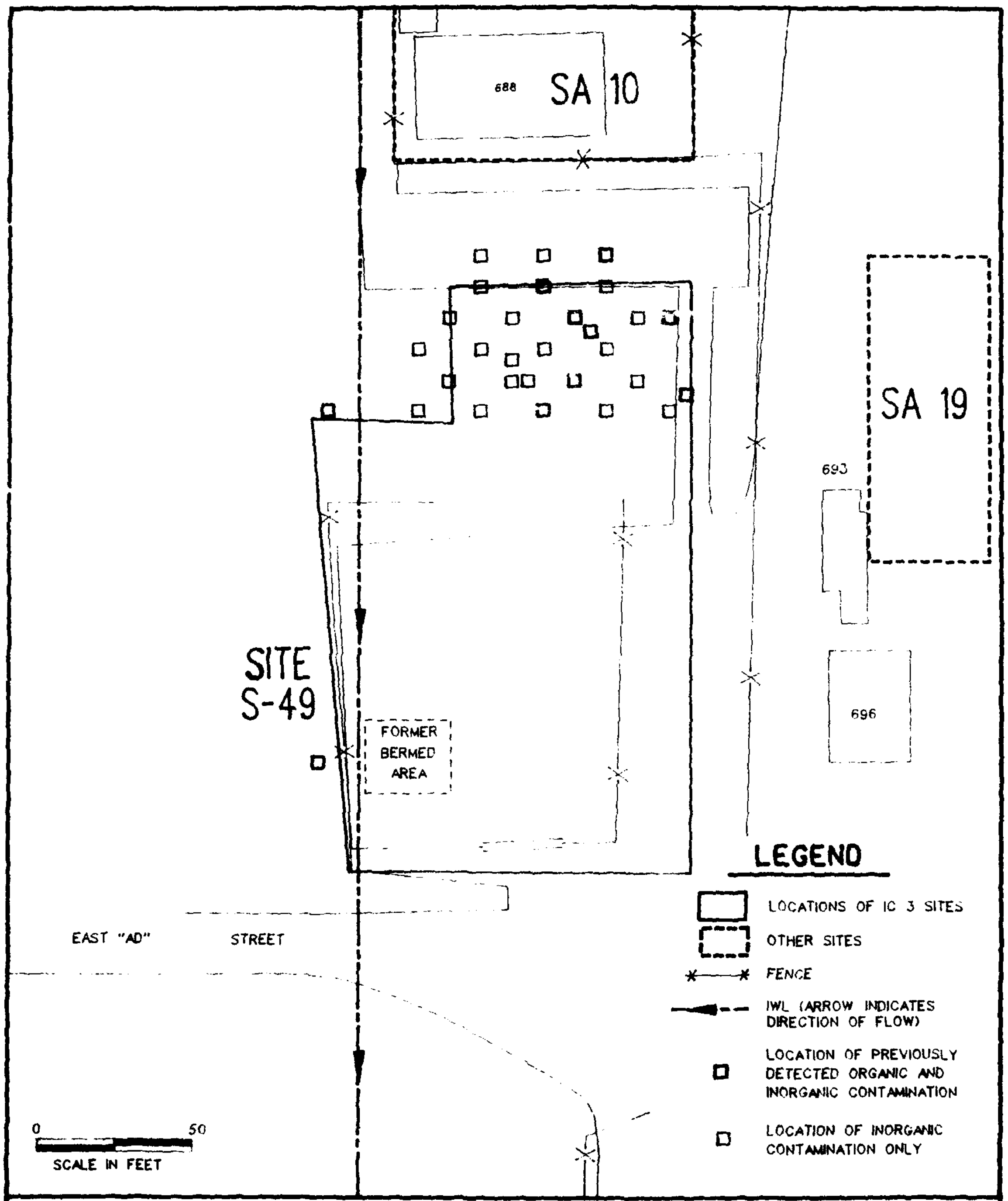

Figure 3.3-2. Approximate Locations of Previous Mcclellan EMC Borings at Site S-49.

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organochlorine pesticides, and volatile organic compounds were detected (McClellan AFB EMC, 1990b). As a result, approximately 190 cubic yards of contaminated soil were removed from the facility and disposed of at a Class I landfill.

A soil gas investigation of IC 3 was conducted by Radian Corporation in 1990 as part of the OU B Soil Gas Investigation. Thirty soil gas probes were placed and sampled for the soil gas investigation of IC 3. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 8 of these 30 probes at concentrations that exceeded the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the 30 probes, ranged from 1.4 to 439 ppbv. The total AVOC concentration, detected in 1 of the 30 probes, was 265 ppbv. Total UVOC concentrations, detected in 2 of the 30 probes, were 353 and 2,291 ppbv.

Results of the soil gas investigation at IC 3 indicate two areas of soil gas contamination which represent targets for the placement of soil borings and are depicted in Figure 3.3-1. The HVOC target is the largest in areal extent and contains chloroform/1,1,1-TCA and PCE concentrations above 100 ppbv. A UVOC target with greater than 1,000 ppbv total UVOCs also exists at IC 3.

3.3.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 3 is to determine the presence of VOC or other contamination in the area. A total of 37 reconnaissance borings, 2 deep borings, 8 hand auger borings, and 19 soil gas probes will be placed at IC 3 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Site S-49

Reconnaissance Borings. Nine reconnaissance borings (B1 through B9) will be located in a triangular grid within the boundary of Site S-49. Locations within the grid will be spaced at 50-foot intervals to determine the presence of soil contamination. Boring B7 will be located in the former bermed area near which contamination was previously detected. Samples will be collected to a minimum depth of 20 feet BGS.

Deep Boring. One deep boring (B10) will be placed at Site S-49 to confirm the presence of previously detected contamination and to characterize subsurface lithologic conditions that would affect contaminant migration. Samples will be collected to a depth of 95 feet BGS.

Contaminants of concern in soils at Site S-49 are metals, arsenic, mercury, volatile and extractable petroleum hydrocarbons, pesticides, herbicides, VOCs, and semivolatile organic compounds. Table 3.3-2 presents DQOs for the potential surface discharge area at Site S-49.

PRL L-5E

Soil Gas Investigation. The section of the IWL in IC 3, PRL L-5E, was not pressure tested or visually inspected for leakage or breakage. Therefore, 19 soil gas probes (P1 through P19) will initially be placed at 50-foot intervals parallel to the IWL in IC 3 to determine if contaminants are present in soil gas. "Stepout" probes will be sampled at locations parallel to the IWL and 25 feet from initial sample locations with total VOC concentrations of 100 ppbv or greater as a result of leakage from PRL L-5E. The section of the IWL extending to Building 692 in OU C will also be investigated. After the initial and stepout probes are sampled, reconnaissance or deep soil borings will be placed along the IWL to determine if VOCs are present on soil particles. Table 3.3-3 presents DQOs for locations of potential IWL leakage at PRL L-5E.

SA 3

Reconnaissance Borings. Two reconnaissance borings (B11 and B12) will be placed in areas where washwater would potentially drain from the washrack and penetrate the soils at SA 3 (Figure 3.3-1). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.3-4 presents DQOs for the washrack at SA 3.

TABLE 3.3-2. DQOs FOR THE POTENTIAL SURFACE DISCHARGE AREA AT SITE S-49

Objective:	To determine the presence of contamination potentially resulting from surface spillage.
Source Description:	
Source Type:	Nonuniform surface spill
Area of Characterization:	15,000 square feet
Approximate Years of Operation:	1970s - present
Phase:	1
Media to be Samples:	Soil/soil gas
Contaminants of Concern:	Metals, arsenic, mercury, volatile and extractable petroleum hydrocarbons, pesticides, herbicides, VOCs, semivolatile organic compounds
Sampling Methodology:	
Lateral Spacing Basis:	Triangular grid with a 50-foot spacing
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 688
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B1: 55′ S, 35′ E
	B2: 80′ S, 15′ W
	B3: 105′ S, 35′ E
	B4: 130′ S, 15′ W
	B5: 130′ S, 75′ E
	B6: 155′ S, 35′ E
	B7: 190′ S, 15′ W
	B8: 180′ S, 75′ E
	B9: 210′ S, 35′ E
Total Number of Locations:	9
Analytical Methods:	SW6010, SW7060, SW7471, SW8015/3550, SW8080, SW8140, SW8150, SW8270, FVOC, FGC
Deep Boring Location and Depth:	**B10: 80′ S, 75′ E (95 feet BGS)**
Total Number of Locations:	**1**
Analytical Methods:	**SW6010, SW7060, SW7471, SW8015/3550, SW8080, SW8140, SW8150, SW8270, FVOC, FGC**

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-3. DQOs FOR THE LOCATIONS OF POTENTIAL IWL LEAKAGE AT PRL L-5E

Objective:	To determine the presence of soil gas contamination resulting from potential leakage of the IWL.	
Source Description		
Source Type:	Underground pipeline	
Area of Characterization:	900 linear feet	
Phase:	1	
Medium to be Sampled:	Soil gas	
Contaminants of Concern:	VOCs	
Sampling Methodology		
Lateral Spacing Basis:	Locations adjacent to suspected source areas	
Drilling Method:	Soil gas probe driver	
Probe Locations and Depths:	(All probes to a depth of 4 - 6 feet BGS)	
	P1 to P5:	At 50-foot intervals beginning at a point 55´ N, 85´ E of the northeast corner of Building 688
	P6 to P19:	At 50-foot intervals beginning at a point 250´ S, 20´ W of the southwest corner of Building 688.
Total Number of Locations:	19	
Analytical Methods:	FGC	

FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-4. DQOs FOR THE WASHRACK AT SA 3

Objective:	To determine the presence of contamination potentially resulting from leakage of the washrack.
Source Description	
Source Type:	Nonuniform surface spill
Area of Characterization:	2,160 square feet
Approximate Years of Operation:	1966-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placement at locations of potential contamination
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Locations and Depths:	B11: Southwest corner of washrack (20 feet BGS) B12: Southeast corner of washrack (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

The industrial waste drain, located adjacent to and north of the washrack at SA 3, will be investigated by placement of two borings (B13 and B14) in locations of potential leakage (Figure 3.3-1). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.3-5 presents DQOs for the drains at SA 3.

Four borings (B15 through B18) will be drilled and sampled in a triangular grid (Figure 3.3-1) because washwater from the washrack has historically overflowed into this area. Locations within the grid will be spaced at 50-foot intervals. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.3-6 presents DQOs for the contaminated soil area north of the washrack at SA 3.

Deep Boring. One deep boring (B19) will be placed adjacent to the industrial waste drain sump at SA 3 to assess contamination resulting from potential leakage of the sump. Samples in this boring will be collected to a depth of 95 feet BGS to confirm the presence of contamination and to characterize subsurface lithologic conditions that would affect contaminant migration. Contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.3-7 presents DQOs for the sump at SA 3.

SA 10

Reconnaissance Boring. One reconnaissance boring (B20) will be drilled adjacent to the sump to determine if pesticides or other contaminants have entered the soils as a result of leakage from the sump (Figure 3.3-1). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, arsenic, mercury, pesticides, herbicides, volatile organic compounds, and semivolatile organic compounds. Table 3.3-8 presents the DQOs for the underground sump at SA 10.

TABLE 3.3-5. DQOs FOR THE DRAIN LINE AT SA 3

Objective:	To determine the presence of contamination resulting from leakage of the drain at the washrack.
Source Description	
Source Type:	Underground trench
Area of Characterization:	600 square feet
Approximate Years of Operation:	1966-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placement at locations of potential leakage
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of asphalt washrack
Reconnaissance Boring Locations and Depths:	B13: At reference point (20 feet BGS) B14: At northeast corner of asphalt washrack (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-6. DQOs FOR THE SOIL AREA NORTH OF THE WASHRACK AT SA 3

Objective:	To determine the presence of contamination potentially resulting from surface spillage from the washrack.
Source Description	
Source Type:	Uniform spill area
Area of Characterization:	22,278 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placement at areas of likely contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of asphalt washrack
Reconnaissance Boring Locations and Depths:	B15: 5′ N, 115′ W (20 feet BGS)
	B16: 60′ N, 25′ W (20 feet BGS)
	B17: 60′ N, 75′ W (20 feet BGS)
	B18: 60′ N, 125′ W (20 feet BGS)
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-7. DQOs FOR THE SUMP AT SA 3

Objective:	To determine the presence of contamination resulting from leakage of the sump at the washrack.
Source Description	
Source Type:	Underground sump
Area of Characterization:	600 square feet
Approximate Years of Operation:	1966-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of 1 boring placed at sumps
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of asphalt washrack
Deep Boring Location and Depth:	B19: 25' E (95 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-8. DQOs FOR THE UNDERGROUND SUMP AT SA 10

Objective:	To determine the presence of contamination potentially resulting from leakage of the sump.
Source Description	
Source Type:	Underground sump
Area of Characterization:	30 square feet
Approximate Years of Operation:	1980-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, arsenic, mercury, pesticides, herbicides, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of 1 boring placed at each sump
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Location and Depth:	B20: Adjacent to south side of sump (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW7060, SW7471, SW8080, SW8140, SW8150, SW8270, FVOC. FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

SA 17

Reconnaissance Borings. Four reconnaissance borings (B21 through B24) will be placed at SA 17 in a triangular grid to determine the presence contamination potentially caused by leaking oil drums (Figure 3.3-1). The borings will be placed in 35-foot intervals to assure areal coverage of SA 17. Samples will be collected to a minimum depth of 20 feet BGS.

Hand Auger Borings. Four hand auger borings (H1 through H4) will be placed at SA 17. The hand augers borings will be placed at the perimeter of the paved area at SA 17 in addition to the reconnaissance borings within the paved area due to the potential for runoff from the paved area. Samples will be collected to a minimum depth of 5 feet BGS.

Contaminants of concern at the soils at SA 17 include volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.3-9 presents DQOs for the potential surface discharge area at SA 17.

SA 19

Reconnaissance Borings. Four reconnaissance borings (B25 through B28) will be placed in a triangular grid at SA 19 to investigate possible contamination from historical activities at Building 690 and the presence of a discolored surface south of the building (Figure 3.3-1). The borings will be placed in 35-foot intervals to assure areal coverage of SA 19. Samples will be collected to a minimum depth of 20 feet BGS.

Hand Auger Borings. Four hand auger borings (H5 through H8) will be placed at SA 19. These hand auger borings will be placed at the perimeter of the paved area at SA 19 in addition to the reconnaissance borings within the paved area due to the potential for runoff from the paved area. Samples will be collected to a depth of 5 feet BGS.

Contaminants of concern at the soils at SA 19 include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.3-10 presents DQOs for the possible discharge area at SA 19.

TABLE 3.3-9. DQOS FOR THE POTENTIAL SURFACE DISCHARGE AREA AT SA 17

Objective:	To determine if the presence of contamination resulting from potential surface discharge.
Source Description	
Source Type:	Uniform surface spill
Area of Characterization:	3,600 square feet
Approximate Years of Operation:	1955 - 1974
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid with a 35-foot spacing
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 693
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B21: 115' N, 125' E B22: 105' N, 160' E B23: 80' N, 135' E B24: 65' N, 175' E
Total Number of Locations:	4
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC
Hand Auger Boring Locations and Depths:	(All borings to a depth of 5 feet BGS) H1: 130' N, 150' E H2: 90' N, 185' E H3: 55' N, 150' E H4: 90' N, 110' E
Total Number of Locations:	4
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-10. DQOs FOR THE POSSIBLE DISCHARGE AREA AT SA 19

Objective:	To determine the presence of contamination potentially resulting from surface discharge.
Source Description	
Source Type:	Uniform surface spill
Area of Characterization:	4,000 square feet
Approximate Years of Operation:	1951-1974
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid with a 35-foot spacing
Drilling Methodology:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 693
Reconnaissance Boring Location and Depths:	(All borings to a depth of 20 feet BGS)
	B25: 70' N, 25' E
	B26: 40' N, 35' E
	B27: 15' N, 25' E
	B28: 20' S, 10' E
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC
Hand Auger Boring Locations and Depths:	(All borings to a depth of 5 feet BGS)
	H5: 80' N, 25' E
	H6: 30' N, 50' E
	H7: 30' S, 25' E
	H8: 30' N, 10' W
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

IC 3 Areal Borings

Reconnaissance Borings. Eleven reconnaissance borings (B29 through B39) will be located in a triangular grid within IC 3 (Figure 3.3-1). Locations within the grid will be spaced at 50-foot intervals within soil gas target areas. Outside of soil gas target areas, spacing between borings will be approximately 100 feet. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at these locations include metals, arsenic, mercury, pesticides, herbicides, VOCs, and semivolatile organic compounds. Table 3.3-11 presents DQOs for the areal borings at IC 3.

Table 3.3-12 presents the sampling and analysis matrix for all sampling locations at IC 3.

TABLE 3.3-11. DQOs FOR THE AREAL BORINGS AT IC 3

Objective:	To determine if volatile organic and other contamination is present in soils at IC 3.
Source Description	
Source Type:	Undetermined, as indicated by soil gas
Area of Characterization:	60,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, arsenic, mercury, pesticides, herbicides, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular grids with 50-foot spacing in soil gas target
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 688
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B29: 5′ N, 50′ W
	B30: 30′ N, 25′ W
	B31: 40′ S, 30′ W
	B32: 60′ S, 15′ E
Total Number of Locations:	4
Analytical Methods:	SW6010, SW7060, SW7471, SW8080, SW8140, SW8150, SW8270, FVOC, FGC
Reference Point:	Northeast corner of asphalt washrack
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B33: 85′ S, 15′ W
	B34: 50′ S, 35′ E
	B35: 20′ S, 160′ E
	B36: 100′ S, 65′ E
	B37: 175′ S, 115′ E
	B38: 210′ S, 15′ W
	B39: 50′ N, 80′ W
Total Number of Locations:	7
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.3-12. SAMPLING AND ANALYSIS MATRIX FOR IC 3

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval					
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B1-B9[b]	Reconnaissance Borings B20[c] B29-B32[d]	Deep Boring B10[b]	Reconnaissance Borings B11-B18[e,f,g] B25-B28[h] B33-B39[d]	Deep Boring B19[i]	Reconnaissance Borings B7-B23[g] B21-B24
0 - 20	1[i]	SW6010 SW7060 SW7471 SW8015/3550 SW8080 SW8140 SW8150 SW8270 FVOC	SW6010 SW7060 SW7471 SW8080 SW8140 SW8150 SW8270 FVOC	SW6010 SW7060 SW7471 SW8015/3550 SW8080 SW8140 SW8150 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC
0 - 20	2	SW6010 SW7060 SW7471 SW8015/3550 SW8080 SW8140 SW8150 SW8270 FVOC	SW6010 SW7060 SW7471 SW8080 SW8140 SW8150 SW8270 FVOC	SW6010 SW7060 SW7471 SW8015/3550 SW8080 SW8140 SW8150 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC
0 - 20	3	SW8015/3550 FVOC FGC	FVOC FGC	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC
20 - 95	4	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS
20 - 95	5	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS
20- 95	6	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS
20- 95	7	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS

(Continued)

TABLE 3.3-12. (Continued)

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval		
Depth Interval (ft. BGS)	Sample Horizons[a]	Hand Auger Borings H1-H4[j]	Hand Auger Borings H5-H8[h]	Probes P1-P19[k]
0 - 20	1[l]	SW8015/3550 SW8270 FVOC FGC	SW6010 SW8015/3550 SW8270 FVOC FGC	FGC
0 - 20	2	NS	NS	NS
0 - 20	3	NS	NS	NS
20 - 95	4	NS	NS	NS
20 - 95	5	NS	NS	NS
20 - 95	6	NS	NS	NS
20 - 95	7	NS	NS	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for the potential surface discharge area at Site S-49.

[c] Boring location for the underground sump at SA 10.

[d] Locations for the areal borings at IC 3.

[e] Boring locations for the washrack at SA 3.

[f] Boring locations for the drain line at SA 3.

[g] Boring locations for the soil area north of the washrack at SA 3.

[h] Boring locations for the possible discharge area at SA 19.

[i] Boring location for the sump at SA 3.

[j] Boring locations for the potential surface discharge area at SA 17.

[k] Soil gas probe locations along PRL L-5E (4 to 6 feet).

[l] Collect first sample for nonvolatile analyses between 0 and 3 inches for hand auger samples. Collect samples for volatile analyses between 1 and 5 feet BGS.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues below depth of previous sample.

3.4 Investigation Cluster 4 (Site 30, Southern Section of PRL L-6, and SA 2)

Investigation Cluster 4 consists of Site 30, the southern section of PRL L-6, and SA 2, and is located south of the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 4. Although each of these three sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

3.4.1 Site Descriptions

Site 30

Site 30 is a chemical storage area located directly east of Building 628 (Figure 3.4-1), and was used by the 1155th Technical Squadron for storage and disposal of chemicals used in gas, applied-physics, and radiation analyses. Site 30 continues to be used as a chemical storage facility for other base operations. Buildings 629 and 631, located within Site 30 (Figure 3.4-1), are currently used for hazardous materials, paint, and compressed gas storage.

The western side of Site 30 has been paved with asphalt and concrete (Figure 3.4-1) since at least 1960. Soil with little vegetative cover is exposed east of the chain-linked fence around Building 629 except along the course of a concrete-lined drainage canal. A parking lot was constructed to the east of Site 30 in 1991, covering up railroad tracks and a small drainage ditch.

Historical practices or operations in three areas may have caused contamination at Site 30. One of these areas is located between Buildings 628 and 629 (Figure 3.4-1), where approximately 100 gallons per year of TCE were discharged in 1960 and 1961 and 2 gallons per year of TCE were discharged between 1961 and 1975 to the paved surface. Five gallons per year of radioactive washwater were also discharged in this area. An underground fuel tank, which exists beneath the paved area between Buildings 628 and 629, is another potential source of contamination. The 500-gallon tank contained #2 diesel fuel, which may have leaked into the soil.

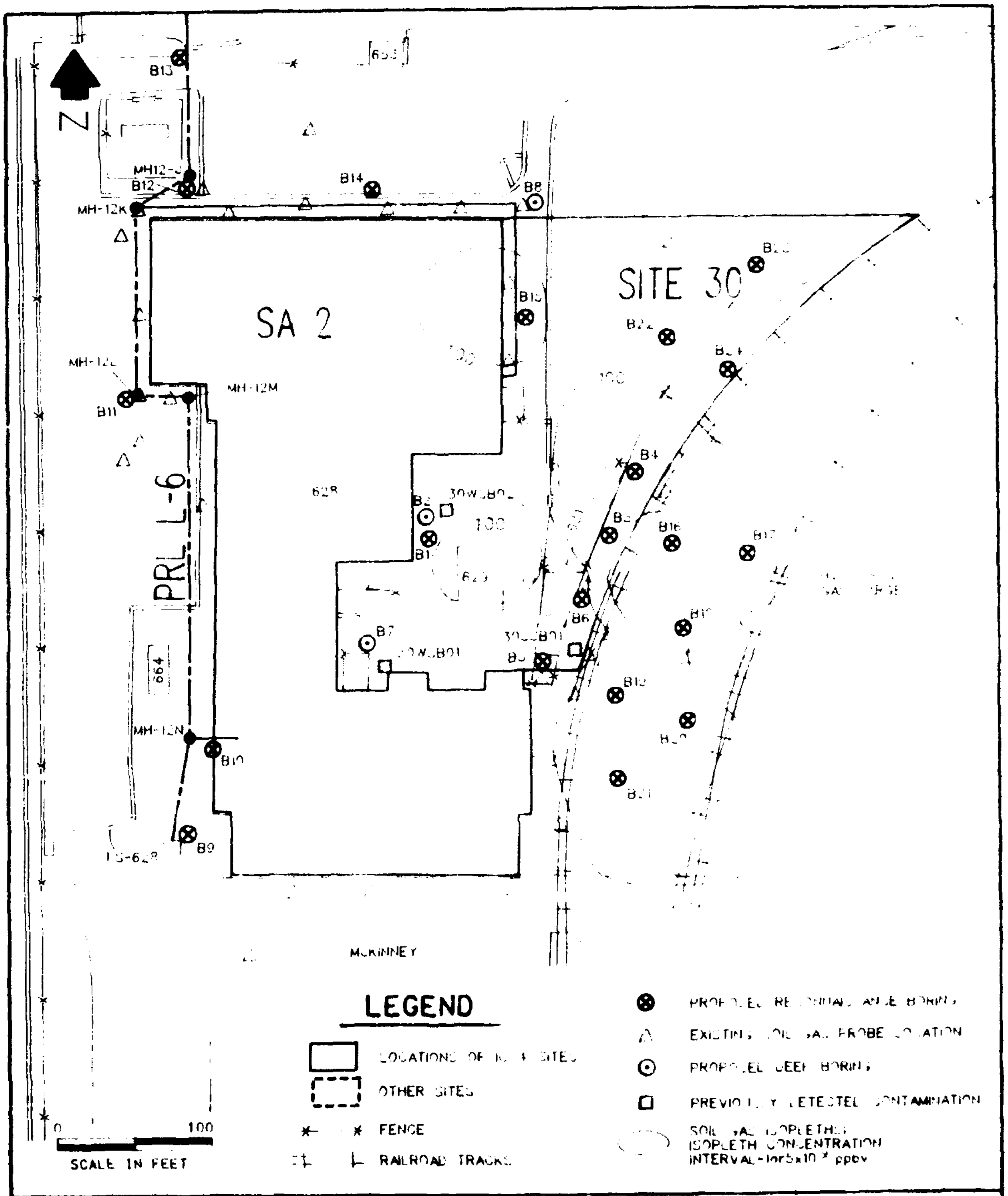

Figure 3.4-1. Site Features and Soil Boring Locations at IC 4 (Site 30, Southern Section of PRL L-6, and SA 2).

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A second area of potential contamination in soil at Site 30 is a paved low-level waste storage or staging area located east of Building 628, next to the former location of railroad tracks (Figure 3.4-1). Contaminated paper, glassware, and gloves stored in sealed and labeled 55-gallon drums were placed at the staging area from 1981 to 1988.

An unpaved surface spill area located between the staging area and the former railroad tracks is a third area of potential contamination (Figure 3.4-1). Surface disposal of approximately 100 gallons per year of Freon® (1960 to 1980) and 2 quarts per year of ethyl ether (1976 to 1979) occurred in this area.

An unpaved surface storage area located at the lower northeast corner of Building 628 is a fourth area of potential contamination (Figure 3.4-1). Radionuclides were detected in the surface soil in the storage area. Approximately 6 inches to 1 foot of soil were removed from the storage area in 1990. Nothing was found in the soils. Radiation was detected around one fence post, which was also removed.

Southern Section of PRL L-6

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater moves through the IWL by gravity flow assisted by lift stations. Lift stations increase wastewater flow velocity by raising the elevation of the wastewater in the pipes. The IWL at the southern part of PRL L-6 is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-6 has a length of approximately 1,910 feet paralleling Kilzer Avenue in the southwestern portion of OU B at McClellan AFB. A branch of PRL L-6 extends east along the north end of SA 2 and turns south into the northeastern corner of Site 30. Figure 3.4-1 shows the surface trace of PRL L-6, locations of access covers and lift stations, and soil gas probe locations. The piping system is constructed of six-inch vitrified clay pipe, but 6-inch asbestos-concrete and cast iron pipes are also present in some sections of PRL L-6. The IWL at PRL L-6 received wastewater from Building 628 and from the washrack at Building 652 since 1957. The washrack at Building 652 was used for washing and steam cleaning air conditioners. As a result of historical operations at the two facilities, acids, bases, metals, radionuclides, solvents, unspecified volatile and semivolatile organic compounds, and phenols may have passed through the IWL at PRL L-6.

Study Area 2

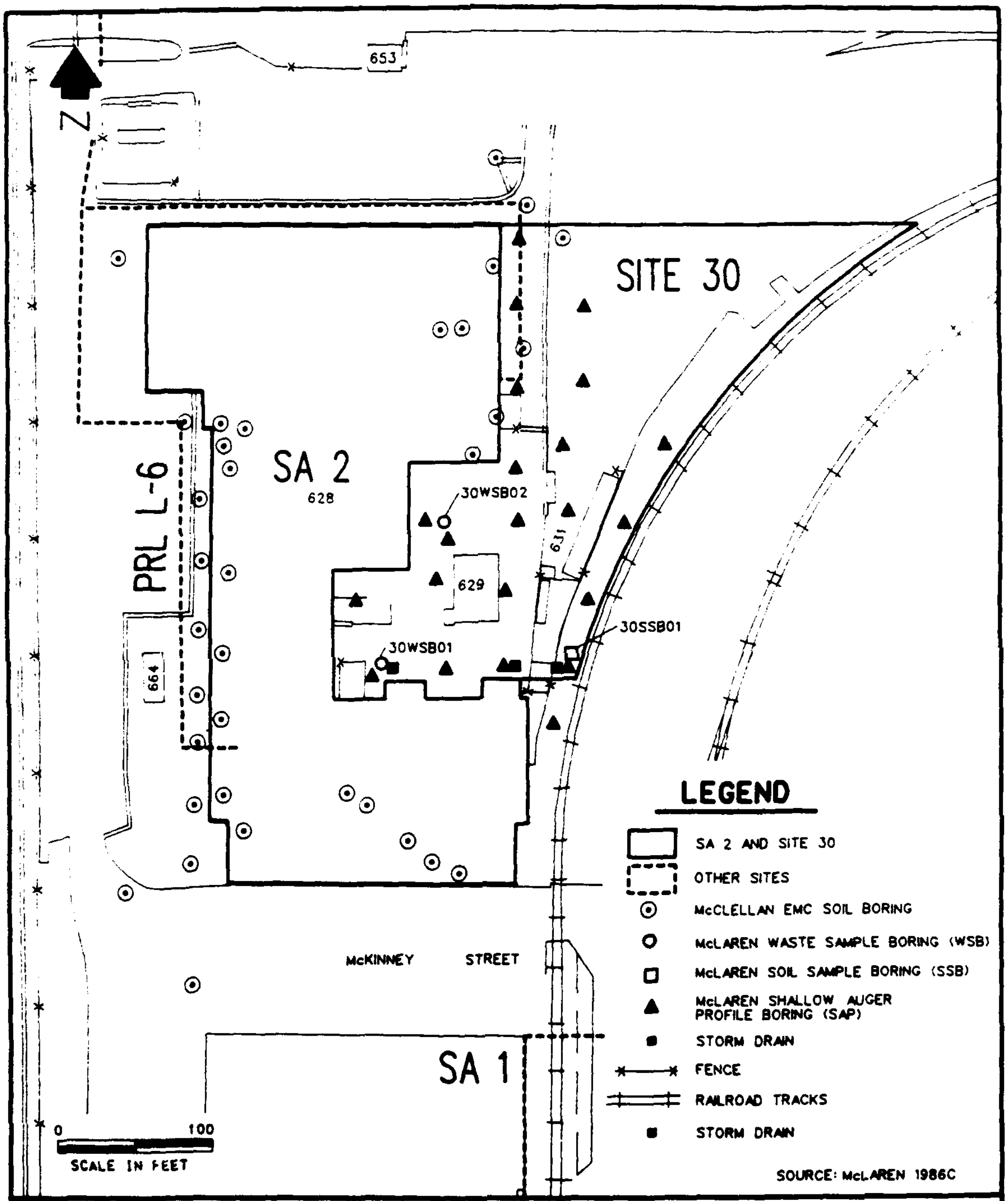
Study Area 2 consists of Building 628 and is located between the southern part of PRL L-6 and Site 30 (Figure 3.4-1). The 1155th Technical Squadron Central Laboratory reportedly performed gas analyses, applied physics-related analyses, and radiation analyses in Building 628 from 1959 to 1988. Many hazardous compounds, including radioactive materials, were handled in Building 628.

Laboratory research within Building 628 was terminated in August 1988. The building is currently unused with the exception of one room that is used for equipment storage (Paisley, personal communication, 1989). Building 628 is being decommissioned as a laboratory and is expected to be converted to an office facility in 1991. Potential sources of contamination at SA 2, which were previously described in the OU B Preliminary Assessment Summary Report (Radian, 1990a), were the laboratory and other operations within Building 628. Because a McClellan AFB EMC investigation of Building 628 described below indicated that the soil did not present significant impact to public health or the environment, the building is no longer considered a contaminant source. Therefore, the investigation of IC 4 is focused on Site 30 and the southern section of PRL L-6.

3.4.2 Previous Investigations

Four source investigations were performed within the boundaries of IC 4. A McLaren Environmental Engineering, Inc. soil investigation in 1985, an EG&G Idaho, Inc. investigation of the IWL in 1988, a soil investigation performed in mid-1990 as part of the decommissioning process of Building 628, and a soil gas investigation performed in 1990 by Radian.

Twenty-five borings were drilled by McLaren in 1985 at Site 30 (Figure 3.4-2). Soil samples were collected from Borings 30SSB01, 30WSB01, and 30WSB02 and included chemical and physical characterization of soil as well as qualitative characterization of soil gas in the area. Results from this investigation are discussed in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Six VOCs were detected from 24 to 60 feet BGS. Bis(2-ethylhexyl)phthalate, a semivolatile organic compound and common laboratory contaminant, was identified in one sample. Oil and grease were detected at concentrations ranging from 140 to 930 mg/kg.



SOURCE: McLAREN 1986C

Figure 3.4-2. Previous Boring Locations for SA 2 and Site 30.

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In 1988, EG&G tested the integrity of the IWL at PRL L-6. During the investigation, access ways were cleaned, the pipe segments were observed, either by direct or remote inspection, and pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through the pipes. Two pipeline segments were found to be incompatible with the type of wastewater flowing through them. The proposed soil sampling locations and analytical methods are based on evidence found during the EG&G investigation.

The second soil investigation was performed in mid-1990 as a part of the decommissioning process of Building 628. One hundred-sixty soil samples from 39 borings (Figure 3.4-2) were collected as described in the Soil Management Decision Document for Decommissioning B/628 (McClellan AFB EMC, 1990a). Fifty of the 160 samples were selected and analyzed for pH, halogenated hydrocarbons, aromatics, semivolatile organic compounds, metals, and perchlorates. Results of the analyses indicated trace amounts of laboratory contaminants [bis(2-ethylhexyl)phthalate and butyl benzyl phthalate], as well as toluene and perchlorates. The pH of the samples ranged from 6.47 and 9.32. The McClellan AFB report (1990a) concludes that "the soil below or adjacent to Building 628, using surface swipe samples, does not present a significant impact to public health or the environment." Therefore, the investigation of IC 4 will focus on Site 30 and the southern section of PRL L-6. A preliminary survey of the Building 628 area, using surface swipe samples, was also performed to determine radiological contamination (McAlister, personal communication, 1990).

A soil gas investigation of IC 4 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Forty-two soil gas probes were installed and sampled during the soil gas investigation of IC 4. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 5 of the 42 probes at concentrations that exceeded the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the 42 probes, ranged from 3.0 to 5,100 ppbv. Total AVOC concentrations, detected in 2 of the 42 probes, were both 286 ppbv. Total UVOC concentrations, detected in 3 of the 42 probes, ranged from 5.6 to 57.6 ppbv. Results of the soil gas investigation of IC 4 indicate that three areas exceeded the criteria for soil gas targets (Appendix A). One target had a soil gas concentration exceeding 1,000 ppbv total HVOCs.

In 1991, a geophysical investigation of the underground storage tank (UST) at Site 30 was conducted using magnetics and ground penetrating radar (Radian, 1991). The location of the UST was determined using both methods. In addition, a pipe that appears to be the fill pipe for the tank was found near the anomalies. The tank is located approximately 20 feet north and 6 feet west of the northwest corner of Building 629.

3.4.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 4 is to determine the presence of VOC or other contamination in the area. A total of 21 reconnaissance and 3 deep borings will be placed at IC 4 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Site 30

Reconnaissance and Deep Borings. One reconnaissance boring (B1) and one deep boring (B2) will be drilled adjacent to the UST located between Buildings 628 and 629. The borings are also located in a surface spill area where solvents were spilled onto the pavement. Boring B1 will be drilled (at the southern end of the UST) to a minimum depth of 20 feet BGS. The exact location of the tank was located using a magnetometer and ground penetrating radar. Boring B2 will be drilled to 95 feet BGS because contamination was detected at 60 feet BGS in a previous contractor boring (30WSB02). The contaminants of concern include metals, VOCs, semivolatile organic compounds, radionuclides, and volatile and extractable petroleum hydrocarbons. Table 3.4-1 lists the DQOs for the UST at Site 30.

One reconnaissance boring (B3) will be drilled and sampled to a minimum depth of 20 feet BGS in a surface storage area where low-level radioactive soil contamination was detected. The contaminants of concern include metals, VOCs,

TABLE 3.4-1. DQOs FOR THE UNDERGROUND STORAGE TANK AT SITE 30

Objective:	To determine if soil adjacent to or beneath the underground storage tank is contaminated.
Source Description	
Source Type:	Potential leaks form underground storage tank
Area of Characterization:	225 square feet
Approximate Years of Operation:	1959 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, radionuclides, volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to ends of tank and previously detected contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 629
Reconnaissance Boring Location and Depth:	B1: 10' N, 15' W (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW9310, U.S. EPA 901.1, SW8015/3550, SW8015/5030, FVOC, FGC
Deep Boring Location and Depth:	B2: 25' N, 25' W (95 ft. BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW9310, U.S. EPA 901.1, SW8015/3550, SW8015/5030, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

semivolatile organic compounds, and radionuclides. Table 3.4-2 lists the DQOs for the surface storage area at Site 30.

Three reconnaissance borings (B4 through B6) will be drilled to a minimum depth of 20 feet BGS to investigate potential contamination resulting from the former staging area and from the former area of Freon® and ethyl ether disposal. These borings are located along the unpaved area adjacent to the drainage ditch, where runoff from the staging area may have penetrated the soil and where the chemicals were reportedly discharged (Figure 3.4-1). The contaminants of concern include metals, VOCs, semivolatile organic compounds, and radionuclides. In addition, volatile and extractable petroleum hydrocarbons are contaminants of concern for Boring B5. Table 3.4-3 lists the DQOs for the former staging and surface spill area at Site 30.

Deep Borings. Two deep borings (B7 and B8) will be drilled to 95 feet BGS at Site 30. Samples will be collected in the borings to confirm the presence of contamination and to characterize subsurface lithologic conditions that would affect contaminant migration. The contaminants of concern include metals, VOCs, semivolatile organic compounds, and radionuclides. Table 3.4-4 lists the DQOs for previously detected soil contamination at Site 30.

PRL L-6

Reconnaissance Borings. Seven reconnaissance borings (B9 through B15) will be drilled adjacent to the IWL in the southern section of PRL L-6 to determine if the IWL has leaked and caused soil contamination. Boring B9 is located adjacent to Lift Station 628 and will be drilled and sampled to a minimum depth of 20 feet BGS. Borings B10 through B15 will be drilled and sampled to 20 feet BGS next to pipeline failures (e.g., leaking manholes, cracks, and etching) or along sections of the IWL that were not tested during the EG&G investigation. The contaminants of concern along the IWL include metals, phenols, VOCs, semivolatile organic compounds, acids, bases, and radionuclides. Table 3.4-5 lists the DQOs for locations of IWL breakage in the southern part of PRL L-6.

TABLE 3.4-2. DQOs FOR SURFACE STORAGE AREA AT SITE 30

Objective:	To determine the extent and magnitude of previously detected contamination in the storage area.
Source Description	
Source Type:	Surface spill
Area of Characterization:	350 square feet
Phase:	1
Approximate Years of Operation:	1960 - present
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, radionuclides
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at location of potential contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southeast corner of Building 629
Reconnaissance Boring Location and Depth:	B3: 31′ S, 23′ E (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW9310, U.S. EPA 901.1, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.4-3. DQOs FOR THE FORMER STAGING AND SURFACE SPILL AREA AT SITE 30

Objective:	To determine if contaminants are present in soils as a result of surface discharge and runoff.
Source Description	
Source Type:	Surface spill
Area of Characterization:	10,000 square feet
Phase:	1
Approximate Years of Operation:	1960 - 1971
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, radionuclides, volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at location of potential contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 628
Reconnaissance Boring Locations and Depths:	B4: 165' S, 81' E (20 ft. BGS) B5: 208' S, 69' E (20 ft. BGS) B6: 250' S, 69' E (20 ft. BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8270, SW9310, U.S. EPA 901.1, SW8015/3550, SW8015/5030, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.4-4. DQOs FOR PREVIOUSLY DETECTED SOIL CONTAMINATION AT SITE 30

Objective:	To determine the extent and magnitude of previously detected contamination at Site 30.
Source Description	
Source Type:	Previously detected soil contamination
Area of Characterization:	150 square feet
Phase:	1
Approximate Years of Operation:	1960 - 1971
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, radionuclides
Sampling Methodology	
Lateral Spacing Basis:	Borings placed at locations of potential contamination
Drilling Method:	Power assisted split spoon sampler
Reference Point:	Northeast corner of Building 628
Reconnaissance Boring Locations and Depths:	B7: 277' S, 88' W (95 ft. BGS)
	B8: 10' N, 20' E (95 ft. BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8270, SW9310, U.S. EPA 901.1, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.4-5. DQOs FOR LOCATIONS OF IWL BREAKAGE IN THE SOUTHERN PART OF PRL L-6

Objective: To determine presence of soil contamination resulting from leaks in the IWL.

Source Description

Source Type: Underground pipeline

Area of Characterization: 850 linear feet

Phase: 1

Approximate Years of Operation: 1957 - present

Media to be Sampled: Soil/soil gas

Contaminants of Concern: Metals, phenols, VOCs, semivolatile organic compounds, acids and bases, radionuclides

Sampling Methodology

Lateral Spacing Basis: Borings placed at pipeline failures or along untested sections of the IWL

Drilling Method: Coring

Reference Point: Northwest corner of Building 628

Reconnaissance Boring Locations and Depths: (All borings to a depth of 20 feet BGS)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B9	396' S, 27' E		Previously untested[b]
B10	342' S, 42' E		Previously untested[b]
B11	115' S, 15' W	31,32	Not pressure tested[c]
B12	20' N, 20' E	28	Not pressure tested[d]
B13	104' N, 20' E	29	Leaking joints[e]
B14	17' N, 138' E		Previously untested[b]
B15	58' S, 240' E		Previously untested[b]

Total Number of Locations: 7

Analytical Methods: SW6010, SW8040, SW8270, SW9045, SW9310, U.S. EPA 901.1, FVOC, FGC

IR = Immediate Report referenced in EG&G (1988).

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3E and 3H

[b] No EG&G ID number

[c] SWP-E-22(A) and 23(A)

[d] SWP-E-23-A

[e] SWP-E-24-A

IC 4 Areal Borings

Reconnaissance Borings. Six reconnaissance borings (B16 through B21) will be drilled to 30 feet BGS to determine the presence of VOC soil contamination indicated by VOC soil gas contamination (Figure 3.4-1). These borings will be located within a triangular grid with 50-foot spacing. Samples will be collected to 30 feet BGS because the area has been recently filled in to make a parking lot. The contaminants of concern are VOCs. Table 3.4-6 lists the DQOs for the areal borings at IC 4.

Three reconnaissance borings (B22 through B24) will be drilled to a minimum of 20 feet BGS to determine if soil contamination is present in the parking area east of Building 628 where soil gas results indicate no VOC contamination. These borings are located within a triangular grid with 50-foot spacing. The contaminants of concern are VOCs. Table 3.4-7 lists the DQOs for the parking lot area at IC 4.

Table 3.4-8 presents the sampling and analysis matrix for all sampling locations at IC 4.

TABLE 3.4-6. DQOs FOR AREAL BORINGS AT IC 4

Objective:	To determine if VOC or other contaminants are present in the soil and to further characterize soil gas contamination.
Source Description	
Source Type:	Soil gas target
Area of Characterization:	35,000 square feet
Phase:	1
Approximate Years of Operation:	Unknown
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid with 50-foot spacing in soil gas target
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 628
Reconnaissance Boring Locations and Depth:	B16: 210′ S, 108′ E (30 ft. BGS[a]) B17: 210′ S, 154′ E (30 ft. BGS[a]) B18: 265′ S, 112′ E (30 ft. BGS[a]) B19: 304′ S, 70′ E (30 ft. BGS[a]) B20: 324′ S, 113′ E (30 ft. BGS[a]) B21: 358′ S, 72′ E (30 ft. BGS[a])
Total Number of Locations:	6
Analytical Methods:	FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

[a] These reconnaissance borings will be sampled at greater than 20 feet because the original surface has been raised to create a parking lot.

TABLE 3.4-7. DQOs FOR PARKING LOT AREA AT IC 4

Objective:	To determine if VOC or other contaminants are present in the soil.
Source Description	
Source Type:	Surface spill
Area of Characterization:	15,000 square feet
Phase:	1
Approximate Years of Operation:	Unknown
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	50-foot triangular grid
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 628
Reconnaissance Boring Locations and Depths:	B22: 75' S, 106' E (20 ft. BGS) B23: 31' S, 161' E (20 ft. BGS) B24: 96' S, 146' E (20 ft. BGS)
Total Number of Locations:	3
Analytical Methods:	FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.4-8. SAMPLING AND ANALYSIS MATRIX FOR IC 4

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval					
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1[b], B5[c]	Deep Boring B2[b]	Reconnaissance Boring B3[d] B4, B6[c]	Deep Borings B7-B8[e]	Reconnaissance Borings B9-B15[f]	Reconnaissance Borings B16-B21[g], B22-B24[h]
0 - 20	1	SW6010 SW8015/3550 SW8015/5030 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8040 SW8270 SW9045 SW9310 U.S. EPA 901.1 FVOC	FVOC
0 - 20	2	SW6010 SW8015/3550 SW8015/5030 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8270 SW9310 U.S. EPA 901.1 FVOC	SW6010 SW8040 SW8270 SW9045 SW9310 U.S. EPA 901.1 FVOC	FVOC
0 - 20	3	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC	FVOC FGC	FVOC FGC	SW8040 SW9045 FVOC FGC	FVOC FGC
20 - 95	4	NS	FVOC FGC	NS	FVOC FGC	NS	NS
20 - 95	5	NS	FVOC FGC	NS	FVOC FGC	NS	NS
20 - 95	6	NS	FVOC FGC	NS	FVOC FGC	NS	NS
20 - 95	7	NS	FVOC FGC	NS	FVOC FGC	NS	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for UST at Site 30.

[c] Boring locations for former staging and surface spill area at Site 30.

[d] Boring location for surface storage area at Site 30.

[e] Boring location for previously detected soil contamination at Site 30.

[f] Borings for locations of IWL breakage in the southern part of PRL L-6.

[g] Areal boring locations at IC 4.

[h] Boring locations for parking lot area at IC 4.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues from 20 feet depth.

3.5 Investigation Cluster 5 (Site 31, PRL 29, PRL P-2, SA 12, SA 13)

Investigation Cluster 5 consists of Site 31, PRL 29, PRL P-2, SA 12, and SA 13, and is located in the western portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 5. Although each of these five sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

3.5.1 Site Descriptions

Site 31

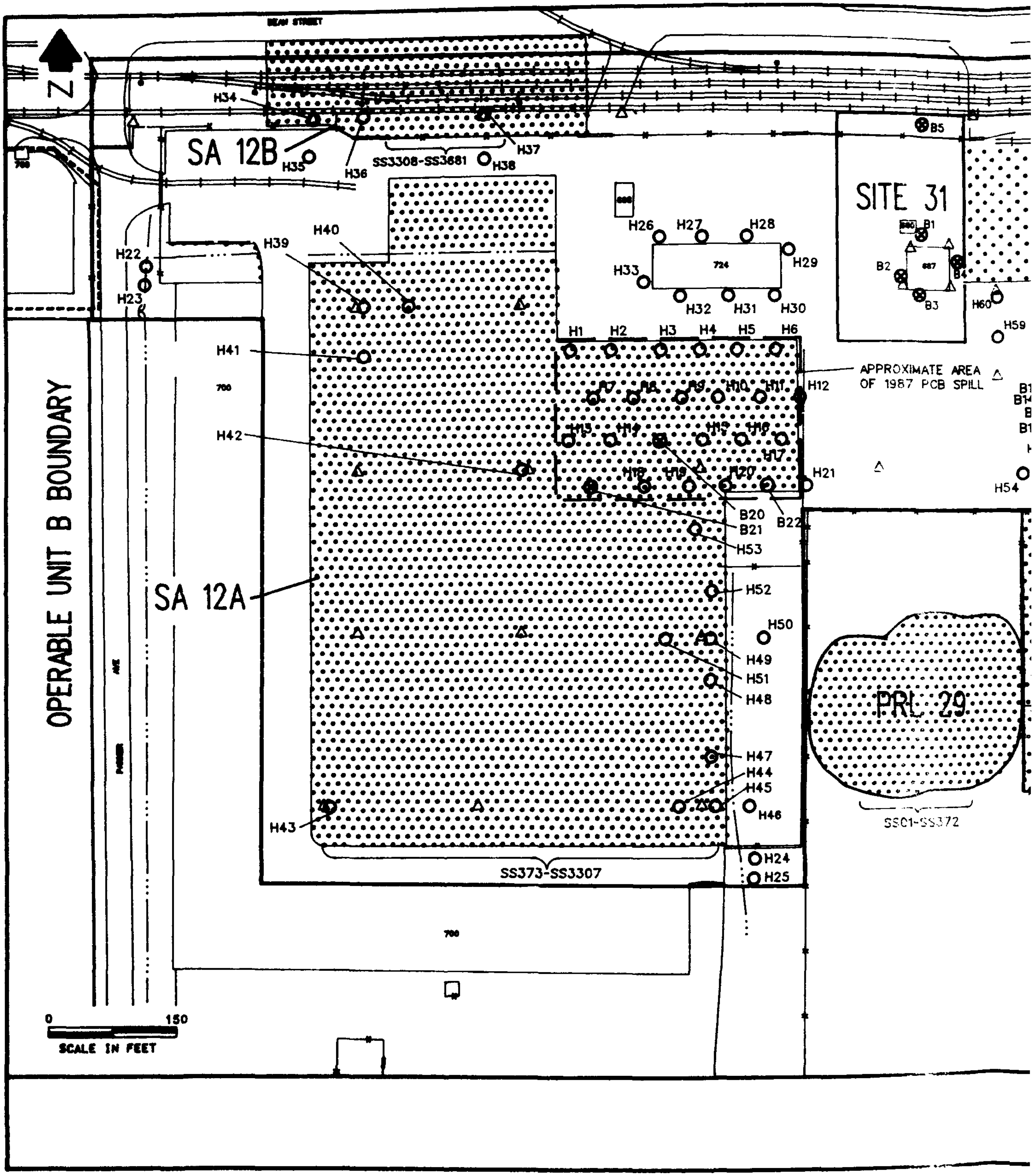
Site 31 is the site of a refuse incinerator that operated between 1963 and 1968. The incinerator was closed in 1968 and dismantled in the early 1970s. Buildings 680 and 687 are within the site boundaries (Figure 3.5-1). Asphalt and concrete cover most of the area.

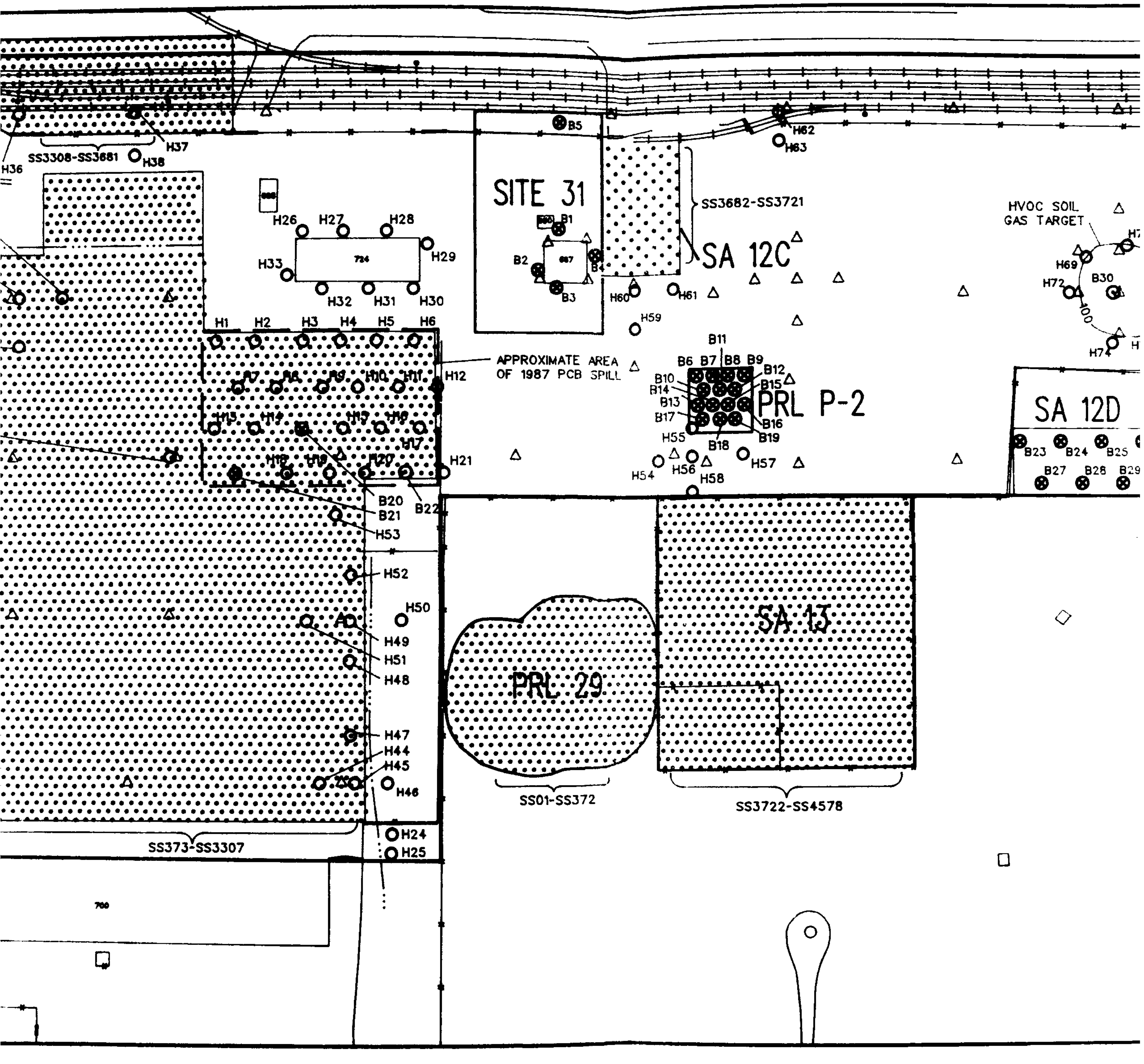
Two potential sources of contamination associated with the incinerator operations have been identified at Site 31. Aerial photographs indicate that refuse was stored in an unpaved area in the southeast corner of the location (Figure 3.5-1) before being placed on a conveyer belt and transferred to the incinerator. Specific materials handled have not been identified but may have consisted of hazardous materials. A second potential source of contamination is the area adjacent to the railroad tracks to the north of Site 31, where ash from the incinerator was reportedly stored (Figure 3.5-1). Polychlorinated biphenyls (PCBs) are suspected contaminants for both sources because of widespread transformer storage in the area adjacent to Site 31.

Potential Release Location 29

Potential Release Location 29 is an area of undeveloped grassland immediately west of the Civil Engineering (CE) Storage Yard. Although the northeast corner of Dean Street and Patrol Road and the area north of the CE Storage Yard have also been identified in previous investigations as possible locations of PRL 29 (Radian,

RADIAN CORPORATION




SITE 31
SA 12C
SA 12D
SA 13
PRL P-2
PRL 29
HVOC SOIL GAS TARGET
APPROXIMATE AREA OF 1987 PCB SPILL
SS3308-SS3681
SS3682-SS3721
SS01-SS372
SS3722-SS4578
SS373-SS3307
724
687
700
H1
H2
H3
H4
H5
H6
H7
H8
H9
H10
H11
H12
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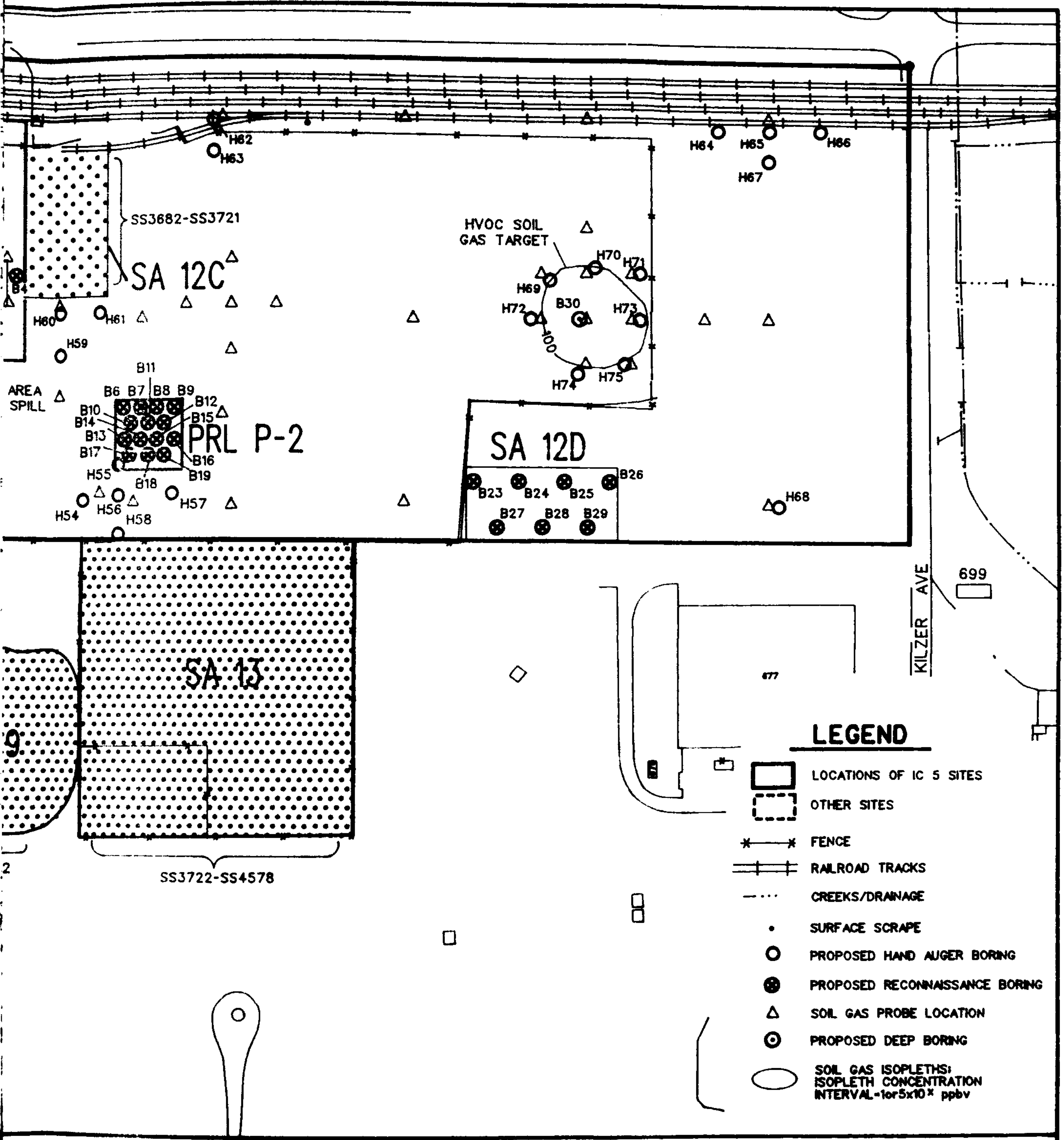


Figure 3.5-1. Site Features and Soil Boring Locations at IC 5 (Site 31, PRL 29, PRL P-2, SA 12, and SA 13).

1990a), this sampling and analysis plan will only focus on the area west of the CE Storage Yard (Figure 3.5-1).

Previous reports identified three possible activities at PRL 29. First, the area may have been used as a scrap material burn pit in the 1950s and 1960s. Aerial photographs give no indication that such a pit existed within the present boundaries of PRL 29 or in any of the other possible locations of PRL 29. Furthermore, base personnel who were interviewed did not recall a scrap material burner located west of the CE Storage Yard. Thus, because no evidence exists that the burn pit was located within the present boundaries of PRL 29, it is not considered a potential contaminant source. Secondly, 50 to 60 aircraft generators were reportedly buried at PRL 29 in 1974. However, they are not considered potential contaminant sources because there is no indication that the generators contained hazardous materials. Thirdly, transformers, which may have leaked oils containing PCBs, were also reportedly stored at PRL 29. Because this area is unpaved, a route for contaminants to directly enter the soil exists. Therefore, leaking transformers are considered the only potential contaminant source at PRL 29.

Potential Release Location P-2

Potential Release Location P-2 is a possible disposal pit located approximately 75 feet north of the CE Storage Yard (Figure 3.5-1). The only sources of information that identify the location are aerial photographs from 1962 through 1968 that show a dark circular area approximately 20 feet in diameter. Because the area may have been used as a waste disposal pit, it is considered a potential source of contamination. However, no information about specific materials handled at the location is available.

Study Area 12

Study Area 12 is located northeast of Building 700 (Figure 3.5-1) and consists of an open storage lot, a transformer loading and unloading area, a transformer oil disposal area, the location of a possible waste pit, and two drainage ditches. Potential Release Locations P-2 and B-1, and Site 31 are located within the boundaries of SA 12. No further action is recommended for PRL B-1.

The open storage lot, designated SA 12A (Figure 3.5-1), is currently used by the Defense Reutilization and Marketing Office (DRMO) for receipt, storage, and resale of usable materials. The western half of the lot has been used for this purpose since it was first developed in the early 1960s. The eastern half of this lot was used primarily as a soil holding area during the 1960s; since the mid-1970s, it has also been used for material storage. Most of the materials stored at this lot are considered nonhazardous except for transformers, which are filled with PCB-containing oils.

In the northeastern portion of SA 12A, Building 724 has historically been the location of metals from scrap. Precious metals were recovered from scrap materials, and capacitors and transformers were separated from scrap piles. Chemicals handled in the building were PCBs, acids, bases, metals, radionuclides, and cyanide solutions.

Transformers with PCB-containing oil were also loaded and unloaded from railroad cars on the tracks in the area designated as SA 12B (Figure 3.5-1), located northwest of the DRMO storage lot. Because PCB-containing oil from the transformers may have leaked onto the unpaved ground surface next to the railroad tracks during movement of the transformers, the soils of SA 12B are also considered a potential source of PCB contamination.

A third potential source of PCB contamination is the area designated as SA 12C, located adjacent to the eastern boundary of Site 31 (Figure 3.5-1). Transformer oil was reportedly discharged onto the ground in this area; therefore, the soils of SA 12C are another potential source of PCB contamination.

Aerial photographs from 1963 to 1965 show approximately five dark stains in the area designated as SA 12D (Figure 3.5-1). The presence of stains in this area in three consecutive annual photographs suggests that activities at this site may have resulted in liquid discharges to the soil. The area may have been used as a waste disposal pit, and therefore, the soils are a potential contaminant source.

Two open drainage ditches within SA 12, which receive runoff from the area, will also be investigated. One ditch carries runoff westward from the Building 724 area across the northern portion of the lot. This ditch has been lined with Gunite® since 1981; before that, it was unlined. A section of this ditch remains unpaved between the open storage lot, SA 12A, and Parker Avenue. The second ditch collects water that runs under the aluminum planking east of Building 700 (Figure 3.5-1).

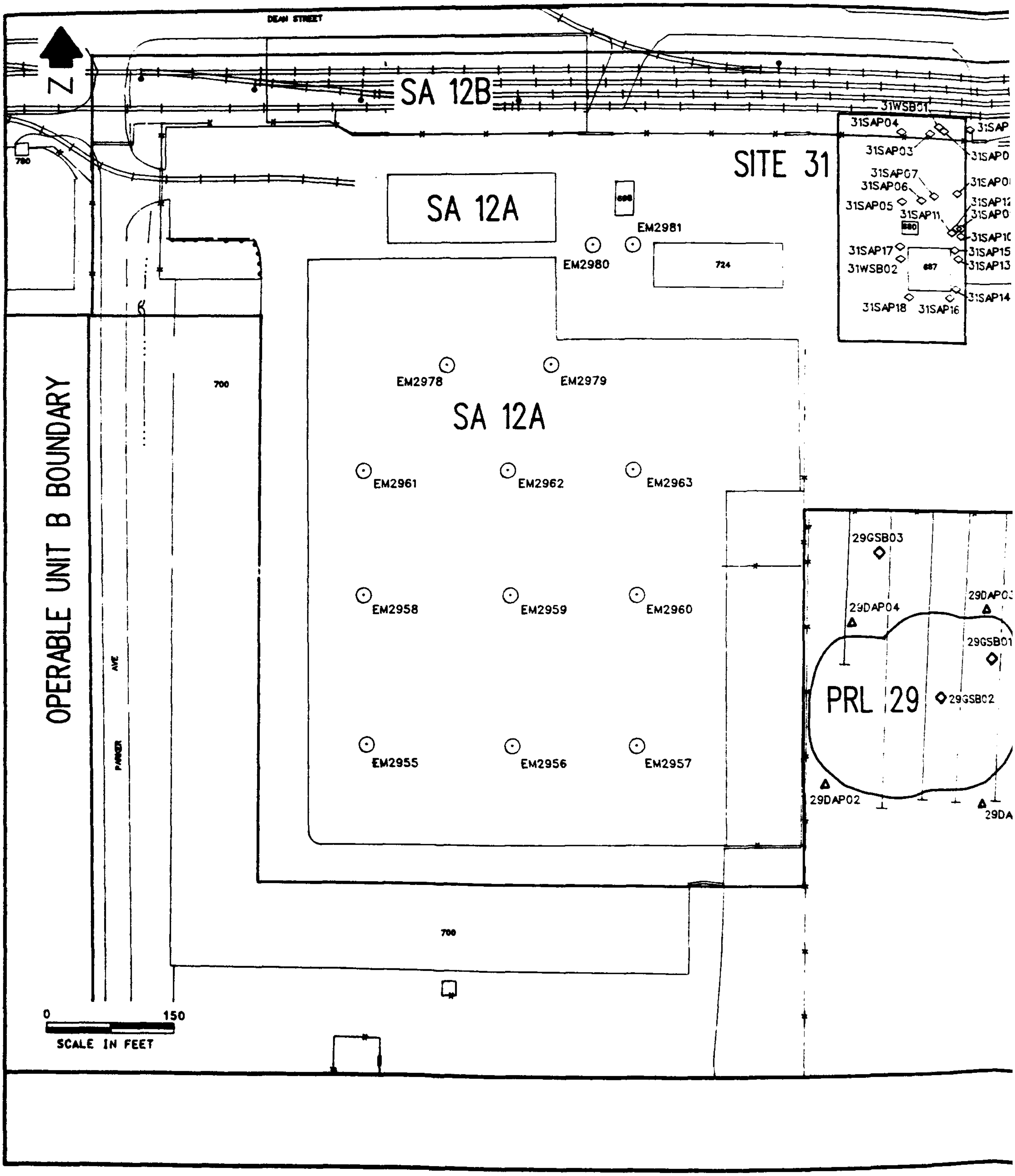
Study Area 13

Study Area 13 is situated in the western section of OU B. The CE Storage Yard has been located at SA 13 since approximately 1962. Prior to that time, the area was undeveloped. The boundary of the study area is delineated by the fence surrounding the storage yard (Figure 3.5-1). Most of the materials now stored at SA 13 are nonhazardous; however, transformers, which may have leaked oils containing PCBs, have reportedly been stored on site. The ground surface of SA 13 was originally unpaved. Presently, most of the yard is covered with asphalt except for a 100-foot by 150-foot section in the southwest corner.

3.5.2 Previous Investigations

Previous investigations of Site 31 included 20 soil borings, drilled, described, and partially sampled by previous investigators in 1985, as summarized in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Discolored soil was noted in Borings 31WSB02, 31SAP15, and 31SAP18 approximately 2 to 3 feet BGS (Figure 3.5-2). Odors were noted in Borings 31SAP17 and 31SAP18 approximately 2 to 3 feet BGS, and soil gas readings above background were detected in Borings 31WSB02, 31SAP17, and 31SAP18. The data collected from these borings, which were drilled in the refuse storage area, indicate possible soil contamination. Discoloration, odors, or soil gas readings above background were not detected in any other borings. Samples were collected from two borings (31WSB01 and 31WSB02), but only low levels of oil and grease were detected at 8.5 and 14 feet BGS, respectively, in each boring. Further sampling is necessary to verify the presence or absence of contaminants at the two source areas in Site 31, particularly from depths where discoloration and odors were detected.

In November 1987, 13 soil samples from SA 12A were collected and analyzed for PCBs, halogenated and aromatic VOCs, semivolatile organic compounds, and metals to verify the cleanup of a PCB spill that had occurred at the site. Borings were drilled to a maximum depth of 10 feet BGS. Oil stains were noted on the ground surface where


DEAN STREET
N
SA 12B
SA 12A
SITE 31
31WSB01
31SAP04
31SAP03
31SAP07
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31SAP05
31SAP11
31SAP17
31WSB02
31SAP18
31SAP16
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EM2981
EM2980
EM2978
EM2979
SA 12A
EM2961
EM2962
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EM2958
EM2959
EM2960
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EM2956
EM2957
29GSB03
29DAP04
29GSB01
29GSB02
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OPERABLE UNIT B BOUNDARY
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700
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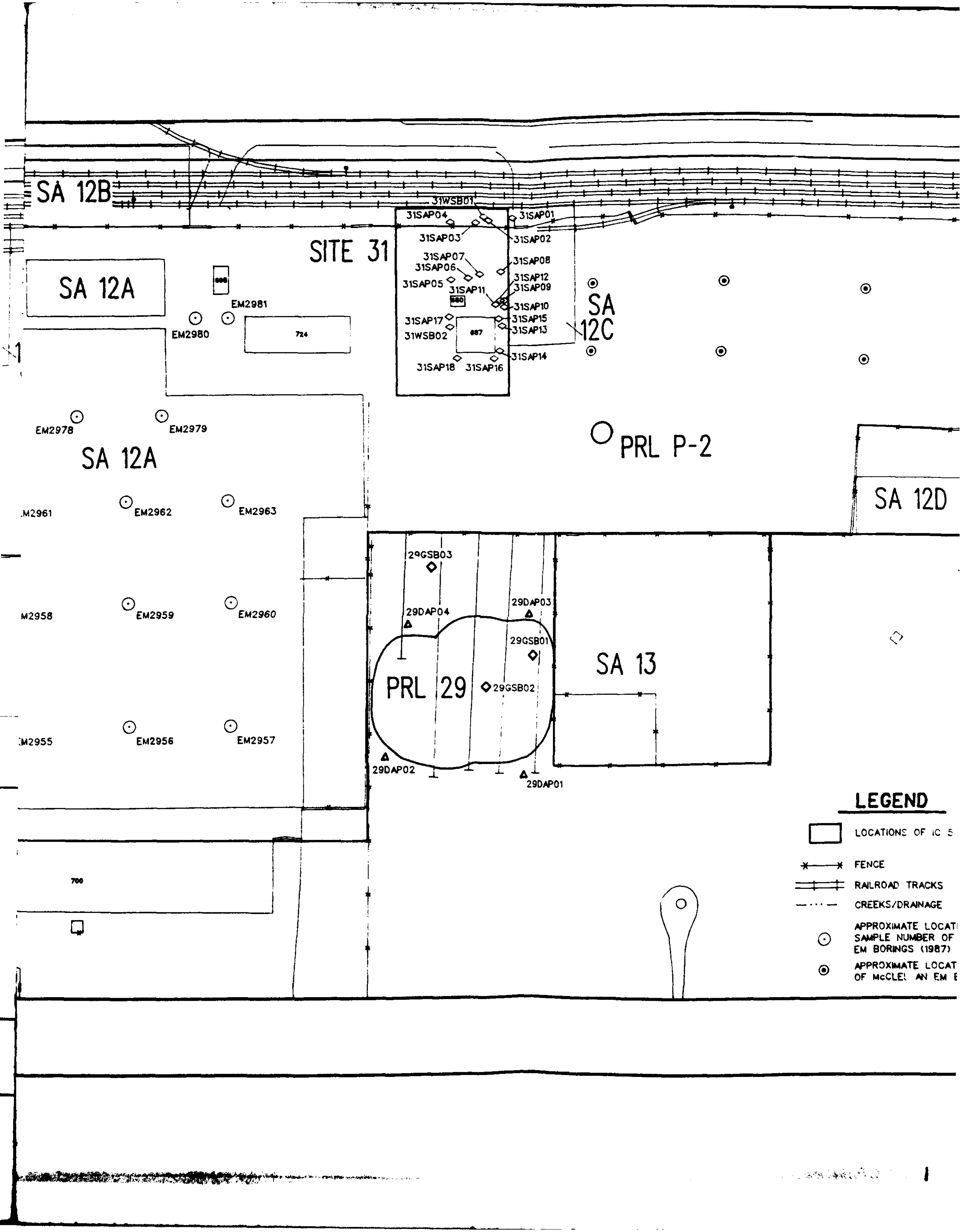
SCALE IN FEET


SA 12B
SITE 31
SA 12A
686
724
680
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EM2981
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31WSB01
31SAP04
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31SAP02
31SAP07
31SAP08
31SAP06
31SAP12
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31SAP11
31SAP09
31SAP10
31SAP17
31SAP15
31WSB02
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SA
12C
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SA 12A
PRL P-2
SA 12D
M2961
EM2962
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29GSB03
M2958
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LEGEND
LOCATIONS OF IC 5
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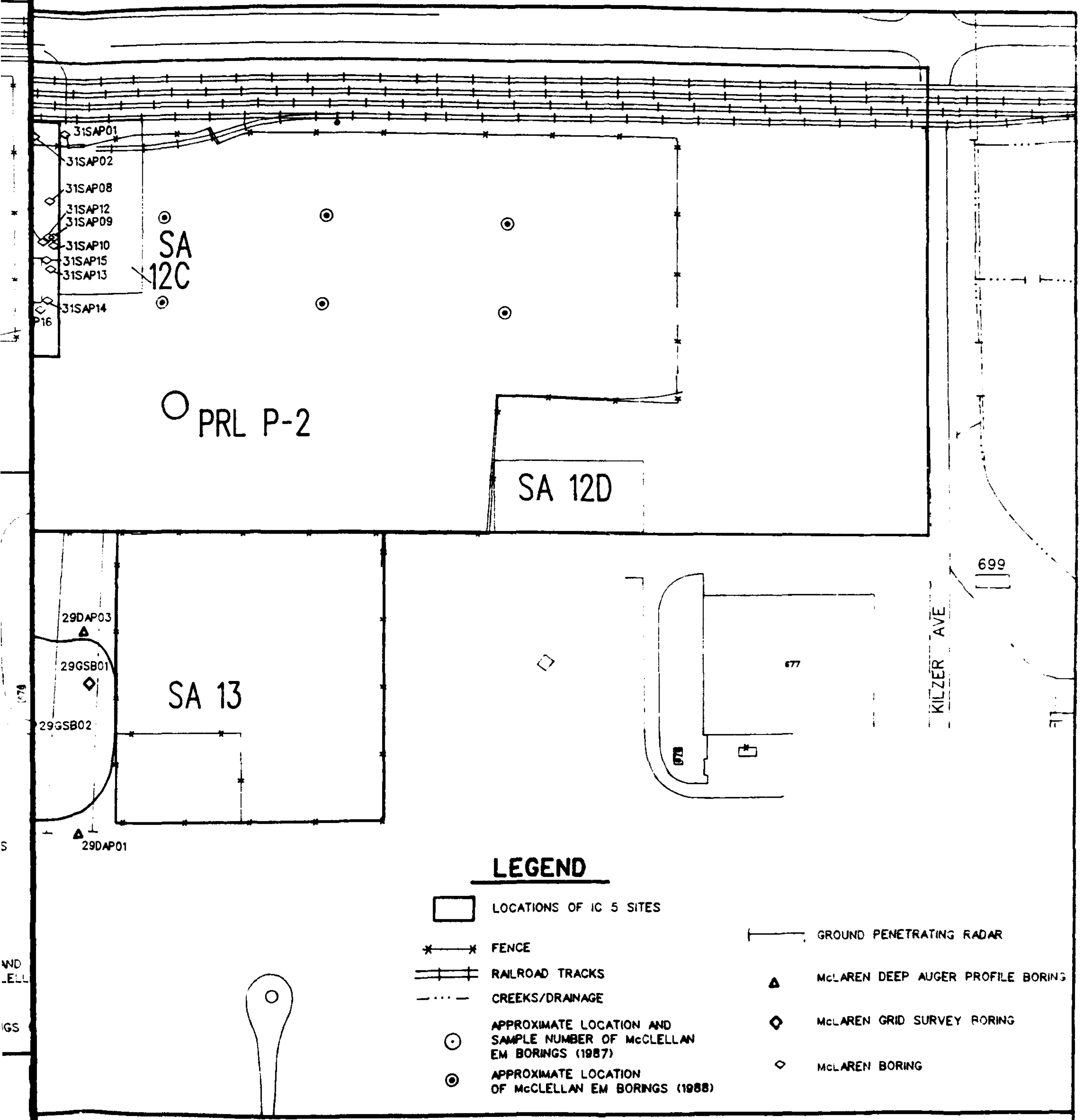

Figure 3.5-2. Previous Borings at IC 5.

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the PCB spill took place. "Carbonaceous material" was detected between 2 and 4 feet BGS in 8 of the 13 borings. Polychlorinated biphenyl concentrations detected in 11 samples ranged from 0.2 to 12.9 ppm. Four different VOCs in concentrations ranging from 1 to 7 ppm and 20 different semivolatile organic compounds ranging from not detected to 330 ppm [bis(2-ethylhexyl)phthalate] were detected in 13 samples. Because PCBs, VOCs, and semivolatile compounds were detected, SA 12A is considered a source of contamination.

In 1990, McClellan AFB EMC collected 18 samples from six borings from SA 12 in preparation for the construction of a Conforming Storage Facility. The samples were analyzed for pH and sulfides. Analytical results showed trace amounts of sulfides ranging from 3.7 to 29.3 ppm. Soil pH ranged from 6.01 to 7.75. The soil at the project site was "considered to be fairly clean from chemical contamination" (McClellan AFB EMC, 1990a).

Previous contractors delineated the boundaries of PRL 29 using ground penetrating radar (Radian, 1990a). As a part of that investigation, seven borings were drilled to determine the extent of contamination and to verify the presence or absence of buried waste. Because no evidence of contamination or disturbance was detected, no soil samples were collected. Soil gas measurements were recorded from soil cuttings using a portable PID. All readings were less than one part per million by volume (ppmv). However, additional soil borings are necessary to verify the absence of PCBs in soil because visual and soil gas evidence are not sufficient to detect PCBs.

A soil gas investigation of IC 5 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Fifty-two soil gas probes were installed and sampled during the soil gas investigation of IC 5. Total HVOCs concentrations, detected in all of the 52 probes, ranged from 1.6 to 1,119.7 ppbv. Total AVOCs concentrations, detected in 9 of the 52 probes, ranged from not detected to 4,165 ppbv. The AVOC result of 4,165 ppbv is most likely a result of field contamination. The soil gas sampling probes were contaminated by gasoline fumes from a gasoline can that was temporarily stored next to the probes. Results of the soil gas investigation at IC 5 indicate two areas that exceed the criteria for soil gas targets (Appendix A). One target had a soil gas concentration exceeding 1,000 ppbv total HVOCs. The location of this target is depicted in Figure 3.5-1.

3.5.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 5 is to determine the presence of soil contamination. A total of 4,578 surface scrapes, 75 hand auger borings, 28 reconnaissance borings, and 2 deep borings are planned at IC 5 to investigate potential sources of contamination. If contamination is detected, additional borings will be drilled during Phases 2 and 3 to determine the horizontal and vertical extent of contamination, support the development of health risk assessments, develop cleanup levels, identify the need for treatability studies, and identify remedial alternatives. Volatile organic compounds and volatile petroleum hydrocarbons will be analyzed on site using laboratory grade equipment. Polychlorinated biphenyls will also be analyzed on site using laboratory grade equipment.

Site 31 - Refuse and Ash Storage Areas

Reconnaissance Borings. Four reconnaissance borings (B1 through B4) will be sampled to a minimum depth of 20 feet BGS to investigate the refuse storage area at Building 687 (Figure 3.5-1). The borings will be located near previous contractor boring locations in which odors, discoloration, and oil and grease were detected in soil to a depth of 14 feet BGS. The contaminants of concern for borings B1 through B4 include metals, PCBs, VOCs, semivolatile organic compounds, and volatile and extractable petroleum hydrocarbons. One reconnaissance boring (B5) will be drilled and sampled to a minimum depth of 20 feet BGS in the ash storage area. The contaminants of concern for boring B5 include metals, PCBs, VOCs, semivolatile organic compounds, dioxins and furans, polynuclear aromatic hydrocarbons, and volatile and extractable petroleum hydrocarbons. Dioxin compounds are included because of the potential for thermal transformation of PCBs and semivolatile organic compounds into dioxin compounds. Tables 3.5-1 and 3.5-2 lists the DQOs for the refuse and incinerator ash storage areas at Site 31.

PRL 29 - Transformer Storage Area

Surface Scrapes. Three hundred and seventy-two surface scrape locations (SS01 through SS372) will be sampled from 0 to 3 inches BGS to determine if soils are contaminated with PCBs at PRL 29. The surface scrapes will be located within a

TABLE 3.5-1. DQOs FOR THE REFUSE STORAGE AREA AT SITE 31

Objective:	To determine the presence of soil contaminants from incinerator operations in the refuse storage area.
Source Description	
Source Type:	Uniform surface spill area
Area of Characterization:	5,000 square feet
Approximate Years of Operation:	1963-1968
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, PCBs, VOCs, semivolatile organic compounds, volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Locations along perimeter of Building 687 and adjacent to previous contractor borings where contamination was detected
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 687
Reconnaissance Boring Locations and Depths:	B1: 65′ N, 23′ E (20 feet BGS)
	B2: 10′ N, 10′ W (20 feet BGS)
	B3: 10′ S, 23′ E (20 feet BGS)
	B4: 25′ N, 65′ E (20 feet BGS)
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8270, SW8015/3550, SW8015/5030, FVOC, FPCB, FGC

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.5-2. DQOs FOR OPEN STORAGE OF INCINERATOR ASH AT SITE 31

Objective:	To determine the presence soil contamination resulting from incinerator ash storage.
Source Description	
Source Type:	Uniform surface discharge area
Area of Characterization:	4,000 square feet
Approximate Years of Operation:	1963-1968
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, PCBs, VOCs, semivolatile organic compounds, dioxins and furans, polynuclear aromatic hydrocarbons, volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Location within uniform discharge area
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 687
Reconnaissance Boring Location and Depth:	B5: 200′ N, 35′ W (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW8280, SW8310, SW8015/3550, SW8015/5030, FVOC, FPCB, FGC

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.
FGC = Field gas chromatograph screening of soil gas.

triangular grid with a 10.1-foot spacing determined by a 10 percent or less statistical risk of missing PCB discharges 5 feet or larger in radius. The contaminants of concern in surface soils at PRL 29 are PCBs. Table 3.5-3 lists the DQOs for the transformer storage area at PRL 29.

PRL P-2 - Potential Disposal Pit

Because the potential disposal pit is not located near any points of reference and it was identified from an areal photograph, the location of PRL P-2 is not accurately known. The uncertainty is compounded by distortion of the areal photograph and the small size of the potential disposal pit (approximately 20 feet in diameter). Therefore, the boundaries of PRL P-2 have been revised to a 70-foot by 70-foot square.

Reconnaissance Borings. Fourteen reconnaissance borings (B6 through B19) will be sampled to a minimum depth of 20 feet BGS in the approximate area of the potential disposal pit. Because the potential disposal pit may be approximately 20 feet in diameter, borings will be located within a triangular grid with a 20-foot spacing determined by a 10 percent or less statistical risk of missing the disposal pit. The contaminants of concern include metals, VOCs, PCBs, and semivolatile organic compounds. Table 3.5-4 lists the DQOs for the possible waste disposal pit at PRL P-2.

SA 12A - Open Storage Area

Surface Scrapes. Approximately 2,935 surface scrape locations (SS373 through SS3307) will be sampled at a depth of 0 to 3 inches below gravel (Figure 3.5-1). The surface scrapes will be located within a triangular grid with a 10.1-foot spacing determined by a 10 percent or less statistical risk of missing PCB discharges 5 feet or larger in radius (see Section A3.2, Appendix A). Surface scrapes will also be collected from any stained soil areas that are observed between grid locations. The principal contaminants of concern at SA 12A are PCBs in surface soils. Table 3.5-5 lists the DQOs for the open storage of transformers at SA 12A.

SA 12A - PCB Spill Area

Hand Auger Borings. Twenty-one hand auger borings (H1 through H21) will be sampled to 5 feet BGS in order to verify the presence of VOC and semivolatile

TABLE 3.5-3. DQOs FOR THE TRANSFORMER STORAGE AREA AT PRL 29

Objective:	To determine if PCB-contaminated soil is present at PRL 29.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	47,000 square feet
Approximate Years of Operation:	Unknown
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	PCBs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling for nonuniform areas of contamination
Sampling Method:	Surface scrape
Reference Point:	Southwest corner of Civil Engineering Storage Yard
Grid Initiation Point:	7' S, 75' W
Grid Ray Angles:	60°, 120°
Grid Spacing:	10.1 feet[a]
Surface Scrape Locations and Depths:	SS01 through SS372 within a grid array (3 inches BGS)
Total Number of Locations:	372
Analytical Method:	FPCB

[a] Sample spacing was determined by the following criteria: 1) 10 % or less probability of missing PCB discharges in surface soils; 2) at least 5 transformers discharged PCB-contaminated oil; 3) each discharge was at least 5 gallons; and 4) each discharge had a circular shape with a radius of 5 feet.

FPCB = Field polychlorinated biphenyl screening.

TABLE 3-5.4. DQOs FOR THE POSSIBLE DISPOSAL PIT AT PRL P-2

Objective:	To determine whether soil contamination is present at the dark area seen in aerial photographs.
Source Description	
Source Type:	Disposal pit
Area of Characterization:	4,900 square feet
Approximate Years of Operation:	1962-1968
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, PCBs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southeast corner of Building 687
Reconnaissance Boring Locations and Depths:	(all borings to a depth of 20 feet BGS)
	B6: 128' S, 150' E
	B7: 128' S, 170' E
	B8: 128' S, 190' E
	B9: 128' S, 210' E
	B10: 148' S, 160' E
	B11: 148' S, 180' E
	B12: 148' S, 200' E
	B13: 168' S, 150' E
	B14: 168' S, 170' E
	B15: 168' S, 190' E
	B16: 168' S, 210' E
	B17: 188' S, 160' E
	B18: 188' S, 180' E
	B19: 188' S, 200' E
Total Number of Locations:	14
Analytical Methods:	SW6010, SW8270, FVOC, FPCB, FGC

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.5-5. DQOs FOR THE OPEN STORAGE OF TRANSFORMERS AT SA 12A

Objective:	To determine if PCB-contaminated soils are present.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	365,000 square feet
Approximate Years of Operation:	1962-present
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	PCBs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling over a nonuniform area of contamination
Sampling Method:	Surface scrape
Reference Point:	Inside corner of Building 700 "L" configuration
Grid Initiation Point:	45' N, 450' E
Grid Ray Angles:	60°, 120°
Grid Spacing:	10.1 feet[a]
Surface Scrape Locations and Depths:	SS373 through SS3307, within grid array (3 inches BGS)
Total Number of Locations:	2,935
Analytical Methods:	FPCB

[a] Sample spacing was determined by the following criteria: 1) 10 % or less probability of missing PCB discharges in surface soils; 2) at least 5 transformers discharged PCB-contaminated oil; 3) each discharge was at least 5 gallons; and 4) each discharge had a circular shape with a radius of 5 feet.

FPCB = Field screening of polychlorinated biphenyls.

contamination, which was detected in previous investigations at SA 12A. Because VOCs and semivolatile organic compounds were detected in 11 of 13 widely spaced sample locations, the contamination is assumed to be present over a uniform surface spill area. The borings will be located within a triangular grid with a 50-foot spacing in the former spill area.

Reconnaissance Borings. Two reconnaissance borings (B20 and B21) will be sampled to a minimum depth of 20 feet in order to verify the presence of VOC and semivolatile organic compound contamination, which was detected in previous investigations at SA 12A. The borings will be located within the grid for the PCB spill area, described above, where VOCs were detected in the soil gas.

Deep Boring. One deep boring (B22) will be sampled to 95 feet BGS to verify the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration. The boring will be located within the grid for the PCB spill area, described above, where VOCs were detected in the soil gas.

Contaminants of concern in the soil of the PCB spill area are VOCs and semivolatile organic compounds. Table 3.5-6 lists the DQOs for the PCB spill area at SA 12A.

SA 12B - Transformer Loading Area

Surface Scrapes. Three hundred and seventy-four surface scrape locations (SS3308 through SS3681) will be sampled from 0 to 3 inches BGS in the area to the north and south of the railroad tracks where transformers were loaded and unloaded (Figure 3.5-1). The surface scrapes will be located within a triangular grid with a 10.1-foot spacing determined by the same criteria used for locations in SA 12A. Surface scrapes will also be collected from stained soil areas that lay outside the grid. The contaminants of concern in surface soils at SA 12B are PCBs. Table 3.5-7 lists the DQOs for the transformer loading and unloading area at SA 12B.

TABLE 3.5-6. DQOs FOR THE PCB SPILL AREA AT SA 12A

Objective:	To determine if volatile and semivolatile organic soil contamination is present in the former PCB spill area at SA 12A.	
Source Description		
Source Type:	PCB spill area	
Area of Characterization:	50,000 square feet	
Approximate Years of Operation:	1987	
Phase:	1	
Media to be Sampled:	Soil/soil gas	
Contaminants of Concern:	VOCs, semivolatile organic compounds	
Sampling Methodology		
Lateral Spacing Basis:	Triangular grid for statistical sampling in uniform spill area	
Drilling Method:	Hand auger or power assisted split-spoon sampler	
Reference Point:	Northern, northeast corner of Building 700	
Hand Auger Boring Locations and Depths:	(all borings to a depth of 5 feet BGS)	
	H1: 45' S, 365' E	H2: 45' S, 415' E
	H3: 45' S, 465' E	H4: 45' S, 515' E
	H5: 45' S, 565' E	H6: 45' S, 615' E
	H7: 95' S, 390' E	H8: 95' N, 440' E
	H9: 95' S, 490' E	H10: 95' S, 540' E
	H11: 95' S, 590' E	H12: 95' S, 640' E
	H13: 145' S, 365' E	H14: 145' S, 415' E
	H15: 145' S, 515' E	H16: 145' S, 565' E
	H17: 145' S, 615' E	H18: 195' N, 440' E
	H19: 195' S, 490' E	H20: 195' S, 540' E
	H21: 195' S, 640' E	
Total Number of Locations:	21	
Analytical Methods:	SW8270, FVOC, FGC	
Reconnaissance Boring Locations and Depths:	B20: 145' S, 465' E (20 feet BGS)	
	B21: 195' S, 390' E (20 feet BGS)	
Total Number of Locations:	2	
Analytical Methods:	SW8270, FVOC, FGC	
Deep Boring Locations and Depths:	B22: 195' N, 590' E (95 feet BGS)	
Total Number of Locations:	1	
Analytical Methods:	SW8270, FVOC, FGC	

FVOC = Field volatile organic compound screening

FGC = Field gas chromatograph screening of soil gas.

TABLE 3.5-7. DQOs FOR THE TRANSFORMER LOADING AND UNLOADING AREA AT SA 12B

Objective:	To determine if PCB-contaminated soil is present.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	30,000 square feet
Approximate Years of Operation:	Unknown
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	PCBs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling over a nonuniform area of contamination
Sampling Method:	Surface scrape
Reference Point:	Northern, northeast corner of Building 700
Grid Initiation Point:	165' N, 150' E
Grid Ray Angles:	60°, 120°
Grid Spacing:	10.1 feet[a]
Surface Scrape Locations and Depths:	SS3308 through SS3681, within grid array (3 inches BGS)
Total Number of Locations:	374
Analytical Method:	FPCB

[a] Sample spacing was determined by the following criteria: 1) 10 % or less probability of missing PCB discharges in surface soils; 2) at least 5 transformers discharged PCB-contaminated oil; 3) each discharge was at least 5 gallons; and 4) each discharge had a circular shape with a radius of 5 feet from SA 12.

FPCB = Field polychlorinated biphenyl screening.

SA 12C - Transformer Storage Area

Surface Scrapes. Forty surface scrape locations (SS3682 through SS3721) will be sampled at a depth of 0 to 3 inches in the transformer storage area at SA 12C (Figure 3.5-1). The surface scrapes will be located within a triangular grid with a 10.1-foot spacing determined by a 10 percent or less statistical risk of missing PCB discharges 5 feet or larger in radius (see Section A3.2, Appendix A). Surface scrapes will also be collected from any stained soil areas that are observed between grid locations. The area is currently paved, and samples will be collected in the soils below the pavement. The contaminants of concern in the surface soils are PCBs. Table 3.5-8 lists the DQOs for the transformer storage area at SA 12C.

SA 12D - Potential Waste Disposal Pit

Reconnaissance Borings. Seven reconnaissance borings (B23 through B29) will be sampled to a minimum depth of 20 feet BGS to determine if contamination is present in the potential disposal pit at SA 12D (Figure 3.5-1). The borings will be located within a triangular grid with a 50-foot spacing. The potential contaminants of concern in the soils at SA 12D include metals, PCBs, VOCs, and semivolatile organic compounds. Table 3.5-9 lists the DQOs for the possible waste disposal pit area at SA 12D.

SA 12 - Drainage Ditches

Hand Auger Borings. Four hand auger borings (H22 through H25) will be sampled to 5 feet BGS in two drainage ditches that receive surface runoff from SA 12, to determine if contaminants that may have been present in the runoff have entered the soil beneath the ditches. The contaminants of concern in soils beneath the drainage ditches include metals, PCBs, VOCs, and semivolatile organic compounds. Table 3.5-10 lists the DQOs for the drainage ditches that receive runoff from SA 12.

SA 12 - Building 724

Hand Auger Borings. Eight hand auger borings (H26 through H33) will be sampled to 5 feet BGS to determine if contamination is present in soils adjacent to Building 724 (Figure 3.5-1). Borings will be located at 50-foot intervals around the

TABLE 3.5-8. DQOs FOR THE TRANSFORMER STORAGE AREA AT SA 12C

Objective:	To determine if PCB-contaminated soil is present.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	19,000 square feet
Approximate Years of Operation:	Unknown
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	PCBs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling over a nonuniform area of contamination
Sampling Method:	Surface scrapes
Reference Point:	Northeast corner of Building 687
Grid Initiation Point:	54' N, 31' E
Grid Ray Angles:	60°, 120°
Grid Spacing:	20 feet[a]
Surface Scrape Locations and Depths:	SS3682 through SS3721 within grid array (3 inches BGS)
Total Number of Locations:	40
Analytical Method:	FPCB

[a] The 20-foot grid spacing will be used because the area is paved.

FPCB = Field polychlorinated biphenyl screening.

TABLE 3.5-9. DQOs FOR THE POSSIBLE WASTE DISPOSAL PIT AT SA 12D

Objective:	To determine if PCB or other contamination is present.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	11,000 square feet
Approximate Years of Operation:	1963-1965
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, PCBs, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling in nonuniform areas of contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Intersection of fences as seen on Figure 3.5-1
Reconnaissance Boring Locations and Depths:	B23: 68' N, 10' E (20 feet BGS) B24: 68' N, 60' E (20 feet BGS) B25: 68' N, 110' E (20 feet BGS) B26: 68' N, 160' E (20 feet BGS) B27: 18' N, 35' E (20 feet BGS) B28: 18' N, 85' E (20 feet BGS) B29: 18' N, 135' E (20 feet BGS)
Total Number of Locations:	7
Analytical Methods:	SW6010, SW8270, FVOC, FPCB, FGC

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.5-10. DQOs FOR THE DRAINAGE DITCHES THAT RECEIVE RUNOFF FROM SA 12

Objective:	To determine if PCB or other contamination is present in soils beneath the ditches.
Source Description	
Source Type:	Surface drainage area
Area of Characterization:	1,500 square feet
Approximate Years of Operation:	Unknown to present
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	Metals, PCBs, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Locations at surface runoff discharge points
Drilling Method:	Hand auger
Hand Auger Boring Locations and Depths:	(all borings to a depth of 5 feet BGS) H22, H23: Unlined section which runs across northwestern part of the lot. H24, H25: In ditch that receives surface runoff from aluminum planking area east of Building 700. (See Figure 3.5-1).
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8270, FVOC, FPCB

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.

perimeter of the building. However, the borings may be moved to stained soil areas adjacent to Building 724. The contaminants of concern for the soils adjacent to Building 724 include metals, PCBs, VOCs, semivolatile organic compounds, acids, bases, and cyanide. Table 3.5-11 lists the DQOs for Building 724 at SA 12.

SA 12 - Areal Borings

Hand Auger Borings. Forty-two hand auger borings (H34 through H75) will be sampled to 5 feet BGS to confirm soil gas results and determine if contamination is present in surface soils at SA 12. The borings are located adjacent to or at 50-foot stepout distances from previous soil gas probe locations where VOC-contaminated soil gas was detected. Samples will only be collected to 5 feet BGS because evidence of any VOC contamination that resulted from surface spills will be detectable in samples from 1 to 5 feet BGS.

Deep Borings. One deep boring (B30) will be sampled to 95 feet BGS to confirm soil gas results and to characterize subsurface lithologic conditions that would affect contaminant migration. The boring is located in the center of the HVOC soil gas target in the eastern part of SA 12.

The contaminants of concern for the areal borings include metals, PCBs, VOCs, and semivolatile organic compounds. Table 3.5-12 lists the DQOs for the areal borings at SA 12.

SA 13 - Transformer Storage Area

Surface Scrapes. Eight hundred and fifty-seven surface scrape locations (SS3722 through SS4578) will be sampled from 0 to 3 inches BGS to determine if PCB-contaminated soils are present in the transformer storage area at SA 13. The surface scrapes will be located within a triangular grid with a 10.1-foot spacing determined by a 10 percent or less statistical risk of missing PCB discharges 5 feet or larger in radius. The contaminants of concern in the surface soils at SA 13 are PCBs. Table 3.5-13 lists the DQOs for the transformer storage area at SA 13.

Table 3.5-14 presents the sampling and analysis matrix for all sampling locations at IC 5.

TABLE 3.5-11. DQOs FOR BUILDING 724 AT SA 12

Objective:	To determine if soil contamination is present adjacent to Building 724 at SA 12.
Source Description	
Source Type:	Surface spill area
Area of Characterization:	7,500 square feet
Approximate Years of Operation:	Unknown to present
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	Metals, PCBs, VOCs, semivolatile organic compounds, acids, bases, cyanide
Sampling Methodology	
Lateral Spacing Basis:	Locations spaced at 50-foot intervals adjacent to a suspected source target
Drilling Method:	Hand auger
Reference Point:	Northeast corner of Building 724
Hand Auger Boring Locations and Depths:	H26: 5' N, 150' W (5 feet BGS) H27: 5' N, 100' W (5 feet BGS) H28: 5' N, 50' W (5 feet BGS) H29: 10' S, 5' E (5 feet BGS) H30: 60' S, 10' W (5 feet BGS) H31: 60' S, 60' W (5 feet BGS) H32: 60' S, 110' W (5 feet BGS) H33: 45' S, 160' W (5 feet BGS)
Total Number of Locations:	8
Analytical Methods:	SW6010, SW8270, SW9010, SW9045, FVOC, FPCB

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.

TABLE 3.5-12. DQOs FOR AREAL BORINGS AT SA 12

Objective: To confirm soil gas results and to determine if soil contamination is present at SA 12.

Source Description

Source Type: Spill area/soil gas target

Area of Characterization: 550,000 square feet

Approximate Years of Operation: 1963-present

Phase: 1

Media to be Sampled: Soil/soil gas

Contaminants of Concern: Metals, PCBs, VOCs, semivolatile organic compounds, PCBs

Sampling Methodology

Lateral Spacing Basis: Locations at previous soil gas probe locations and at 50-foot stepouts

Drilling Method: Hand auger and power assisted split-spoon sampler

Reference Point: Northern, northeast corner of Building 700

Hand Auger Boring Locations and Depths: (all borings to a depth of 5 feet BGS)

H34: 233' N, 45' E
H35: 183' N, 45' E
H36: 233' N, 95' E
H37: 225' N, 263' E
H38: 165' N, 230' E
H39: 20' N, 100' E
H40: 20' N, 150' E
H41: 30' S, 100' E
H42: 188' S, 250' E
H43: 575' S, 80' E
H44: 575' S, 480' E
H45: 575' S, 530' E
H46: 575' S, 580' E
H47: 525' S, 530' E
H48: 450' S, 530' E
H49: 375' S, 530' E
H50: 375' S, 580' E
H51: 375' S, 480' E
H52: 325' S, 530' E
H53: 400' S, 520' E
H54: 180' S, 915' E
H55: 130' S, 965' E
H56: 180' S, 965' E
H57: 180' S, 1015' E
H58: 230' S, 965' E
H59: 30' S, 900' E
H60: 20' N, 900' E
H61: 20' N, 950' E
H62: 225' N, 1080' E
H63: 175' N, 1080' E
H64: 225' N, 1650' E
H65: 225' N, 1700' E
H66: 225' N, 1750' E
H67: 175' N, 1700' E
H68: 180' S, 1700' E
H69: 60' N, 1450' E
H70: 60' N, 1500' E
H71: 60' N, 1550' E
H72: 10' N, 1425' E
H73: 10' N, 1525' E
H74: 40' S, 1500' E
H75: 40' S, 1550' E

Total Number of Locations: 42

Analytical Methods: SW6010, SW8270, FVOC, FPCB, FGC

Deep Boring Location and Depth: B30: 185' N, 831' E (95 feet BGS)

Total Number of Locations: 1

Analytical Methods: SW6010, SW8270, FVOC, FPCB, FGC

FVOC = Field volatile organic compound screening.
FPCB = Field polychlorinated biphenyl screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.5-13. DQOs FOR THE TRANSFORMER STORAGE AREA AT SA 13

Objective	To determine the locations of any PCB contamination that may exist at SA 13.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	100,000 square feet
Approximate Years of Operation:	1962-present
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	PCBs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling for nonuniform area of contamination
Sampling Method:	Surface scrape
Reference Point:	Southwest corner of CE Storage Yard
Grid Initiation Point:	130' E of reference point
Grid Ray Angles:	60°, 120°
Grid Spacing:	10.1 feet[a]
Surface Scrape Locations and Depths:	SS3722 through SS4578 in grid array (3 inches BGS)
Total Number of Locations:	857
Analytical Method:	FPCB

[a] Sample spacing was determined by the criteria: 1) 10 % or less probability of missing PCB discharges in surface soils; 2) at least 5 transformers discharged PCB contaminated oil; 3) each discharge was at least 5 gallons; and 4) each discharge had a circular shape with a radius of 5 feet.

FPCB = Field polychlorinated biphenyl screening.

TABLE 3.5-14. SAMPLING AND ANALYSIS MATRIX FOR IC 5

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval				
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B1-B4[c]	Reconnaissance Boring B5[d]	Surface Scrapes SS1-SS4578[e,g,k,l,r]	Reconnaissance Borings B6-B19[f], B23-B29[m]	Hand Auger Borings H1-H21[h]
0 - 20	1[b]	SW6010 SW8015/3550 SW8015/5030 SW8270 FPCB FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 SW8280 SW8310 FVOC FPCB	FPCB	SW6010 SW8270 FPCB FVOC	SW8270 FVOC
0 - 20	2	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC	NS	SW6010 SW8270 FVOC	SW8270 FVOC
0 - 20	3	SW6010 SW8015/3550 SW8270 FVOC FGC	FVOC FGC	NS	FVOC FGC	NS
20 - 95	4	NS	FVOC FGC	NS	NS	NS
20 - 95	5	NS	FVOC FGC	NS	NS	NS
20 - 95	6	NS	FVOC FGC	NS	NS	NS
20 - 95	7	NS	FVOC FGC	NS	NS	NS

(Continued)

TABLE 3.5-14. (Continued)

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval					
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B20-B21[i]	Deep Boring B22[j]	Hand Auger Borings H22-H25[n]	Hand Auger Borings H34-H75[p]	Hand Auger Borings H26-H33[o]	Deep Boring B30[q]
0 - 20	1[b]	SW8270 FVOC	SW8270 FVOC	SW6010 SW8270 FPCB FVOC	SW6010 SW8270 FPCB FVOC	SW6010 SW8270 SW9010 SW9045 FPCB FVOC	SW6010 SW8270 FPCB FVOC
0 - 20	2	SW8270 FVOC	SW8270 FVOC	SW6010 SW8270 FVOC	SW6010 SW8270 FVOC FGC	SW6010 SW8270 SW9010 SW9045 FVOC	SW6010 SW8270 FPCB FVOC
0 - 20	3	FVOC FGC	FVOC FGC	NS	NS	NS	FVOC FGC
20 - 95	4	NS	FVOC FGC	NS	NS	NS	FVOC FGC
20 - 95	5	NS	FVOC FGC	NS	NS	NS	FVOC FGC
20 - 95	6	NS	FVOC FGC	NS	NS	NS	FVOC FGC
20 - 95	7	NS	FVOC FGC	NS	NS	NS	FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Collect first sample for nonvolatile analyses between 0-3 inches for surface scrapes and hand auger samples. Collect samples for volatile analyses between 1-5 feet BGS.

[c] Reconnaissance borings for refuse storage area at Site 31.

[d] Deep boring for ash storage area at Site 31.

[e] Surface scrapes for transformer storage area at PRL 29.

[f] Reconnaissance borings for possible disposal pit at PRL P-2.

[g] Surface scrapes for transformer open storage area at SA 12A.

[h] Hand auger samples for PCB spill area at SA 12A.

[i] Reconnaissance borings for PCB spill area at SA 12A.

[j] Deep boring for PCB spill area at SA 12A.

[k] Surface scrapes for transformer loading area at SA 12B.

[l] Surface scrapes for transformer storage area at SA 12C.

[m] Reconnaissance borings for possible waste disposal pit at SA 12D.

[n] Hand auger samples for drainage ditches at IC 5.

[o] Hand auger samples for Building 724 at SA 12.

[p] Hand auger samples for areal coverage at SA 12.

[q] Deep boring for areal coverage at SA 12.

[r] Surface scrapes for nonuniform spill area at SA 13.

(footnotes continued on next page)

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

FPCB = Screening analysis of soils for 7 PCB compounds by field gas chromatograph; samples with detectable concentrations will be sent to off-site laboratory for SW8080 analysis.

NS = Not sampled unless contamination continues from 20 feet depth for reconnaissance borings or below depth of previous sample for hand auger borings and surface scrapes.

3.6 Investigation Cluster 6 (PRL T-60, SA 5, and SA 6)

Investigation Cluster 6 consists of PRL T-60, SA 5, and SA 6 and is located in the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 6. Although each of these three sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

Potential Release Location S-29, which consists of Building 655 (Figure 3.6-1), is included in the discussion of IC 8 (Section 3.8); however, several of the borings placed at IC 6, located west of Building 655, will also assist in the determination of contamination resulting from operations at PRL S-29.

3.6.1 Site Descriptions

Potential Release Location T-60

Potential Release Location T-60 is an abandoned 30,000-gallon underground fuel storage tank that has been filled with concrete (Figure 3.6-1). The tank contained Bunker Fuel No. 5, which was used to fuel the boilers at Building 656. The concrete underground tank was installed in 1953 when Building 656 was built. A tank closure plan was prepared in 1986, and the tank contents were sampled. The tank contents were subsequently removed and the tank was filled with concrete.

The ground surface above the tank is paved with concrete except for a steel cover, which provides access to the tank below and a vent pipe. The top of the tank is approximately 6 feet BGS, and the bottom is approximately 21 feet BGS. The tank is approximately 14 feet in diameter and 26 feet long. The orientation of the tank was explored during a geophysical investigation of the area by JR Associates in mid-1991; however, the orientation could not be verified and further investigation is required.

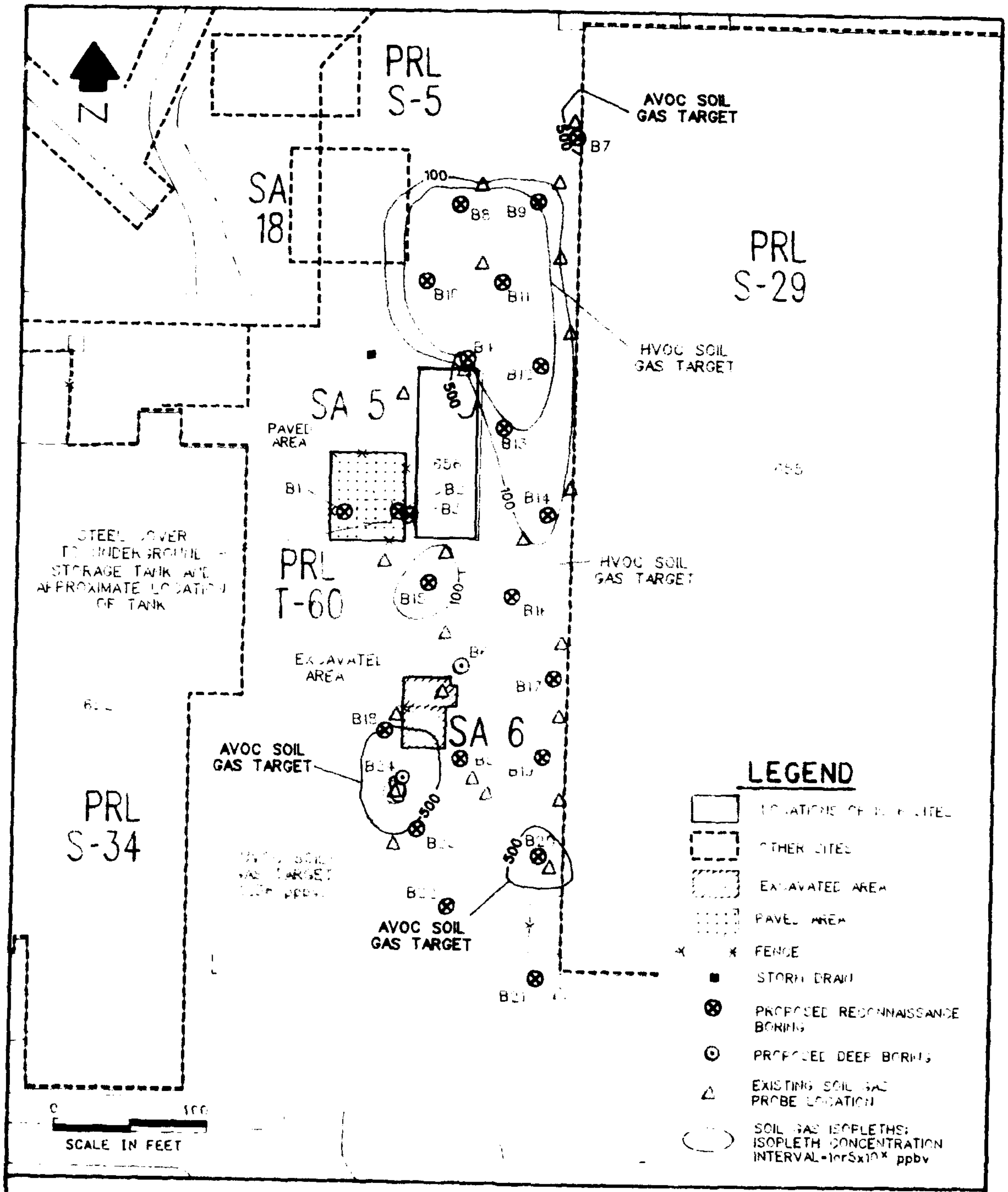

Figure 3.6-1. Site Features and Soil Boring Locations at IC 6 (PRL T-60, SA 5, and SA 6).

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Study Area 5

Study Area 5 is the location of Building 656 (Figure 3.6-1), a steam boiler plant and paint storage facility. Steam boiler operations in Building 656 began in approximately 1953. Three boilers in the building currently produce steam to support operations at other locations in OU B. Fuel to supply the boilers is obtained from an aboveground tank (PRL T-60) at the southwest corner of Building 656; fuel to the boilers was formerly piped from the underground fuel tank at PRL T-60 via an underground fuel line.

The northern quarter of Building 656 is used as a paint storage warehouse. Paints and lacquers are stored in sealed containers on shelves in the warehouse portion of the building. No waste materials are produced at Building 656, nor does the building connect to the IWL.

Study Area 6

Study Area 6 consists of a former gas station located south of Building 656 (Figure 3.6-1). Four underground storage tanks including a 10,000-gallon tank containing unleaded fuel, a 5,000-gallon tank containing leaded fuel, and two 750-gallon diesel tanks, were in operation at the gas station from 1955 to 1990. A contractor inspected the 10,000-gallon and 5,000-gallon tanks and found leaks in the access ways of both tanks; the tanks were later repaired. The 10,000-gallon and 5,000-gallon tanks were removed in November 1990. The 750-gallon tanks were removed in May 1991.

The area in which the tanks were located is currently an open excavation with an average depth of approximately 20 feet BGS. McClellan AFB EM is planning to backfill the excavation in October 1991.

3.6.2 Previous Investigations

A total of 14 borings were placed at SA 6 by McClellan AFB EMC in May 1991 to determine the extent of contamination resulting from leakage of the four former underground storage tanks (Figure 3.6-2). Table 3.6-1 presents sample collection depths and results for these borings. Boring placement for the remedial investigation of this site

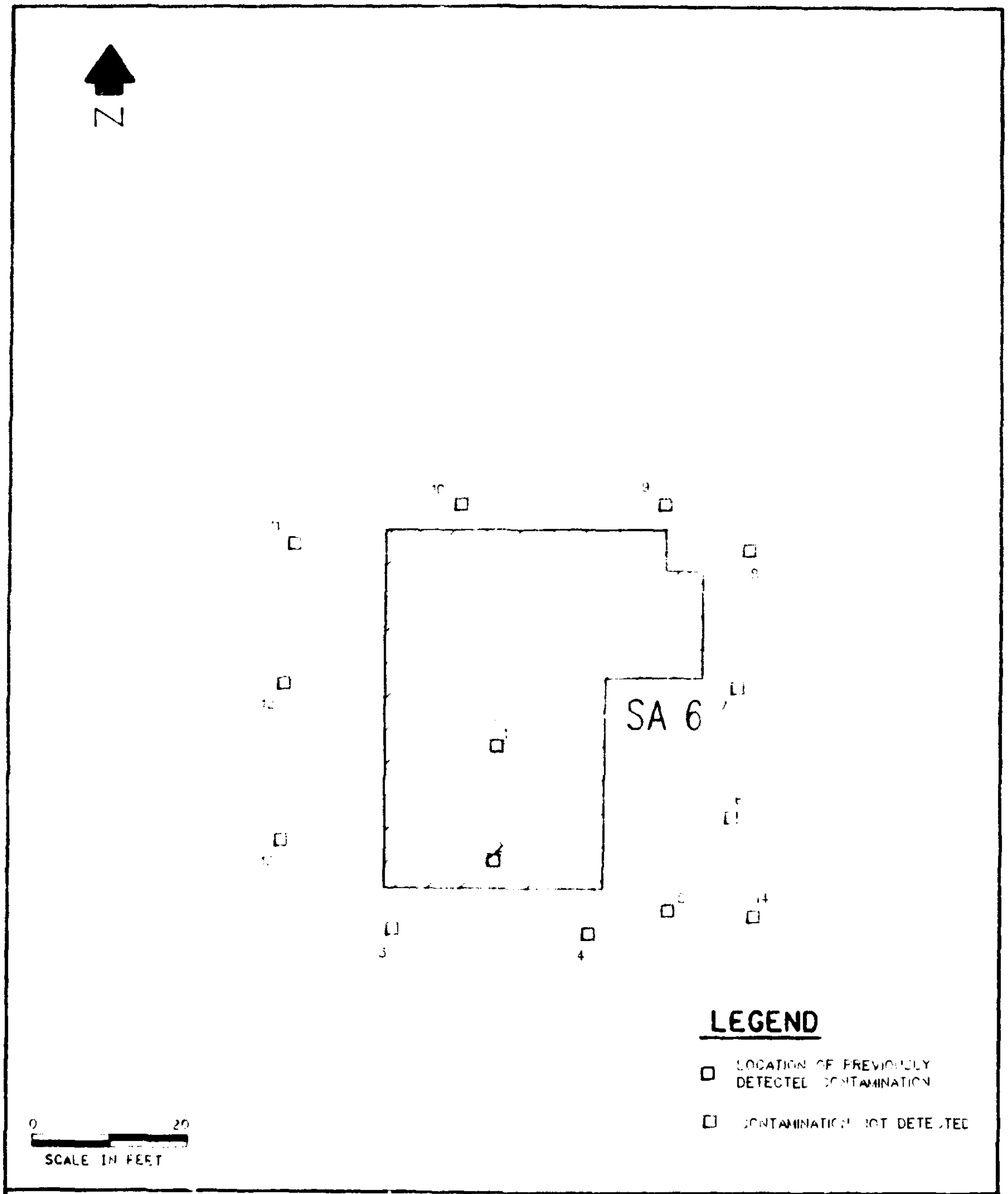

Figure 3.6-2. Approximate Locations of Previous McClellan EMC Borings at SA 6.

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TABLE 3.6-1. McCLELLAN AFB EMC BORING SAMPLE SUMMARY[a]

	Depth of Sample (in feet) and Contaminant Detected (in ppm)							
Boring No.	5′	10′	15′	20′	25′	30′	35′	40′
1[b]		2,500 (gasoline)		ND		ND	ND	
2[c]		1,960 (gasoline)		ND				
3		ND		ND				
4				22 (gasoline)				
5					295 (gasoline)		38 (gasoline)	ND
6		ND		ND				
7		ND		ND				
8			51 (motor oil)	ND				
9		43 (motor oil)		ND				
10		ND		ND	ND			
11		ND		ND				
12		ND		ND				
13			ND	ND				

[a] Samples were not collected for Boring No. 14.
[b] Boring drilled in an area excavated 8 feet BGS.
[c] Boring drilled in an area excavated 3 feet BGS.

will be influenced by the location of contaminants found in the McClellan EMC boring samples.

A soil gas investigation of IC 6 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Twenty-three soil gas probes were placed and sampled. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 2 of the 23 probes at concentrations exceeding the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the 23 probes, ranged from 6.7 to 9,429.4 ppbv. Total AVOC concentrations, detected in 4 of the 11 probes, ranged from 577 to 5,920 ppbv. One UVOC was detected in a probe at a concentration of 236 ppbv.

Results of the soil gas investigation of IC 6 indicate five areas of contamination that exceed the criteria for soil gas targets (Figure 3.6-1), as described in Appendix A. One target area contained total HVOC concentrations greater than 1,000 ppbv coincident with total AVOCs greater than 500 ppbv. A second target had a soil gas concentration exceeding 100 ppbv total HVOCs. A third target area contained total AVOCs greater than 1,000 ppbv coincident with a single UVOC concentration above 100 ppbv. Two other targets had total AVOCs exceeding 500 ppbv.

3.6.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 6 is to determine the presence of VOC or other contamination in the area. A total of 22 reconnaissance and 2 deep borings will be placed at IC 6 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Potential Release Location T-60

Reconnaissance Borings. Two reconnaissance borings (B1 and B2) will be placed on either side of the underground fuel storage tank at PRL T-60 (Figure 3.6-1). As the exact orientation of the tank is not currently known, the boring locations shown are approximate. The bottom of the tank, the lowest possible discharge point, is located 21 feet BGS; samples will be collected to a minimum depth of 26 feet BGS. The contaminants of concern include organic lead, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.6-2 presents DQOs for the underground fuel storage tank at PRL T-60.

One reconnaissance boring (B3) will be placed adjacent to the underground fuel line, which connects the fuel tank at PRL T-60 to Building 656 (Figure 3.6-1). Samples will be collected to a minimum depth of 20 feet BGS. The contaminants of concern include organic lead, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.6-3 presents DQOs for the fuel line at SA 5.

Study Area 5

Reconnaissance Boring. One reconnaissance boring (B4) will be placed directly outside the northern end of Building 656 (Figure 3.6-1). The boring will be placed at this location because most of the paints and lacquers are stored on the other side of the northern wall of Building 656. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern include metals, VOCs, and semivolatile organic compounds. Table 3.6-4 presents DQOs for the potential paint spillage area outside of Building 656 at SA 5.

Study Area 6

Reconnaissance Boring. One reconnaissance boring (B5) will be placed at SA 6 near the location of previously detected contamination resulting from leakage of underground storage tanks (Figure 3.6-1). Samples will be collected to a minimum depth of 40 feet BGS because contamination was previously detected at 35 feet BGS.

Deep Boring. One deep boring (B6) will be drilled to 95 feet BGS at SA 6. Samples will be collected in the boring to confirm the presence of contaminants from 5 to 35 feet BGS and to characterize subsurface lithologic conditions that would affect contaminant migration.

TABLE 3.6-2. DQOs FOR THE UNDERGROUND FUEL STORAGE TANK AT PRL T-60

Objective:	To determine the presence of contamination potentially resulting from leakage of the underground fuel storage tank.
Source Description	
Source Type:	Underground tank
Area of Characterization:	2,450 square feet
Approximate Years of Operation:	1953 - 1988
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Organic lead, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring placed adjacent to underground storage tank
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Locations and Depths:	B1: West end of tank (26 feet BGS) B2: East end of tank (26 feet BGS)
Number of Locations:	2
Analytical Methods:	HML 338, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.6-3. DQOs FOR THE FUEL LINE AT SA 5

Objective:	To determine the presence of contamination potentially resulting from leakage of the fuel line.
Source Description:	
Source Type:	Underground pipeline
Area of Characterization:	300 square feet
Approximate Years of Operation:	1953-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Organic lead, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Reconnaissance boring adjacent to a suspected discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 656
Reconnaissance Boring Location and Depth:	B3: 15' N, 4' W (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	HML 338, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.6-4. DQOs FOR THE POTENTIAL PAINT SPILLAGE AREA OUTSIDE BUILDING 656 AT SA 5

Objective:	To determine the presence of contamination potentially resulting from spillage of paints or lacquers stored at the northern quarter of Building 656.
Source Description:	
Source Type:	Surface spill area
Area of Characterization:	314 square feet
Approximate Years of Operation:	1953-present
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Reconnaissance boring adjacent to a suspected discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	*Northeast corner of Building 656*
Reconnaissance Boring Location and Depth:	B4: 5' N, 10' W (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

Contaminants of concern in soils at SA 6 include organic lead, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.6-5 presents DQOs for the location of the formerly existing underground storage tanks at SA 6.

IC 6 Areal Borings

Reconnaissance Borings. Sixteen reconnaissance borings (B7 through B23) will be located in a triangular grid within IC 6 along the west side of PRL S-29 (Figure 3.6-1). Locations within the grid will be spaced at 50-foot intervals within soil gas target areas. Outside of soil gas target areas, spacing between borings will be greater than 50 feet but less than 100 feet. Samples from reconnaissance borings will be collected to a minimum depth of 20 feet BGS.

Deep Boring. One deep boring (B24) will be drilled and sampled to a depth of 95 feet BGS. The boring will evaluate coincident AVOC and UVOC soil gas target areas and provide information on subsurface lithologic conditions that would affect contaminant migration south of SA 6 in IC 6.

Contaminants of concern in the soils of IC 6 include volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.6-6 presents DQOs for the areal borings at IC 6.

Table 3.6-7 presents the sampling and analysis matrix for all sampling locations at IC 6.

TABLE 3.6-5. DQOs FOR THE LOCATION OF THE FORMERLY EXISTING UNDERGROUND STORAGE TANKS AT SA 6

Objective:	To determine the presence of contamination potentially resulting from leakage of the underground storage tanks.
Source Description:	
Source Type:	Underground storage tanks
Area of Characterization:	1600 square feet
Approximate Years of Operation:	1955-1990
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Organic lead, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Reconnaissance and deep borings in an area of known contamination
Drilling Method:	*Power assisted split-spoon sampler*
Reference Point:	Southeast corner of Building 656
Reconnaissance Boring Location and Depth:	B5: 145′ S, 15′ W (40 feet BGS)
Number of Locations:	1
Analytical Methods:	HML 338, SW8015/3550, SW8270, FVOC, FGC
Deep Boring Location and Depth:	B6: 85′ S, 10′ W (95 feet BGS)
Number of Locations:	1
Analytical Methods:	HML 338, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.6-6. DQOs FOR THE AREAL BORINGS AT IC 6

Objective:	To determine if volatile organic and other contamination is present in soils at IC 6.
Source Description:	
Source Type:	Undetermined, as indicated by soil gas
Area of Characterization:	50,000 square feet
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Triangular grids with 50-foot spacing in soil gas target
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 656
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B7: 155' N, 60' E
	B8: 110' N, 20' W
	B9: 110' N, 40' E
	B10: 55' N, 35' W
	B11: 55' N, 15' E
	B12: 5' N, 40' E
	B13: 40' S, 15' E
	B14: 95' S, 45' E
Reference Point:	Southwest corner of Building 655
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B15: 250' N, 90' W
	B16: 240' N, 40' W
	B17: 190' N, 10' W
	B18: 155' N, 120' W
	B19: 140' N, 15' W
	B20: 75' N, 15' W
	B21: 5' S, 15' W
	B22: 45' N, 75' W
	B23: 95' N, 95' W

(Continued)

TABLE 3.6-6 (Continued)

Total Number of Locations:	17
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC
Deep Boring Location and Depth:	B24: 130' N, 105' W (95 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.6-7. SAMPLING AND ANALYSIS MATRIX FOR IC 6

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval					
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B2[b], B5[c]	Reconnaissance Boring B3[d]	Reconnaissance Boring B4[e]	Deep Boring B6[f]	Reconnaissance Borings B7 - B23[g]	Deep Boring B24[g]
0 - 20	1	HML 338 SW8015/3550 SW8270 FVOC	HML 338 SW8015/3550 SW8270 FVOC	SW6010 SW8270 FVOC	HML 338 SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC
0 - 20	2	HML 338 SW8015/3550 SW8270 FVOC	HML 338 SW8015/3550 SW8270 FVOC	SW6010 SW8270 FVOC	HML 338 SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC
0 - 20	3	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC	FVOC FGC	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC
20 - 95	4	SW8015/3550 FVOC FGC	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC
20 - 95	5	NS	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC
20 - 95	6	NS	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC
20 - 95	7	NS	NS	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for underground fuel tank at PRL T-60 (samples to be collected to a depth of 26 feet BGS).

[c] Boring locations for locations of formerly existing underground storage tanks at SA 6 (samples to be collected to a depth of 40 feet BGS).

[d] Boring location for fuel line at SA 5.

[e] Boring location for the potential paint spillage area outside Building 656 at SA 5.

[f] Boring locations for locations of formerly existing underground storage tanks at SA 6 (samples to be collected to a depth of 95 feet BGS).

[g] Locations for areal borings at IC 6.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues from 20 feet depth.

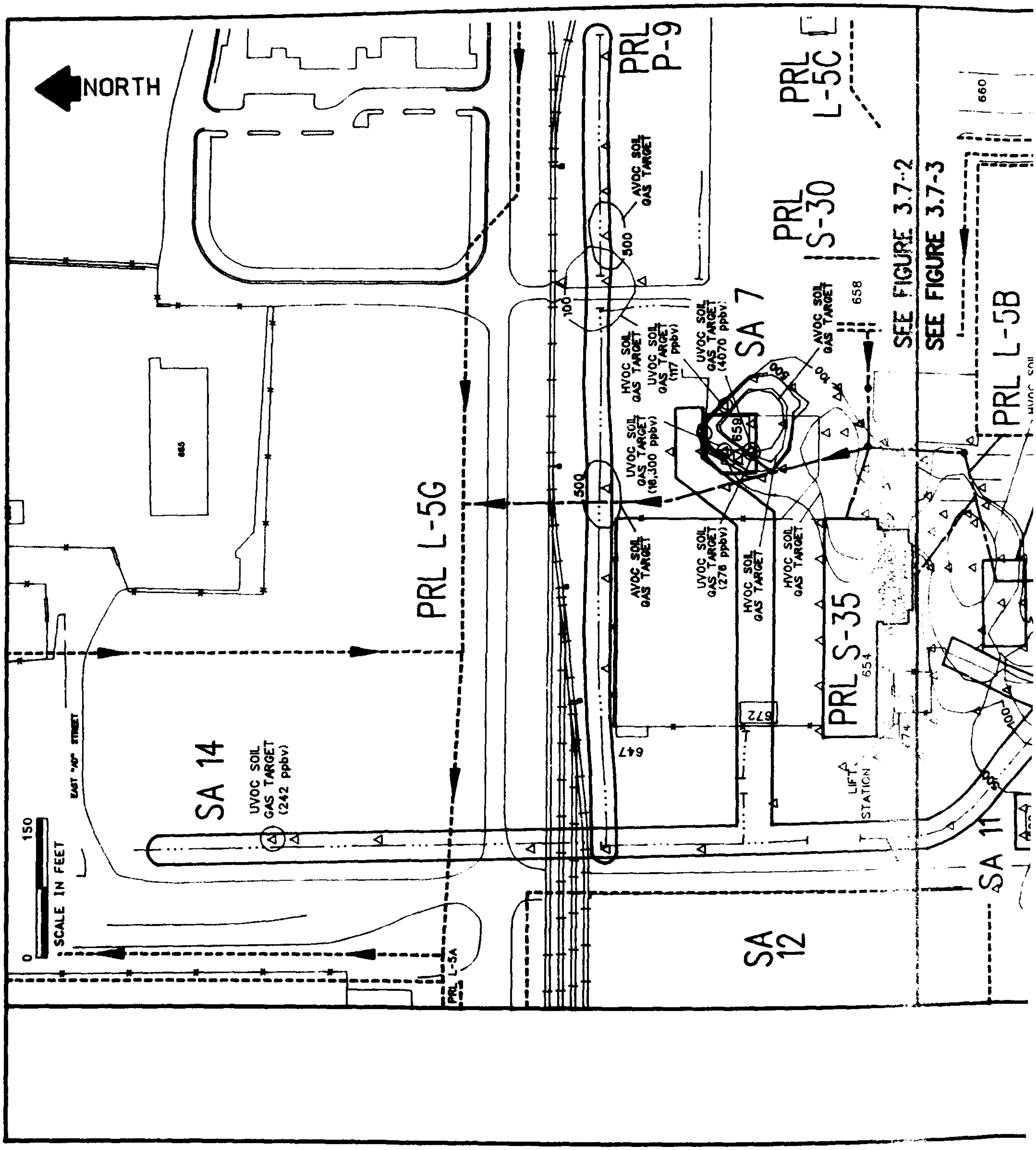
3.7 Investigation Cluster 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18)

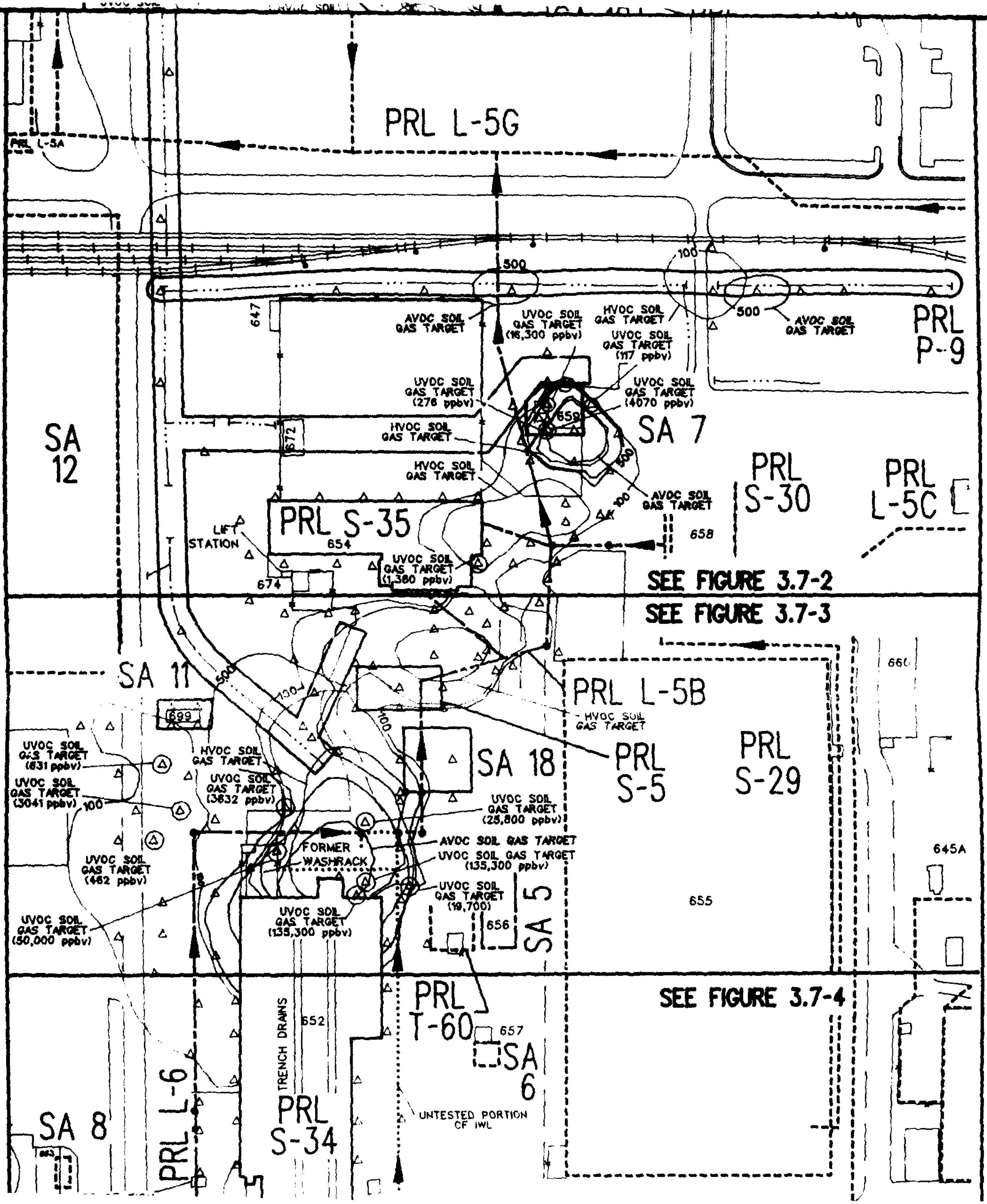
Investigation Cluster 7 consists of PRL L-5B, the northern section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18, and is located in the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 7. Although each of these ten sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

3.7.1 Site Descriptions

Potential Release Location L-5B

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the pipes. The IWL at PRL L-5 is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-5B is the section of PRL L-5 extending throughout the IC 7 area. Figures 3.7-1, 3.7-2B, 3.7-3B, and 3.7-4B show the surface trace of PRL L-5B and locations of access covers or manholes (MH). Most of the piping system is constructed of 8-inch vitrified clay pipe, but 4-, 8-, and 10-inch asbestos-concrete, cast iron, and vitrified clay pipes are found in some sections of PRL L-5B. The flow from IWL section PRL L-6 converges with the flow of PRL L-5B north of Building 652 (Figure 3.7-3B). The IWL at PRL L-5B has received wastewater from 10 different facilities since 1953. Industrial activities at the facilities connected to PRL L-5 include maintenance, paint removal, painting, cleaning, industrial wastewater processing, and hazardous material storage described previously in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Table 3.7-1 summarizes the available information concerning the historical operations performed and materials handled in buildings contributing to the flow through the IWL in PRL L-5B.


NORTH
PRL P-9
PRL L-5C
PRL S-30
PRL L-5G
PRL S-35
PRL L-5B
PRL L-5A
SEE FIGURE 3.7-2
SEE FIGURE 3.7-3
SA 7
SA 14
SA 12
SA 11
AVOC SOIL GAS TARGET
HVOC SOIL GAS TARGET
UVOC SOIL GAS TARGET (117 ppbv)
UVOC SOIL GAS TARGET (4070 ppbv)
UVOC SOIL GAS TARGET (16,300 ppbv)
UVOC SOIL GAS TARGET (276 ppbv)
UVOC SOIL GAS TARGET (242 ppbv)
500
100
655
658
659
660
654
572
647
LIFT STATION
EAST "AD" STREET
SCALE IN FEET
0
150


PRL L-5G
PRL L-5A
500
100
AVOC SOIL GAS TARGET
UVOC SOIL GAS TARGET (16,300 ppbv)
HVOC SOIL GAS TARGET
UVOC SOIL GAS TARGET (117 ppbv)
500
AVOC SOIL GAS TARGET
PRL P-9
647
UVOC SOIL GAS TARGET (276 ppbv)
UVOC SOIL GAS TARGET (4070 ppbv)
659
SA 7
SA 12
672
HVOC SOIL GAS TARGET
HVOC SOIL GAS TARGET
500
100
AVOC SOIL GAS TARGET
PRL S-30
PRL L-5C
PRL S-35
654
LIFT STATION
658
674
UVOC SOIL GAS TARGET (1,380 ppbv)
SEE FIGURE 3.7-2
SEE FIGURE 3.7-3
660
SA 11
500
100
PRL L-5B
HVOC SOIL GAS TARGET
699
100
UVOC SOIL GAS TARGET (631 ppbv)
HVOC SOIL GAS TARGET
SA 18
PRL S-5
PRL S-29
UVOC SOIL GAS TARGET (3041 ppbv)
100
UVOC SOIL GAS TARGET (3632 ppbv)
UVOC SOIL GAS TARGET (25,800 ppbv)
AVOC SOIL GAS TARGET
FORMER WASHRACK
UVOC SOIL GAS TARGET (135,300 ppbv)
645A
UVOC SOIL GAS TARGET (462 ppbv)
UVOC SOIL GAS TARGET (19,700)
655
UVOC SOIL GAS TARGET (50,000 ppbv)
UVOC SOIL GAS TARGET (135,300 ppbv)
656
SA 5
SEE FIGURE 3.7-4
PRL T-60
657
652
TRENCH DRAINS
SA 6
PRL L-6
UNTESTED PORTION OF IWL
SA 8
PRL S-34

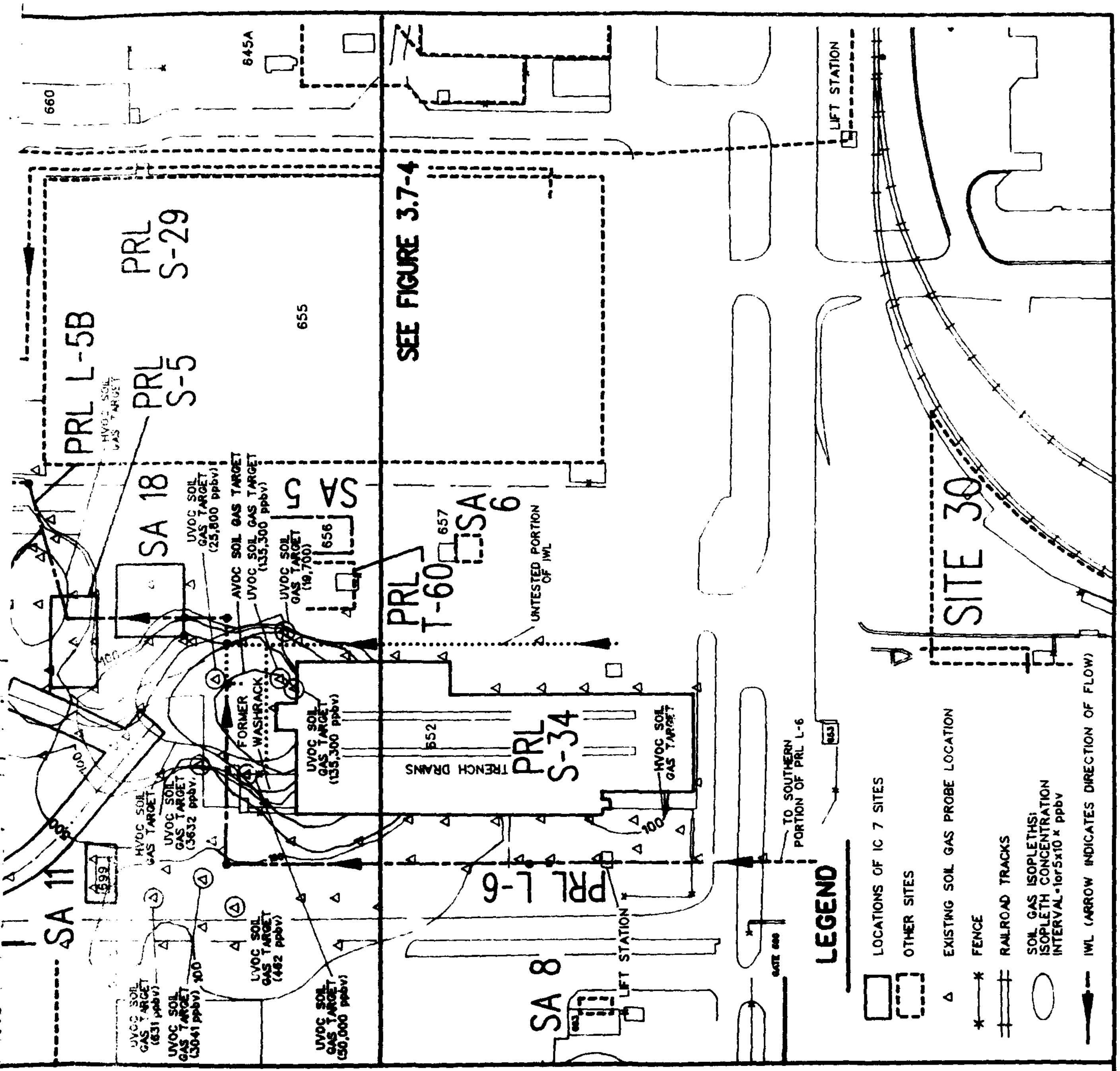
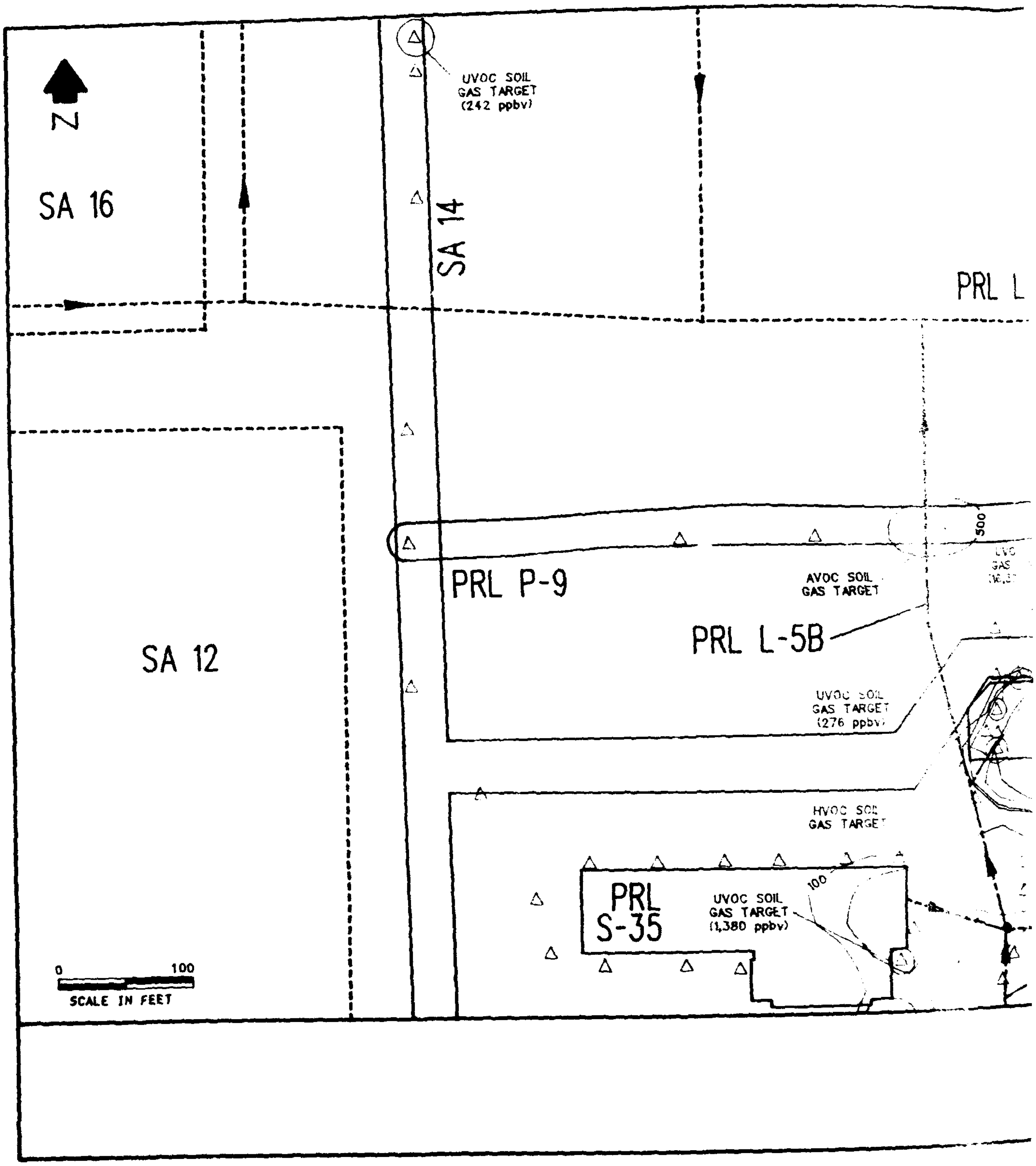
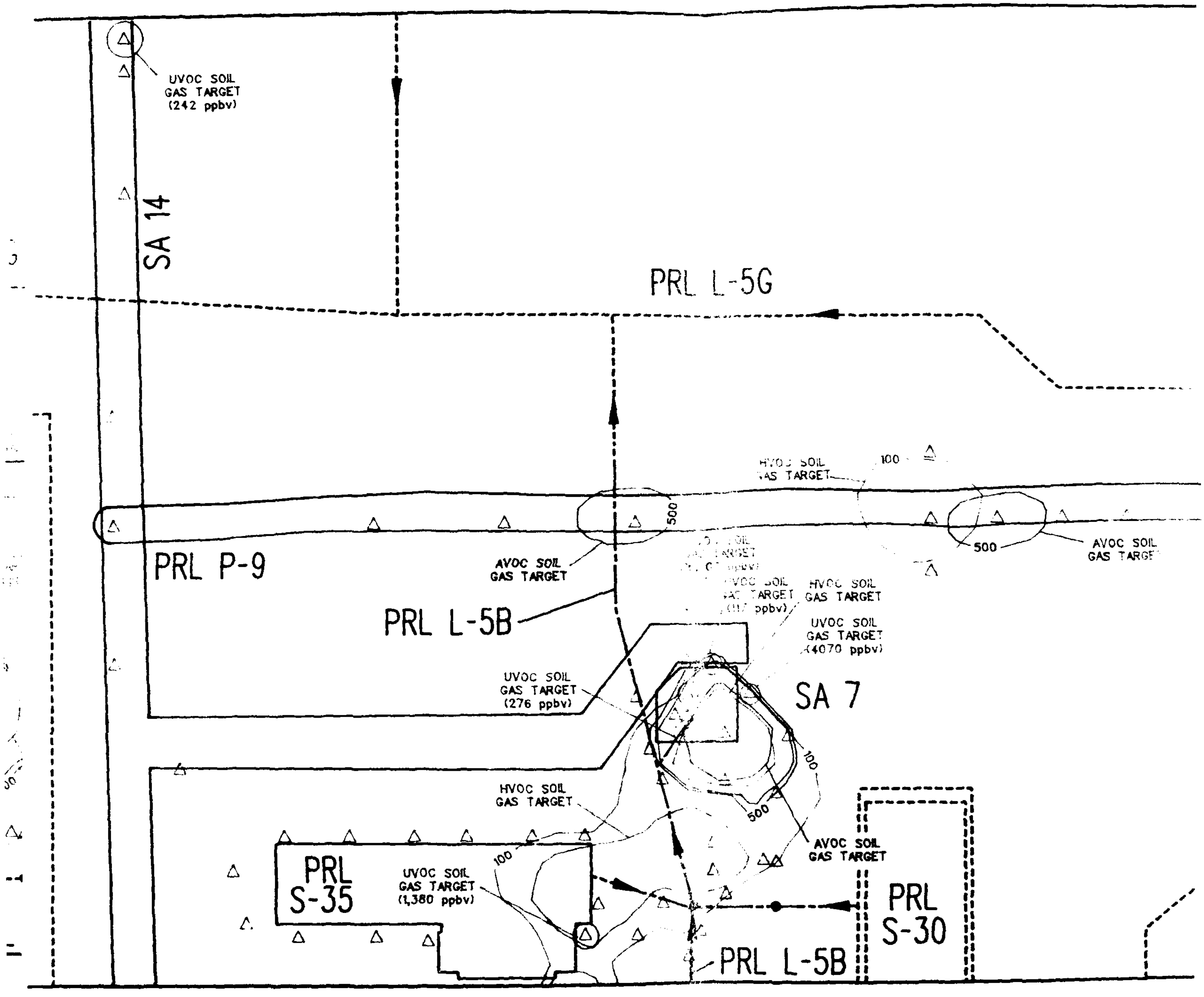


Figure 3.7-1. Soil Gas Investigation Data for IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

RADIAN CORPORATION




UVOC SOIL
GAS TARGET
(242 ppbv)
SA 14
PRL L-5G
HVOC SOIL
GAS TARGET
100
500
AVOC SOIL
GAS TARGET
500
AVOC SOIL
GAS TARGE
PRL P-9
AVOC SOIL
GAS TARGET
HVOC SOIL
GAS TARGET
HVOC SOIL
GAS TARGET
ppbv)
UVOC SOIL
GAS TARGET
(4070 ppbv)
PRL L-5B
UVOC SOIL
GAS TARGET
(276 ppbv)
SA 7
100
HVOC SOIL
GAS TARGET
500
AVOC SOIL
GAS TARGET
100
PRL
S-35
UVOC SOIL
GAS TARGET
(1,380 ppbv)
PRL
S-30
PRL L-5B

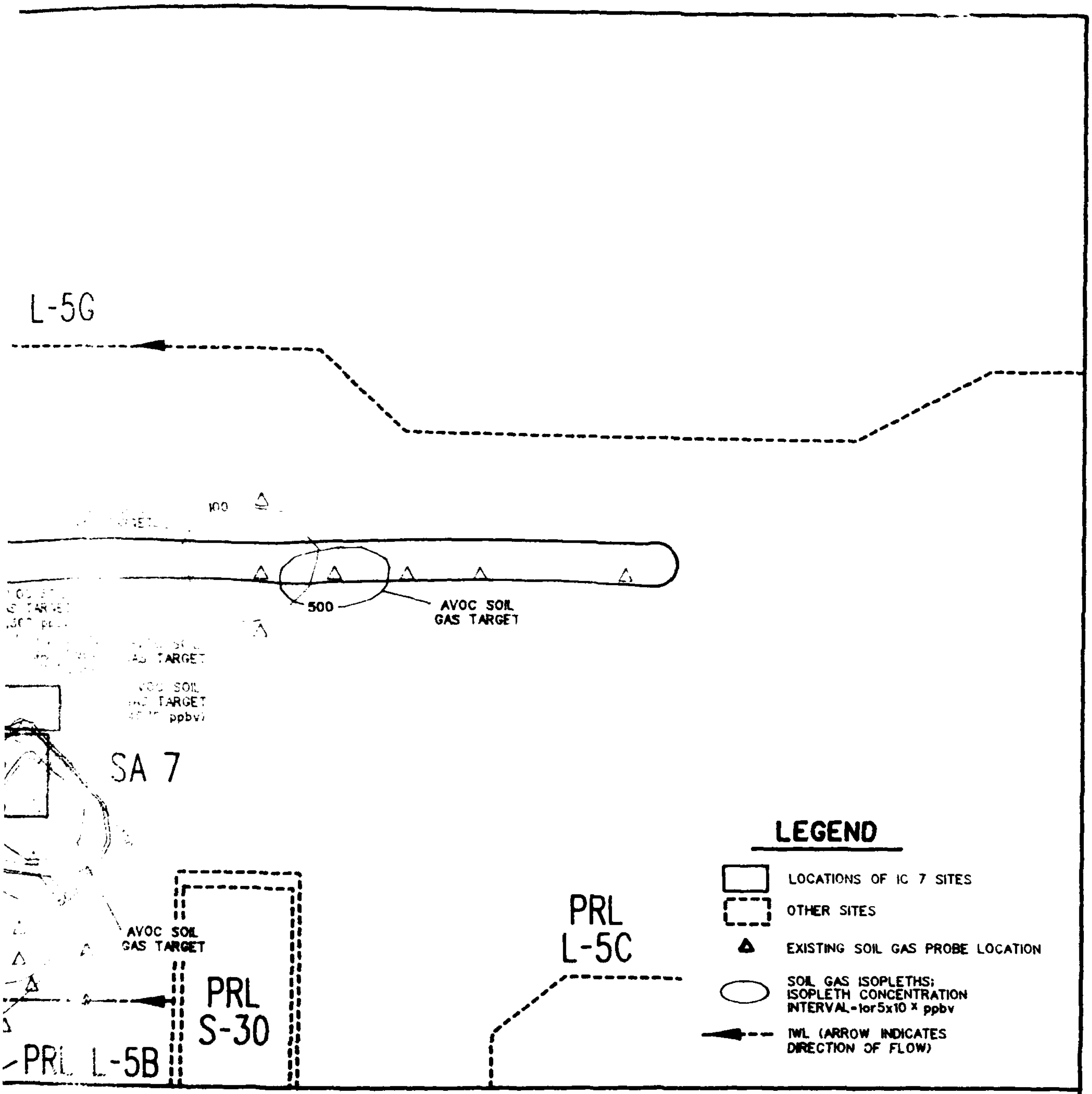


Figure 3.7-2A. Soil Gas Investigation Data for Northern Portion of IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

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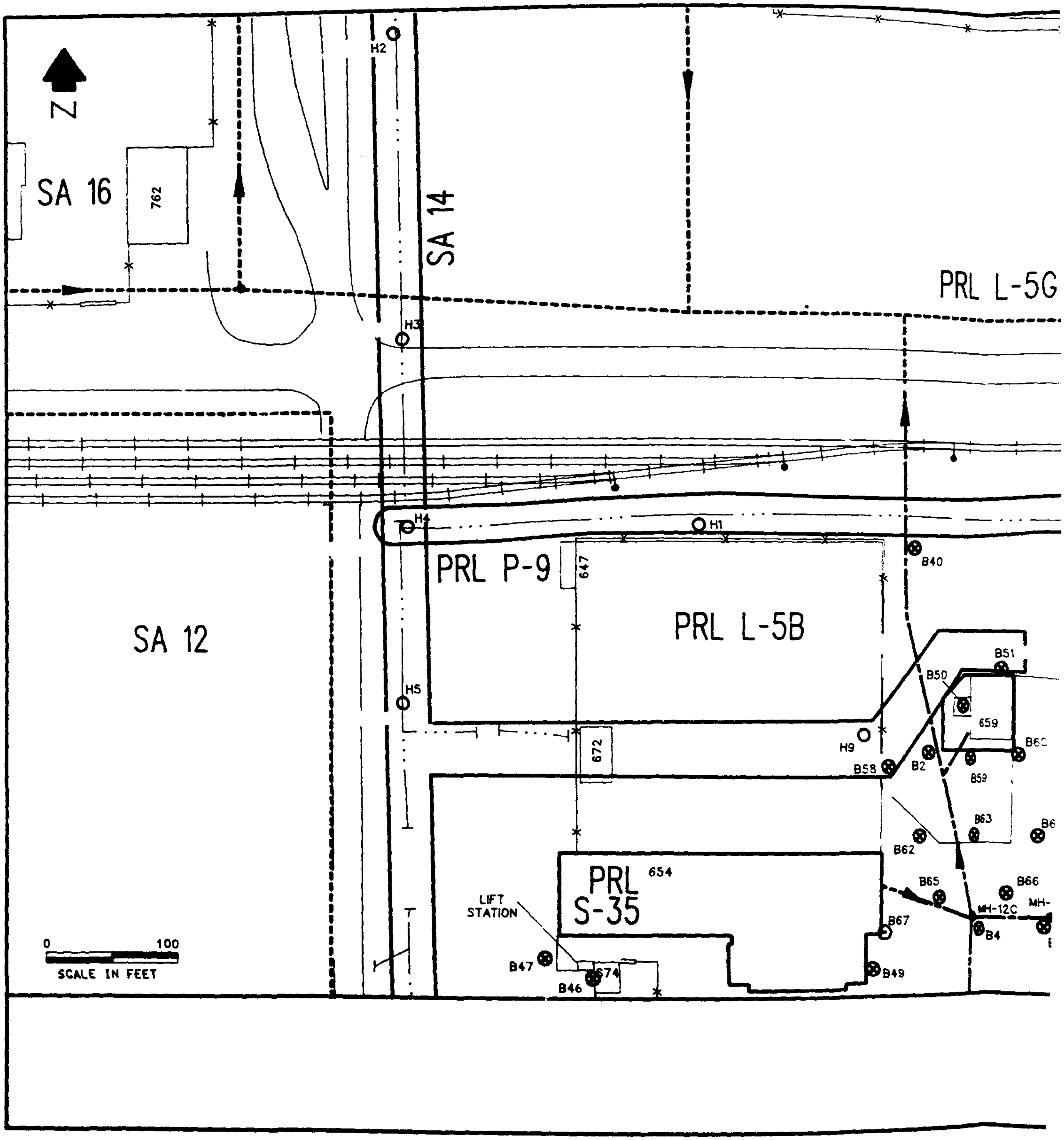
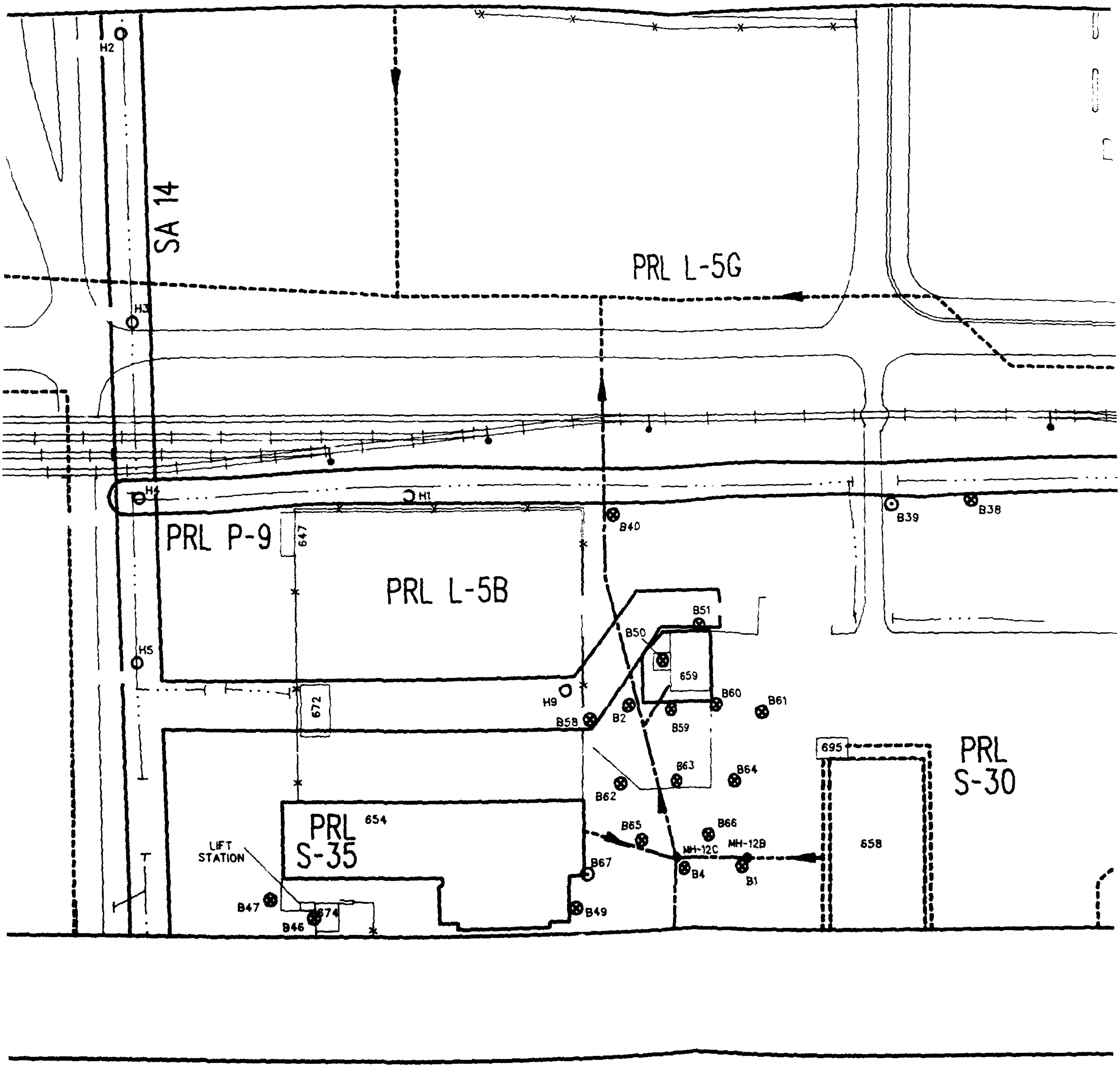

N
SA 16
762
SA 14
H2
H3
PRL L-5G
H4
H1
PRL P-9
647
PRL L-5B
B40
SA 12
H5
B51
B50
659
H9
B6C
B58
B2
B59
672
B63
B62
B6
PRL
654
S-35
B65
B66
LIFT
STATION
MH-12C
MH-
B67
B4
B47
B46
674
B49
0
100
SCALE IN FEET


H2
SA 14
PRL L-5G
H3
H4
H1
B39
B38
PRL P-9
647
B40
PRL L-5B
B51
B50
H5
659
B60
B61
H9
B58
B2
B59
672
695
PRL
S-30
B63
B64
B62
PRL
S-35
654
B65
B66
LIFT
STATION
MH-12C
MH-12B
658
B67
B4
B1
B47
674
B49
B46

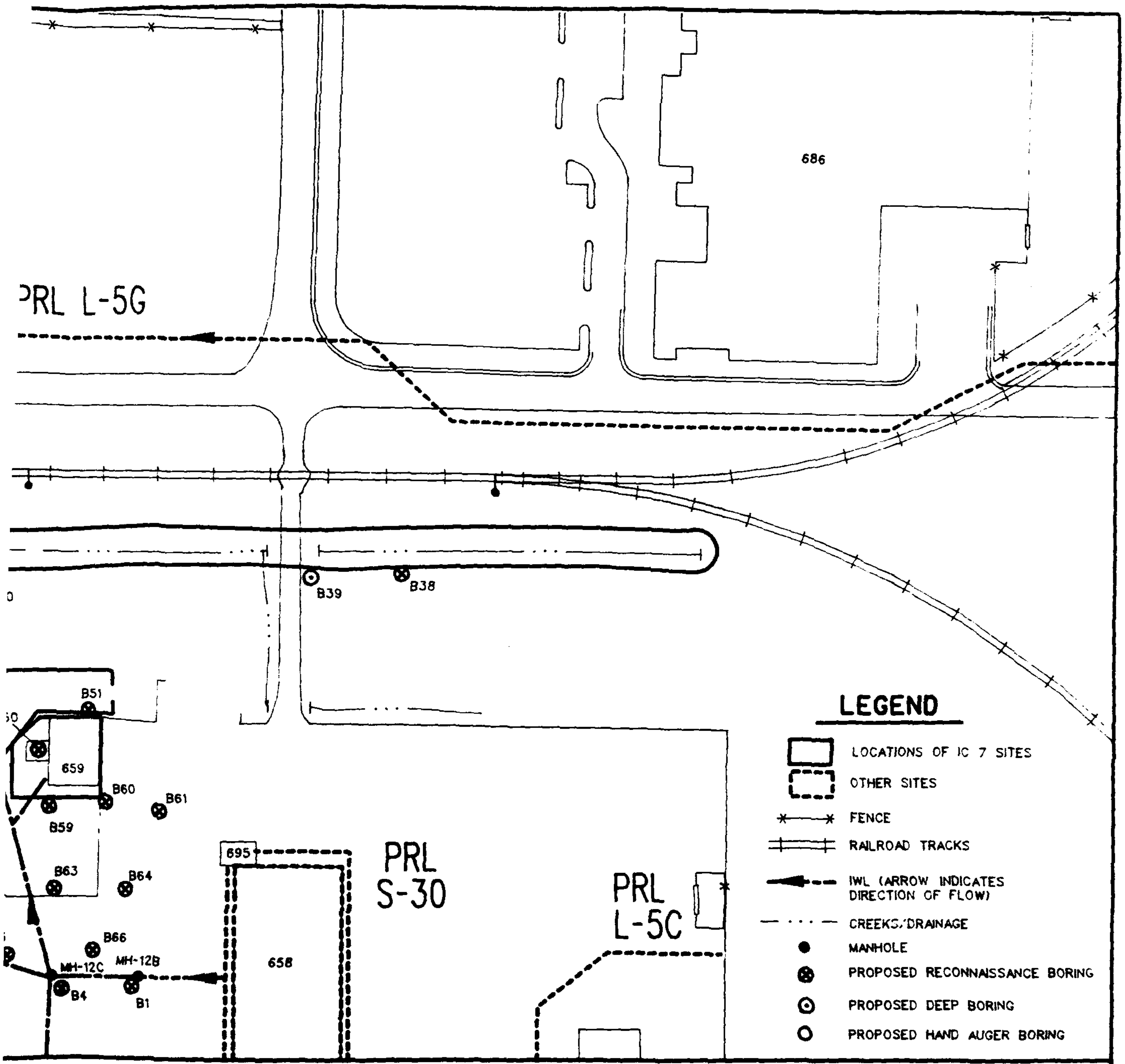


Figure 3.7-2B. Site Features and Soil Boring Locations for Northern Portion of IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

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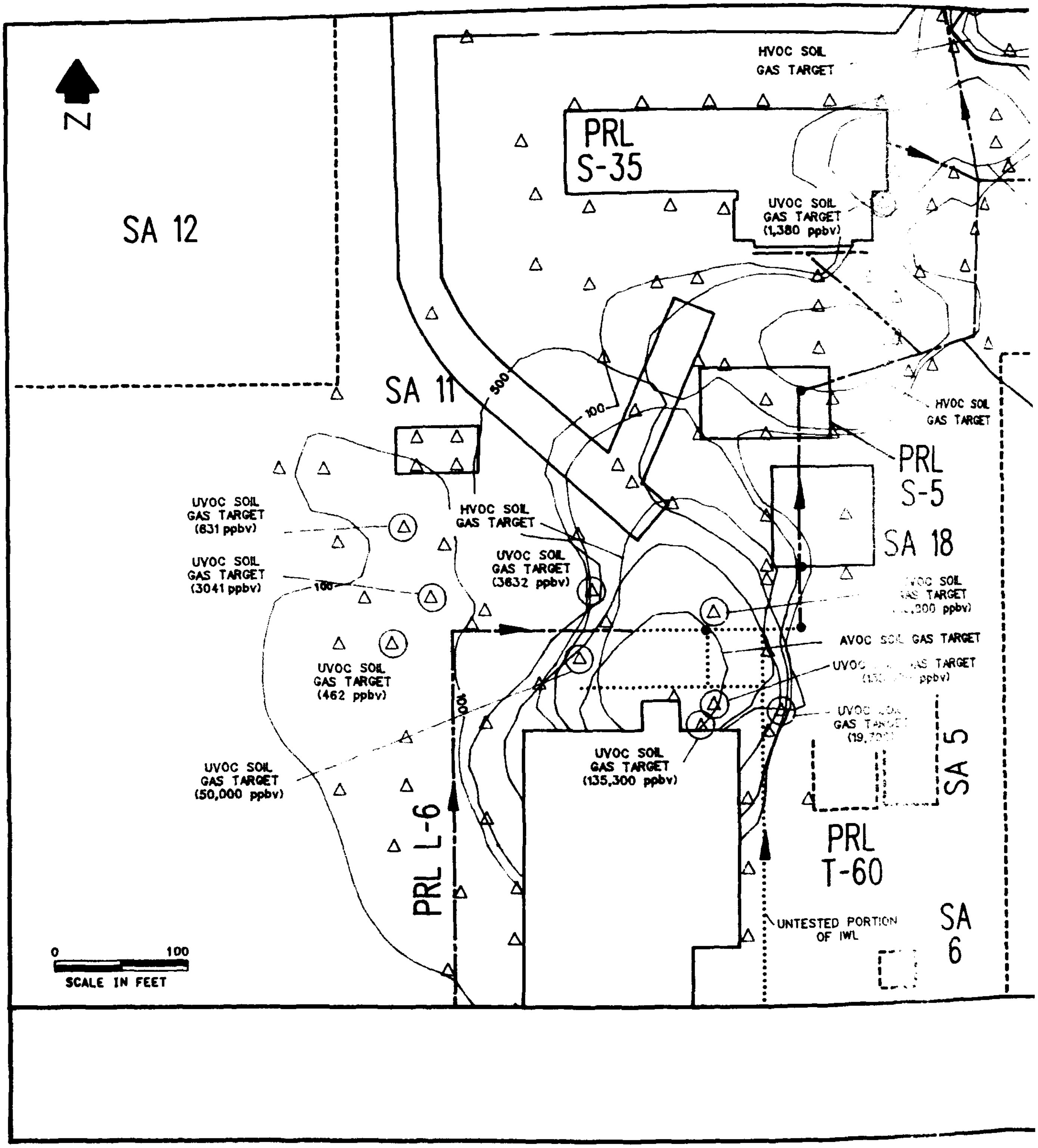
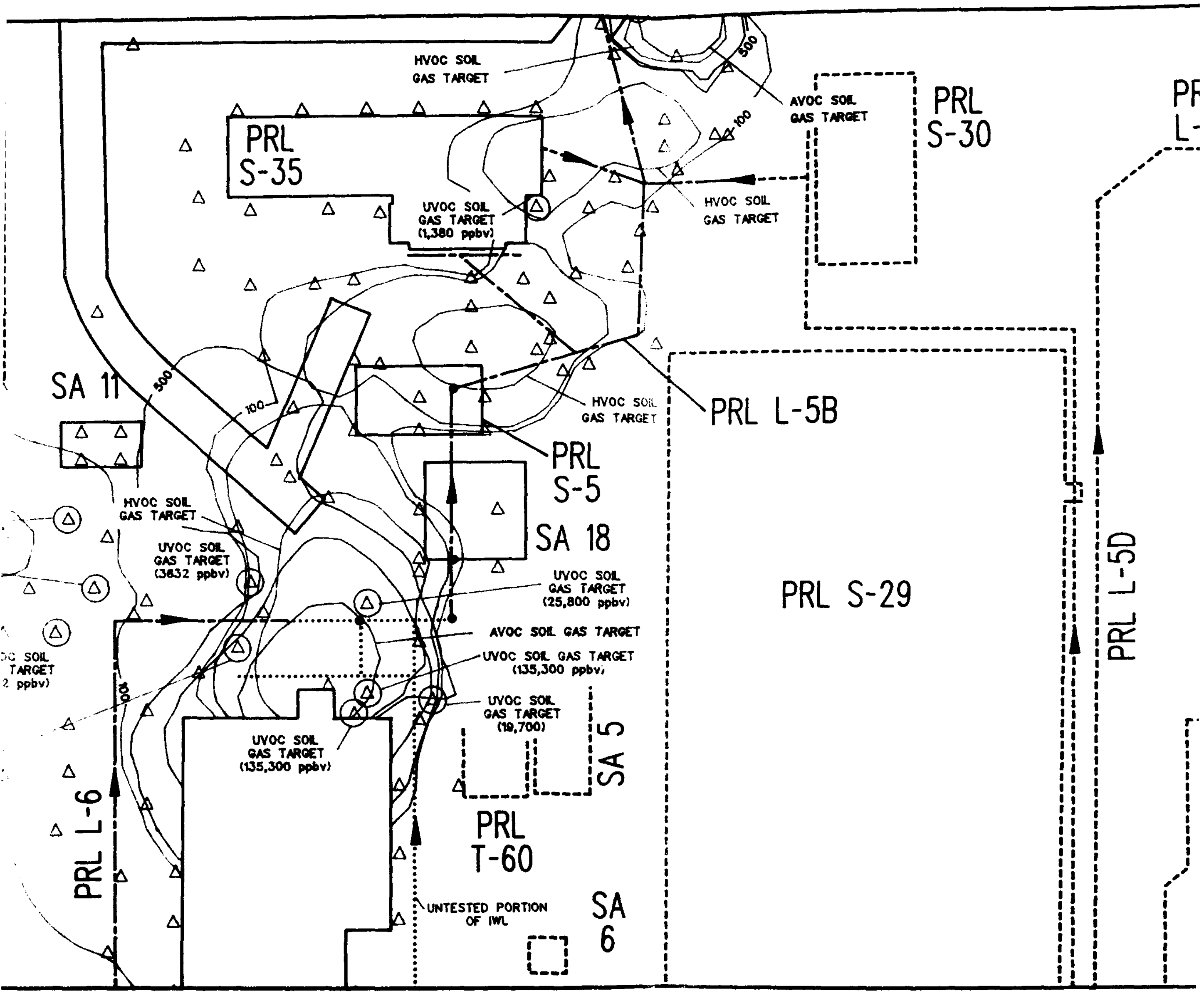
RADIAN CORPORATION




HVOC SOIL GAS TARGET
500
AVOC SOIL GAS TARGET
PRL S-30
PR
L-
PRL S-35
100
UVOC SOIL GAS TARGET (1,380 ppbv)
HVOC SOIL GAS TARGET
SA 11
500
100
HVOC SOIL GAS TARGET
PRL L-5B
PRL S-5
HVOC SOIL GAS TARGET
UVOC SOIL GAS TARGET (3632 ppbv)
SA 18
UVOC SOIL GAS TARGET (25,800 ppbv)
AVOC SOIL GAS TARGET
PRL S-29
PRL L-5D
OC SOIL
TARGET
2 ppbv)
UVOC SOIL GAS TARGET (135,300 ppbv)
100
UVOC SOIL GAS TARGET (19,700)
SA 5
PRL L-6
UVOC SOIL GAS TARGET (135,300 ppbv)
PRL T-60
UNTESTED PORTION OF IWL
SA 6

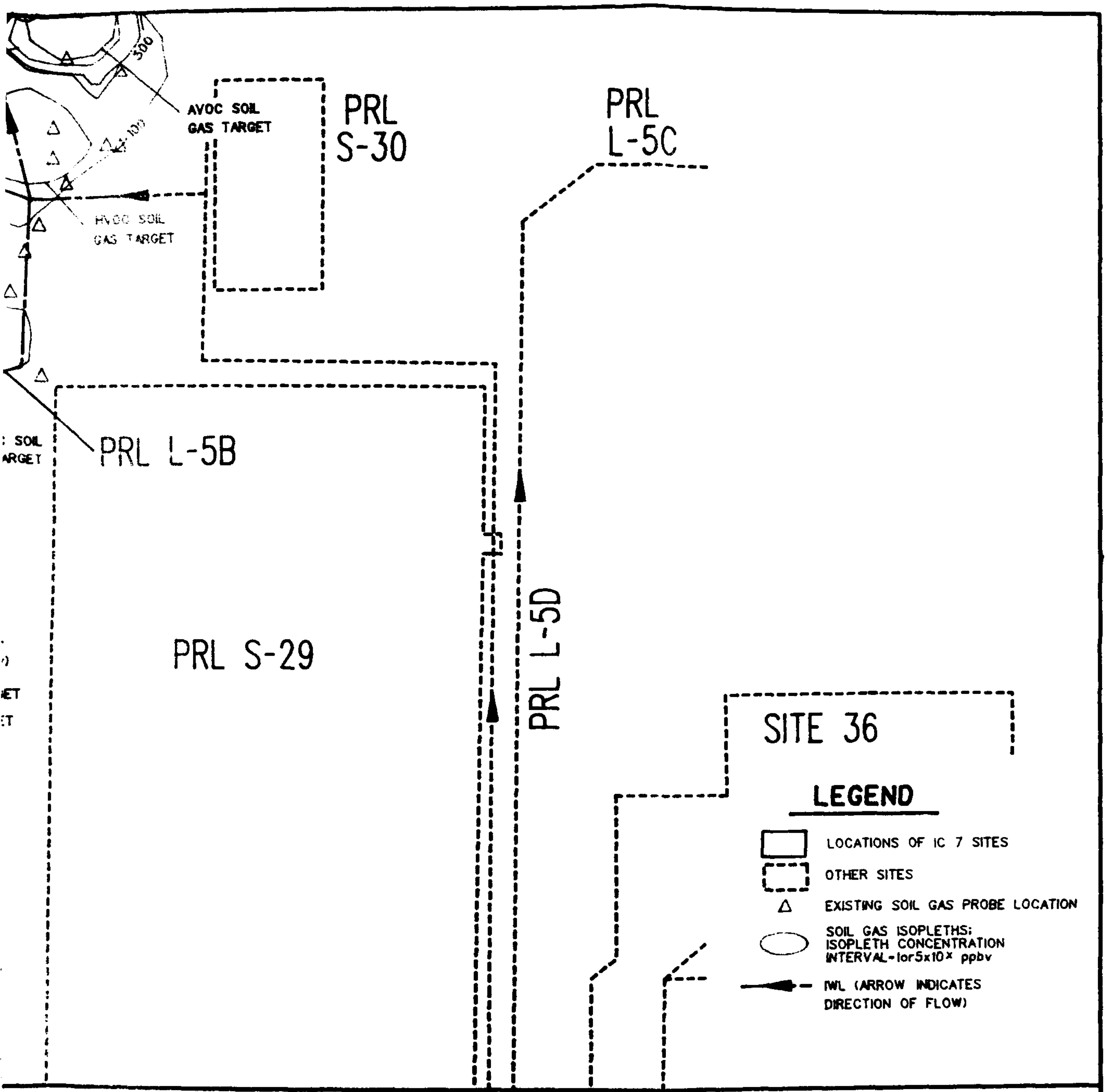
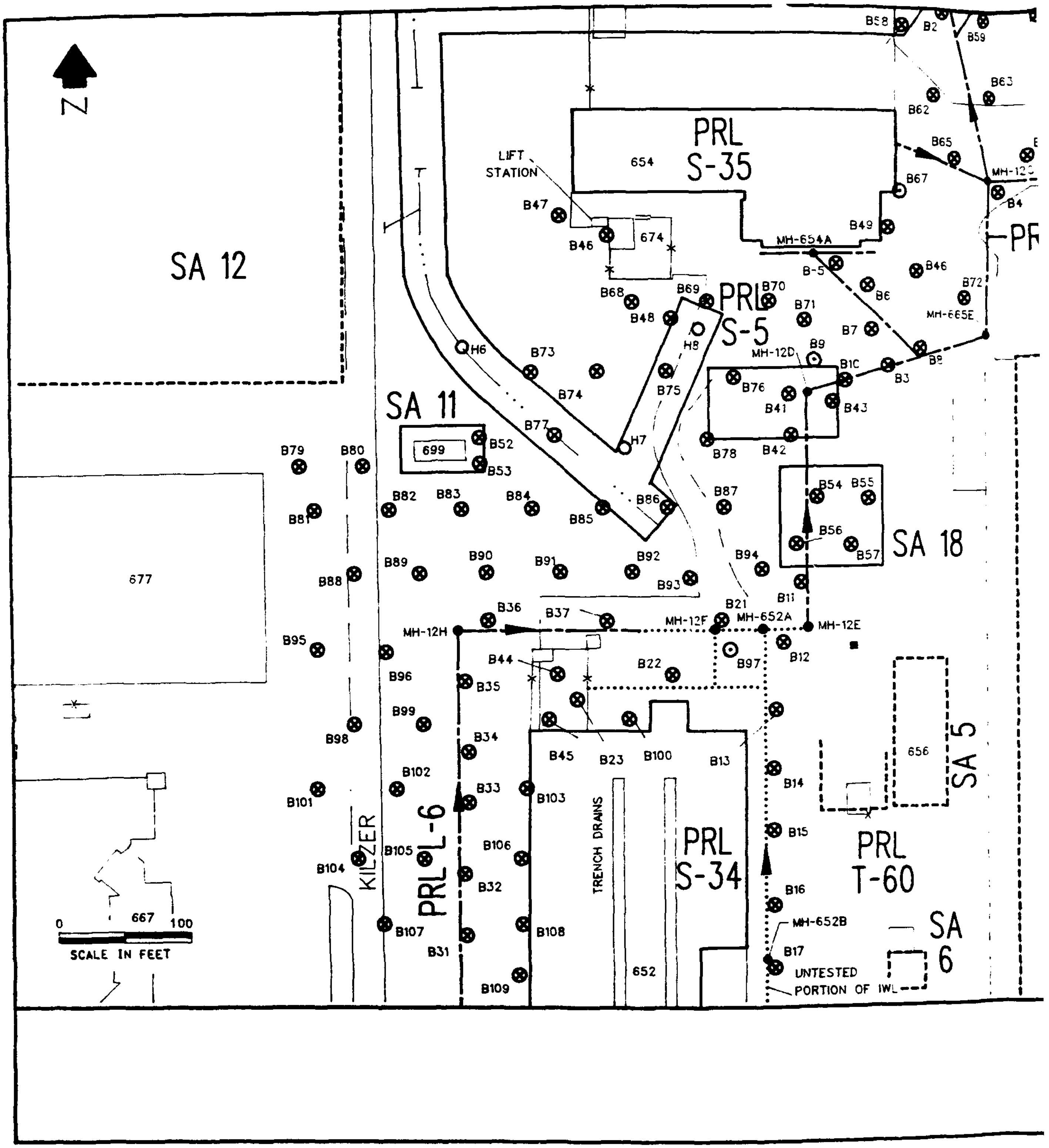
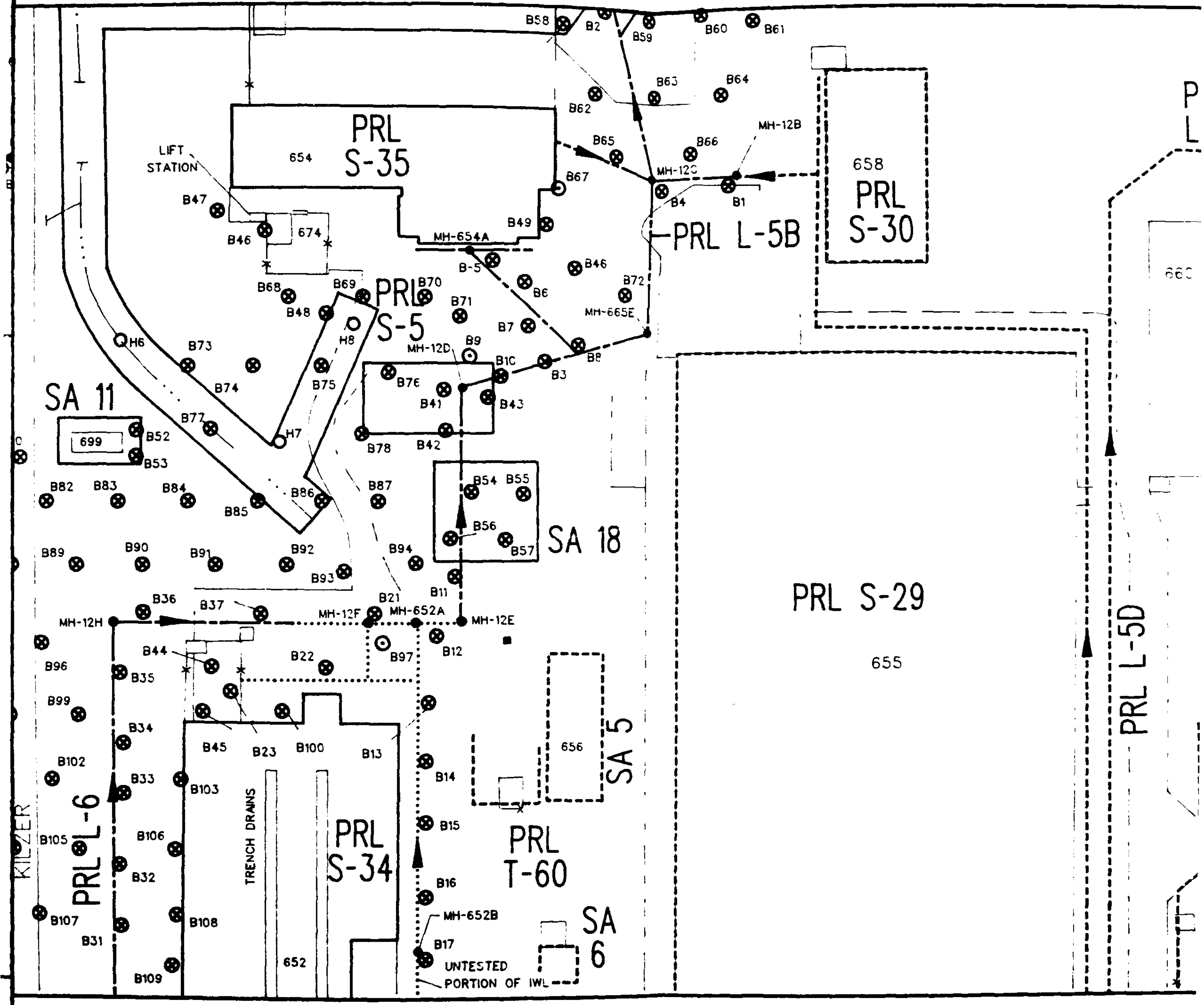


Figure 3.7-3A. Soil Gas Investigation Data for Central Portion of IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

RISAP2 RIC781 8/30/91

RADIAN
CORPORATION




PRL S-35
654
LIFT STATION
674
PRL S-5
PRL L-5B
658
PRL S-30
SA 11
699
SA 18
SA 5
656
PRL S-29
655
PRL L-5D
PRL L-6
KILZER
TRENCH DRAINS
PRL S-34
652
PRL T-60
SA 6
UNTESTED PORTION OF IWL
MH-654A
MH-12C
MH-12B
MH-665E
MH-12D
MH-12H
MH-12F
MH-652A
MH-12E
MH-652B
H6
H7
H8
B-5
B1
B2
B3
B4
B6
B7
B8
B9
B10
B11
B12
B13
B14
B15
B16
B17
B21
B22
B23
B31
B32
B33
B34
B35
B36
B37
B41
B42
B43
B44
B45
B46
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B48
B49
B52
B53
B54
B55
B56
B57
B58
B59
B60
B61
B62
B63
B64
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B66
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B68
B69
B70
B71
B72
B73
B74
B75
B76
B77
B78
B82
B83
B84
B85
B86
B87
B89
B90
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B103
B105
B106
B107
B108
B109
660

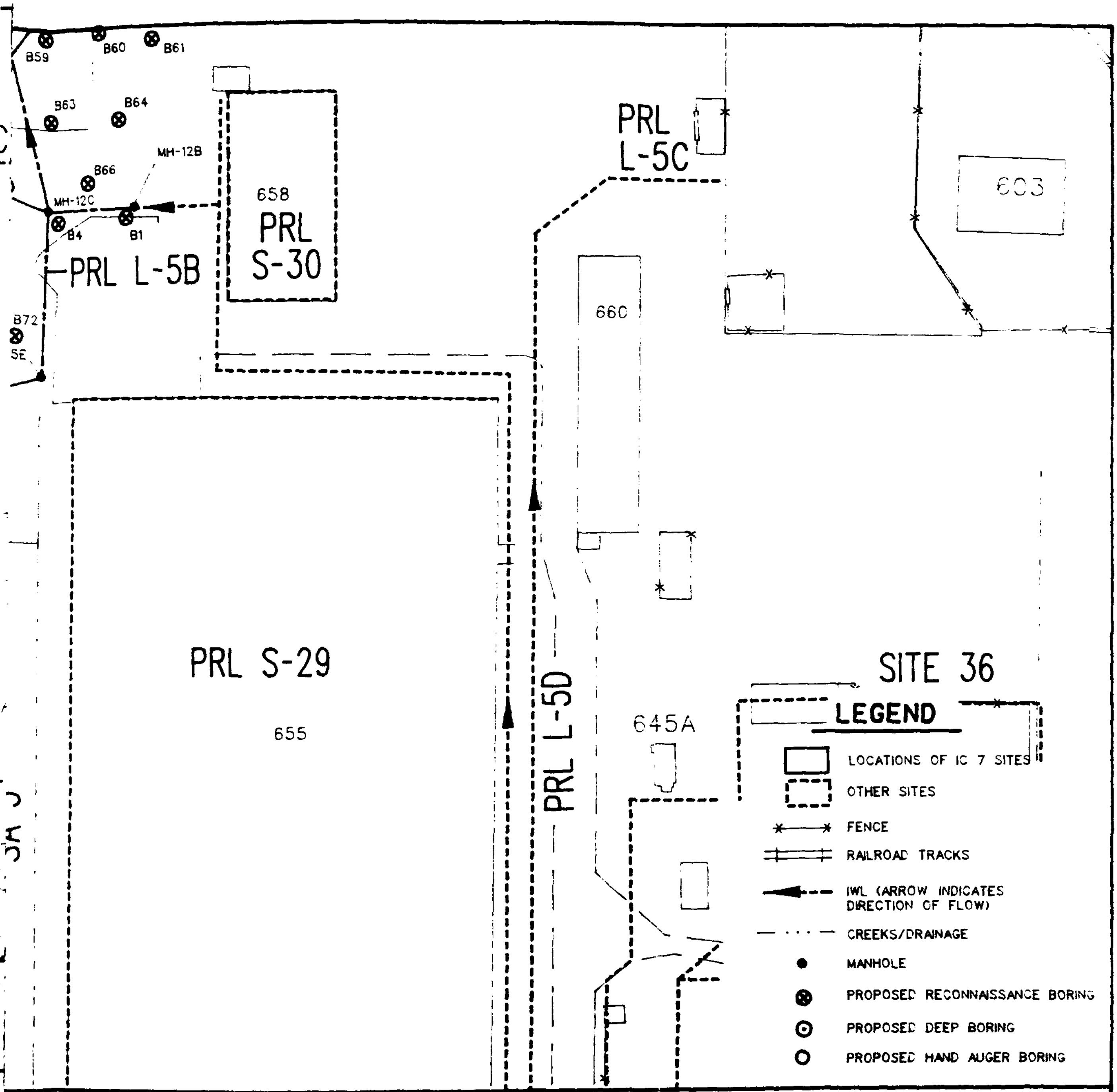

Figure 3.7-3B. Site Features and Soil Boring Locations for Central Portion of IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

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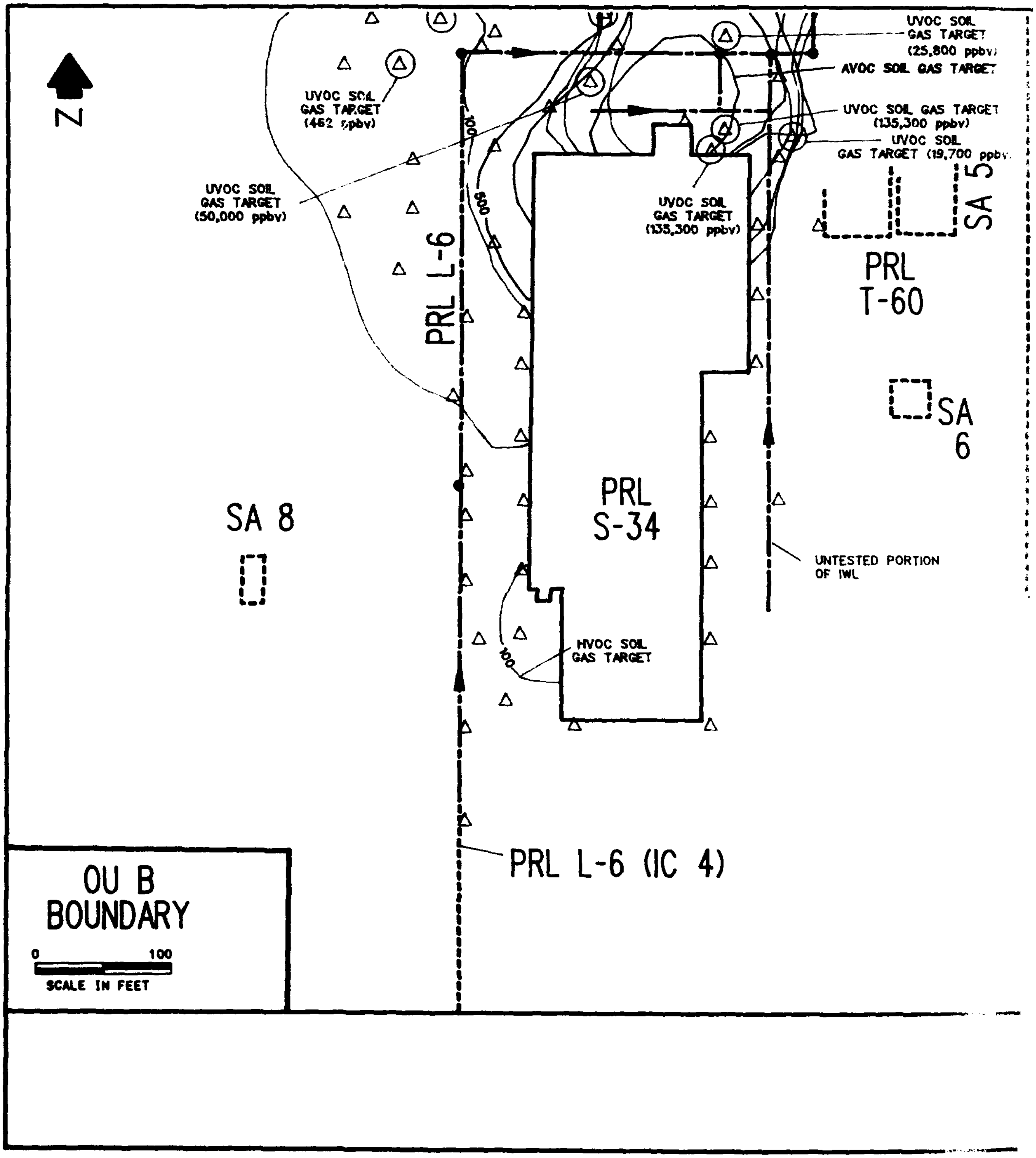
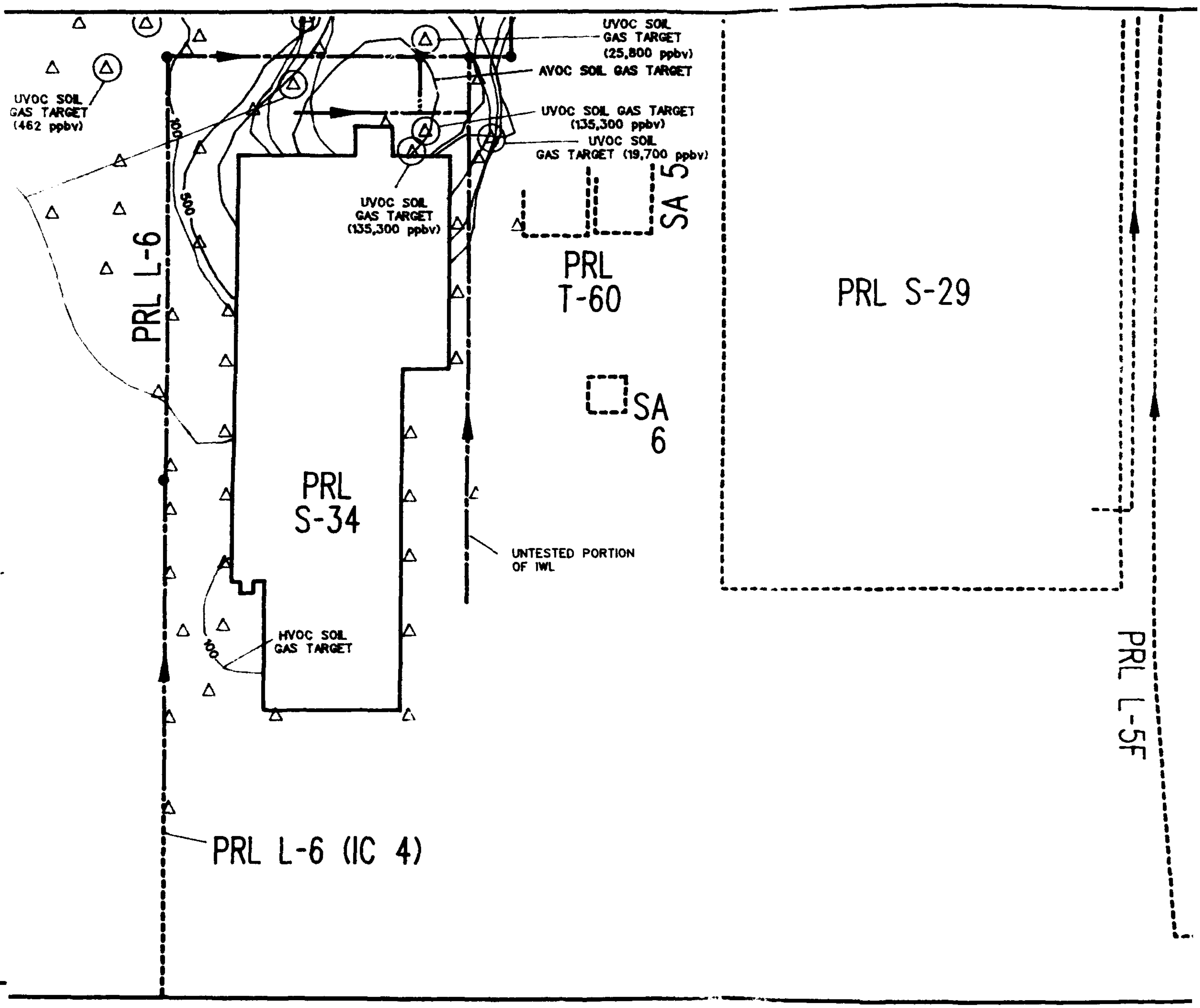

N
UVOC SOIL GAS TARGET (25,800 ppbv)
AVOC SOIL GAS TARGET
UVOC SOIL GAS TARGET (462 ppbv)
UVOC SOIL GAS TARGET (135,300 ppbv)
UVOC SOIL GAS TARGET (19,700 ppbv
UVOC SOIL GAS TARGET (50,000 ppbv)
UVOC SOIL GAS TARGET (135,300 ppbv)
100
800
SA 5
PRL T-60
PRL L-6
SA 6
SA 8
PRL S-34
UNTESTED PORTION OF IWL
HVOC SOIL GAS TARGET
100
PRL L-6 (IC 4)
OU B BOUNDARY
0
100
SCALE IN FEET


UVOC SOIL GAS TARGET (25,800 ppbv)
AVOC SOIL GAS TARGET
UVOC SOIL GAS TARGET (135,300 ppbv)
UVOC SOIL GAS TARGET (19,700 ppbv)
UVOC SOIL GAS TARGET (462 ppbv)
UVOC SOIL GAS TARGET (135,300 ppbv)
100
500
PRL L-6
SA 5
PRL T-60
PRL S-29
SA 6
PRL S-34
UNTESTED PORTION OF IWL
HVOC SOIL GAS TARGET
100
PRL L-5F
PRL L-6 (IC 4)

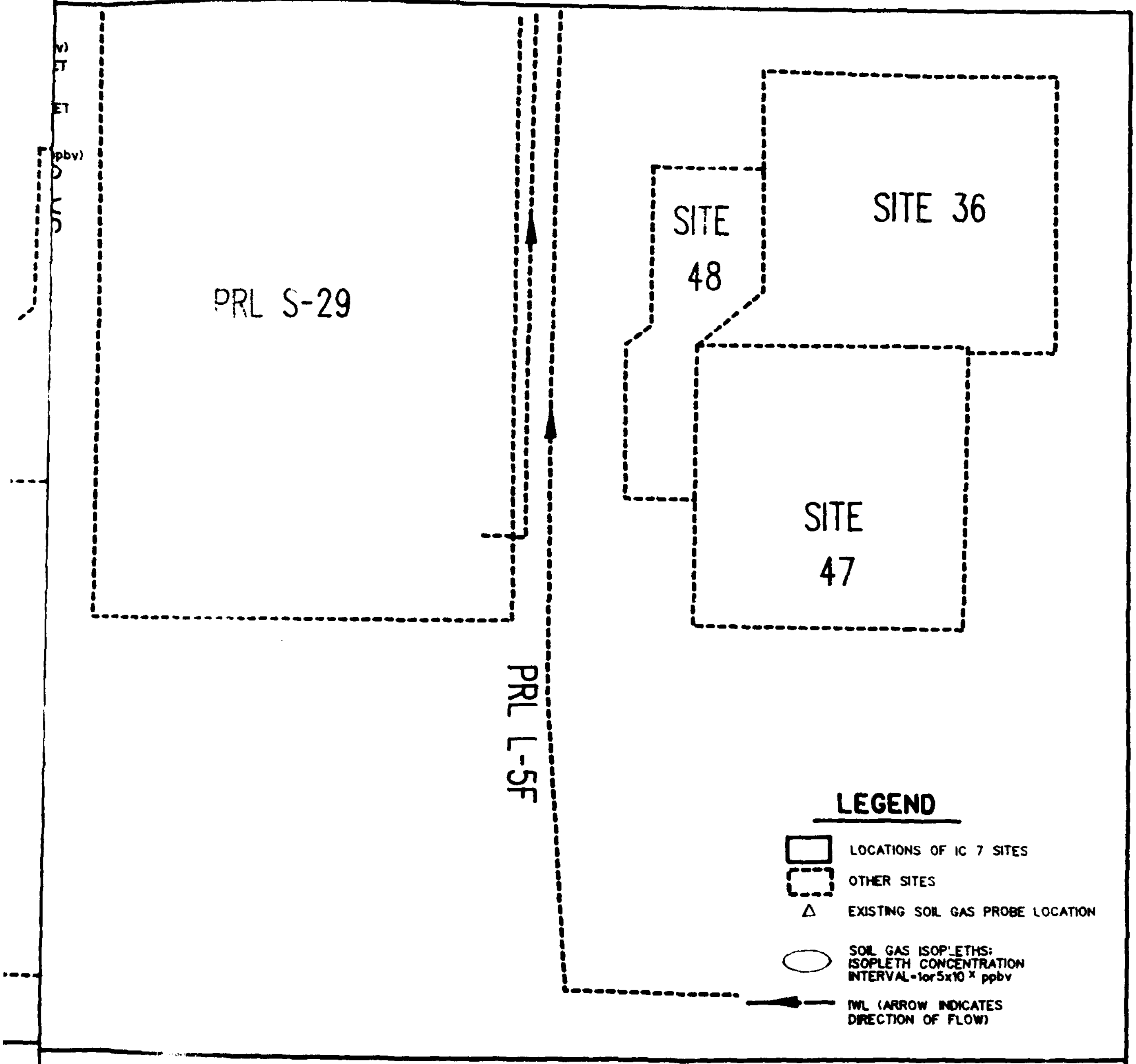
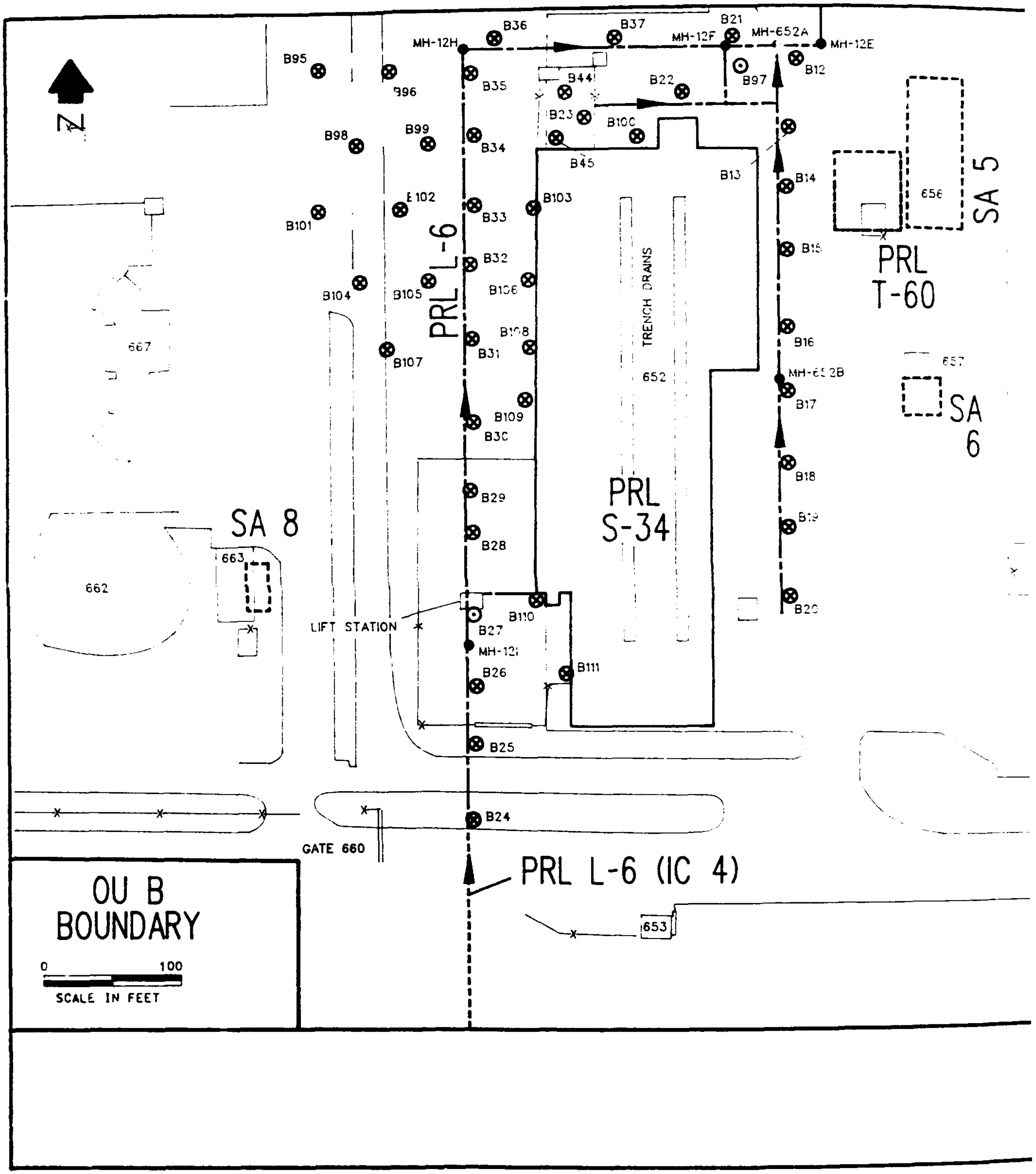
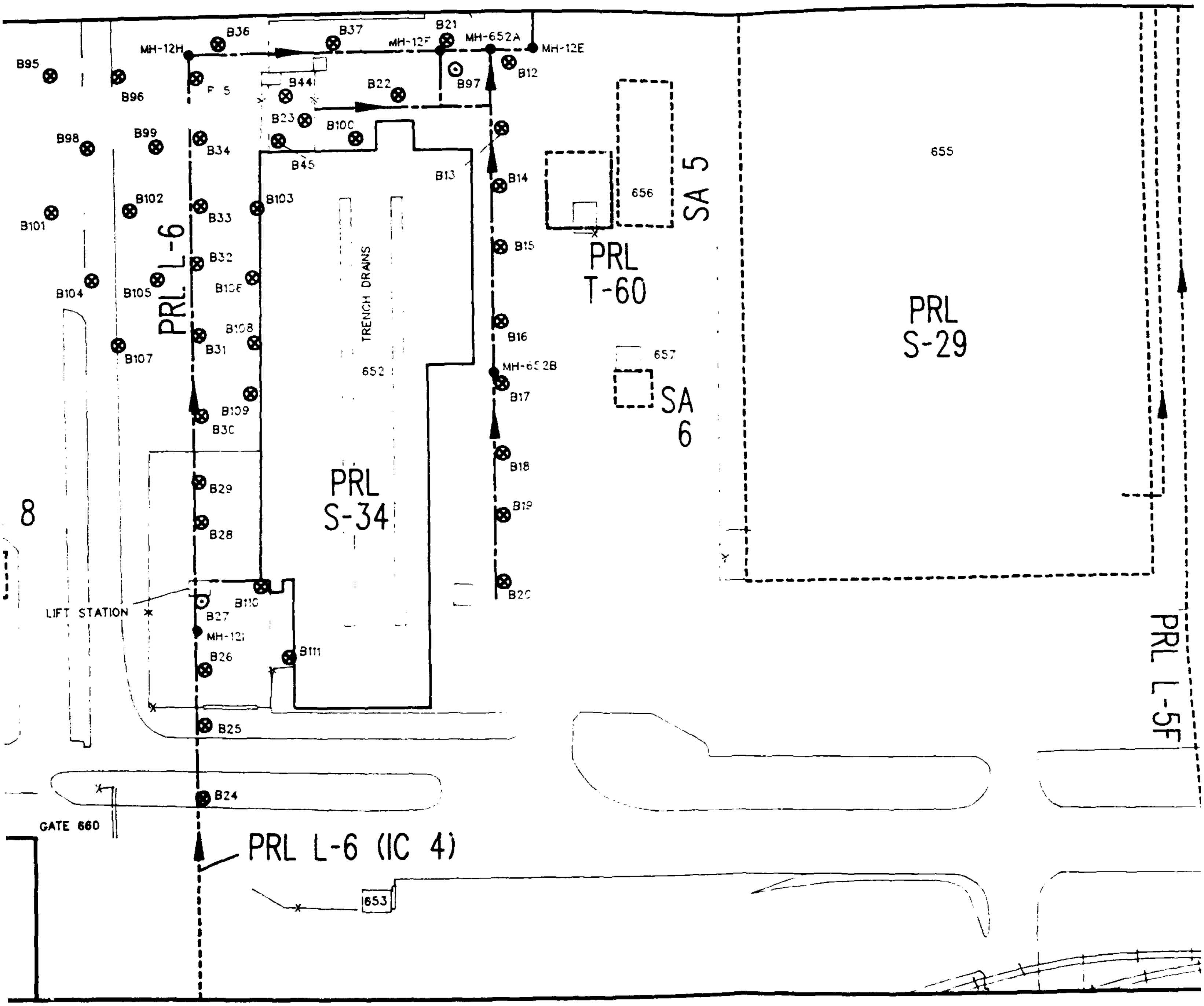


Figure 3.7-4A. Soil Gas Investigation Data for Southern Portion of IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

RISAP2 RIC7C1 8/28/91


N
B95
B96
B98
B99
B101
B102
B104
B105
B107
MH-12H
B36
B35
B34
B33
B32
B31
B30
B29
B28
B27
MH-12I
B26
B25
B24
PRL L-6
B37
B44
B23
B45
B100
B22
B21
MH-12F
B97
MH-652A
MH-12E
B12
B13
B14
B15
B16
MH-652B
B17
B18
B19
B20
B103
B106
B108
B109
B110
B111
TRENCH DRAINS
652
PRL S-34
656
SA 5
PRL T-60
657
SA 6
667
SA 8
662
663
LIFT STATION
GATE 660
PRL L-6 (IC 4)
653
OU B BOUNDARY
0
100
SCALE IN FEET


B95
B96
MH-12H
B36
B37
MH-12F
B21
MH-652A
MH-12E
B12
B97
B44
B22
B23
B100
B45
B13
B14
B98
B99
B34
B102
B101
B33
B103
PRL L-6
B32
B106
B104
B105
TRENCH DRAINS
B108
B31
B107
652
B109
B30
B29
B28
PRL S-34
8
LIFT STATION
B27
B110
MH-12I
B26
B111
B25
B24
GATE 660
PRL L-6 (IC 4)
653
B15
B16
MH-652B
B17
B18
B19
B20
656
SA 5
PRL T-60
657
SA 6
655
PRL S-29
PRL L-5F

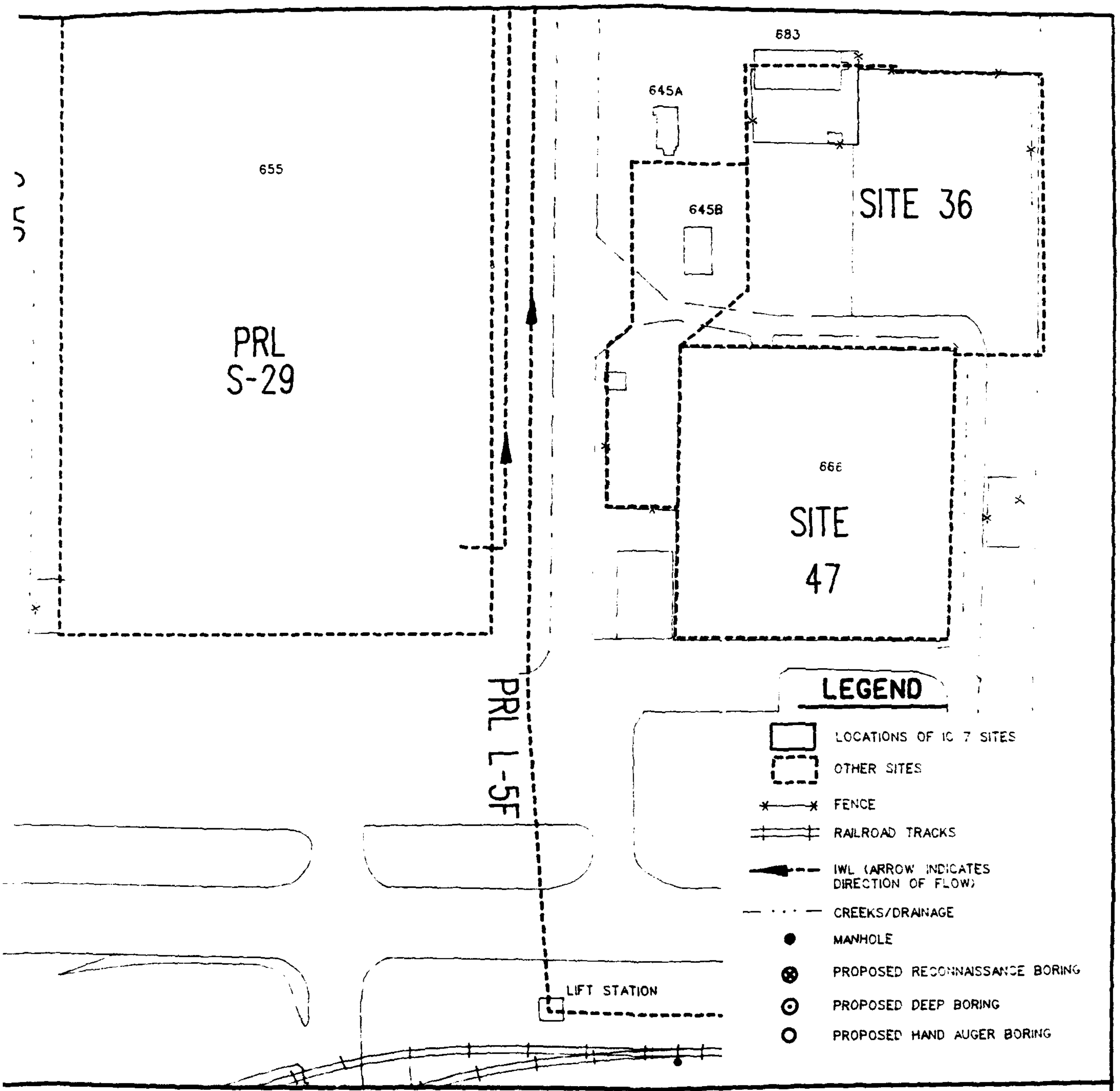


Figure 3.7-4B. Site Features and Soil Boring Locations for Southern Portion of IC 7 (PRL L-5B, Northern Section of PRL L-6, PRL P-9, PRL S-5, PRL S-34, PRL S-35, SA 7, SA 11, SA 14, and SA 18).

RIIC7C2 9/2/91

TABLE 3.7-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED IN BUILDINGS CONTRIBUTING TO THE FLOW THROUGH PRL L-5B (IC 7)

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL carrying wastewater from:		
Building 610: VAN repair, maintenance	1953 - Present	S
Building 613: washrack, electronics shop	1953 - Present	NA
Building 640: electronics repair shop, paint shop, paint booth, and solvent booths (PRL T-7)	1953 - Present	S, P
Building 603: oil separator	1953 - Present	F
IWTP No. 4: pretreatment of plating shop wastes, now removed (Site 48)	1957 - 1980	A, B, C, M
Building 655: fuel-tanker servicing, aircraft/vehicle painting, PCB storage, and van repair (PRL S-29)	1955 - Present	F, P, PCB, S
Building 658: washrack, solvent/steam cleaning, and paint stripping (PRL S-30)	1953 - Present	A, F, P, S
Building 654: ground power equipment repair (PRL S-35)	1953 - Present	S, F
Building 569: washrack fueling area, and staging area (SA 7)	1951 - Present	F, S
IWTP No. 2	1956 - 1974	F, M, P, S

PRL = Potential Release Location
A = Acids
B = Bases
C = Cyanide compound
F = Fuels and oils
M = Metals listed in California Code of Regulations, Title 22
NA = Not Available
P = Paint
PCB = Polychlorinated biphenyls
S = Solvents

The section of PRL L-5 which appears on McClellan AFB utilities maps extending from MH-12C to MH-665B to MH-12D has been investigated by EG&G (1988). The section extending from MH-665E to MH-12C showed no evidence of damage; the sections extending from MH-665E to MH-12D had cracks. The portion of PRL L-5B east of MH-12F and south of MH-12E was also investigated by EG&G in 1988 but was not pressure tested or grout repaired.

Northern Section of PRL L-6

The IWL at PRL L-6 is also an underground piping system that carries wastewater using gravity flow and one lift station. Figures 3.7-1 and 3.7-4B shows the surface trace of PRL L-6 in IC 7 and locations of access covers. The piping system is constructed of 6-inch vitrified clay pipe, but 6-inch asbestos-concrete and cast iron pipes are also present in some sections of PRL L-6. The IWL at PRL L-6 has received wastewater from Building 628 and from the washrack at Building 652 since 1957. Building 628 was a research laboratory from 1957 to late 1988, where classic wet chemistry and classified research, some of which involved radionuclides, were performed. The washrack at Building 652 was used for washing and steam cleaning air conditioners. As a result of historical operations at the two facilities, acids, bases, metals, radionuclides, solvents, unspecified volatile and semivolatile organic compounds, and phenols may have passed through the IWL at PRL L-6.

Potential Release Location P-9 and Study Area 14

Potential Release Location P-9 and SA 14 constitute different portions of an interconnected drainage ditch system (Figures 3.7-1, 3.7-2B, and 3.7-3B) and will be investigated as one location. The unlined ditch system at PRL P-9 and SA 14 historically received effluent from three known locations: IWTP Nos. 2 and 4, and Building 659 (Radian, 1990a). The ditch may also have received effluent from an underground fuel tank near Building 699 and spills from aboveground fuel tanks near Building 654. The potential contaminants discharged to the drainages at PRL P-9 and SA 14 include acids and bases, cyanide compounds, fuels and oils, metals, paints, and solvents.

Potential Release Location S-5

Potential Release Location S-5 is the historical location of IWTP No. 2 (Figures 3.7-1 and 3.7-3B). The IWTP operated from approximately 1956 to 1974, when it was dismantled. According to employee interviews, influent to the plant consisted primarily of paints, oils, solvents, chromate from paint stripping operations, and possibly metals.
Wastewater was transported to the IWTP via the IWL (PRL L-5), which crosses the southeast corner of the site. Treated effluent from the plant was discharged to the ditch west of the plant, now designated as SA 14.

The potential contaminant sources at PRL S-5 include an underground storage sump and an adjacent, aboveground, open-top equalization tank (Figures 3.7-1 and 3.7-3B). The 3,800-gallon concrete sump was used to temporarily store influent to the plant while oils were skimmed from the influent. The sump was 11 feet deep and may have leaked. It may have been removed when the IWTP was dismantled. The 37,000-gallon aboveground equalization tank was located on a concrete pad without a secondary containment structure. Any spills from the open-top tank may have infiltrated the soils in the unpaved area surrounding the tank. The open-top tank has been removed, and the entire area of PRL S-5 has been paved with asphalt.

Potential Release Location S-34

Potential Release Location S-34 is Building 652 (Figures 3.7-1, 3.7-3B, and 3.7-4B), which was constructed in approximately 1949 and was originally used for the cleaning and repair of automotive equipment. In approximately 1955, operations in Building 652 were changed to include a paint spray booth and a degreaser washrack. Liquid wastes from these two operations were drained into two concrete trenches that parallel the length of Building 652 and discharge at its northern end to PRL L-6. The paint spray booth has since been removed; it was reportedly located in the southern portion of the building. The degreaser washrack, which has also been decommissioned, was located adjacent to the north side of Building 652. Exact dates of operation of the spray booth and washrack are not known. Materials handled in Building 652 operations include solvents, paints, fuels, oils, hydraulic fluids, and other unspecified volatile and semivolatile organic compounds. Building 652 is currently being refurbished for a new operation. The building will become the location of a repair and manufacturing operation for the servicing and repairing of wing tanks.

Potential Release Location S-35

Potential Release Location S-35 is Building 654 and the solvent spray booth that operated in it (Figures 3.7-1, 3.7-2B, and 3.7-3B). Constructed in 1965, operations in Building 654 include testing and repair of ground support equipment, such as gasoline and diesel generators. The solvent spray booth, which stood along the building's eastern wall, was removed in 1981; the exact date when the booth was constructed is not known. The spray booth was used to clean small parts; used solvent was collected in a holding tank and recycled. Materials handled in the building include fuels, hydraulic fluids, and solvents. Wastes are discharged to a trench drain that runs lengthwise down the center of the building. The drain connects to the IWL, PRL L-5B, on the east side of Building 654 (Figures 3.7-1, 3.7-2B, and 3.7-3B).

Building 674 will also be included in the investigation of PRL S-35; it is a small steam cleaning washrack located south of Building 654 that is used to remove dirt and oil residues from equipment. The washrack drain connects to the trench drain in the west end of Building 654. No information is available for the length of operation of the washrack or the trench drain in Building 654. The floors of both Building 654 and the washrack are paved. Both Buildings 654 and 674 are active Air Force facilities.

Study Area 7

Study Area 7 is Building 659, an abandoned washrack and tanker fueling facility (Figures 3.7-1 and 3.7-2B), which operated from approximately 1951 to 1981. The washrack is divided into three bays underlain by concrete and surrounded by concrete berms. Each bay is equipped with a floor drain; a fourth drain is located on top of a small elevated washrack. The concrete pavement and berms, which were most likely installed when the washrack was constructed in 1951, are believed to have been sufficient to contain contaminants within the washrack. Therefore, contamination of the surface surrounding the washrack is not suspected. However, the drains and underground piping that collected the wastewater are potential contaminant sources. The depth of the drain lines will be determined during the remedial investigation.

Three 1,000-gallon underground fuel tanks used for refueling of tanker trucks with JP-4 and JP-5 jet fuels were located immediately west of Building 659 within the study area boundary and are considered potential contaminant sources because they may have leaked. The tanks were not used after 1981. The tanks were emptied in 1987. Closure plans were written for all three tanks.

The closure plans state that the tanks were emptied and removal of the tanks was recommended; however, their removal has not been verified. A geophysical investigation of the area by JR Associates in 1991 indicated no anomalous radar reflections indicative of buried tanks around or inside Building 659.

Building 659 has been used as a hazardous materials staging area since 1987. Because the drains were sealed before storage of hazardous materials began and available information indicates that there have not been any spills in this area, the staging area is not considered a potential contaminant source.

Study Area 11

Study Area 11 is an underground storage tank near Building 699 (Figures 3.7-1 and 3.7-3B). The 200-gallon tank contained gasoline, which fueled the pump for Base Well 17. A plan for the closure and removal of the tank was prepared in 1986, and the contents of the tank were sampled and removed at that time. Oil and grease (1,200 ppm), benzene (18,200 ppm), ethyl benzene (6,700 ppm), toluene (28,100 ppm), xylenes (20,900 ppm), naphthalene (3,897 ppm), 2-methylnaphthalene (1,544 ppb), fluorene (7 ppb), phenanthrene (15 ppb), and anthracene (8 ppb) were detected in the samples. It is not known whether the tank was removed. A geophysical investigation performed by JR Associates in June 1991 indicated an anomalous reflection east of Building 699 that may be due to an object similar to a small tank. The ground surface north of the building is unpaved, and the drainage ditch (SA 14) receives storm runoff from the area.

Study Area 18

McClellan AFB Civil Engineering drawings and aerial photographs indicate that SA 18 was a fenced-in oil storage yard from approximately 1957 to 1975. The fenceline of the yard delineates the study area boundaries (Figures 3.7-1 and 3.7-3B).

Drums that may have leaked oil during storage are a potential source of contamination. Although asphalt pavement now covers the area, it is not known whether the area was paved while it was used for storage.

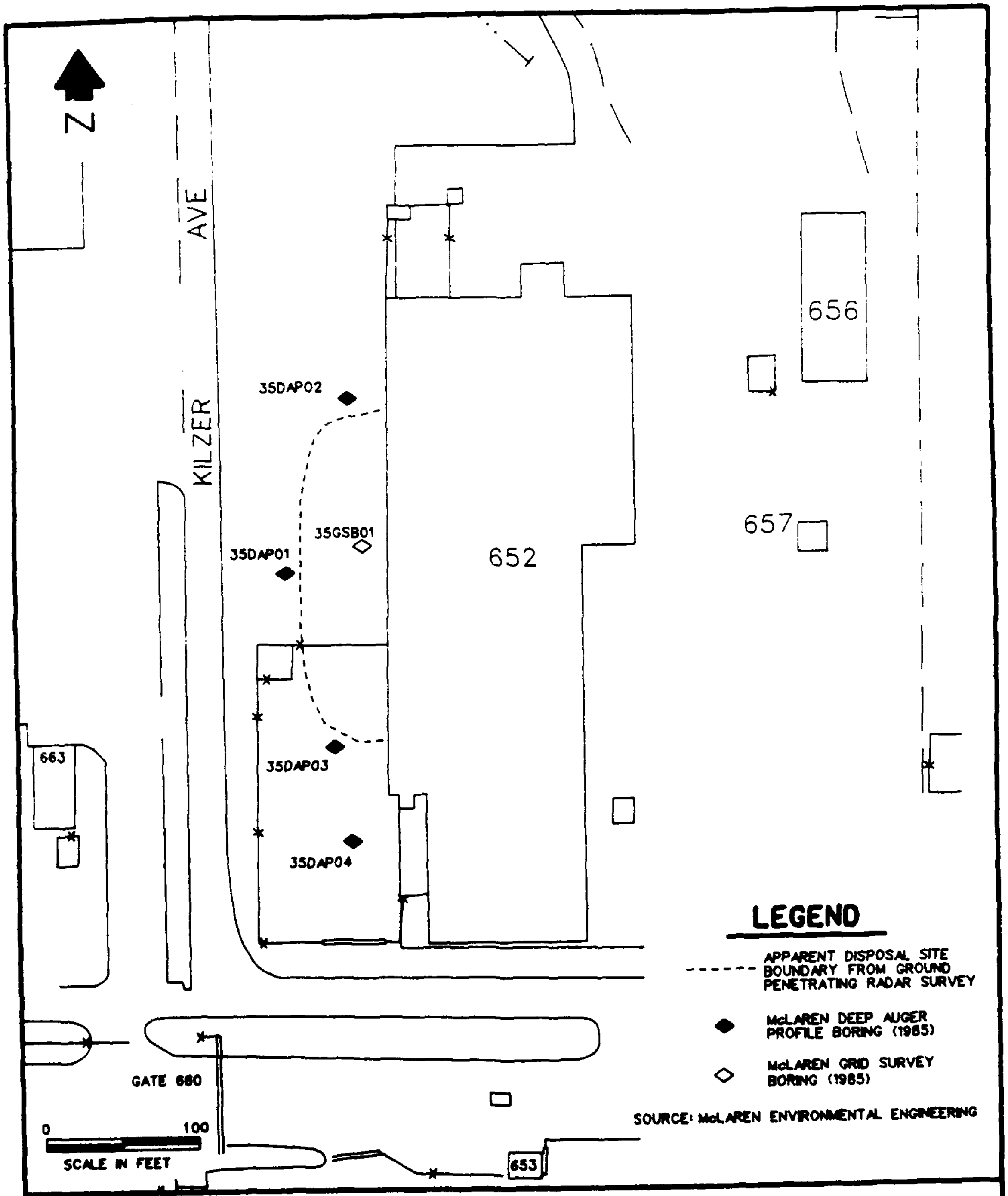
3.7.2 Previous Investigations

In February 1985, McLaren Environmental Engineering used ground penetrating radar (GPR) in an attempt to locate a scrap metal burial pit adjacent to Building 652 (PRL S-34). The survey delineated an area of apparent soil disturbance to the west of the building. Four deep auger profile borings and one grid survey boring were drilled in and around the GPR delineation at the locations shown in Figure 3.7-5. No evidence of wastes or contamination was found in the borings and the investigation of the burial pit was terminated. It has been reported that the materials disposed of at the pit were removed in 1950.

In 1988, EG&G Idaho, Inc., tested the integrity of the IWL at PRL L-5 and PRL L-6. During the investigation, access ways were cleaned, and the pipe segments were observed either by direct or remote inspection and were pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through the pipes. All of the pipeline sections in PRL L-5 were found to be compatible with wastewater passing through them; two pipeline segments in PRL L-6 were found to be incompatible. Several sections of both PRL L-5B and PRL L-6 reportedly contained cracked joints and areas of breakage.

A soil gas investigation of IC 7 was conducted by Radian Corporation in 1990 as part of the OU B Soil Gas Investigation. One hundred forty-eight soil gas probes were placed and sampled for the soil gas investigation of IC 7. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 55 of these 148 probes at concentrations that exceed the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of these 148 probes, ranged from 0.5 to 117,621 ppbv. Total AVOC concentrations, detected in 28 of the 148 probes, ranged from 94.9 to 385,700 ppbv. Total UVOC concentrations, detected in 15 of the 148 probes, ranged from 242 to 135,300 ppbv.

Results of the soil gas investigation at IC 7 indicate 28 areas which exceed the criteria for soil gas targets (Appendix A). Because of the large number of soil gas



SOURCE: McLAREN ENVIRONMENTAL ENGINEERING

Figure 3.7-5. Approximate Location of Former Metal Burial Pit and Previous Boring Locations.

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probe locations and isopleths, soil gas data are depicted in Figures 3.7-1, 3.7-2A, 3.7-3A, and 3.7-4A. Soil gas data are shown on figures separate from proposed borings and surface features to enhance the understanding of the Phase 1 sampling and analysis plans. Two HVOC targets had soil gas concentrations exceeding 10,000 ppbv total HVOCs. Two other targets contained greater than 1,000 ppbv total HVOCs, and two targets exceeded 100 ppbv TCE and PCE. Two AVOC targets exceeded 50,000 ppbv total AVOCs, and two others had concentrations greater than 500 ppbv of o-xylene and p-xylene. Of the 15 UVOC targets, 11 have total UVOC concentrations exceeding 1,000 ppbv, and 4 have individual UVOC concentrations exceeding 100 ppbv.

3.7.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 7 is to determine the presence of VOC or other contamination in the area. A total of 106 reconnaissance borings, 5 deep borings, and 9 hand auger borings will be placed at IC 7 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

PRL L-5B

Reconnaissance Borings. Twenty-two reconnaissance borings (B1 through B8 and B10 through B23) will be placed in order to determine the presence of contamination at potential leaks in sections of the IWL at PRL L-5B (Figures 3.7-2B, 3.7-3B, and 3.7-4B). Borings B1, B2, B3, B4, B10, and B11 will be placed adjacent to leaks or breaks in PRL L-5B identified by the 1988 EG&G report. Borings B5, B6, B7, and B8 will be placed adjacent to a previously untested IWL section within a soil gas target area. Samples will be collected to a minimum depth of 20 feet BGS.

Borings B12 through B20 will be placed adjacent to the untested portion of PRL L-5B east of MH-12F and south of MH-12E at 50-foot intervals to determine if contamination potentially resulting from leakage of the IWL is present. Borings 21, 22, and 23 will be placed adjacent to leaks and pressure test failures. Samples will be collected to a minimum depth of 20 feet BGS.

Deep Boring. One deep boring (B9) will be placed 25 feet north of MH-12D (Figure 3.7-3B) to confirm the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration. Samples will be collected to a depth of 95 feet BGS.

Contaminants of concern at this location include metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.7-2 presents DQOs for potential leaks in the IWL at PRL L-5B.

Northern Section of PRL L-6

Reconnaissance Borings. Thirteen reconnaissance borings (B24 through B26, and B28 through B37) will be placed adjacent to leaks in the IWL at PRL L-6 (Figures 3.7-3B and 3.7-4B) that were previously identified in the EG&G report (1988). Samples will be collected to a minimum depth of 20 feet BGS.

Deep Boring. One deep boring (B27) will also be drilled at PRL L-6 (Figure 3.7-4B) to confirm the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration. Samples will be collected to a depth of 95 feet BGS.

Contaminants of concern at the soils of PRL L-6 include metals, phenols, VOCs, semivolatile organic compounds, acids, bases, radionuclides, and cyanide. Table 3.7-3 presents DQOs for locations of potential leaks in the IWL at PRL L-6.

PRL P-9 and SA 14

Reconnaissance Borings. Two reconnaissance borings (B38 and B40) will be drilled along the ditch system at PRL P-9 (Figure 3.7-2B), in order to determine if contaminants are present in soil underlying the ditch as a result of historical wastewater

TABLE 3.7-2. DQOs FOR LOCATIONS OF IWL LEAKS AT PRL L-5B

Objective:	To detect the presence of contamination in soils potentially resulting from leaks in the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	2,300 square feet
Approximate Years of Operation:	1953-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at each potential leak location
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 652 or location given
Reconnaissance Boring Locations and Depths:	(all borings to a depth of 20 feet BGS)

Boring	Location	EG&G (1988)[a] IR	Boring Placement Rationale
B1	3' W of MH-12B	61	Joint that failed leak testing[b]
B2	135' N of MH-12C	63	Joint that failed leak testing[c]
B3	60' NE of MH-12D	33	Circumferential crack[d]
B4	at MH-12C	61	Joint leakage[b]
B5	20' SE of MH-654A	138	Previously untested pipeline/soil gas target area[e]
B6	50' SE of MH-654A	138	Previously untested pipeline/soil gas target area[e]
B7	75' SE of MH-654A	138	Previously untested pipeline/soil gas target area[e]
B8	110' SE of MH-654A	138	Previously untested pipeline/soil gas target area[e]
B10	30' NE of MH-12D	33	Joint not tested[d]
B11	33' N of MH-12E	46	Failed pressure test[f]
B12	60' N, 15' E	137	Previously untested pipeline[g]
B13	15' N, 15' E	137	Previously untested pipeline[g]
B14	30' S, 15' E	137	Previously untested pipeline[g]
B15	70' S, 15' E	137	Previously untested pipeline[g]
B16	130' S 15' E	137	Previously untested pipeline[g]
B17	180' S 15' E	137	Previously untested pipeline[g]
B18	230' S 15' E		Previously untested pipeline[h]
B19	280' S 15' E		Previously untested pipeline[h]
B20	330' S 15' E		Previously untested pipeline[h]
B21	at MH-12F	38	Joint leakage[i]

(Continued)

TABLE 3.7-2. (Continued)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B22	40' N, 55' W	110	Failed pressure test[j]
B23	10' N, 125' W	110	Failed pressure test[j]

Total Number of Locations: 22

Analytical Methods: SW6010, SW7471, SW8015/3550, SW8040, SW8270, SW9010, SW9045, FPCB, FVOC, FGC

Deep Boring Location and Depth:

Boring	Location	IR	Boring Placement Rationale
B9	25' N of MH-12D	46	Failed pressure test[f]

Total Number of Locations: 1

Analytical Methods: SW6010, SW7471, SW8015/3550, SW8040, SW8270, SW9010, SW9045, FPCB, FVOC, FGC

IR = Immediate Report referenced in EG&G (1988).
FPCB = Field polychlorinated biphenyl screening.
FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3E and 3H
[b] SWP-E-20-A
[c] SWP-E-33-A
[d] SWP-E-31-A
[e] SWP-E-31-B
[f] SWP-E-30-A
[g] SWP-E-28-A
[h] No EG&G ID number
[i] SWP-E-27-A
[j] SWP-E-27-C

TABLE 3.7-3. DQOs FOR LOCATIONS OF POTENTIAL LEAKS IN THE IWL AT PRL L-6

Objective: To detect the presence of contamination in soils potentially resulting from leaks in the IWL.

Source Description

Source Type: Underground pipeline

Area of Characterization: 1200 linear feet

Approximate Years of Operation: 1957-present

Phase: 1

Media to be Sampled: Soil/soil gas

Contaminants of Concern: Metals, phenols, VOCs, semivolatile organic compounds, acids, bases, radionuclides, cyanides

Sampling Methodology

Lateral Spacing Basis: Boring placed at each potential leak location

Drilling Method: Power assisted split-spoon sampler

Reference Point: Various, see below

Reconnaissance Boring Locations and Depths: (All borings to a depth of 20 feet BGS)

Borings	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B24	163' N of MH-12J	29	Joint failed leak testing[b]
B25	207' N of MH-12J	29	Circumferential crack[b]
B26	256' N of MH-12J	29	Circumferential crack[b]
B28	75' N of MH-12I	30	Crushed pipe[c]
B29	109' N of MH-12I	30	Crack in joint[c]
B30	166' N of MH-12I	30	Longitudinal crack[c]
B31	226' N of MH-12I	30	Crack in joint[c]
B32	276' N of MH-12I	30	Boring placed at 50' interval[c]
B33	326' N of MH-12I	30	Boring placed at 50' interval[c]
B34	376' N of MH-12I	30	Boring placed at 50' interval[c]
B35	415' N of MH-12I	30	Crack in joint[c]
B36	15' E of MH-12H	39	Joint failed leak testing[d]
B37	108' E of MH-12H	39	Joint failed leak testing[d]

Total Number of Locations: 13

Analytical Methods: SW6010, SW8040, SW8270, SW9010, SW9045, SW9310, U.S. EPA 901.1, FVOC, FGC

Deep Boring Location and Depth: B27 28' N of MH-12I 30 Crushed pipe[c]

Total Number of Locations: 1

Analytical Methods: SW6010, SW8040, SW8270, SW9010, SW9045, SW9310, U.S. EPA 901.1, FVOC, FGC

IR = Immediate Report referenced in EG&G (1988).

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3E and 3H

[b] SWP-E-24A

[c] SWP-E-25A

[d] SWP-E-26A

discharges of surface water runoff to the ditch and to verify contamination detected in the soil gas. Samples will be collected to a minimum depth of 20 feet BGS.

Deep Boring. One deep boring (B39) will also be drilled at PRL P-9 (Figure 3.7-2B) to confirm the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration. Samples will be collected to a depth of 95 feet BGS.

Hand Auger Borings. Nine hand auger borings (H1 through H9) will be drilled within the ditch at SA 14 (Figures 3.7-2B and 3.7-3B). Borings H1 through H5 will be drilled along the ditch at equally spaced intervals because sediments along the entire length of the ditch have potentially been contaminated. Hand auger borings (H6 through H7) will be drilled downstream of the discharge points and possible runoff locations of IWTP Nos. 2 and 4, and Buildings 654, 659, and 699. Samples will be collected to a depth of 4 to 6 feet BGS. After analytical results from the hand augers have been evaluated, reconnaissance borings may be drilled adjacent to the ditch near the hand auger locations that have contaminant concentrations above background.

Contaminants of concern at PRL P-9 and SA 14 include metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.7-4 presents DQOs for the drainage ditches at PRL P-9 and SA 14.

PRL S-5

Reconnaissance Borings. Two reconnaissance borings (B41 and B42) will be drilled at either end of the former location of the aboveground tank (Figure 3.7-3B). Boring B43 will be placed at the southern end of the underground sump (Figure 3.7-3B). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at PRL S-5 include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Tables 3.7-5 and 3.7-6 present DQOs for the equalization tank and sump at PRL S-5, respectively.

TABLE 3.7-4. DQOs FOR THE DRAINAGE DITCHES AT PRL P-9 AND SA 14

Objective:	To detect the presence of contamination of soil underlying the ditches resulting from historical wastewater discharges or surface water runoff to the ditches.
Source Description	
Source Type:	Surface drainage area
Area of Characterization:	Approximately 14,000 square feet
Approximate Years of Operation:	1951-unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Borings placed in areas of likely contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	See below

Reconnaissance Boring Locations and Depths: (All borings to a depth of 20 feet BGS)

Borings	Reference Point	Location
B38	NE corner of Bldg. 659	95' N, 220' E
B40	NE corner of Bldg. 647	235' E

Total Number of Locations:	2
Analytical Methods:	SW6010, SW7471, SW8270, SW8015/3550, SW9010, SW9045, FVOC, FGC

Deep Boring Location and Depth: (Boring to a depth of 95 feet BGS)

Borings	Reference Point	Location
B39	NE corner of Bldg. 659	95' N, 150' E

Total Number of Locations:	1
Analytical Methods:	SW6010, SW7471, SW8270, SW8015/3550, SW9010, SW9045, FVOC, FGC

(Continued)

TABLE 3.7-4. (Continued)

Hand Auger Boring Locations and Depths:	(All borings to a depth of 4-6 feet BGS)		
	Borings	Reference Point	Location
	H1	NE corner of Bldg. 647	15′ N, 100′ E
	H2	NW corner of Bldg. 647	385′ N, 120′ W
	H3	NW corner of Bldg. 647	155′ N, 120′ W
	H4	NW corner of Bldg. 647	15′ N, 120′ W
	H5	NW corner of Bldg. 647	120′ S, 120′ W
	H6	NE corner of Bldg. 699	60′ N
	H7	NE corner of Bldg. 699	5′ S, 115′ E
	H8	NE corner of Bldg. 699	80′ N, 175′ E
	H9	SW corner of Bldg. 659	90′ W
Total Number of Locations:	9		
Analytical Methods:	SW6010, SW7471, SW8015/3550, SW8270, SW9010, SW9045, FVOC		

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of soil gas.

TABLE 3.7-5. DQOs FOR THE ABOVEGROUND OPEN-TOP EQUALIZATION TANK AT PRL S-5

Objective:	To detect the presence of contamination potentially resulting from tank leakage.
Source Description	
Source Type:	Aboveground tank
Area of Characterization:	490 square feet
Approximate Years of Operation:	1956-1974
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring placed at each tank
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Locations and Depths:	B41: Adjacent to south side of tank (20 feet BGS) B42: Adjacent to north side of tank (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.7-6. DQOs FOR THE UNDERGROUND SUMP THAT COLLECTED WASTEWATER AT PRL S-5

Objective:	To detect the presence of contamination potentially resulting from leakage of the sump.
Source Description	
Source Type:	Underground sump
Area of Characterization:	49 square feet
Approximate Years of Operation:	1956-1974
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring placed at sumps
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Location and Depth:	B43: Adjacent to north side of sump (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

PRL S-34

Reconnaissance Borings. Two reconnaissance borings (B44 and B45) will be drilled at PRL S-34 near the washrack area at the north end of Building 652 (Figure 3.7-3B) to determine if contaminants are present in soils as a result of leakage from trenches that collected liquid wastes in the washrack. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at PRL S-34 include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.7-7 presents the DQOs for the washrack at PRL S-34.

PRL S-35

Reconnaissance Borings. Four reconnaissance borings (B46 through B49) will be placed at PRL S-35 (Figure 3.7-3B). Two of the borings (B46 and B47) will be placed along the pipeline receiving wastes from the steam cleaning washrack. Boring B48 will be placed next to a washdown drain that extends from south of Building 634 toward the IWL between MH-12C and MH-12D. Samples at PRL S-35 will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.7-8 presents the DQOs for the pipeline receiving wastes from the washrack and the washdown drain at PRL S-35.

Because a solvent booth was contained within Building 654 at PRL S-35 and drilling is not possible within an active building, Boring B49 will be placed outside the eastern wall of Building 654, adjacent to the former location of the solvent booth, in order to determine the presence of contamination resulting from potential discharge to soils (Figure 3.7-3B). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.7-9 presents the DQOs for the solvent booth at PRL S-35.

SA 7

Reconnaissance Borings. Two reconnaissance borings (B50 and B51) will be drilled at SA 7 to detect the presence of soil contamination resulting from leakage of drains or underground fuel tanks (Figure 3.7-2B). Because the three previously existing

TABLE 3.7-7. DQOs FOR THE WASHRACK AT PRL S-34

Objective:	To detect the presence of contamination potentially resulting from leakage of the trenches that collected liquid waste in the washrack.
Source Description	
Source Type:	Degreaser washrack
Area of Characterization:	3,750 square feet
Approximate Years of Operation:	Unknown to mid-1980s
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Criteria:	Boring placement adjacent to a potential area of contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point.	Northwest corner of Building 652
Reconnaissance Boring Locations and Depths:	B44: 45′ N, 20′ E (20 feet BGS) B45: 5′ N, 15′ E (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.7-8. DQOs FOR THE PIPELINE RECEIVING WASTES FROM THE WASHRACK AND THE WASHDOWN DRAIN AT PRL S-35

Objective:	To detect the presence of contamination potentially resulting from leakage of the pipeline.
Source Description:	
Source Type:	Pipeline receiving wastes from washrack
Area of Characterization:	8,000 square feet
Approximate Years of Operation:	Unknown to present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring placed at the washrack and drain
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Bldg. 654
<u>Reconnaissance Boring Locations and Depths</u>:	B46: 90′ S, 25′ E (20 feet BGS) B47: 80′ S, 10′ W (20 feet BGS) B48: 115′ S, 200′ E (20 feet BGS)
Total Number of Locations:	3
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.7-9. DQOs FOR THE SOLVENT BOOTH AT PRL S-35

Objective:	To detect the presence of soil contamination resulting from surface spillage.
Source Description	
Source Type:	Solvent booth
Area of Characterization:	500 square feet
Approximate Years of Operation:	Unknown to 1981
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placed adjacent to a suspected discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Bldg. 654
Reconnaissance Boring Location and Depth:	B49: 85' S, 5' W (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

tanks were located adjacent to one another, with only two feet of separation between tanks, boring B50 will be placed in the center where the middle tank was located. Boring B51 will be placed to detect the presence of contamination from leakage of the drain at SA 7 (Figure 3.7-2B). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.7-10 presents DQOs for the underground fuel tanks and drain at SA 7.

SA 11

Reconnaissance Borings. Two reconnaissance borings (B52 and B53) will be placed adjacent to the underground storage tank at SA 11 to detect the presence of contamination potentially resulting from tank leakage (Figure 3.7-3B). Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at SA 11 include organic lead, metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.7-11 presents the DQOs for the underground storage tank at SA 11.

SA 18

Reconnaissance Borings. Four reconnaissance borings (B54 through B57) will be placed in a triangular grid at SA 18 to investigate potentially leaking drums that were uniformly distributed across an area near the perimeter of the oil storage yard (Figure 3.7-3B). Locations within the grid will be spaced at 50-foot intervals for areal coverage of SA 18. Samples will be collected to a minimum depth of 20 feet BGS. Contaminants of concern at this location include metals, volatile and extractable petroleum hydrocarbons, VOCs, and semivolatile organic compounds. Table 3.7-12 presents the DQOs for the oil storage yard at SA 18.

IC 7 Areal Borings

Reconnaissance Borings. Fifty-one reconnaissance borings (B58 through B66, B68 through B96, and B98 through B111) will be located within a triangular grid at IC 7 (Figures 3.7-2B, 3.7-3B, and 3.7-4B). Locations within the grid will be spaced at 50-foot intervals in soil gas target areas. Outside of soil gas target areas, spacing between

TABLE 3.7-10. DQOs FOR THE UNDERGROUND FUEL TANKS AND DRAIN AT SA 7

Objective	To detect the presence of contamination resulting from leakage of underground fuel tanks.
Source Description	
Source Type:	Underground storage tanks
Area of Characterization:	200 square feet
Approximate Years of Operation:	1951-1981
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring placed near tanks
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 659
Reconnaissance Boring Locations and Depths:	B50: 25' S, 5' W (20 feet BGS) B51: 5' N, 30' E (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.7-11. DQOs FOR THE UNDERGROUND STORAGE TANK AT SA 11

Objective:	To detect the presence of contamination potentially resulting from tank leakage.
Source Description	
Source Type:	Underground storage tanks
Area of Characterization:	2000 square feet
Approximate Years of Operation:	1966-unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Organic lead, metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	A minimum of one boring placed near tanks
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 699
Reconnaissance Boring Locations and Depths:	B52: 5′ N, 10′ E (20 feet BGS)
	B53: 15′ S, 10′ E (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	HML 338, SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.7-12. DQOs FOR THE OIL STORAGE YARD AT SA 18

Objective:	To detect the presence of contamination potentially resulting from surface spillage.
Source Description	
Source Type:	Uniform surface spill
Area of Characterization:	4,280 square feet
Approximate Years of Operation:	1957-1975
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Systematic triangular grid
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	SE corner of SA 18 (73'N, 14'W of NW corner of Building 656)
Reconnaissance Boring Locations and Depths:	B54: 50' N, 55' W (20 feet BGS) B55: 50' N, 5' W (20 feet BGS) B56: 15' N, 65' W (20 feet BGS) B57: 15' N, 15' W (20 feet BGS)
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

borings will be approximately 100 feet. Samples from these borings will be collected to a minimum depth of 20 feet BGS.

Deep Borings. Two borings (B67 and B97) will be located within the triangular grid at IC 7 (Figure 3.7-3B) to confirm the presence of contaminants and to characterize subsurface lithologic conditions that would affect contaminant migration. Samples will be collected to a depth of 95 feet BGS.

Contaminants of concern in soils at IC 7 include organic lead, metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, cyanide, acids, bases, and radionuclides. Table 3.7-13 presents DQOs for the areal borings at IC 7.

Table 3.7-14 presents the sampling and analysis matrix for all samples to be collected at IC 7.

TABLE 3.7-13. DQOs FOR AREAL BORINGS AT IC 7

Objective:	To determine if volatile organic or other contaminants is present in the soils at IC 7.
Source Description	
Source Type:	Undetermined, as indicated by soil gas.
Area of Characterization:	225,000 square feet
Approximate Years of Operation:	1957-1975
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Organic lead, metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds cyanide, acids, bases, radionuclides
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid with a 50-foot spacing in soil gas target
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	*Northeast corner* of Building 654
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)
	B58: 65′ N, 5′ E
	B59: 70′ N, 75′ E
	B60: 75′ N, 125′ E
	B61: 70′ N, 160′ E
	B62: 15′ N, 30′ E
	B63: 15′ N, 80′ E
	B64: 15′ N, 135′ E
	B65: 35′ S, 50′ E
	B68: 140′ S, 200′ W
	B69: 140′ S, 150′ W
	B70: 140′ S, 100′ W
	B71: 140′ S, 50′ W
Total Number of Locations:	12
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

(Continued)

TABLE 3.7-13. (Continued)

Reference Point:	Northeast corner of Building 654
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B66: 30′ S, 110′ E B72: 135′ S, 55′ E
Total Number of Locations:	2
Analytical Methods:	SW6010, SW7471, SW8015/3550, SW8040, SW8270, SW9010, SW9045, FPCB, FVOC, FGC
Reference Point:	Northeast corner of Building 654
Deep Boring Location and Depth:	B67: 60′ S, 5′ E (95 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC
Reference Point:	Northeast corner of Building 699
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B73: 50′ N, 50′ E B74: 50′ N, 100′ E B75: 50′ N, 150′ E B77: 5′ N, 65′ E B85: 50′ S, 100′ E B86: 50′ S, 150′ E B87: 50′ S, 200′ E
Total Number of Locations:	7
Analytical Methods:	SW6010, SW7471, SW8015/3550, SW8270, SW9010, SW9045, FVOC, FGC
Reference Point:	Northwest corner of Building 652
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B76: 260′ N, 150′ E B78: 215′ N, 130′ E B94: 120′ N, 175′ E

(Continued)

TABLE 3.7-13. (Continued)

Reconnaissance Boring Locations and Depths: (Continued)	B100: 10′ N, 75′ E B103: 40′ S, 5′ W B108: 145′ S, 5′ W B110: 325′ S, 5′ W B111: 380′ S, 25′ E
Total Number of Locations:	8
Analytical Methods:	SW6010, SW8015/3550, SW8270, FVOC, FGC
Reference Point:	Southwest corner of Building 699
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B80: 5′ S, 40′ W B82: 35′ S, 20′ W B83: 35′ S, 35′ E B84: 35′ S, 85′ E
Total Number of Locations:	4
Analytical Methods:	HML 338, SW6010, SW8015/3550, SW8270, FVOC, FGC
Reference Point:	Northwest corner of Building 652
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B99: 5′ N, 80′ W B105: 95′ S, 80′ W B106: 95′ S, 5′ W B109: 180′ S, 5′ W
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8040, SW8270, SW9010, SW9045, SW9310, U.S. EPA 901.1, FVOC, FGC
Reference Point:	Southwest corner of Building 699
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS) B79: 5′ S, 90′ W B81: 35′ S, 80′ W

(Continued)

TABLE 3.7-13. (Continued)

Reconnaissance Boring Locations and Depths: (Continued)	B88: 85′ S, 50′ W
	B89: 85′ S
	B90: 85′ S, 50′ E
	B91: 85′ S, 100′ E
	B92: 85′ S, 150′ E
	B93: 85′ S, 200′ E
	B95: 140′ S, 80′ W
	B96: 140′ S, 30′ W
	B98: 190′ S, 50′ W
	B101: 240′ S, 80′ W
	B102: 240′ S, 30′ W
	B104: 290′ S, 50′ W
	B107: 340′ S, 25′ W
Total Number of Locations:	15
Analytical Methods:	FVOC, FGC
Reference Point:	Northeast corner of Building 652
Deep Boring Location and Depth:	B97: 60′ N, 10′ W
Total Number of Locations:	1
Analytical Methods:	SW8015/3550, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.
FPCB = Field polychlorinated biphenyl screening.

TABLE 3.7-14. SAMPLING AND ANALYSIS MATRIX FOR IC 7

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval			
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1-B6, B8 - B23[b], B66[b], B72[c]	Deep Boring B7[b]	Reconnaissance Borings B24-B26[d] B28-B37[d] B99,B105[c] B106[c], B109[c]	Deep Boring B27[d]
0 - 20	1[l]	SW6010 SW7471 SW8015/3550 SW8040 SW8270 SW9010 SW9045 FPCB FVOC	SW6010 SW7471 SW8015/3550 SW8040 SW8270 SW9010 SW9045 FPCB FVOC	SW6010 SW8040 SW8270 SW9010 SW9045 SW9310 US EPA 901.1 FVOC	SW6010 SW8040 SW8270 SW9010 SW9045 SW9310 US EPA 901.1 FVOC
0 - 20	2	SW6010 SW7471 SW8015/3550 SW8040 SW8270 SW9010 SW9045 FPCB FVOC	SW6010 SW7471 SW8015/3550 SW8040 SW8270 SW9010 SW9045 FPCB FVOC	SW6010 SW8040 SW8270 SW9010 SW9045 SW9310 US EPA 901.1 FVOC	SW6010 SW8040 SW8270 SW9010 SW9045 SW9310 US EPA 901.1 FVOC
0 - 20	3	SW8015/3550 SW8040 SW9045 FVOC FGC	SW8015/3550 SW8040 SW9045 FVOC FGC	SW8040 SW9045 FVOC FGC	SW8040 SW9045 FVOC FGC
20 - 95	4	NS	SW8015/3550 SW8040 SW9045 FVOC FGC	NS	SW8040 SW9045 FVOC FGC
20 - 95	5	NS	SW8015/3550 SW8040 SW9045 FVOC FGC	NS	SW8040 SW9045 FVOC FGC
20 - 95	6	NS	SW8015/3550 SW8040 SW9045 FVOC FGC	NS	SW8040 SW9045 FVOC FGC
20 - 95	7	NS	SW8015/3550 SW8040 SW9045 FVOC FGC	NS	SW8040 SW9045 FVOC FGC

(Continued)

TABLE 3.7-14. (Continued)

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval			
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B38,B40[e], B73-B75, B77, B85-B87	Deep Boring B39[e]	Reconnaissance Borings B41-B45[f,g] B54-B57[h],B76[c], B78[c],B94[c],B100[c], B103[c],B108[c], B110,[c],B111[c]	Reconnaissance Borings B46-B51[i,j] B58-B65[c] B68-B71[c]
0 - 20	1[l]	SW6010 SW7471 SW8015/3550 SW8270 SW9012 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8270 SW9010 SW9045 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC
0 - 20	2	SW6010 SW7471 SW8015/3550 SW8270 SW9012 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8270 SW9010 SW9045 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW8015/3550 SW8270 FVOC
0 - 20	3	SW8015/3550 SW9045 FVOC FGC	SW8015/3550 SW9045 FVOC FGC	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC
20 - 95	4	NS	SW8015/3550 SW9045 FVOC FGC	NS	NS
20 - 95	5	NS	SW8015/3550 SW9045 FVOC FGC	NS	NS
20 - 95	6	NS	SW8015/3550 SW9045 FVOC FGC	NS	NS
20 - 95	7	NS	SW8015/3550 SW9045 FVOC FGC	NS	NS

(Continued)

TABLE 3.7-14. (Continued)

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval				
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B52,B53[k] B80[c] B82-B84[c]	Deep Boring B67[c]	Reconnaissance Borings (B79, B81, B88-B93, B95, B96 B98, B101, B102, B104, B107)[c]	Deep Boring B97[c]	Hand Auger Borings H1-H9[e]
0 - 20	1[l]	HML 338 SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	FVOC	SW8015/3550 SW8270 FVOC	SW6010 SW7471 SW8015/3550 SW8270 SW9010 SW9045 FVOC
0 - 20	2	HML 338 SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	FVOC	SW8015/3550 SW8270 FVOC	NS
0 - 20	3	SW8015/3550 FVOC FGC	SW8015/3550 FVOC FGC	FVOC FGC	SW8015/3550 FVOC FGC	NS
20 - 95	4	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS
20 - 95	5	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS
20 - 95	6	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS
20 - 95	7	NS	SW8015/3550 FVOC FGC	NS	SW8015/3550 FVOC FGC	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for locations of IWL leaks at PRL L-5B.

[c] Locations of areal borings at IC 7.

[d] Boring locations for locations of potential IWL leaks at PRL L-6.

[e] Boring locations for drainage ditches at PRL P-9 and SA 14.

[f] Boring locations for the aboveground open-top equalization tank and underground sump that collected wastewater at PRL S-5.

[g] Boring locations for the washrack at PRL S-34.

[h] Boring locations for the oil storage yard at SA 18.

[i] Boring locations for the pipeline receiving wastes from the washrack and the solvent booth at PRL S-35.

[j] Boring locations for the underground fuel tanks at SA 7.

[k] Boring locations for the underground storage tank at SA 11.

[l] Collect first sample for nonvolatile analyses between 0 and 3 inches for hand auger samples. Collect samples for volatile analyses between 1 and 5 feet BGS.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

FPCB = Screening analysis of soils for 7 PCB compounds by field gas chromatograph; samples with detectable concentrations will be sent to off-site laboratory for SW8080 analysis.

NS = Not sampled unless contamination continues from depth of previous sample.

3.8 Investigation Cluster 8 (PRL L-5C, PRL S-29, and PRL S-30)

Investigation Cluster 8 consists of PRL L-5C, PRL S-29, and PRL S-30 and is located in the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of IC 8. Although each of these three sites has distinctive physical characteristics, they will be investigated as a cluster because of their geographic proximity to one another and their related historical activities.

3.8.1 Site Descriptions

Potential Release Location L-5C

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the pipes. The IWL at PRL L-5 is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-5C is the section of PRL L-5 that begins at manhole 12B (MH-12B), encircles Building 658, parallels the north side of Building 655, and joins the north end of PRL L-5D, and is approximately 1,500 feet long. Potential Release Location L-5C also includes the length of pipeline running from Building 603 to the eastern side of Building 655. Figure 3.8-1 shows the surface trace of PRL L-5C and locations of access covers. Most of the piping system is constructed of 8-inch vitrified clay pipe, but 4-, 8-, and 10-inch asbestos-concrete, cast iron, and vitrified clay pipes are found in some sections of PRL L-5. Industrial activities at the facilities connected to PRL L-5 include maintenance, paint removal, painting, cleaning, industrial wastewater processing, and hazardous material storage described previously in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Table 3.8-1 summarizes the available information concerning the historical operations performed and materials handled at buildings contributing to the flow through the IWL at PRL L-5C.

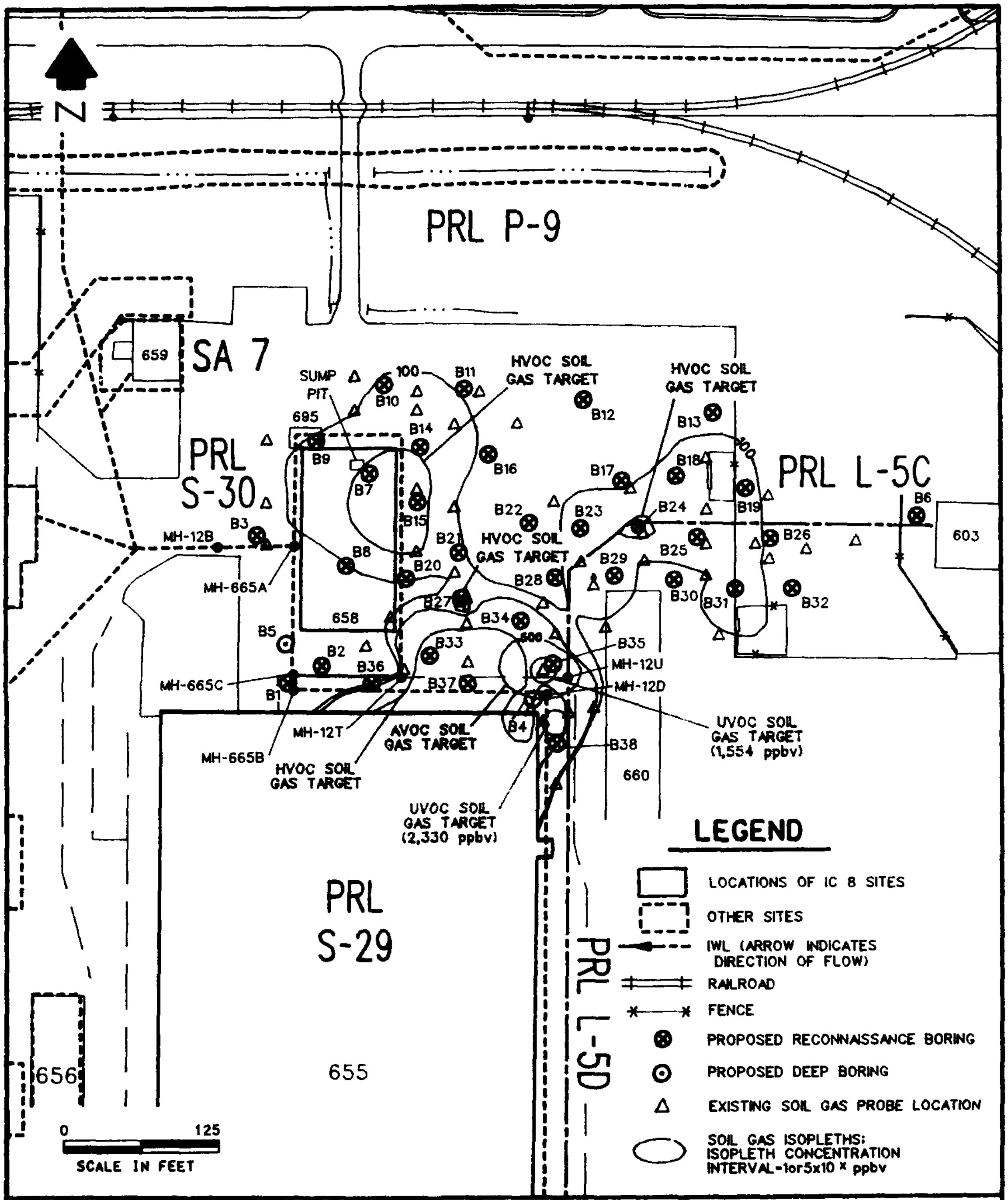

Figure 3.8-1. Site Features and Soil Boring Locations at IC 8 (PRL S-29, PRL-S-30, and PRL L-5C).

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TABLE 3.8-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED AT BUILDINGS CONTRIBUTING TO THE FLOW THROUGH THE IWL AT PRL L-5C (IC 8)

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL carrying wastewater from:		
Building 610: 6 VAN repair, maintenance	1953-Present	S
Building 613: washrack, electronics shop	1953-Present	NA
Building 640: electronics repair shop, paint shop, paint booth, and solvent booths (PRL T-7)	1953-Present	S, P
Building 603: oil separator	1953-Present	F
IWTP No. 4: pretreatment of plating shop wastes, now removed (Site 48)	1957-1980	A, B, C, M
Building 655: fuel-tanker servicing, aircraft/vehicle painting, PCB storage, and van repair (PRL S-29)	1955-Present	F, P, PCB, S
Building 658: washrack, solvent/steam cleaning, and paint stripping (PRL S-30)	1953-Present	A, F, P, S

PRL = Potential release location
A = Acids
B = Bases
C = Cyanide compound
F = Fuels and oils
M = Metals listed in California Code of Regulations, Title 22.
NA = Not available
P = Paint
PCB = Polychlorinated biphenyls
S = Solvents

Potential Release Location S-29

Potential Release Location S-29 is Building 655 (Figure 3.8-1). Constructed in 1955, the building has historically included facilities for fuel tank servicing, radar repair, and spray painting. Historical information regarding exact dates and locations of operations within Building 655 is not available. McClellan AFB utility drawings show IWL segments exiting eastward from the interior of the building to the IWL main line, PRL L-5D, which parallels the eastern side of the building and is included in IC 1. Locations of interior drains that connect to the IWL have not been identified. Materials handled historically at Building 655 include fuels, oils, PCBs, paints, and solvents. Building 655 is an active Air Force facility. Current operations in Building 655 include a paint shop for ground support equipment and trailers, and cleaning and repair areas for electronic components. Three paint booths generate water-based and enamel paint wastes. Isopropyl alcohol is used in the cleaning and washdown of electronic components. Other wastes are generated from the mop and bucket cleaning of floor surfaces using a Soap System 1000 product.

Potential Release Location S-30

Potential Release Location S-30 is the location of a paint stripping and equipment cleaning washrack at Building 658 (Figure 3.8-1). Building 658 was constructed in approximately 1953. The building is not enclosed; the roof is supported by columns. The floor consists of a concrete pad that contains a network of 44 floor drains.

Underground pipes transport waste from each of the floor drains to two parallel trench drains that run down the center of the washrack. At the north end of the central trenches, a sump pit collects liquid waste from the washrack. The sump pit empties into the IWL via a trench drain that runs along the perimeter of the washrack and connects to the main IWL south of the washrack.

The washrack operations include solvent and steam cleaning of and paint removal from parts. Materials handled include acids, bases, solvents, paints, and other volatile and semivolatile organic compounds. Solvents used in the paint stripping operations are stored in aboveground tanks on the concrete pad.

3.8.2 Previous Investigations

In 1988, EG&G Idaho, Inc. tested the integrity of the IWL at PRL L-5. During the investigation, access ways were cleaned, and the pipe segments were observed either by direct or remote inspection and were pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through the pipes. All of the pipeline sections were compatible with wastewater passing through them. However, several sections of PRL L-5C reportedly contained cracked joints and areas of breakage.

The GSAP at McClellan AFB has confirmed the presence of contamination in groundwater near PRL S-29. Four VOCs detected in samples of soils at Site 48 (McLaren, 1986c) have been detected in the groundwater from MWs 41S and 65 located south and southeast of PRL S-29, respectively. Chloroform, PCE, and TCE have been detected in the groundwater of MW-41S; TCE and toluene have been detected in the groundwater of MW-65.

During the OUBGRI in 1989, the contaminants in the groundwater southwest of Site 48 were further characterized. Trichloroethene, 1,2-DCE, PCE, and chloroform were detected in MW-159 located 200 feet east of the eastern boundary of PRL S-29 at concentrations of 85 μg/L, 48 μg/L, 1.3 μg/L, and 3.9 μg/L, respectively. Volatile organic contamination in the area has been designated as the TCE/PCE plume in the OU B EE/CA-EA report (Radian, 1990e) and appears to be migrating beneath PRL S-29 in a southwesterly direction. However, the source of the contamination has not been verified.

Construction of an ERA described in the OU B EE/CA-EA report (Radian, 1990e) for controlling migration of the TCE/PCE plume, was implemented in October 1990 because of the potential threat that the plume poses for a principal McClellan AFB water supply well (BW-18) and groundwater resources beneath off-base areas beyond the base supply well. The ERA for the TCE/PCE plume will consist of two groundwater extraction wells, which remove contaminated groundwater and transport it to a nearby treatment plant (Figure 3.8-2). Treated water will be discharged to the McClellan AFB IWL.

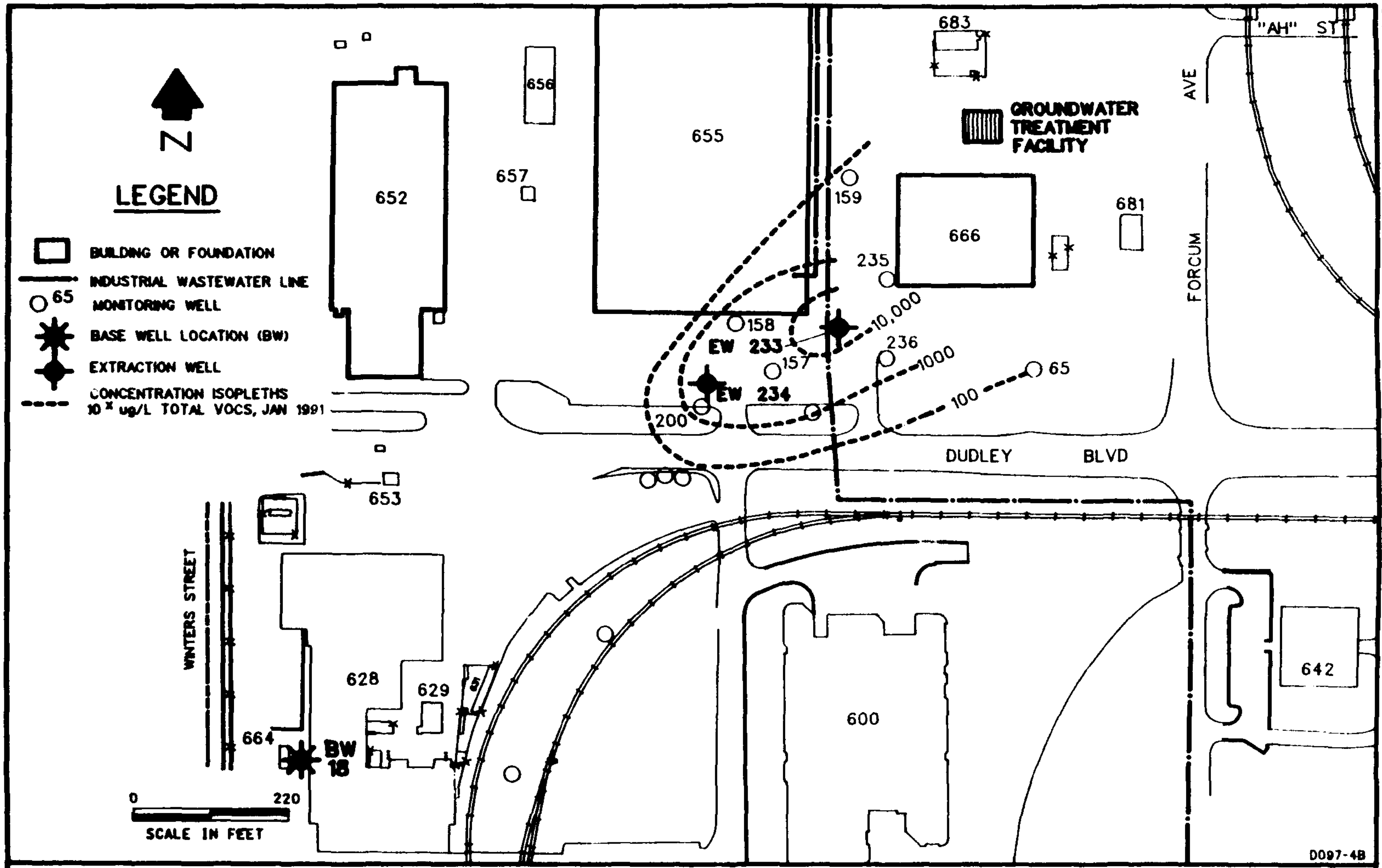

Figure 3.8-2. Location of Extraction Wells and Groundwater Treatment Facility for Expedited Removal Action, Operable Unit B, McClellan AFB.

A soil gas investigation of IC 8 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Forty-five soil gas probes were placed and sampled for the soil gas investigation of IC 8. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 20 of these 45 probes at concentrations that exceed the criteria for soil gas targets (Appendix A). Total HVOC concentrations, detected in all of the 45 probes, ranged from 2.1 to 51,197 ppbv. Total AVOC concentrations, detected in 2 of the 45 probes, were 273 and 1,397 ppbv. Total UVOC concentrations, detected in 2 of the 45 probes, were 1,554 and 2,330 ppbv.

Results of the soil gas investigation at IC 8 indicate seven areas of contamination that exceed the criteria for soil gas targets (Appendix A). They are shown in Figure 3.8-1. The four HVOC target areas shown contain concentrations of total HVOCs exceeding 1,000 ppbv. The AVOC target contains greater than 1,000 ppbv of total AVOCs. The two UVOC target areas contain total UVOC concentrations greater than 1,000 ppbv.

3.8.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of IC 8 is to determine the presence of VOC or other contamination in the area. A total of 36 reconnaissance and 2 deep borings will be placed at IC 8 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Potential Release Location L-5C

Leaks in sections of the IWL at PRL L-5C are potential sources of contamination in the area of IC 8.

Reconnaissance Borings. Three reconnaissance borings (B1 through B3) will be placed adjacent to leaks or breaks in the IWL identified by the 1988 EG&G report (Figure 3.8-1). Table 3.8-2 presents DQOs for the detection of IWL leaks at PRL L-5C. Reconnaissance boring B6 will be placed at a location where wastewater from

TABLE 3.8-2. DQOs FOR DETECTION OF IWL LEAKS AT PRL L-5C

Objective:	To determine the presence of contamination resulting from leaks in the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	1,650 linear feet
Approximate Years of Operation:	1953-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, extractable and volatile petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, acids, bases, cyanide
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at each potential leak location
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
Reconnaissance Boring Locations and Depths:	(All borings to a depth of 20 feet BGS)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B1	3′ N of MH-665B	51	Circumferential crack & offset joint[b]
B2	30′ E of MH-665C	37	Joint that failed leak testing[c]
B3	31′ W of MH-665A	60	Joint that failed leak testing[d]

Total Number of Locations:	3
Analytical Method:	SW6010, SW7471, SW8015/3550, SW8015/5030, SW8040, SW8270, SW9010, SW9045, FVOC, FGC, FPCB
Deep Boring Locations and Depths:	(All borings to a depth of 95 feet BGS)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B4	3′ E of MH-12P	59	Joint that failed leak testing[e]
B5	82′ S of MH-665A	51	Offset joint[b]

Number of Locations:	2
Analytical Method:	SW6010, SW7471, SW8015/3550, SW8015/5030, SW8040, SW8270, SW9010, SW9045, FVOC, FGC, FPCB

IR = Immediate Report referenced in EG&G (1988).
FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.
FPCB = Field polychlorinated biphenyl screening.

[a] Appendix 3E and 3H
[b] SWP-E-18A
[c] SWP-E-14A
[d] SWP-E-19A
[e] SWP-E-17A

Building 603 initially discharges to PRL L-5C (Figure 3.8-1). Samples will be collected to a minimum depth of 20 feet BGS. Table 3.8-3 presents DQOs for the detection of leakage where discharges from Building 603 enter the IWL.

Deep Borings. Two deep borings (B4 and B5) will be located in IC 8 to determine if contaminants have migrated to depths at known leaks along the IWL and to characterize subsurface lithologic conditions that would affect migration. Samples will be collected to 95 feet BGS. One deep boring (B4) will be placed within the area of IC 8, west of Building 660.

A second deep boring (B5) will be placed at a location where a leak in the IWL was identified in the 1988 EG&G report (Figure 3.8-1). Table 3.8-2 presents DQOs for the detection of IWL leaks at PRL L-5C.

Contaminants of concern at PRL L-5C include metals, mercury, extractable and volatile petroleum hydrocarbons, phenols, polychlorinated biphenyls, VOCs, semivolatile organic compounds, acids, bases, and cyanide.

Potential Release Location S-29

No borings will be drilled specifically for the investigation of PRL S-29. All areas of contamination and suspected contaminant sources adjacent to PRL S-29 will be investigated by borings placed in adjacent sites and ICs.

Potential Release Location S-30

Reconnaissance Borings. Two reconnaissance borings (B7 and B8) will be drilled and sampled within the washrack at PRL S-30 to determine if soil contamination is present as a result of leakage of floor drains and a sump in the washrack. Boring B7 will be placed near the drain in the center of the washrack, and Boring B8 will be placed next to the washrack sump (Figure 3.8-1). The contaminants of concern include metals, VOCs, semivolatile organic compounds, acids, and bases. Samples will be collected to a minimum depth of 20 feet BGS. Table 3.8-4 presents DQOs for the detection of leakage from a drain and a sump in the washrack at PRL S-30.

TABLE 3.8-3. DQOs FOR THE DETECTION OF LEAKAGE WHERE DISCHARGES FROM BUILDING 603 ENTER THE IWL AT IC 8

Objective:	To determine the presence of contamination resulting from leakage of the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	10 linear feet
Approximate Years of Operation:	1953-present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, mercury, extractable and volatile petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, acids, bases, cyanide
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at discharge point
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 603
Reconnaissance Boring Location and Depth:	B6: 19´ S, 12.5´ W (20 feet BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW7471, SW8015/3550, SW8015/5030, SW8040, SW8080, SW8270, SW9010, SW9045, FVOC, FGC, FPCB

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.
FPCB = Field polychlorinated biphenyl screening.

TABLE 3.8-4. DQOs FOR THE DETECTION OF LEAKAGE FROM A DRAIN AND A SUMP IN THE WASHRACK AT PRL S-30

Objective:	To determine the presence of contamination resulting from leakage of the drain and sump in the washrack.
Source Description	
Source Type:	Sump and drain leaks within washrack
Area of Characterization:	11,250 square feet
Approximate Years of Operation:	Mid-1950s to present
Phase 1:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source targets
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Locations and Depths:	B7: Next to sump (20 feet BGS) B8: Near drain in the center of the washrack (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8270, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

IC 8 Areal Borings

Reconnaissance Borings. Thirty reconnaissance borings (B9 through B38) will be placed in the areas of VOC contamination detected during the soil gas investigation (Figure 3.8-1), in order to determine the presence of VOC contamination in the soil and to further characterize soil gas contamination. These borings will be located in an approximate triangular grid within IC 8 along the north side of PRL S-29 (Figure 3.8-1). Locations within the grid will be spaced at approximately 50-foot intervals within the soil gas target areas. Spacing between borings will be approximately 100 feet in areas outside the soil gas target areas. Samples will be collected to a minimum depth of 20 feet BGS. The contaminants of concern in the soils of areal borings in IC 8 are VOCs. Table 3.8-5 presents the DQOs for the areal borings at IC 8.

Table 3.8-6 presents the sampling and analysis matrix for all sampling locations at IC 8.

TABLE 3.8-5. DQOs FOR THE AREAL BORINGS AT IC 8

Objective:	To determine the presence of VOC and other contamination in the soil and to further characterize soil gas contamination.
Source Description:	
Source Type:	Soil gas targets
Area of Characterization:	14,844 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	VOCs
Sampling Methodology:	
Lateral Spacing Basis:	Triangular grid for statistical sampling in areas of soil gas contamination
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northeast corner of Building 655
<u>Reconnaissance Boring Locations and Depths</u>:	(all borings to a depth of 20 feet BGS)
	B9: 220′ N, 120′ W
	B10: 260′ N, 120′ W
	B11: 260′ N, 70′ W
	B12: 260′ N, 30′ E
	B13: 260′ N, 130′ E
	B14: 215′ N, 95′ W
	B15: 170′ N, 100′ W
	B16: 190′ N, 35′ E
	B17: 190′ N, 55′ E
	B18: 190′ N, 110′ E
	B19: 190′ N, 165′ E
	B20: 115′ N, 105′ W
	B21: 130′ N, 60′ W
	B22: 150′ N, 13′ W
	B23: 155′ N, 30′ E

(Continued)

TABLE 3.8-5. (Continued)

Reconnaissance Boring Locations and Depths (Continued):	B24: 148´ N, 82´ E B25: 140´ N, 140´ E B26: 140´ N, 180´ E B27: 92´ N, 58´ W B28: 110´ N, 15´ E B29: 110´ N, 55´ E B30: 110´ N, 105´ E B31: 110´ N, 155´ E B32: 110´ N, 205´ E B33: 45´ N, 85´ W B34: 72´ N, 12´ W B35: 40´ N, 11´ E B36: 19´ N, 106´ W B37: 10´ N, 75´ W B38: 24´ S, 17´ E
Total Number of Locations:	30
Analytical Methods:	FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.8-6. SAMPLING AND ANALYSIS MATRIX FOR IC 8

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval			
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B3[b], B6[c]	Deep Borings B4[b], B5[b]	Reconnaissance Borings B7, B8[d]	Reconnaissance Borings B9 - B38[e]
0 - 20	1	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8270 SW9012 SW9045 FPCB FVOC	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8270 SW9012 SW9045 FPCB FVOC	SW6010 SW8270 SW9045 FVOC	FVOC
0 - 20	2	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8270 SW9012 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8270 SW9012 SW9045 FVOC	SW6010 SW8270 SW9045 FVOC	FVOC
0 - 20	3	SW7471 SW8015/3550 SW8015/5030 FVOC FGC	SW7471 SW8015/3550 SW8015/5030 FVOC FGC	SW9045 FVOC FGC	FVOC FGC
20 - 95	4	NS	FVOC FGC	NS	NS
20 - 95	5	NS	FVOC FGC	NS	NS
20 - 95	6	NS	FVOC FGC	NS	NS
20 - 95	7	NS	FVOC FGC	NS	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are: 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for detection of IWL leaks at PRL L-5C.

[c] Boring locations for the detection of leakage where discharges from Building 603 enter the IWL at IC 8.

[d] Boring locations for the detection of leakage from a drain and a sump in the washrack at PRL S-30.

[e] Areal boring locations at IC 8.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues from 20 feet depth.

3.9 Site 23

Site 23 is located in the western portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of Site 23.

3.9.1 Site Description

Site 23 is the westernmost site in OU B and is bordered on three sides by the western boundary of McClellan AFB (Figure 3.9-1). The site was used as a disposal pit from approximately 1957 to 1969. Previous reports state that refuse, demolitions material, excess military equipment, and chemicals may have been disposed of at Site 23. Building 781, the asphalt lot, and an 8-inch asphalt curb, which surrounds the lot, were constructed in 1971. Building 781 is a chemical storage warehouse. Acids and bases, fuels and oils, metals, paints, and solvents are stored in the building. Building 781 is not considered a source of contamination because the building was designed for chemical storage, and there are no known records of releases from the building.

3.9.2 Previous Investigations

Previous investigations evaluated contaminants in soils beneath two areas of Site 23: one north of Building 781 where an open pit existed in 1971, and the other south of Building 781 where aerial photographs indicated evidence of soil disturbance (Radian, 1990a). The aerial photographs show evidence of disturbed soil across most of Site 23. The topography and coloration of the site, as seen on aerial photographs, changed from year to year, indicating that waste disposal activities were not limited to the two previously delineated areas. Therefore, the entire area within the boundaries of Site 23 is considered to be a potential contaminant source.

Three monitoring wells, MW-3, MW-48S, and MW-116, have been constructed within the boundary of Site 23. Monitoring Well (MW) 3 was constructed in 1980 with a screen interval from 80 to 200 feet BGS; it was sampled in 1980 and 1981. Analyses of samples showed TCE at 0.2 to 1.9 μg/L in three sampling events. The well was abandoned in 1989 because of improper construction. Monitoring Well 48S was constructed in 1982 at a depth of 102 feet BGS with 10 feet of screen. The well was

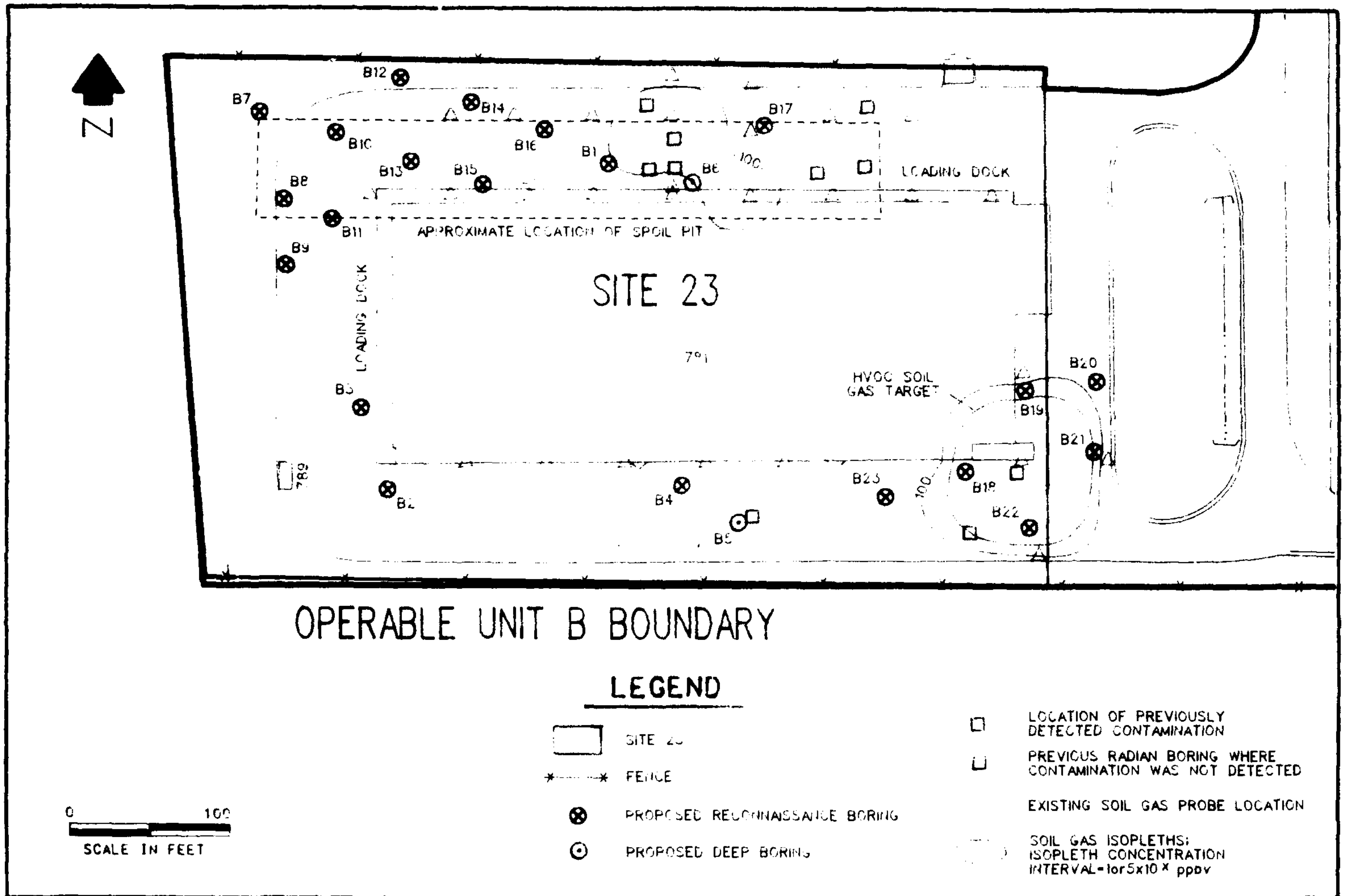

Figure 3.9-1. Site Features and Soil Boring Locations at Site 23.

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reported dry in 1982, and no samples could be collected for analysis. Monitoring Well 116 was constructed in 1985 to a depth of 92 feet BGS with a 10-foot screen interval. The well was sampled from 1985 to 1989. Analyses for VOCs, semivolatile organic compounds, metals, and cyanide were performed. The VOCs, 1,1-dichloroethane (0.2 to 1.1 μg/L), PCE (0.17 to 0.47 μg/L), benzene (0.1 to 0.22 μg/L), and ethylbenzene (0.1 μg/L) were the only organic compounds detected more than one time in the well until 1988. In 1988 and 1989, no VOCs were detected. Cyanide was not detected. Metals were below Maximum Contaminant Levels in each time samples were analyzed. The well is now dry.

Lithologic logs and analytical results from previous investigations (McLaren, 1986a) indicate that contamination at Site 23 is relatively heterogeneous. Results from closely spaced borings were often dissimilar. Odors, discolored soil, or buried debris indicating possible soil contamination were found in 7 of the 10 borings drilled (23SSB01, 23SSB02, 23SSB03, 23SSB04, 23DAP03, 23WSB01, and 23WSB02) (Figure 3.9-2). Nine VOCs were detected at depths ranging from 7.0 to 70 feet BGS in 23SSB02, 23SSB03, and 23WSB02. In addition, four semivolatile organic compounds (including n-nitrosodiphenylamine) were detected at depths ranging from 7.0 to 24.0 feet BGS in 23WSB02. Oil and grease were also detected. Soil in borings located south of Building 781 had other physical evidence of potential contamination: soil discoloration in 23WSB01, 23SSB01, and 23SSB02; odors in 23SSB02; and debris in 23SSB02 and 23DAP03.

A soil gas investigation of Site 23 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Thirty-five soil gas probes were placed and sampled for the soil gas investigation of Site 23. Results of soil gas sampling indicate the presence of VOCs (total HVOCs or total AVOCs) in 13 of these probes at concentrations that exceeded the soil gas target criteria established in Appendix A. Total HVOC concentrations, detected in all of the 35 probes, ranged from 1.5 to 7,561.7 ppbv. Total AVOC concentrations, detected in 23 of the 35 probes, ranged from 134 to 8,080 ppbv. However, the concentrations of AVOCs were disregarded because the total AVOC concentrations were also detected in sample blanks indicating contamination in sampling equipment. Therefore, results of the soil gas investigation at Site 23 indicate two areas that exceed criteria for soil gas targets (Appendix A). The identified target had a soil gas concentration exceeding 1,000 ppbv total HVOCs. The location of this target is shown in Figure 3.9-1.

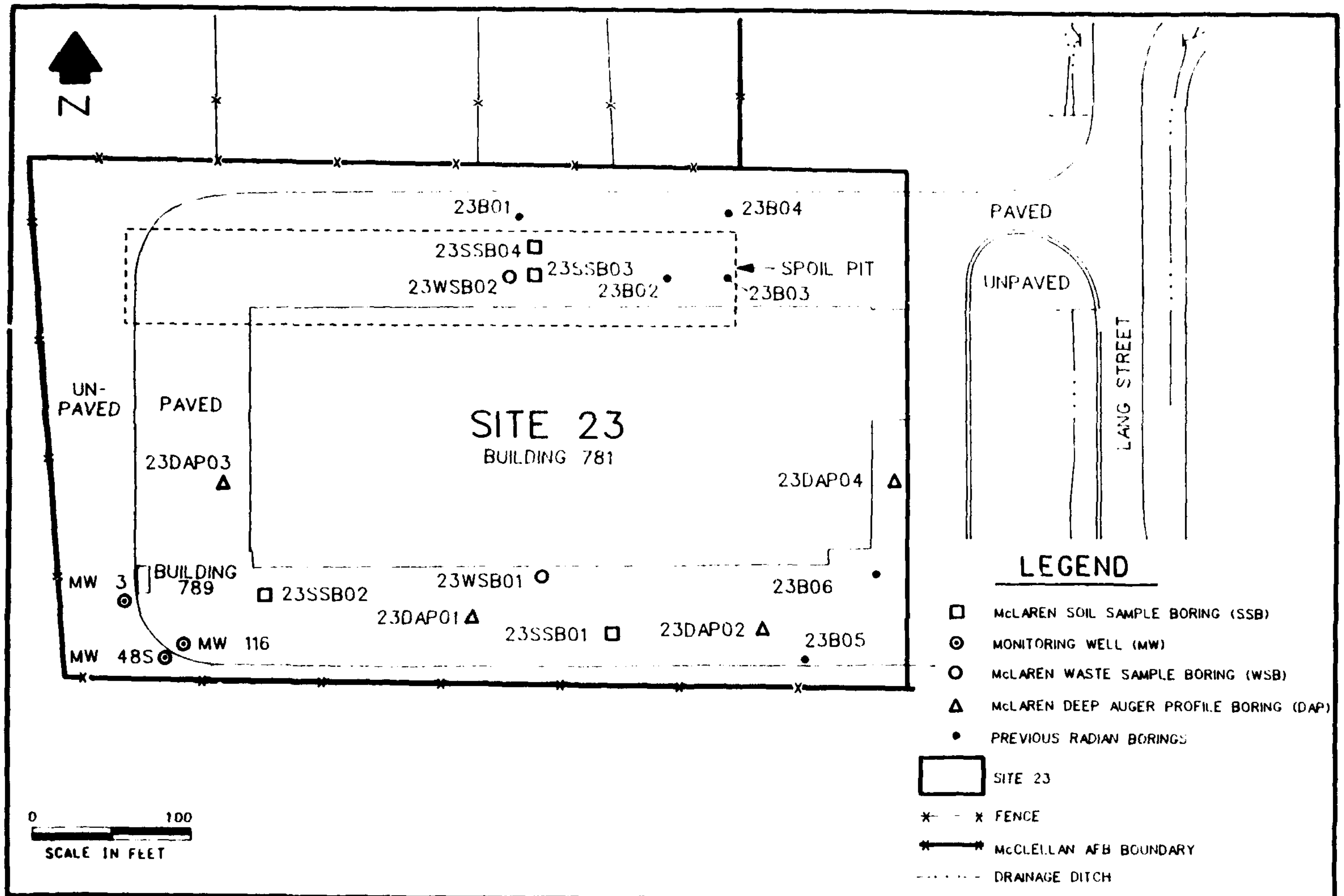

Figure 3.9-2. Previous Boring Locations for Site 23.

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In conjunction with the soil gas investigation at Site 23, Radian drilled and sampled six borings (Figure 3.1-2). Borings 1 and 6 were drilled in locations where the highest concentrations of total HVOCs were detected in soil gas samples. At Boring 1, total VOCs in near-surface soil gas were approximately 240 ppbv. Boring 1 had no detectable HVOCs in four of the five soil samples collected from 8 to 71 feet BGS. The only HVOC detected was 1,1,1-trichloroethane (4.9 micrograms per kilogram [μg/kg]) at 49 feet BGS. Ethylbenzene (1.2 to 5.5 μg/kg) and total xylenes (8.2 to 21.5 μg/kg) were detected in soil samples at 8 and 18 feet, but not in the soil gas samples.

Boring 6 was drilled adjacent to the location where 7,500 ppbv of PCE were detected in soil gas at 4 feet BGS. The VOCs, PCE, TCE, and 1,2-DCE, were detected in soil gas samples at depths of 8, 20, 48, and 69 feet; however, no VOCs were detected in any of the six soil samples collected from 6 to 69 feet in the boring.

Borings 3, 4, 5, and inadvertently, 2, were drilled at locations where total VOC concentrations at 4 to 6 feet were relatively low (less than 150 ppbv), but detectable. No VOCs were detected in soil samples collected just below the depth of soil gas samples. However, methylene chloride, acetone, and 2-butanone, which are common laboratory contaminants, were detected in soil samples collected from depths of 44 to 67 feet in Borings 3 and 4.

3.9.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of Site 23 is to determine the presence of VOC or other contamination in the area. A total of 21 reconnaissance borings and 2 deep borings will be placed at Site 23 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Previously Detected Contamination

Reconnaissance Borings. Four reconnaissance borings (B1 through B4) will be placed and sampled to a minimum depth of 20 feet BGS adjacent to locations of previous contractor borings where shallow soil contamination was detected (B1 and B2) or solvent odors or soil discoloration were noted (B3 and B4) to determine if contamination is present (Figure 3.9-1).

Deep Borings. Two deep borings (B5 and B6) will be placed and sampled to 95 feet BGS adjacent to locations of previous contractor borings where contamination was detected from 50 to 70 feet BGS, to confirm previous results. The deep borings will be used to assess the extent of vertical contamination and to better define the lithologic conditions that would affect contaminant migration beneath the site.

The contaminants of concern for the borings include metals, VOCs, semivolatile organic compounds, and volatile and extractable petroleum hydrocarbons. In addition, dioxin and furan compounds are also contaminants of concern for Borings B1 and B6 because of burn residues that may be present. Table 3.9-1 lists the DQOs for confirmation of previously detected soil contamination at Site 23.

Spoil Pit Area

Reconnaissance Borings. Eleven reconnaissance borings (B7 through B17) will be sampled to 20 feet BGS in the spoil pit area (Figure 3.9-1). These borings will be located within a systematic triangular grid using a 50-foot grid spacing. Reconnaissance borings will not be drilled in the eastern portion of the spoil pit because previous contractor borings did not detect contamination in that area of the site. The contaminants of concern for the spoil pit include metals, VOCs, semivolatile organic compounds, and dioxin and furan compounds. Table 3.9-2 presents the DQOs for the spoil pit area at Site 23.

Site 23 Areal Borings

Reconnaissance Borings. Six reconnaissance borings (B18 through B23) will be sampled to 20 feet BGS to determine if contamination is present in a soil gas target area. These borings will be located within a systematic triangular grid using a

TABLE 3.9-1. DQOs FOR CONFIRMATION OF PREVIOUSLY DETECTED SOIL CONTAMINATION AT SITE 23

Objective:	To confirm previous contractor results.
Source Description	
Source Type:	Previous contractor borings
Area of Characterization:	475 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, volatile and extractable petroleum hydrocarbons, dioxin and furan compounds
Sampling Methodology	
Lateral Spacing Basis:	Adjacent to previous locations where contaminants were detected
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	*Northwest corner of Building 781*
Reconnaissance Boring Locations and Depths:	B1: 23′ N, 138′ E (20 ft. BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW8015/3550, SW8280, FVOC, FGC
Reconnaissance Boring Locations and Depths:	B2: 180′ S, 10′ W (20 ft. BGS) B3: 127′ S, 20′ W (20 ft. BGS) B4: 177′ S, 185′ E (20 ft. BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8270, SW8015/3550, FVOC, FGC
Deep Boring Location and Depth:	B5: 204′ S, 215′ E (95 ft. BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW8015/3550, FVOC, FGC
Deep Boring Location and Depth:	B6: 15′ N, 192′ E (95 ft. BGS)
Total Number of Locations:	1
Analytical Methods:	SW6010, SW8270, SW8015/3550, SW8280, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.9-2. DQOs FOR THE SPOIL PIT AREA AT SITE 23

Objective:	To determine if soil contamination is present in the spoil pit at Site 23.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	24,250 square feet
Approximate Years of Operation:	1957 - 1969
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, dioxin and furan compounds
Sampling Methodology	
Lateral Spacing Basis:	50-foot triangular grid for statistical sampling in spoil pit
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 781
Reconnaissance Boring Locations and Depths:	B7: 62′ N, 77′ W (20 ft. BGS)
	B8: 0′ N, 69′ W (20 ft. BGS)
	B9: 42′ S, 69′ W (20 ft. BGS)
	B10: 42′ N, 35′ W (20 ft. BGS)
	B11: 10′ S, 35′ W (20 ft. BGS)
	B12: 81′ N, 10′ E (20 ft. BGS)
	B13: 31′ N, 12′ E (20 ft. BGS)
	B14: 62′ N, 54′ E (20 ft. BGS)
	B15: 12′ N, 58′ E (20 ft. BGS)
	B16: 46′ N, 96′ E (20 ft. BGS)
	B17: 46′ N, 231′ E (20 ft. BGS)
Total Number of Locations:	11
Analytical Methods:	SW6010, SW8270, SW8280, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

50-foot grid spacing. The contaminants of concern include metals, VOCs, and semivolatile organic compounds. Table 3.9-3 presents the DQOs for areal borings at Site 23.

Table 3.9-4 presents the sampling and analysis matrix for all sampling locations at Site 23.

TABLE 3.9-3. DQOs FOR AREAL BORINGS AT SITE 23

Objective:	To determine the presence of VOC contamination in the soil and to further characterize the soil gas contamination at Site 23.
Source Description	
Source Type:	Undetermined, indicated by soil gas
Area of Characterization:	9,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	50-foot triangular grid for statistical sampling of soil gas target
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 781
Reconnaissance Boring Locations and Depths:	B18: 170′ S, 362′ E (20 ft. BGS)
	B19: 120′ S, 400′ E (20 ft. BGS)
	B20: 110′ S, 442′ E (20 ft. BGS)
	B21: 162′ S, 442′ E (20 ft. BGS)
	B22: 204′ S, 400′ E (20 ft. BGS)
	B23: 188′ S, 308′ E (20 ft. BGS)
Total Number of Locations:	6
Analytical Methods:	SW6010, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.9-4. SAMPLING AND ANALYSIS MATRIX FOR SITE 23

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval					
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Boring B1[b]	Reconnaissance Borings B2 - B4[b]	Deep Boring B5[b]	Deep Boring B6[b]	Reconnaissance Borings B7 - B17[c]	Reconnaissance Borings B18 - B23[d]
0 - 20	1	SW6010 SW8015/3550 SW8270 SW8280 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 SW8280 FVOC	SW6010 SW8270 SW8280 FVOC	SW6010 SW8270 FVOC
0 - 20	2	SW6010 SW8015/3550 SW8270 SW8280 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 FVOC	SW6010 SW8015/3550 SW8270 SW8280 FVOC	SW6010 SW8270 SW8280 FVOC	SW6010 SW8270 FVOC
0 - 20	3	FVOC FGC	FVOC FGC	FVOC FGC	FVOC FGC	FVOC FGC	FVOC FGC
20 - 95	4	NS	NS	FVOC FGC	FVOC FGC	NS	NS
20 - 95	5	NS	NS	FVOC FGC	FVOC FGC	NS	NS
20 - 95	6	NS	NS	FVOC FGC	FVOC FGC	NS	NS
20 - 95	7	NS	NS	FVOC FGC	FVOC FGC	NS	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for confirmation of previously detected soil contamination at Site 23.

[c] Boring locations for the spoil pit area at Site 23.

[d] Areal boring locations at Site 23.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues from 20 feet depth.

3.10 Potential Release Location L-5F

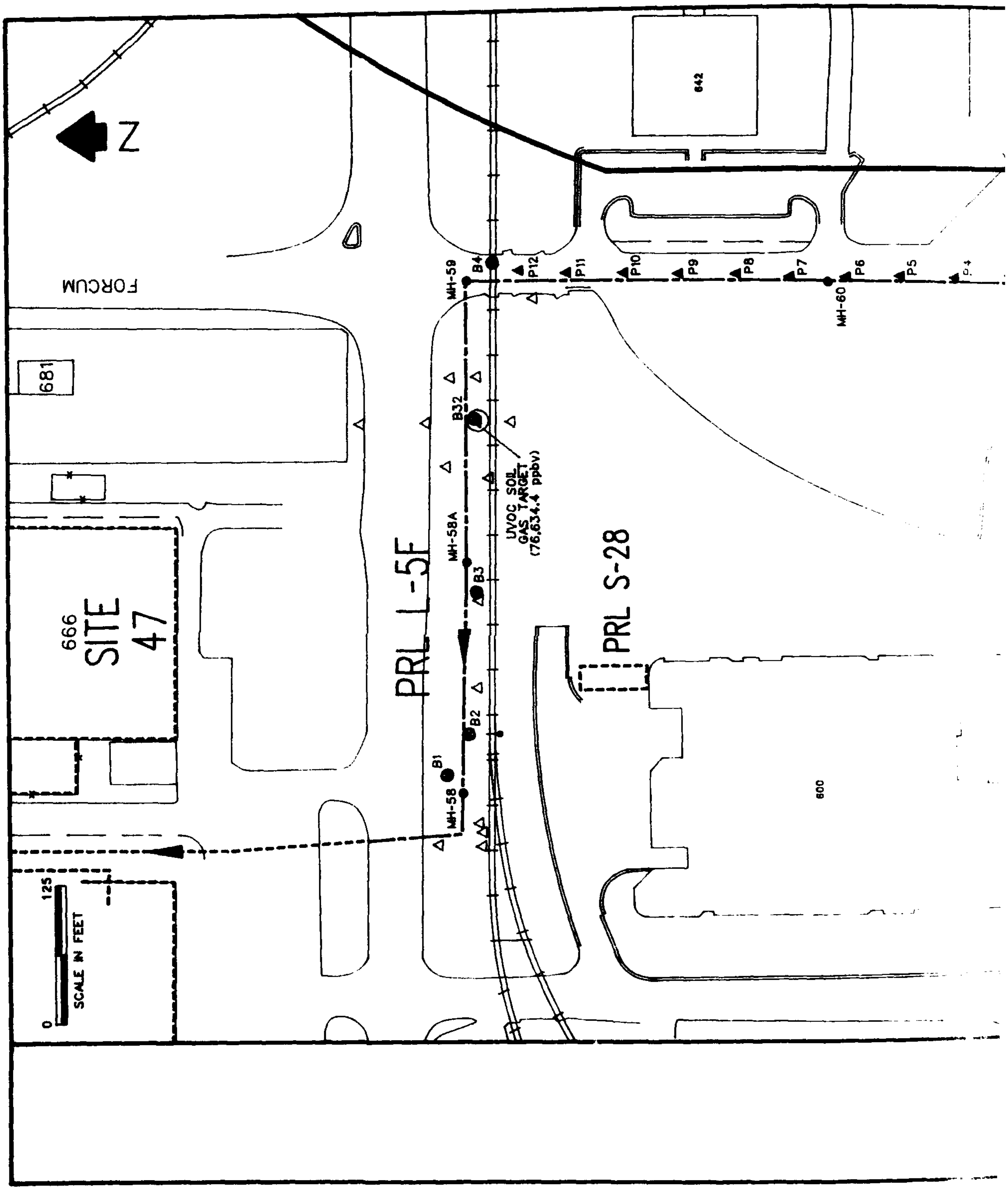
Potential Release Location L-5F is located in the southeastern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of PRL L-5F.

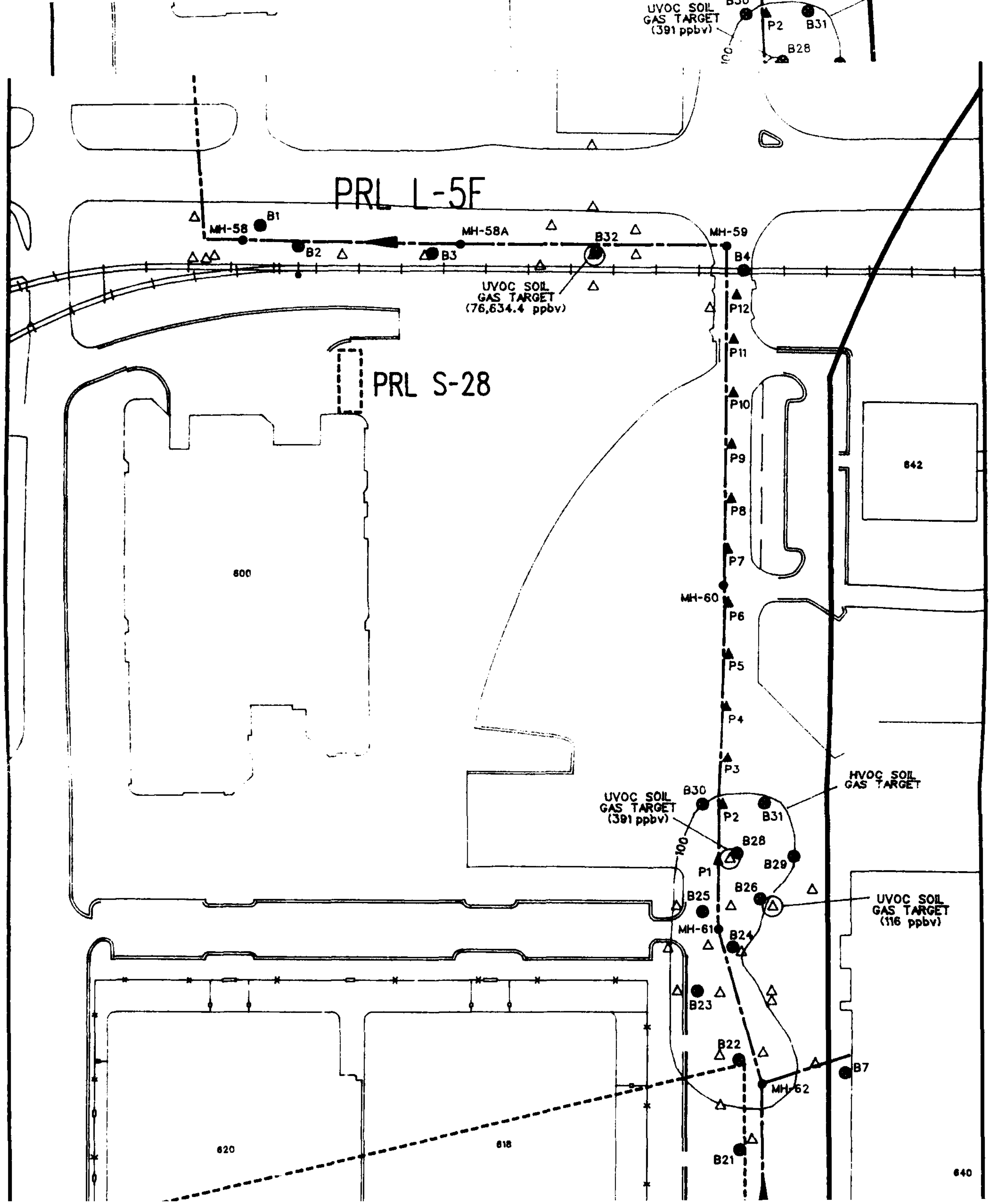
3.10.1 Site Description

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the pipes. The IWL at PRL L-5 is an underground piping system that carries wastewater using gravity flow and one lift station. PRL L-5 is approximately 6,150 feet long, beginning in the southeast corner of OU B and running north through the Building 655 area. Potential Release Location L-5F is the section of PRL L-5 beginning in the southeast corner of OU B and running north to the Building 666 area (IC 1) and is approximately 2,500 feet long. Figure 3.10-1 shows the surface trace of PRL L-5 and locations of access covers. Most of the piping system is constructed of 8-inch vitrified clay pipe, but 4-, 8-, and 10-inch asbestos-concrete, cast iron, and vitrified clay pipes are found in some sections of PRL L-5. Industrial activities at the facilities connected to PRL L-5 include maintenance, paint removal, painting, cleaning, industrial wastewater processing, and hazardous material storage described previously in the OU B Preliminary Assessment Summary Report (Radian, 1990a). Table 3.10-1 summarizes the available information concerning the historical operations performed and materials handled in buildings contributing to the flow through the IWL at PRL L-5F.

3.10.2 Previous Investigations

In 1988, EG&G Idaho, Inc. tested the integrity of the IWL at PRL L-5. During the investigation, access ways were cleaned, and the pipe segments were observed either by direct or remote inspection and were pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through them. However, several sections of PRL L-5F reportedly contained cracked joints and areas of breakage.


N
FORCUM
642
681
666
SITE
47
PRL L-5F
PRL S-28
600
MH-59
B4
P12
P11
P10
P9
P8
P7
P6
P5
P4
MH-60
B32
UVOC SOIL GAS TARGET (76,634.4 ppbv)
MH-58A
B3
B2
B1
MH-58
0
125
SCALE IN FEET


UVOC SOIL GAS TARGET (391 ppbv)
B30
P2
B31
B28
100
PRL L-5F
B1
MH-58
B2
MH-58A
B3
B32
MH-59
B4
UVOC SOIL GAS TARGET (76,634.4 ppbv)
P12
P11
PRL S-28
P10
P9
842
P8
600
P7
MH-60
P6
P5
P4
P3
HVOC SOIL GAS TARGET
B30
UVOC SOIL GAS TARGET (391 ppbv)
P2
B31
B28
100
P1
B29
B26
UVOC SOIL GAS TARGET (116 ppbv)
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B24
B23
B22
B7
MH-62
620
618
B21
640

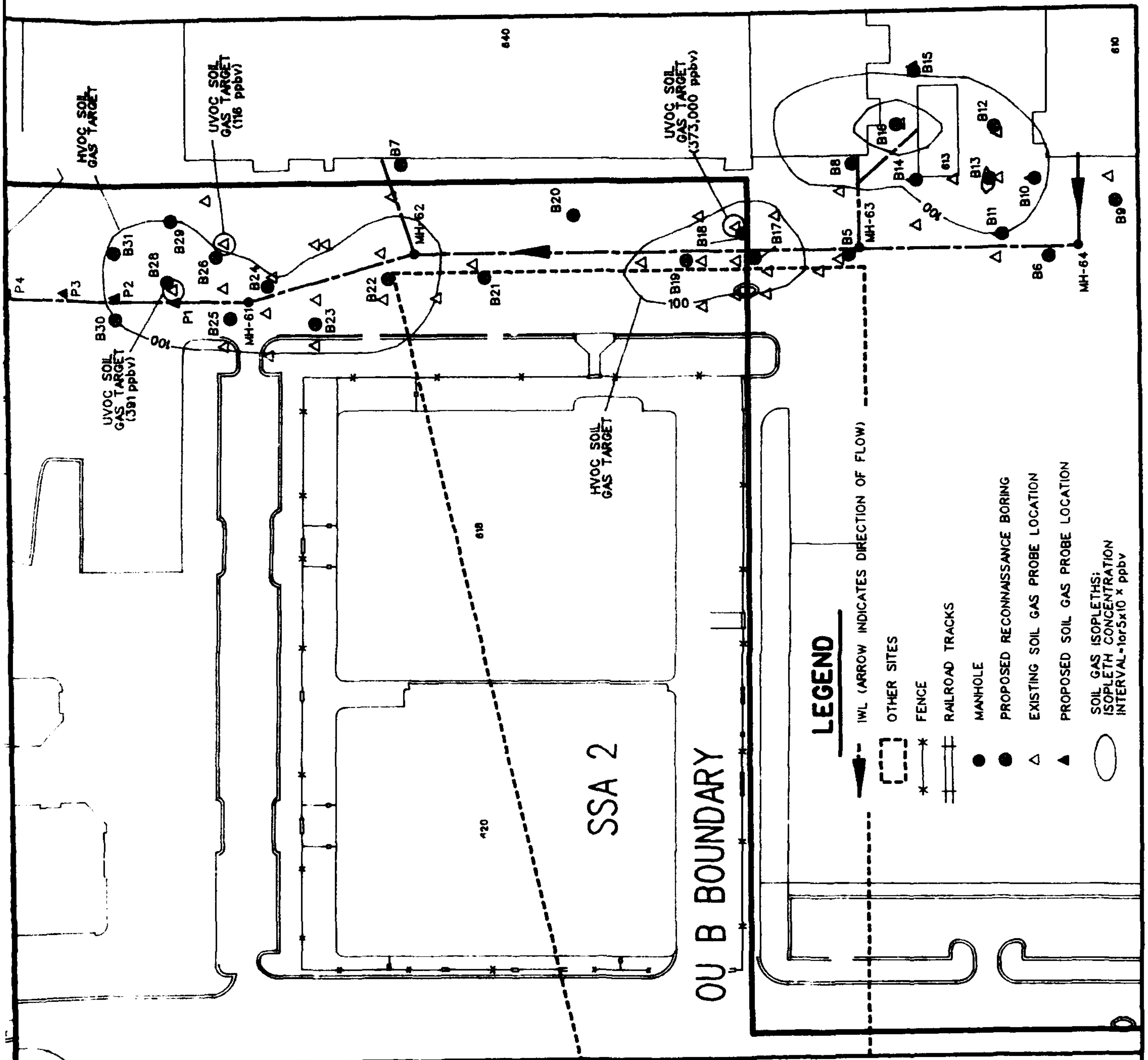

Figure 3.10-1. Site Features and Soil Boring Locations at PRL L-5F.

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TABLE 3.10-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED IN BUILDINGS CONTRIBUTING TO FLOW THROUGH THE IWL AT PRL L-5F

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL Carrying Wastewater From:		
Building 610: 6 VAN repair, maintenance	1953 - Present	S
Building 613: washrack, electronics shop	1953 - Present	NA
Building 640: electronics repair shop, paint shop, paint booth, and solvent booths (PRL T-7)	1953 - Present	S, P

NA = Not available
P = Paint
S = Solvents

A soil gas investigation of PRL L-5F was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Fifty-six soil gas probes were placed and sampled for the soil gas investigation of PRL L-5F. Results of soil gas sampling indicated the presence of VOCs (total HVOCs, total AVOCs, or total UVOCs) in 17 of these 56 probes at concentrations that exceeded the soil gas criteria. The HVOC concentrations, detected in all of the 56 probes, ranged from 2.6 to 1,750.7 ppbv. The AVOC concentrations, detected in 2 of the 56 probes, were 352 and 524 ppbv. The UVOC concentrations, detected in 4 of the 56 probes, ranged from 116 to 373,000 ppbv.

Results of the soil gas investigation at PRL L-5F indicate four areas of soil gas contamination depicted in Figure 3.10-1 that exceed the criteria for soil gas targets (Appendix A). Two HVOC targets had soil gas concentrations that exceeded 1,000 ppbv of total HVOCs, and one other HVOC target that had PCE in concentrations exceeding 100 ppbv. Soil gas concentrations exceeded 1,000 ppbv of total UVOCs in two probes, one of which occurs within an HVOC target. Two UVOC soil gas concentrations exceeded 100 ppbv for an individual UVOC, both of which coincide with an HVOC target.

3.10.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of PRL L-5F is to determine the presence of VOC or other contamination in the area. A total of 32 reconnaissance borings and 12 soil gas probes will be placed along PRL L-5F to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Soil Gas Investigation. Soil gas samples will be collected from 12 locations along the IWL in PRL L-5F. The IWL segments in PRL L-5F were tested, had cracks, but have not been sampled for VOCs in soil gas. Samples will initially be collected from probes driven to 6 feet BGS and spaced 50 feet apart along the length of the IWL (Figure 3.10-1). On the basis of concentrations detected in the initial soil gas samples, "stepout" probes will be placed along the IWL segments at distances of 25 feet from any initial probe with a total VOC concentration of 100 ppbv total HVOCs or UVOCs or 500 ppbv total AVOCs. Soil gas samples collected in the probes will be analyzed for HVOCs and AVOCs in the field with a gas chromatograph (GC). Table 3.10-2 presents DQOs for soil gas probes.

After the initial and stepout soil gas probes are sampled, additional reconnaissance or deep soil sample borings may be placed along the IWL to determine if VOCs are present on soil particles. Locations of the borings will be determined by the distribution of VOC concentrations in soil gas and results of the reconnaissance borings located in areas of cracks or damage to the IWL.

Reconnaissance Borings. Leaks in sections of the IWL at PRL L-5F are potential sources of contamination in the area. Six reconnaissance borings (B1 through B6) will be placed adjacent to leaks or breaks identified in the 1988 EG&G report (Figure 3.10-1). Table 3.10-3 presents DQOs for locations of IWL leaks at PRL L-5F.

Borings B7 and B8 will be placed at locations along previously untested branches of the IWL where wastewater from various facilities is initially discharged to the IWL (Figure 3.10-1). Table 3.10-4 presents DQOs for the discharge locations to the IWL at PRL L-5F.

Borings B9 through B32 will be placed in the areas of VOC contamination detected during the soil gas investigation (Figure 3.10-1). The borings are to determine if VOC contamination is present on the soil particles and to further characterize soil gas contamination. Borings are distributed in a triangular grid with a spacing of approximately 50 feet between locations in soil gas targets. Table 3.10-5 presents the DQOs for the areal borings at PRL L-5F.

Soil samples will be collected and analyzed for metals, lead, VOCs, and semivolatile organic compounds. Analytical methods have been chosen based on contaminants which may have been transported in wastewater passing through this IWL segment.

Table 3.10-6 presents the sampling and analysis matrix for all sampling locations at PRL L-5F.

TABLE 3.10-2. DQOs FOR LOCATIONS OF POTENTIAL IWL LEAKAGE AT PRL L-5F

Objective:	To determine the presence of soil gas contamination resulting from potential leakage of the IWL and in previously uninvestigated portions of PRL L-5F.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	580 linear feet
Phase:	1
Medium to be Sampled:	Soil gas
Contaminants of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source areas
Drilling Method:	Soil gas probe driver
Reference Point:	MH-59
Probe Boring Locations and Depths:	(all probes to a depth of 4 - 6 feet BGS) P1-P12: Probes placed at approximately 50-foot intervals beginning at reference point.
Total Number of Locations:	12
Analytical Methods:	FGC

FGC = Field gas chromatograph screening of soil gas.

TABLE 3.10-3. DQOs FOR LOCATIONS OF IWL LEAKS AT PRL L-5F

Objective:	To determine the presence of contamination potentially resulting from leakage of the IWL at PRL L-5F.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	2,200 linear feet
Approximate Years of Operation:	1953 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, lead, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at each potential discharge location
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
Reconnaissance Boring Locations and Depths:	(all borings to a depth of 20 feet BGS)

			EG&G (1988)[a]
Boring	Location	IR	Boring Placement Rationale
B1	223' W of MH-58A	26	Offset joint[b]
B2	162' W of MH-58A	26	Cracked joint[b]
B3	22' W of MH-58A	26	Cracked joint[b]
B4	311' N of MH-60	20	Offset joint[c]
B5	3' N of MH-63	18	Circumferential crack[d]
B6	30' N of MH-64	17	Longitudinal & circumferential cracks[e]

Total Number of Locations:	6
Analytical Methods:	SW6010, SW7421, SW8270, FVOC, FGC

IR = Immediate Report refrenced in EG&G (1988).
FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3E and 3H

[b] SWP-E-09(A)

[c] SWP-E-07(A)

[d] SWP-E-04(A)

[e] SWP-E-02(A)

TABLE 3.10-4. DQOs FOR DISCHARGE LOCATIONS TO THE IWL AT PRL L-5F

Objective:	To determine the presence of contamination potentially resulting from leakage of the building connections to the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	20 linear feet
Approximate Years of Operation:	1953 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, lead, VOCs, semivolatile organic compounds
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at potential discharge points
Drilling Method:	Power assisted split-spoon sampler
Reference Points:	B7: Southeast corner Bldg. 640 B8: Northeast corner Bldg. 640
Reconnaissance Boring Locations and Depths:	B7: 17′ N, 10′ W (20 feet BGS) B8: 192′ S, 5′ W (20 feet BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW7421, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.10-5. DQOs FOR AREAL BORINGS AT PRL L-5F

Objective: To determine the presence of VOC and other contamination in soil and to further characterize areas of soil gas contamination.

Source Description

Source Type: Undetermined, as indicated by soil gas

Area of Characterization: 165,300 square feet

Phase: 1

Media to be Sampled: Soil/soil gas

Contaminants of Concern: Metals, lead, VOCs, semivolatile organic compounds

Sampling Methodology

Lateral Spacing Basis: Triangular grid for statistical sampling in soil gas targets

Drilling Method: Power assisted split-spoon sampler

Reference Point: Various, see below

Reconnaissance Boring Locations and Depths: (all borings to a depth of 20 feet BGS)

Boring	Reference Point	Location
B9	Northwest corner Bldg. 610	48′ S, 19′ W
B10	Northwest corner Bldg. 610	10′ N, 19′ W
B11	Northwest corner Bldg. 610	38.5′ N, 67′ W
B12	Northwest corner Bldg. 610	48′ N, 29′ E
B13	Northwest corner Bldg. 610	53′ N, 19′ W
B14	Northwest corner Bldg. 610	115′ N, 19′ W
B15	Northwest corner Bldg. 610	115′ N, 82′ E
B16	Northwest corner Bldg. 610	134.5′ N, 29′ E
B17	Southwest corner Bldg. 640	106′ N, 92′ W
B18	Southwest corner Bldg. 640	115′ N, 57′ W
B19	Northwest corner Bldg. 640	184′ N, 92′ W
B20	Northwest corner Bldg. 640	348.5′ N, 48′ W
B21	MH-63	349′ N, of MH-63
B22	Northwest corner Bldg. 640	177′ S, 106′ W
B23	Northwest corner Bldg. 640	115′ S, 143′ W
B24	MH-61	6′ S of MH-61
B25	Northwest corner Bldg. 640	29′ S, 144′ W
B26	Northwest corner Bldg. 640	30′ N, 81′ W

(Continued)

TABLE 3.10-5. (Continued)

Reconnaissance Boring Locations and Depths: (Continued)	B27	Northwest corner Bldg. 640	26′ N, 115′ W
	B28	Northwest corner Bldg. 640	17′ N, 108′ W
	B29	Northwest corner Bldg. 640	9.5′ N, 53′ W
	B30	Northwest corner Bldg. 640	48′ N, 149′ W
	B31	Northwest corner Bldg. 640	62.5′ N, 84′ W
	B32	Inside northeast corner Bldg. 600	161′ N, 275′ E
Total Number of Locations:	24		
Analytical Methods:	SW6010, SW7421, SW8270, FVOC, FGC		

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.10-6. SAMPLING AND ANALYSIS MATRIX FOR PRL L-5F

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval			
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B1-B6[b]	Reconnaissance Borings B7-B8[c]	Reconnaissance Borings B9-B32[d]	Probes P1-P12
0 - 20	1	SW6010 SW7421 SW8270 FVOC	SW6010 SW7421 SW8270 FVOC	SW6010 SW7421 SW8270 FVOC	FGC
0 - 20	2	SW6010 SW7421 SW8270 FVOC	SW6010 SW7471 SW8270 FVOC	SW6010 SW7421 SW8270 FVOC	NS
0 - 20	3	SW8270 FVOC FGC	FVOC FGC	FVOC FGC	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Borings for locations of IWL leaks at PRL L-5F.

[c] Borings for discharge locations to the IWL at PRL L-5F.

[d] Areal boring locations at PRL L-5F.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

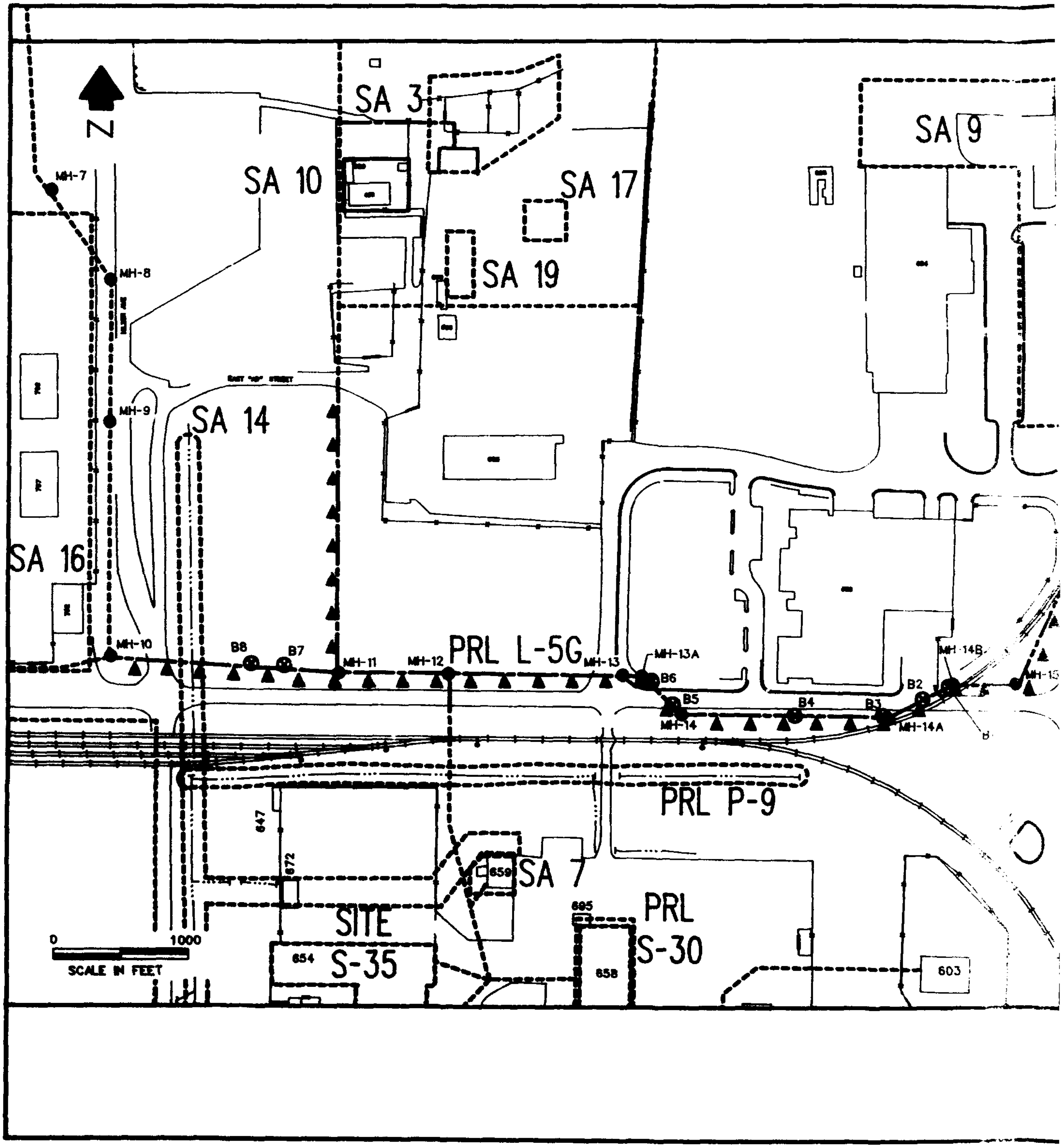
NS = Soil gas probes will not be sampled below 4 - 6 feet BGS.

3.11 Potential Release Location L-5G

Potential Release Location L-5G is located in the northern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of PRL L-5G.

3.11.1 Site Description

The IWL at McClellan AFB is designed to carry wastewater from industrial facilities to the IWTP in OU C of McClellan AFB. Wastewater flows through the IWL by gravity flow and with the assistance of lift stations. Lift stations increase the wastewater flow velocity by raising the elevation of wastewater in the pipes. The IWL at PRL L-5 is an underground piping system that carries wastewater using gravity flow and one lift station. Potential Release Location L-5G is approximately 3,700 feet long and includes the principal flow lines from southern OU B and OU A and one feeder line. The principal flow line, "main line", from OU A (PRL L-3) enters OU B from the east at MH-15 (Figure 3.11-1). From MH-15, the east end of PRL L-5G, the main line flows westerly to MH-12. At that junction, the IWL flow from the entire southern part of OU B enters PRL L-5G. The flow from PRLs L-5B through L-5F and PRL L-6 enter PRL L-5G at that point. The main line of PRL L-5G proceeds westward from MH-12 to MH-11. An IWL feeder line that flows from IC 3 joins the main line at MH-11. This feeder line is included in PRL L-5G. From MH-11, the main line continues west to MH-10. At MH-10, the flow from the main line of PRL L-5G joins the flow from the western feeder line of PRL L-5A. The main line that continues north from MH-10 is included in PRL L-5A. The IWL at PRL L-5G has received wastewater from several different chemical and industrial facilities since 1953. Industrial activities at the facilities connected to PRL L-5 include maintenance, paint removal, painting, cleaning, industrial wastewater processing, and hazardous material storage described previously in the OU B *Preliminary Assessment Summary* Report (Radian, 1990a). Table 3.11-1 summarizes the available information concerning the historical operations performed and materials handled at buildings contributing to flow through the IWL at PRL L-5G.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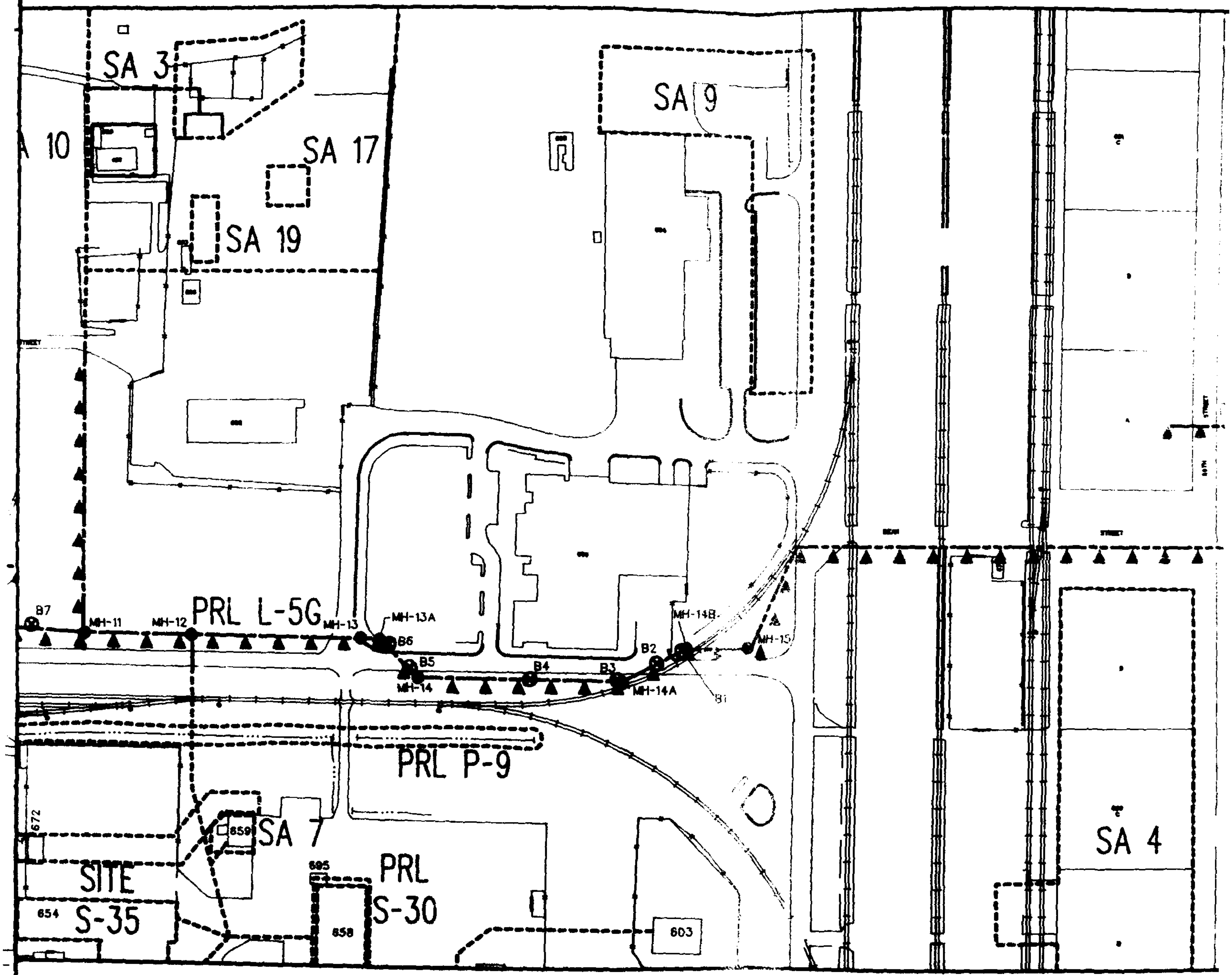
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B4
B3
MH-14A
B2
MH-14B
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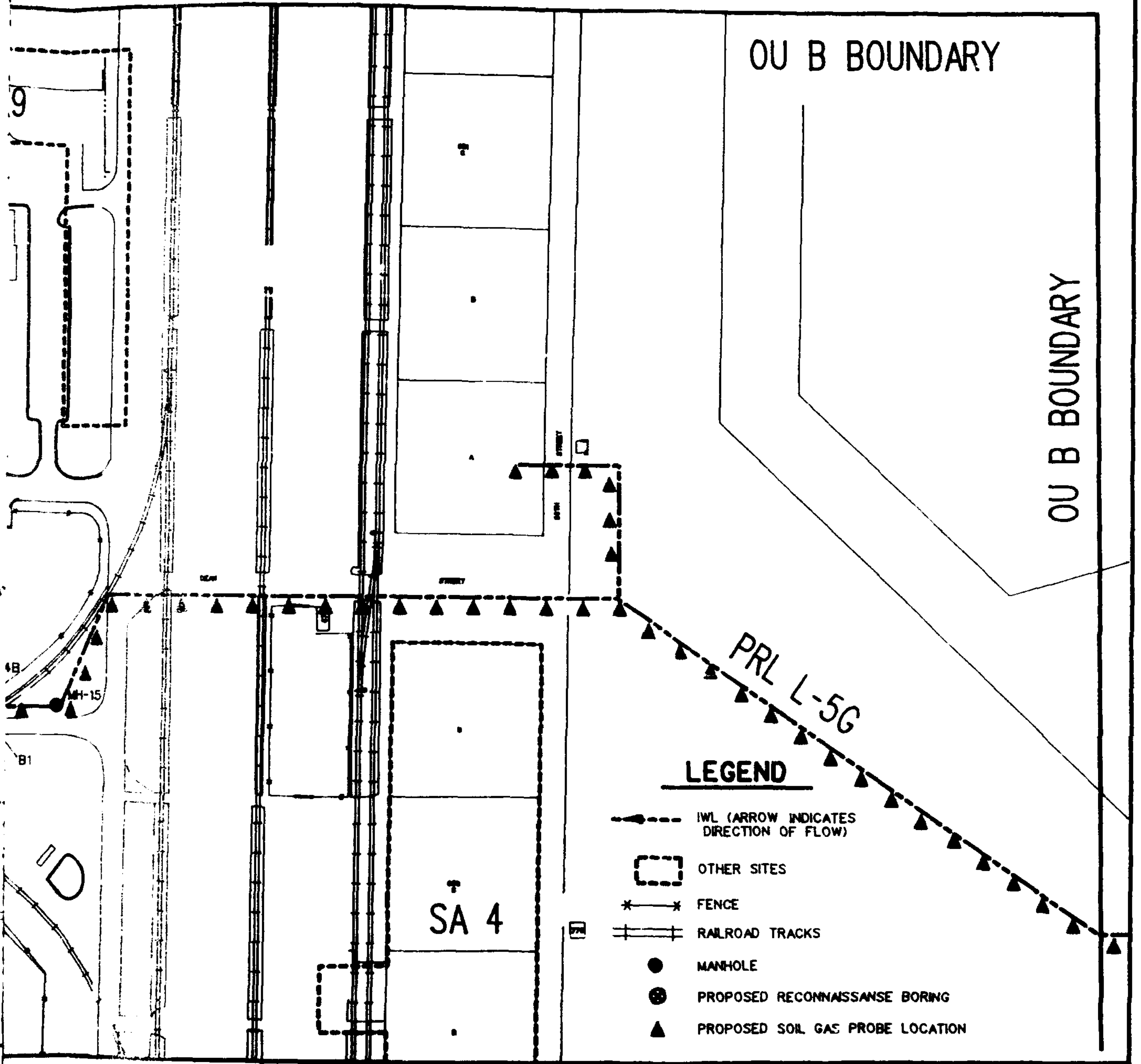

Figure 3.11-1. Site Features and Soil Boring Locations at PRL L-5G.

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TABLE 3.11-1. HISTORICAL OPERATIONS PERFORMED AND MATERIALS HANDLED AT BUILDINGS CONTRIBUTING TO THE FLOW THROUGH THE IWL AT PRL L-5G

Potential Contaminant Source	Approximate Years of Operation	Materials Handled
IWL carrying wastewater from:		
Building 610: 6 VAN repair, maintenance	1953-Present	S
Building 613: washrack, electronics shop	1953-Present	NA
Building 640: electronics repair shop, paint shop, paint booth, and solvent booths (PRL T-7)	1953-Present	S, P
Building 603: oil separator	1953-Present	F
IWTP No. 4: pretreatment of plating shop wastes, now removed (Site 48)	1957-1980	A, B, C, M
Building 655: fuel-tanker servicing, aircraft/vehicle painting, PCB storage, and van repair (PRL S-29)	1955-Present	F, P, PCB, S
Building 658: washrack, solvent/steam cleaning, and paint stripping (PRL S-30)	1953-Present	A, F, P, S
Building 654: ground power equipment repair (PRL S-35)	1953-Present	S, F
Building 659: washrack fueling area, and staging area (SA 7)	1951-Present	F, S
Buildings 688, 689: Entomology Unit	1980-Present	H, M, P, S
Asphalt Washrack at SA 3	1955-Present	NA
PRL L-3: Industrial Wastewater Line from OU A	1953-Present	F, M, P, S

PRL = Potential release location
A = Acids
B = Bases
C = Cyanide compound
F = Fuels and oils
M = Metals listed in California Code of Regulations, Title 22
NA = Not available
P = Paint
PCB = Polychlorinated biphenyls
S = Solvents

3.11.2 Previous Investigations

In 1988, EG&G Idaho, Inc., tested the integrity of the IWL at PRL L-5G (EG&G, 1988). During the investigation, access ways were cleaned, and the pipe segments were observed either by direct or remote inspection and were pressure tested. EG&G also evaluated the compatibility of pipe materials with the wastewater flowing through the pipes. All of the pipeline sections were compatible with wastewater passing through them. EG&G tested all sections of the IWL in PRL L-5G except the feeder line that joins the main line at MH-11. Leaking joints or cracks were identified in the main line between MH-13A and MH-14B and between MH-10 and MH-11. Leaking joints and cracks in the sections were subsequently repaired by in situ grouting. Sampling locations and analytical methods presented here are based upon evidence obtained during the EG&G investigation.

3.11.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of PRL L-5G is to determine the presence of VOC or other contamination in the area. Seventy-four soil gas probes will initially be placed at 50-foot spacing along PRL L-5G to sample soil gas. Eight reconnaissance boring locations have been selected to investigate potential contamination sources at identified cracks in the IWL. Additional Phase 1 reconnaissance borings will be placed along the IWL if VOC concentrations in soil gas indicate the presence of soil gas targets. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Soil Gas Investigation. Soil gas samples will be collected from 74 locations along the IWL in PRL L-5G. The IWL segments in PRL L-5G were tested, had cracks, but were not sampled for VOCs in soil gas. Samples will initially be collected from probes driven to 6 feet BGS and spaced approximately 50 feet apart along the length of the IWL (Figure 3.11-1). Table 3.11-2 presents DQOs for the locations of potential IWL leakage at PRL L-5G. On the basis of concentrations detected in the initial soil gas samples, stepout probes will be placed along the IWL segments at distances of 25 feet from any initial probe with a VOC concentration of 100 ppbv total HVOCs or UVOCs,

TABLE 3.11-2. DQOs FOR THE LOCATIONS OF POTENTIAL IWL LEAKAGE AT PRL L-5G

Objective:	To determine the presence of soil gas contamination resulting from leaks of the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	18,400 linear feet
Phase:	1
Medium to be Sampled:	Soil gas
Contaminants of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to suspected source areas
Drilling Method:	Soil gas probe driver
Reference Point:	MH-10
Reconnaissance Boring Locations and Depths:	(all probes to a depth of 4 - 6 feet BGS) P1 to P74: Probe placement at 50-foot intervals beginning at reference point.
Total Number of Locations:	74
Analytical Method:	FGC

FGC = Field gas chromatograph screening of soil gas.

or 500 ppbv total AVOCs. Soil gas samples collected in the probes will be analyzed for HVOCs and AVOCs in the field with a gas chromatograph (GC).

After the initial and stepout probe locations are sampled, additional reconnaissance borings will be placed in soil gas targets along the IWL to determine if VOCs are present on soil particles. Locations of these borings will be determined by the distribution of VOCs detected in soil gas from probe samples collected along the IWL.

Reconnaissance Borings. Eight reconnaissance borings (B1 through B8) will be placed adjacent to leaks or breaks that have been identified in the 1988 EG&G report (Figure 3.11-1). The boring locations generally follow a 50-foot grid spacing along the IWL. Table 3.11-3 presents DQOs for locations of IWL leaks at PRL L-5G.

Contaminants of concern for soil samples collected from borings along the main lines (Borings B1 through B6) include metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, acids, bases, and cyanide. In addition, contaminants of concern for soil samples collected from Borings B7 and B8 will include pesticides and herbicides that may have entered the line in wastewater from activities occurring upstream from the northern feeder line at SA 10 in IC 3, and radionuclides because they may have entered in wastewater from PRL L-6, which is upstream from this main line section of PRL L-5G.

Table 3.11-4 presents the sampling and analysis matrix for all sampling locations at PRL L-5G.

TABLE 3.11-3. DQOs FOR LOCATIONS OF IWL LEAKS AT PRL L-5G

Objective:	To determine the presence of contamination resulting from leaks in the IWL.
Source Description	
Source Type:	Underground pipeline
Area of Characterization:	850 linear feet
Approximate Years of Operation:	1953-present
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	Metals, mercury, volatile and extractable petroleum hydrocarbons, phenols, PCBs, VOCs, semivolatile organic compounds, acids, bases, cyanide, radionuclides, pesticides, herbicides
Sampling Methodology	
Lateral Spacing Basis:	Boring placed at each potential discharge location
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
Reconnaissance Boring Locations and Depths:	(all borings to a depth of 20 feet BGS)

Boring	Location	IR	EG&G (1988)[a] Boring Placement Rationale
B1	96' E of MH-14A	82	Leaking joints[b]
B2	48' E of MH-14A	82	Leaking joints[b]
B3	8' W of MH-14A	83	Leaking joints[c]
B4	140' W of MH-14A	83	Leaking joints[c]
B5	4' W of MH-14	84	Leaking joints[d]
B6	64' W of MH-14	84	Leaking joints[d]
B7	117' W of MH-11	87	Leaking joints[e]
B8	135' W of MH-11	87	Leaking joints[e]

Total Number of Locations:	8
Analytical Methods:	SW6010, SW7471, SW8015/3550, SW8015/5030, SW8040, SW8080, SW8140, SW8150, SW8270, SW9010, SW9310, SW9045, U.S. EPA 901.1, FVOC, FGC

IR = Immediate Report referenced in EG&G (1988).
FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

[a] Appendix 3D, 3E, and 3H

[b] SWP-D-08(A)

[c] SWP-D-09(A)

[d] SWP-D-10(A)

[e] SWP-E-36(A)

TABLE 3.11-4. SAMPLING AND ANALYSIS MATRIX FOR PRL L-5G

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval		
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B1-B6[b]	Reconnaissance Borings B7-B8[b]	Probes P1-P74
0 - 20	1	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8080 SW8270 SW9010 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8080 SW8140 SW8150 SW8270 SW9010 SW9045 SW9310 U.S. EPA 901.1 FVOC	FGC
0 - 20	2	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8080 SW8270 SW9010 SW9045 FVOC	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8040 SW8080 SW8140 SW8150 SW8270 SW9045 SW9010 SW9310 U.S. EPA 901.1 FVOC	NS
0 - 20	3	SW9045 FVOC FGC	SW9045 SW9310 U.S. EPA 901.1 FVOC FGC	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for IWL leaks at PRL L-5G.

(footnotes continued on next page)

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Soil gas probes not sampled below 4-6 feet BGS.

3.12 Potential Release Location S-13

Potential Release Location S-13 is located in the western portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of PRL S-13.

3.12.1 Site Description

Potential Release Location S-13 is an active hazardous waste storage lot situated along the southern boundary of McClellan AFB in OU B. The location has been used as an outdoor hazardous waste storage area since 1955 (Figure 3.12-1). The storage area was unpaved until 1981. In 1981, the entire location was paved, Buildings 709 and 727 were constructed, a drainage system was installed, and the French drain that previously collected runoff from the site was abandoned and covered with asphalt. Two sumps collect runoff from the storage lot and discharge to the drainage ditch. The sumps and French drain are approximately 4 to 6 feet deep. Both buildings have trench drains designed to collect spills; Building 709 has two self-contained trench drains, and the drain in Building 727 empties into a sump at the building's southeast corner. There are currently five cement-lined trench drains at PRL S-13. Acids, bases, cyanide compounds, fuels, oils, metals, solvents, PCBs, and paints have been stored at PRL S-13 throughout the past 35 years. In 1982, a PCB spill occurred in the southeastern part of the storage lot (southeast of Building 709). All PCB-contaminated asphalt and soil were removed from the location. Solvent (1,1,1-trichloroethane) was used to clean up the PCB spill.

A Gunite®-lined drainage ditch parallels the southern, eastern, and western perimeter of the site (Figure 3.12-1). The ditch has historically received runoff from the French drain and currently receives runoff from two sumps.

3.12.2 Previous Investigations

In 1989, Radian collected a sediment sample from the southwest corner of the drainage ditch (Figure 3.12-1). Volatile organic compounds, semivolatile organic compounds, and metals were detected in the sediment sample (Radian, 1990a). Two VOCs, acetone and methylene chloride, were detected in the sediment sample at

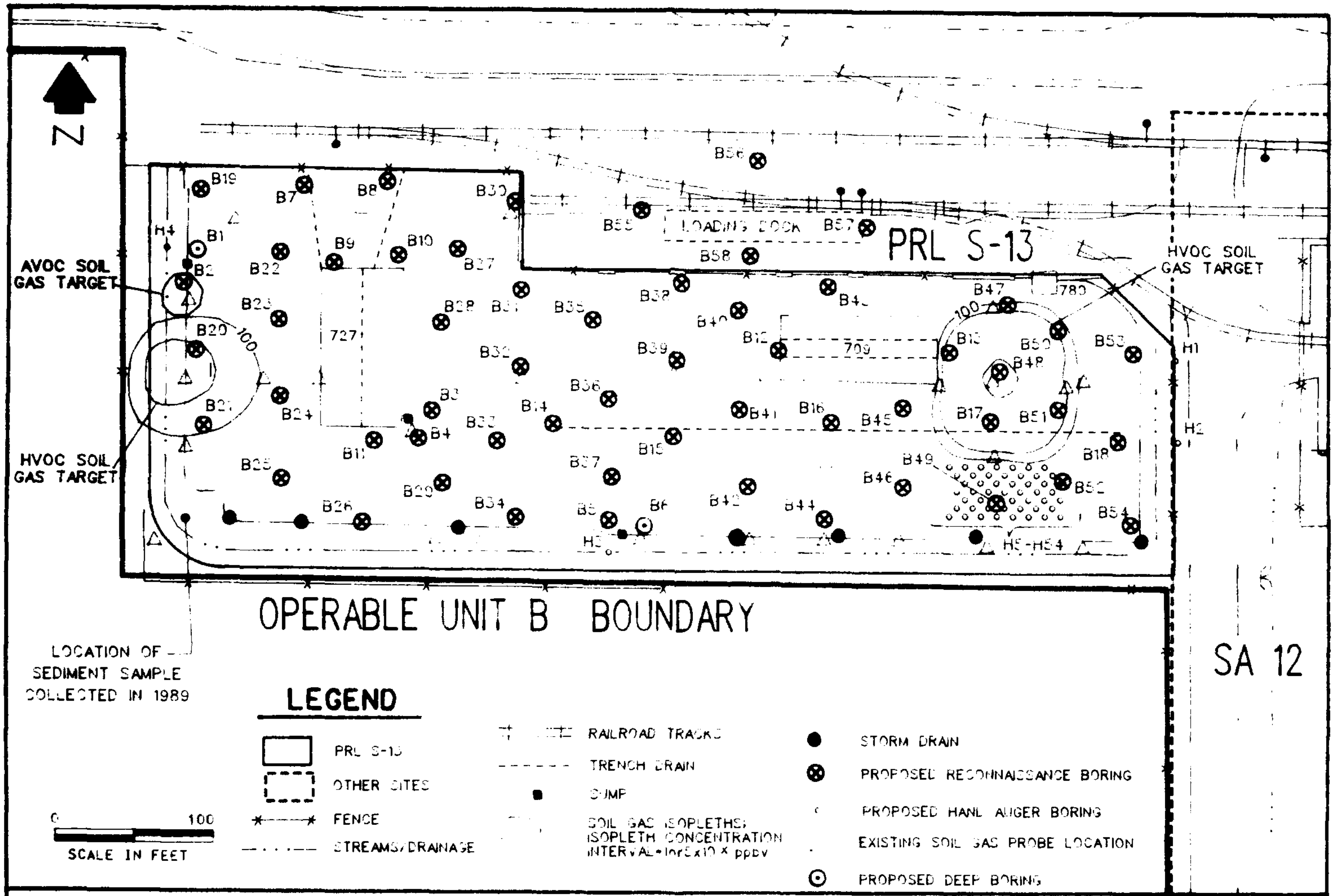

Figure 3.12-1. Site Features and Soil Boring Locations at PRL S-13.

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concentrations of 6.2 and 2.4 μg/kg, respectively; however, the same compounds were also detected in the reagent blank indicating probable laboratory contamination. Three semivolatile organic compounds, acetophenone, di-n-butylphthalate, and phenol, were also detected at similar levels. These same compounds were also detected in laboratory blanks. All total metal concentrations were below the applicable Total Threshold Limit Concentrations.

A soil gas investigation of PRL S-13 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Twenty-eight soil gas probes were placed and sampled for the soil gas investigation of PRL S-13. Results of soil gas sampling indicated the presence of VOCs (total HVOCs or total AVOCs) in 3 of these 28 probes at concentrations that exceed the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the 28 probes, ranged from 1.9 to 13,182 ppbv. The total AVOC concentration, detected in one probe, was 513 ppbv. Results of the soil gas investigation of PRL S-13 indicate that three areas exceed the criteria for soil gas targets. Two targets had soil gas concentrations exceeding 1,000 ppbv total HVOCs, and a third had soil gas concentrations exceeding 500 ppbv total AVOCs. The location of all targets are depicted in Figure 3.12-1.

3.12.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of PRL S-13 is to determine the presence of VOC or other contamination in the area. A total of 54 hand auger borings, 56 reconnaissance borings, and 2 deep borings will be placed at PRL S-13 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Drainage Ditch

Hand Auger Borings. Four hand auger borings (H1 through H4) will be sampled to 5 feet BGS in the drainage ditch that receives runoff from PRL S-13 at three discharge points. Two of the borings (H3 and H4) will be drilled where sumps discharge into the ditch. One boring (H2) will be drilled where the French drain historically discharged into the ditch. The fourth boring (H1) will be located where the drainage ditch enters the boundaries of PRL S-13. The contaminants of concern include metals, PCBs, pesticides, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.12-1 lists the DQOs for the drainage ditch at PRL S-13.

Underground Sumps

Reconnaissance and Deep Borings. Four reconnaissance borings (B2 through B5) and two deep borings (B1 and B6) will be located adjacent to the three sumps at PRL S-13. Borings B2 through B5 will be sampled to a minimum depth of 20 feet BGS. Borings B1 and B6 will be sampled to 95 feet BGS to characterize the lithologic conditions which could affect vertical migration of contaminants (Figure 3.12-1). Reconnaissance boring B2 and deep boring B1 will be drilled adjacent to the sump located along the western berm, which collects drainage from the two trench drains north of Building 727 and the northwest portion of the storage lot. Reconnaissance borings B3 and B4 will be drilled adjacent to the sump at the southeast corner of Building 727. Reconnaissance boring B5 and deep boring B6 will be drilled next to the sump located along the southern berm, which collects runoff from the storage lot. The contaminants of concern in the soils adjacent to the sumps include metals, PCBs, pesticides, VOCs, semivolatile organic compounds, cyanide, acids, and bases. Table 3.12-2 lists the DQOs for the underground sumps at PRL S-13.

Trench Drains

Reconnaissance Borings. Twelve reconnaissance borings (B7 through B18) will be sampled to a minimum depth of 20 feet BGS at each of the ends of the five trench drains at PRL S-13 (Figure 3.12-1). Borings B7 through B10 will be placed adjacent to the trenches located north of Building 727. Reconnaissance boring B11 will be drilled at the southern end of the trench inside Building 727. Reconnaissance borings (B12 and B13) will be located at a point at each end of and between the center lines of the two trenches that run through Building 709. Because the French drain was not cement-lined, five reconnaissance borings (B14 through B18) will be located along its length at 100-foot intervals. Contaminants of concern for the trenches include metals, PCBs, VOCs, semivolatile organic compounds, cyanide, pesticides, acids, and bases.

TABLE 3.12-1. DQOs FOR THE DRAINAGE DITCH AT PRL S-13

Objective:	To determine if contamination is present in the soils beneath the drainage ditch at PRL S-13.
Source Description	
Source Type:	Drainage ditch
Area of Characterization:	9,700 square feet
Approximate Years of Operation:	1974 - present
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	Metals, PCBs, pesticides, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Located at surface runoff discharge entry points
Drilling Method:	Hand auger
Reference Point:	Southeast corner of berm that surrounds storage lot
Hand Auger Boring Locations and Depths:	H1: 20' E, 125' N (5 feet BGS) H2: 20' E, 65' N (5 feet BGS) H3: 35' W, 20' S (5 feet BGS) H4: 630' W, 180' N (5 feet BGS)
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8270, SW9010, SW9045, FVOC, FPCB

FVOC = Field volatile organic compound screening.

FPCB = Field polychlorinated biphenyl screening.

TABLE 3.12-2. DQOs FOR THE UNDERGROUND SUMPS AT PRL S-13

Objective:	To determine if contamination is present in soils adjacent or beneath the underground sumps at PRL S-13.
Source Description	
Source Type:	Underground sumps
Area of Characterization:	300 square feet
Approximate Years of Operation:	1981 - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, PCBs, pesticides, VOCs, semivolatile organic compounds, cyanide, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to sumps
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
<u>Reconnaissance Boring Locations and Depths</u>:	(all borings to a depth of 20 feet BGS) B2: South of sump on western berm B3: North of sump near southeast corner of Building 727 B4: South of sump near southeast corner of Building 727 B5: West of sump on southern berm
Total Number of Locations:	4
Analytical Methods:	SW6010, SW8080, SW8270, SW9010, SW9045, FVOC, FGC
<u>Deep Boring Locations and Depths:</u>	B1: North of sump on western berm (95 ft. BGS) B6: East of sump on southern berm (95 ft. BGS)
Total Number of Locations:	2
Analytical Methods:	SW6010, SW8080, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of soil gas.

Table 3.12-3 lists the DQOs for the underground trenches at PRL S-13.

Surface Spill Areas

Reconnaissance Borings. Thirty-six reconnaissance borings (B19 through B54) will be sampled to a minimum depth of 20 feet BGS in the area used as an outdoor hazardous waste storage lot since 1955 (Figure 3.12-1). These borings will be located within a triangular grid with a 50-foot spacing between locations. The contaminants of concern for the storage lot include metals, PCBs, VOCs, semivolatile organic compounds, cyanide, acids, bases, and pesticides. Table 3.12-4 lists the DQOs for the storage lot spill area at PRL S-13.

Hand Auger Borings. Fifty hand auger borings (H5 through H54) will be sampled to 5 feet BGS in the area of the storage lot where PCBs were spilled. These borings will be located within a triangular grid with a 10-foot spacing between locations. The contaminants of concern for the PCB spill area are PCBs that were initially discharged, and VOCs that were used in the cleanup. Table 3.12-5 lists the DQOs for the PCB spill area at PRL S-13.

Loading Ramp Area

Reconnaissance Borings. Four reconnaissance borings (B55 through B58) will be sampled to a minimum depth of 20 feet BGS adjacent to the concrete loading ramp north of PRL S-13. One boring will be located on each side of the loading ramp. This ramp has been used for chemical loading and unloading since the 1950s. Contaminants of concern include volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, PCBs, and metals. Table 3.12-6 lists the DQOs for the concrete loading ramp area at PRL S-13.

Table 3.12-7 presents the sampling and analysis matrix for all sampling locations at PRL S-13.

TABLE 3.12-3. DQOs FOR THE UNDERGROUND TRENCHES AT PRL S-13

Objective:	To determine if contamination is present in soils adjacent or beneath the underground trench drains at PRL S-13.
Source Description	
Source Type:	Underground trench drains
Area of Characterization:	8,800 square feet
Approximate Years of Operation:	1981-present (French drain: Unknown-1981)
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminant of Concern:	Metals, PCBs, VOCs, semivolatile organic compounds, cyanide, pesticides, acids, bases
Sampling Methodology	
Lateral Spacing Basis:	Potential discharge points from trenches
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
<u>Reconnaissance Boring Locations and Depths</u>:	B7: North end of west trench, north of Bldg. 727 (20 feet BGS) B8: North end of east trench, north of Bldg. 727 (20 feet BGS) B9: South end of west trench, north of Bldg. 727 (20 feet BGS) B10: South end of east trench, north of Bldg. 727 (20 feet BGS) B11: South end of trench inside Bldg. 727 (20 feet BGS) B12: West end of Bldg. 709, between trenches (20 feet BGS) B13: East end of Bldg. 709, between trenches (20 feet BGS) B14: 375' W of east end of French drain (20 feet BGS) B15: 305' W of east end of French drain (20 feet BGS) B16: 195' W of east end of French drain (20 feet BGS) B17: 95' W of east end of French drain (20 feet BGS) B18: 10' W of east end of French drain (20 feet BGS)
Total Number of Locations:	12
Analytical Methods:	SW6010, SW8080, SW8270, SW9010, SW9045, FVOC, FGC

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of soil gas.

TABLE 3.12-4. DQOs FOR THE STORAGE LOT SPILL AREA AT PRL S-13

Objective: To determine if contamination is present in soils at the hazardous waste storage lot at PRL S-13.

Source Description

Source Type: Hazardous waste storage area (uniform surface spill area)
Area of Characterization: 100,000 square feet
Approximate Years of Operation: 1955-present
Phase: 1
Media to be Sampled: Soil/soil gas
Contaminants of Concern: Metals, PCBs, VOCs, semivolatile organic compounds, cyanide, acids, bases, pesticides

Sampling Methodology

Lateral Spacing Basis: 50-foot triangular grid for statistical sampling
Drilling Method: Power assisted split-spoon sampler
Reference Point: Southeast corner of berm that surrounds storage lot

Reconnaissance Boring Locations and Depths: (all borings to a depth of 20 feet BGS)

B19:	212′ N, 600′ W	B37:	27′ N, 347′ W
B20:	115′ N, 602′ W	B38:	148′ N, 300′ W
B21:	70′ N, 600′ W	B39:	104′ N, 300′ W
B22:	185′ N, 552′ W	B40:	131′ N, 256′ W
B23:	127′ N, 552′ W	B41:	81′ N, 256′ W
B24:	81′ N, 552′ W	B42:	27′ N, 256′ W
B25:	31′ N, 552′ W	B43:	148′ N, 204′ W
B26:	8′ N, 502′ W	B44:	10′ N, 204′ W
B27:	177′ N, 440′ W	B45:	81′ N, 150′ W
B28:	131′ N, 450′ W	B46:	27′ N, 150′ W
B29:	27′ N, 447′ W	B47:	131′ N, 95′ W
B30:	206′ N, 402′ W	B48:	104′ N, 95′ W
B31:	148′ N, 402′ W	B49:	20′ N, 95′ W
B32:	104′ N, 402′ W	B50:	131′ N, 50′ W
B33:	55′ N, 416′ W	B51:	81′ N, 50′ W
B34:	10′ N, 402′ W	B52:	27′ N, 50′ W
B35:	131′ N, 354′ W	B53:	104′ N, 10′ W
B36:	81′ N, 343′ W	B54:	10′ N, 10′ W

Total Number of Locations: 36
Analytical Methods: SW6010, SW8140, SW8150, SW8270, SW9010, SW9045, FVOC, FGC, FPCB

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.
FPCB = Field polychlorinated biphenyl screening.

TABLE 3.12-5. DQOs FOR THE PCB SPILL AREA AT PRL S-13

Objective:	To determine if soil contamination is present following the PCB spill and subsequent cleanup with 1,1,1-TCA at PRL S-13.
Source Description	
Source Type:	Nonuniform spill area
Area of Characterization:	5,000 square feet
Approximate Years of Operation:	1982
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	PCBs, VOCs
Sampling Methodology	
Lateral Spacing Basis:	10.1-foot triangular grid for statistical sampling
Sampling Method:	Hand auger
Boring Depth:	5 feet
Reference Point:	Southeast corner of Building 709
Grid Initiation Point:	5′ E, 80′ S from the southeast corner of Building 709
Grid Ray Angles:	60°, 120°
Grid Spacing:	10.1 feet
Total Number of Locations:	50 (H5 - H54)
Analytical Method:	FPCB, FVOC

Conditions and Assumptions

1. The probability of detecting all areas contaminated with PCBs is 90 percent.
2. The soil density is 2.6 g/cm^3.
3. A minimum of five transformers leaked on the site.
4. The density of PCB fluid is 1.45 g/cm^3.
5. Each transformer contained 50 gallons of 5,000 mg/kg PCB oil.
6. Each area of contamination resulted from leakage of 10 percent of transformer containing 50 gallons.
7. Each area of contamination is circular in shape.
8. Each area of contamination has a 5-foot radius.
9. The spill was evenly distributed in the spill area to a depth of 6 inches.

FVOC = Field volatile organic compound screening.

FPCB = Field polychlorinated biphenyl screening.

TABLE 3.12-6. DQOs FOR THE CONCRETE LOADING RAMP AREA AT PRL S-13

Objective:	To determine if soil contamination exists in the area surrounding the concrete ramp used for chemical handling at PRL S-13.
Source Description	
Source Type:	Surface spill
Area of Characterization:	6,500 square feet
Approximate Years of Operation:	1950s - present
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, PCBs, metals
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to loading ramp at center line
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Various, see below
Reconnaissance Boring Locations and Depths:	B55: center of east end of ramp (20 ft. BGS) B56: center of north side of ramp (20 ft. BGS) B57: center of west end of ramp (20 ft. BGS) B58: center of south side of ramp (20 ft. BGS)
Total Number of Locations:	4
Analytical Methods:	SW8015/3550, SW8015/5030, SW8270, SW6010, FVOC, FGC, FPCB

FVOC = Field volatile organic compound screening.

FGC = Field gas chromatograph screening of field gas.

FPCB = Field polychlorinated biphenyl screening.

TABLE 3.12-7. SAMPLING AND ANALYSIS MATRIX FOR PRL S-13

Sampling Specifications		Analytical Method for Samples Collected in Depth Interval					
Depth Interval (ft. BGS)	Sample Horizon[a]	Hand Auger Borings H1-H4[c]	Reconnaissance Boring B2-B5[d] B7-B18[e]	Deep Borings B1, B6[d]	Reconnaissance Borings B19-B54[f]	Hand Auger Borings H5-H54[g]	Reconnaissance Borings B55-B58[h]
0 - 20	1[b]	SW6010 SW8270 SW9010 SW9045 FVOC FPCB	SW6010 SW8080 SW8270 SW9010 SW9045 FVOC	SW6010 SW8080 SW8270 SW9010 SW9045 FVOC	SW6010 SW8140 SW8150 SW8270 SW9010 SW9045 FPCB FVOC	FPCB FVOC	SW6010 SW8015/3550 SW8270 FPCB FVOC
0 - 20	2	SW6010 SW8270 SW9010 SW9045 FVOC FPCB	SW6010 SW8080 SW8270 SW9010 SW9045 FVOC	SW6010 SW8080 SW8270 SW9010 SW9045 FVOC	SW6010 SW8140 SW8150 SW8270 SW9010 SW9045 FPCB FVOC	FPCB FVOC	SW6010 SW8015/3550 SW8270 FPCB FVOC
0 - 20	3	NS	SW9010 SW9045 FVOC FGC	SW9010 SW9045 FVOC FGC	SW9010 SW9045 FVOC FGC	NS	FVOC FGC
20 - 95	4	NS	NS	FVOC FGC	NS	NS	NS
20 - 95	5	NS	NS	FVOC FGC	NS	NS	NS
20 - 95	6	NS	NS	FVOC FGC	NS	NS	NS
20 - 95	7	NS	NS	FVOC FGC	NS	NS	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Collect first sample for nonvolatile analyses between 0-3 inches BGS. Collect samples for volatile analyses between 1-5 feet BGS.

[c] Hand auger locations for drainage ditch at PRL S-13.

[d] Boring locations for underground sumps at PRL S-13.

[e] Boring locations for underground trenches at PRL S-13.

[f] Boring locations for storage lot spill area at PRL S-13.

[g] Hand auger locations for PCB spill area at PRL S-13.

[h] Boring locations for the concrete loading ramp area at PRL S-13.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

NS = Not sampled unless contamination continues from 20 feet depth for reconnaissance borings or below depth of previous sample for hand auger borings.

3.13 Potential Release Location S-28

Potential Release Location S-28 is located in the southeastern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of PRL S-28.

3.13.1 Site Description

Potential Release Location S-28 consists of the former location of Temporary Building 615 (Figure 3.13-1). Temporary Building 615 was located at PRL S-28 from approximately 1968 to 1987; it reportedly was used for paint and oil storage. Little else is known about historical activities at PRL S-28. Although Building 615 is no longer present, oils and paints are known to have been stored at PRL S-28 and would have resulted in contamination of soils if spilled. Grass now covers the location, as part of the landscaping around Building 600 to the south. A storm drain lies in the northwest corner of the location.

3.13.2 Previous Investigations

A soil gas investigation of PRL S-28 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Three soil gas probes were placed and sampled for the soil gas investigation of PRL S-28. Results of soil gas sampling indicated total HVOC concentrations, detected in all of the three probes, ranged from 7.5 to 29 ppbv. Total AVOC concentrations, detected in all of the three probes, ranged from 93 to 206 ppbv. A total UVOC concentration, detected in one of the three probes, was 40,600 ppbv.

Results of the soil gas investigation at PRL S-28 indicate that one sample containing a concentration exceeding 1,000 ppbv total UVOCs exceeded the soil gas target criteria (Appendix A). This target location is shown in Figure 3.13-1.

3.13.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of PRL S-28 is to determine the presence of VOC or other contamination in the area. A total of three

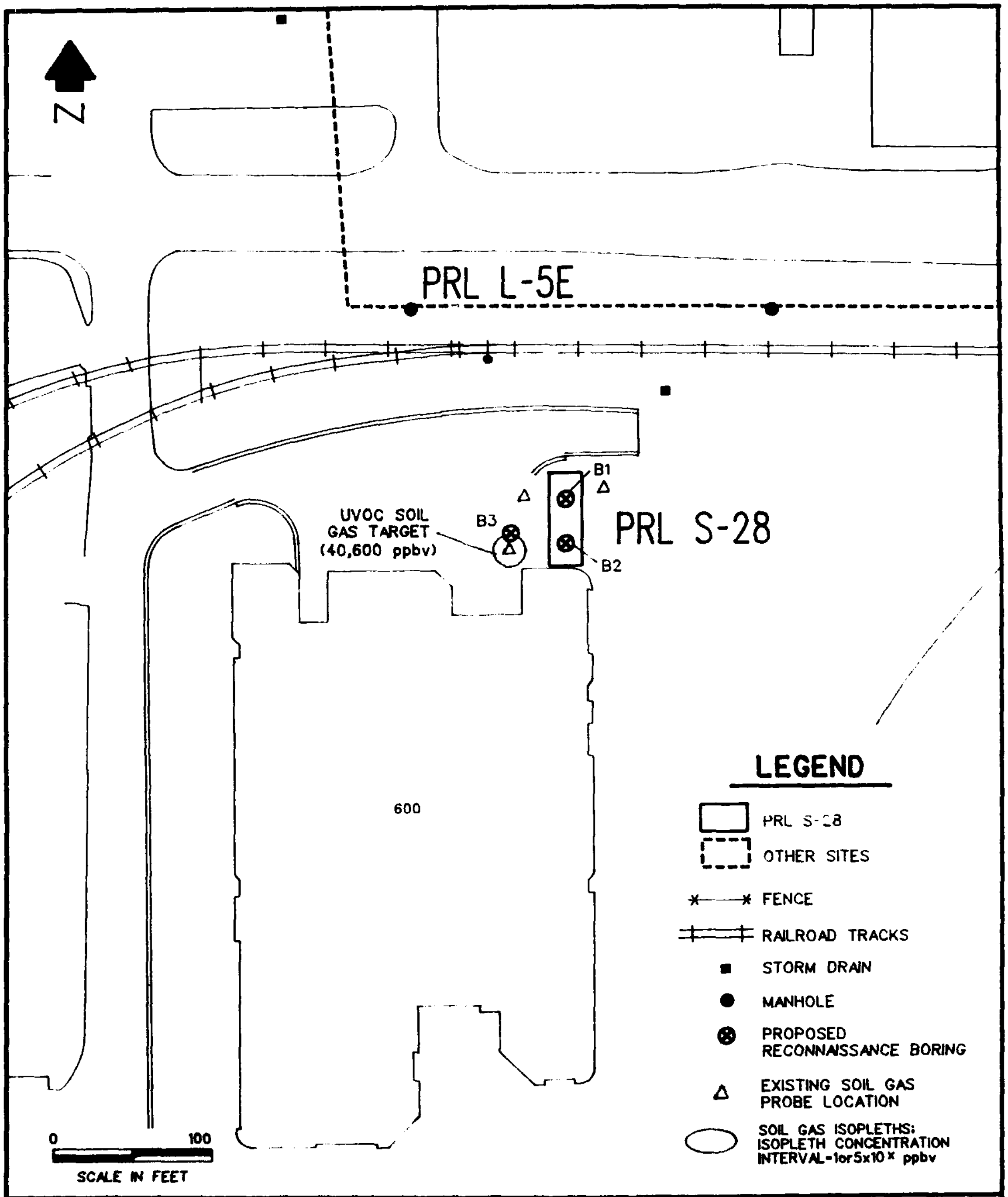

Figure 3.13-1. Site Features and Soil Boring Locations at PRL S-28.

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reconnaissance borings will be placed at PRL S-28 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Reconnaissance Borings. Two reconnaissance borings (B1 and B2) will be placed within the boundaries of the former building at PRL S-28 to detect VOC or other contamination that may have been discharged beneath the former building. A third reconnaissance boring (B3) will be placed at the location of the soil probe, which indicated a soil gas target. Contaminants of concern at PRL S-28 include metals, VOCs, semivolatile organic compounds, and lead. Table 3.13-1 presents DQOs for the potential surface spill area and areal borings at the former location of Building 615.

Table 3.13-2 presents the sampling and analysis matrix for all sampling locations at PRL S-28.

TABLE 3.13-1. **DQOs FOR THE POTENTIAL SURFACE SPILL AREA AND AREAL BORINGS AT THE FORMER LOCATION OF BUILDING 615**

Objective:	To determine the presence of contaminants in the soil.
Source Description	
Source Type:	Surface spill area
Area of Characterization:	1950 square feet
Approximate Years of Operation:	1968-1987
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, lead
Sampling Methodology	
Lateral Spacing Basis:	Approximate 50-foot grid over potential surface discharge area
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Inner northeast corner of Building 600
Reconnaissance Boring Locations and Depths:	B1: 45′ N, 28′ E (20 feet BGS) B2: 15′ N, 28′ E (20 feet BGS) B3: 22′ N, 12′ W (20 feet BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8270, SW7421, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.13-2. SAMPLING AND ANALYSIS MATRIX FOR PRL S-28

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B1-B3[b]
0 - 20	1	SW6010 SW7421 SW8270 FVOC
0 - 20	2	SW6010 SW7421 SW8270 FVOC
0 - 20	3	SW7421 SW8270 FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for the potential surface spill area and areal borings at former location of Building 615.

FVOC = Screening analysis of soils for 10 commonly detected VOCs with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

3.14 Potential Release Location S-33

Potential Release Location S-33 is located in the northwest portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of PRL S-33.

3.14.1 Site Description

Potential Release Location S-33 is the former chemical and chemical waste storage facility at Building 786A (Figure 3.14-1), in the northwestern part of OU B. Building 786A currently houses offices, a boiler room, and a furniture storage area. The building was built in approximately 1955 and was historically used as a distribution point for chemicals as a collection point for chemical wastes from most of the industrial buildings on base. Materials handled at the building include: acids and bases, fuels and oils, paints, semivolatile organic compounds, and solvents. The western side of Building 786A is landscaped and a small drainage ditch flows north approximately 50 feet west of the building. Railroad tracks parallel the edge of the building on the eastern side of the building; the ground is covered by gravel between the building and the railroad tracks. A small drainage ditch flows north along the east side of the railroad tracks. A concrete walkway (formerly the loading dock) abuts the south side of Building 786A; an asphalt parking lot borders on the south side of the walkway. Loading bays are located on the east and west sides of the building. Drums were unloaded along the western, southern, and eastern docks of Building 786A when it was used as a chemical warehouse. During the 1970s, operations at the building changed from hazardous materials storage to its current use.

3.14.2 Previous Investigations

A soil gas investigation of PRL S-33 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Nine soil gas probes were installed and sampled during the soil gas investigation of PRL S-33. Results of soil gas sampling indicated the presence of total HVOCs in all of the nine probes at concentrations below the soil gas criteria established in Appendix A. No AVOCs or UVOCs were detected in any probe. Total HVOC concentrations ranged from 0.50 to 32.5 ppbv. The detected concentrations did not meet criteria for soil gas targets.

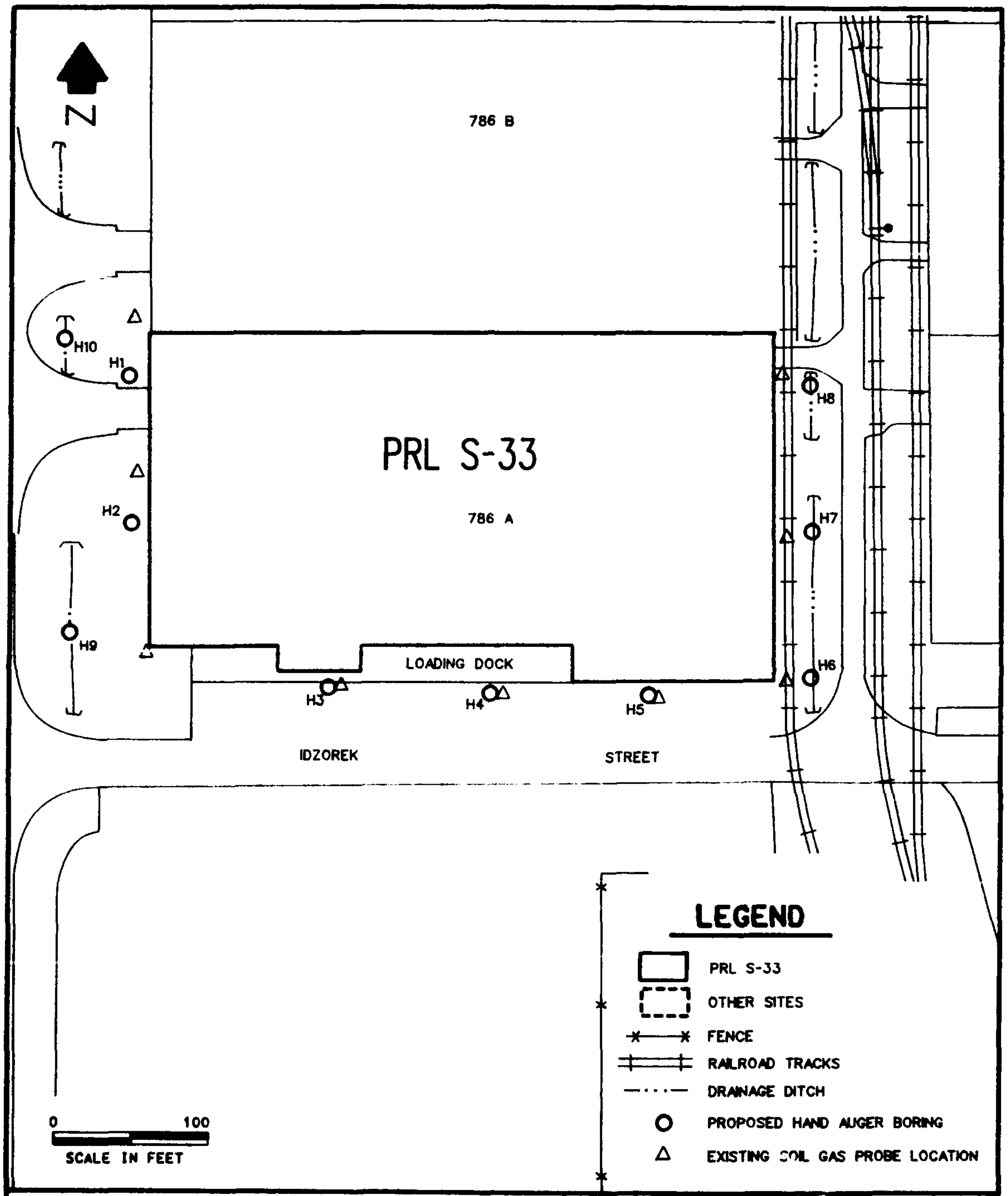

Figure 3.14-1. Site Features and Soil Boring Locations at PRL S-33.

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3.14.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of PRL S-33 is to determine the presence of VOC or other contamination in the area. A total of 10 hand auger borings will be placed at PRL S-33 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Hand Auger Borings. Eight hand auger borings (H1 through H8) will be placed along the perimeter of Building 786A at 100-foot intervals (Figure 3.14-1). This distribution of borings was selected because there is no evidence of historical spills outside of the building and no soil gas targets were identified. Samples will be collected to a depth of 5 feet BGS. The contaminants of concern include metals, extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, and acids and bases. Table 3.14-1 presents the DQOs for the potential spill area along the perimeter of Building 786A at PRL S-33.

Two hand auger borings (H9 and H10) will be placed along the drainage ditch located west of Building 786A. Samples will be collected to a minimum depth of 3 feet BGS. The contaminants of concern include metals, extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, and acids and bases. Table 3.14-2 presents the DQOs for the drainage area to the west of Building 786A.

Table 3.14-3 presents the sampling and analysis matrix for all sampling locations PRL S-33.

TABLE 3.14-1. DQOs FOR THE POTENTIAL SPILL AREA ALONG THE PERIMETER OF BUILDING 786A AT PRL S-33

Objective:	To determine the presence of any soil contamination in the western, southern, and eastern loading areas of Building 786A.
Source Description	
Source Type:	Chemical storage and surface spill area
Area of Characterization:	15,400 square feet
Approximate Years of Operation:	1955-unknown
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	Metals, extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, acids and bases
Sampling Method	
Lateral Spacing Basis:	Borings in potential spill areas
Drilling Method:	Hand auger
Reference Point:	Northwest corner of Building 786A
Hand Auger Boring Locations and Depths:	H1: 25′ S, 10′ W (5 ft. BGS) H2: 125′ S, 10′ W (5 ft. BGS) H3 230′ S, 120′ E (5 ft. BGS) H4: 230′ S, 220′ E (5 ft. BGS) H5: 230′ S, 320′ E (5 ft. BGS) H6: 225′ S, 420′ E (5 ft. BGS) H7: 125′ S, 420′ E (5 ft. BGS) H8: 25′ S, 420′ E (5 ft. BGS)
Total Number of Locations:	8
Analytical Method:	SW6010, SW8015/3550, SW8270, SW9045, FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.14-2. DQOs FOR THE DRAINAGE AREA AT PRL S-33

Objective:	To determine if contamination is present in soils beneath the western drainage ditch at PRL S-33.
Source Description	
Source Type:	Drainage ditch
Area of Characterization:	Approximately 2,500 square feet
Approximate Years of Operation:	1955-1970s
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	Metals, extractable petroleum hydrocarbons, VOCs, semivolatile organic compounds, acids and bases
Sampling Method	
Lateral Spacing Basis:	Borings in drainage ditch
Drilling Method:	Hand auger
Reference Point:	Southwest corner of Building 786A
Hand Auger Boring Locations and Depths:	H9: 10' N, 50' W (5 feet BGS) H10: 200' N, 50' W (5 feet BGS)
Total Number of Locations:	2
Analytical Method:	SW6010, SW8015/3550, SW8270, SW9045, FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.14-3. SAMPLING AND ANALYSIS MATRIX FOR PRL S-33

Sampling Specifications		Analtyical Methods for Samples Collected at Depth Interval
Depth Interval	Sample Horizon[a]	Hand Auger Borings H1 - H10
0 - 3 inches	1	SW6010 SW8015/3550 SW8270
1-5 feet	2	SW9045 FVOC
1-5 feet	3	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for potential spill area and drainage area at PRL S-33.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

NS = Not sampled unless contamination continues below depth of previous sample.

3.15 Potential Release Location T-45

Potential Release Location T-45 is located in the northern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of PRL T-45.

3.15.1 Site Description

Potential Release Location T-45 is the location of a concrete underground oil/water separator tank, which began operating in approximately 1968 and is no longer in use (Figure 3.15-1). It is unknown if the inlet and outlet pipes have been plugged. The tank is 7 feet in diameter and 7 feet deep and has a capacity of 2,500 gallons. The tank may have received waste from Building 711, located south of the tank. After oil separation, wastewater was allowed to flow north to Magpie Creek via an underground discharge pipe. The area surrounding the tank is unpaved.

3.15.2 Previous Investigations

In 1986, EG&G Idaho collected and analyzed three samples from the oil/water separator tank at PRL T-45. Their sampling methodology was not documented. The samples were analyzed for oil and grease, VOCs, semivolatile organic compounds, pesticides, and metals. One VOC, 11 semivolatile organic compounds, oil and grease, and 13 different metals were detected in the samples. Based on the OU B Preliminary Assessment Summary Report (Radian, 1990a), the composition and concentrations of substances detected are only indicative of what the separator contained at the time of sampling and may not be representative of historical wastes collected in the separator. Quantified analytical results for these samples are presented in the EG&G Idaho report, *Underground Storage Tank Program* (EG&G Idaho, 1987, Appendix H).

3.15.3 Sampling Rationale

A soil gas investigation of PRL T-45 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Three soil gas probes were scheduled to be placed at PRL T-45; however, only one probe was placed and sampled

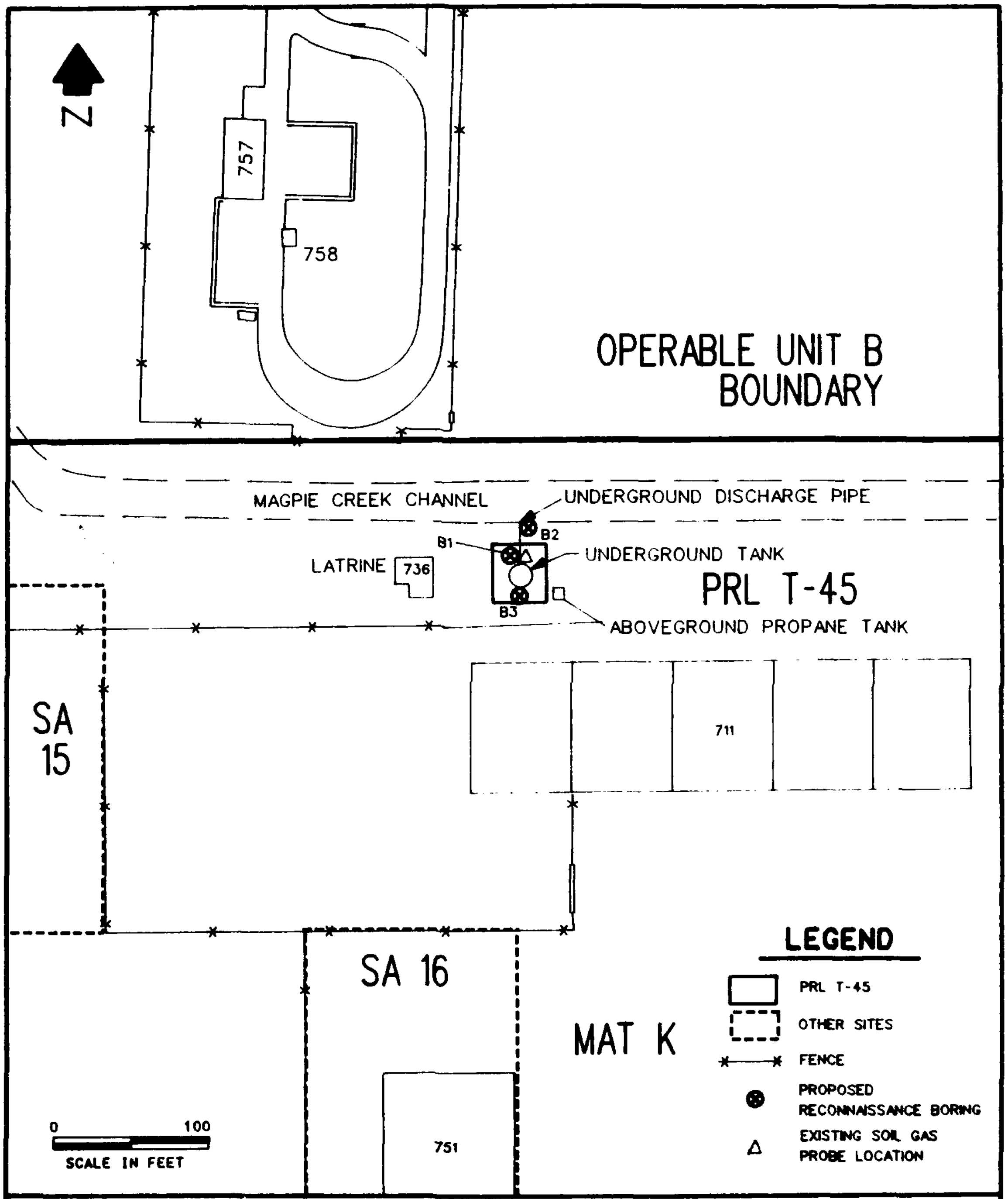

Figure 3.15-1. Site Features and Soil Boring Locations at PRL T-45.

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because probes could not be driven into the soil at two proposed locations (Figure 3.15-1). Results of soil gas sampling indicated the presence of a total HVOC concentration of 20.6 ppbv, and total AVOC concentrations at 3 ppbv. Neither compound concentration exceeds the criteria established from soil gas targets.

The objective of the Phase 1 Remedial Investigation of PRL T-45 is to determine the presence of VOC or other contamination in the area. A total of three reconnaissance borings will be placed at PRL T-45 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Reconnaissance Borings. Three reconnaissance borings (B1 through B3) will be placed adjacent to the tank to determine the presence of soil contamination potentially resulting from leakage of the oil/water separator or from its discharge pipe to Magpie Creek. Boring B1 will be located closest to the connection of the fuel tank to the discharge pipe. Boring B2 will be placed adjacent to the discharge pipe, near the point where it releases to Magpie Creek. Boring B3 will be located adjacent to the tank on the south side.

The contaminants of concern include metals, volatile and extractable petroleum hydrocarbons, and semivolatile organic compounds because they were detected in an analysis of the tank contents in 1986 by previous investigators (as summarized in the OU B Preliminary Assessment Summary Report [Radian, 1990a]). In addition, VOCs will be analyzed. Table 3.15-1 presents DQOs for the underground oil/water separator tank and discharge pipe at PRL T-45.

Table 3.15-2 presents the sampling and analysis matrix for all sampling locations at PRL T-45.

TABLE 3.15-1. DQOs FOR THE UNDERGROUND OIL/WATER SEPARATOR TANK AND DISCHARGE PIPE AT PRL T-45

Objective:	To determine the presence of contamination potentially resulting from leakage of the oil/water separator or from the discharge pipe to Magpie Creek.
Source Description	
Source Type:	Underground tank
Area of Characterization:	1,270 square feet
Approximate Years of Operation:	1968-unknown
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, volatile and extractable petroleum hydrocarbons, semivolatile organic compounds, VOCs
Sampling Methodology	
Lateral Spacing Basis:	Locations adjacent to an underground tank and its discharge pipe
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Locations and Depths:	B1: Adjacent to north side of tank (west of underground discharge pipe connection to tank) (20 feet BGS) B2: Adjacent to west side of tank (20 feet BGS) B3: Adjacent to south side of tank (20 feet BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8015/3550, SW8015/5030, SW8270, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.15-2. SAMPLING AND ANALYSIS MATRIX FOR PRL T-45

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B3[b]
0 - 20	1	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC
0 - 20	2	SW6010 SW8015/3550 SW8015/5030 SW8270 FVOC
0 - 20	3	SW8015/3550 SW8015/5030 FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for the underground oil/water separator tank and discharge pipe at PRL T-45.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field gas chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

3.16 Study Area 1

Study Area 1 is located in the southeastern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, and rationale for sampling methodology in Phase 1 of the remedial investigation of SA 1.

3.16.1 Site Description

Study Area 1 is the area adjacent to the loading dock on the eastern side of Bay A in Building 626 (Figure 3.16-1). Freon® waste from a small washrack used to clean metal equipment was reportedly disposed of in the area during 1979. According to facility personnel interviews, the portable washrack was wheeled out of the building and onto the loading dock, and the washrack's 35-gallon tank was then drained onto the ground adjacent to the loading dock (Radian, 1990a). This practice was reported to have occurred on several occasions in 1979; however, it could not be determined how frequently this activity was repeated. The activity reportedly occurred east of the doorway on the east side of Bay A. Although part of the ground surface east of the doorway between the loading dock and 55th Street is covered with asphalt, there are unpaved, gravel-covered areas north and south of the asphalt where the drained Freon® waste may have entered the soil.

3.16.2 Previous Investigation

A soil gas investigation of SA 1 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Four soil gas probes were placed and sampled at SA 1. Results of the soil gas investigation indicate that no soil gas targets exist at SA 1. Halogenated VOCs were the only compounds detected in soil gas and were found in all probes. Individual compound concentrations ranged from 0.9 to 40.9 ppbv.

3.16.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SA 1 is to determine the presence of VOC or other contamination in the area. A total of two hand auger borings will be placed at SA 1 to investigate potential contamination sources at

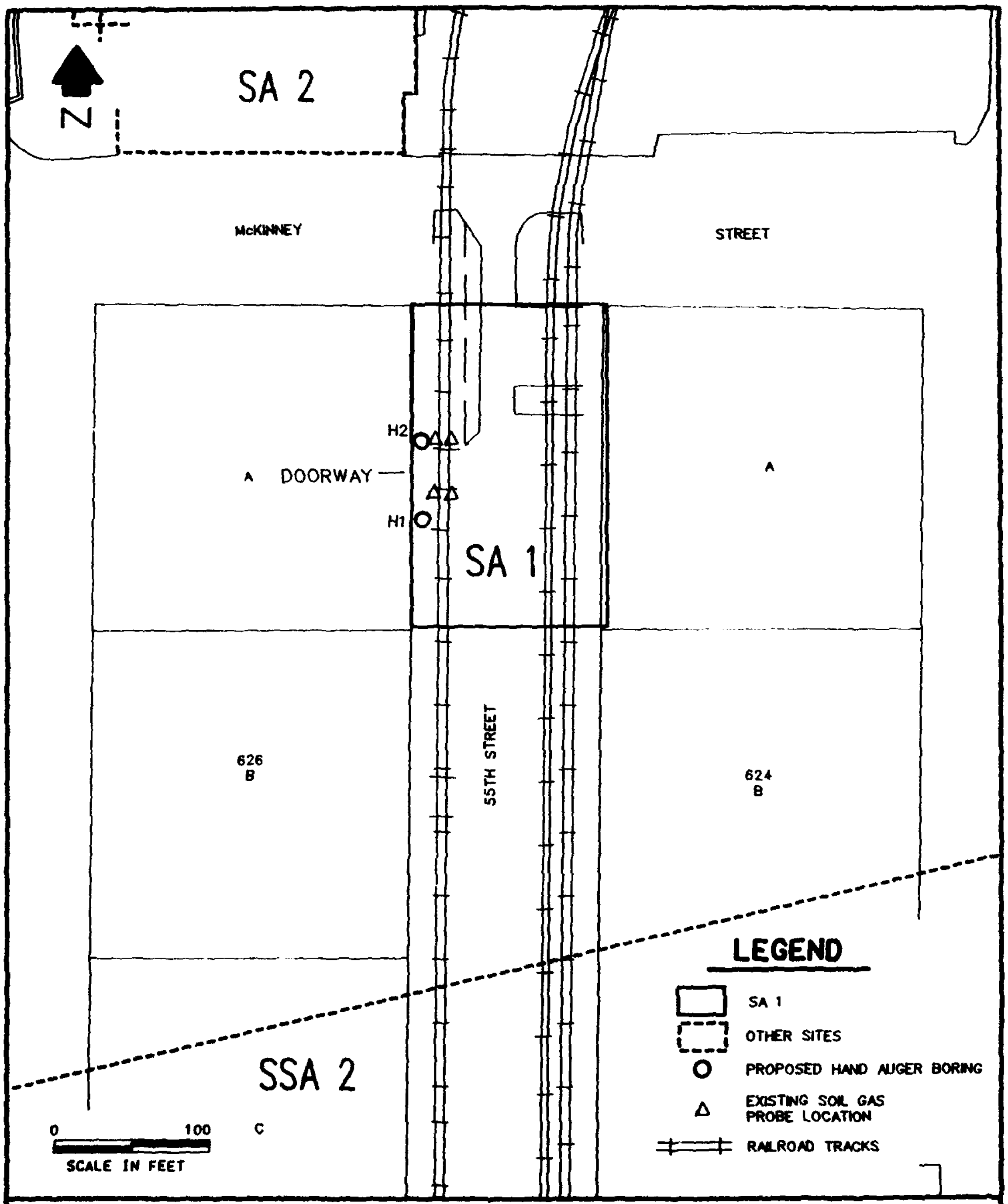

Figure 3.16-1. Site Features and Soil Boring Locations at SA 1.

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this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Hand auger borings H1 and H2 will be placed at SA 1 to determine if soil contamination has resulted from the reported disposal of Freon® waste. Two boring locations are considered adequate because of the physical limitations of the site (i.e., small size, and presence of railroad tracks, sewer lines, and storm drains). Because the concentration of HVOCs increases in a southerly direction south of the asphalt loading dock area, Boring H1 will be placed 5 feet south of the southwesternmost soil gas probe location and 5 to 10 feet east of the loading dock (Figure 3.16-1). Boring H2 will be placed in an unpaved, gravel area north of the loading dock. The contaminants of concern are VOCs. Table 3.16-1 presents the DQOs for the potential Freon® disposal area at SA 1.

Table 3.16-2 presents the sampling and analysis matrix for all sampling locations at SA 1. Placement of the soil borings may have to be relocated due to possible obstacles (railroad track or storm drain sewer line). The exact placement will be decided in the field.

TABLE 3.16-1. DQOs FOR THE POTENTIAL FREON® DISPOSAL AREA AT SA 1

Objective:	To determine if soil contamination has resulted from the reported disposal of Freon® waste.
Source Description	
Source Type:	Uniform surface spill area
Area of Characterization:	800 square feet
Approximate Years of Operation:	1979 to unknown
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	Borings in area of reported surface discharge
Drilling Method:	Hand auger
Reference Point:	Northeast corner of Building 626
Hand Auger Boring Locations and Depths:	H1: 135' S, 15' E (5 feet BGS) H2: 88' S, 15' E (5 feet BGS)
Total Number of Locations:	2
Analytical Method:	FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.16-2. SAMPLING AND ANALYSIS MATRIX FOR SA 1

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval
Depth Interval (ft BGS)	Sample Horizon[a]	Hand Auger Borings H1-H2[c]
1 - 5	1[b]	FVOC
1 - 5	2[b]	FVOC
1 - 5	3	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contaminants, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is presented, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Hand auger samples to be collected from 1 to 5 feet BGS.

[c] Boring locations for the potential Freon® disposal area at SA 1.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

NS = Not sampled unless contamination continues below depth of previous sample.

3.17 Study Area 4

Study Area 4 is located in the northeast portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, and rationale for sampling methodology in Phase 1 of the remedial investigation of SA 4.

3.17.1 Site Description

Study Area 4 consists of Building 650, which is divided into four areas, Buildings 650A through 650D (Figure 3.17-1). Aircraft parts are shipped from Building 650A. Paint booths stand within furniture and metal paint shops in Buildings 650B and 650C, and radar equipment was historically installed in Building 650D. A paved hazardous waste staging area, used to store empty containers, soiled rags and paper, and waste chemicals from the paint shop, is located outside of Building 650B to the west. Extensive lists of chemicals used in each of these areas were found in the McClellan AFB Bioenvironmental Engineering files. The building itself has concrete floors, and the area surrounding the building is paved. The only unpaved areas are beneath and immediately adjacent to the railroad tracks. The potential for soil contamination would have resulted from surface discharges during loading and unloading operations. Sampling will be performed for paved and unpaved areas near the staging area and in areas of soil gas contamination.

3.17.2 Previous Investigation

A soil gas investigation of SA 4 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Twenty-six soil gas probes were placed and sampled for soil gas around the perimeter of SA 4. Results of the soil gas investigation indicated that total HVOC concentrations, detected in all of the 26 probes, ranged from 0.20 to 2,840 ppbv. Total AVOC concentrations, detected in 2 of the 26 probes, ranged from 190 to 1,220 ppbv. The total UVOC concentration, detected in 1 of the 26 probes, was 631 ppbv.

Results of the soil gas investigation indicate the presence of two soil gas target areas that require further investigation during the OU B RI. The locations of

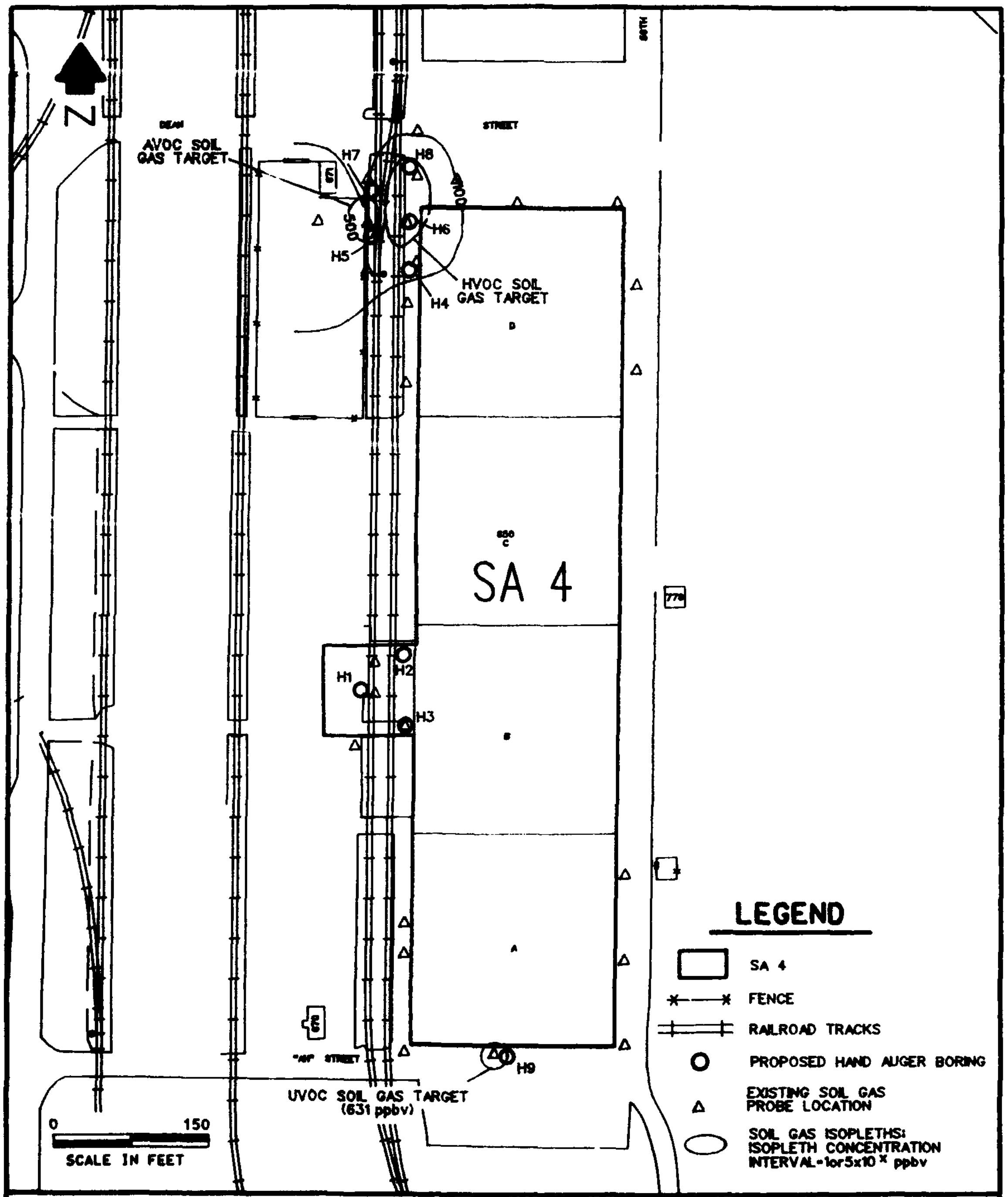

Figure 3.17-1. Site Features and Soil Boring Locations at SA 4.

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these areas are shown in Figure 3.17-1. One is located at the northwest corner of Building 650. Total HVOC and AVOC concentrations exceeded 1,000 ppbv in this area.The second is located on the southern end of Building 650. The presence of individual UVOCs at a concentration exceeding 100 ppbv was found in this area.

3.17.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SA 4 is to determine the presence of VOC or other contamination in the area. A total of nine hand auger borings will be placed at SA 4 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Hand Auger Borings. Three hand auger borings (H1 through H3) will be placed at the hazardous waste staging area. These borings will be located in unpaved areas near the staging area where fuels, oils, herbicides, pesticides, paints, and solvents were reportedly handled at the site and spilled contaminants may have first entered the soil. Samples will be collected to 5 feet BGS.

Borings H4 through H9 will be placed in soil gas target areas where VOC contamination was detected in soil gas (Figure 3.17-1) to determine if VOC contamination is present in soil. Borings H4 through H8 will be placed in unpaved areas adjacent to the railroad tracks.

Contaminants of concern at SA 4 include metals, VOCs, semivolatile organic compounds, pesticides, herbicides,and organic lead. Table 3.17-1 presents the DQOs for the hazardous waste staging area and areal borings at SA 4.

Table 3.17-2 presents the sampling and analysis matrix for all sampling locations SA 4.

TABLE 3.17-1. DQOs FOR THE HAZARDOUS WASTE STAGING AREA AND AREAL BORINGS AT SA 4

Objective:	To determine if hazardous materials stored in the staging area are present in soil beneath the area.
Source Description	
Source Type:	Surface spill area
Area of Characterization:	16,500 square feet
Approximate Years of Operation:	Unknown to present
Phase:	1
Medium to be Sampled:	Soil
Contaminant of Concern:	Metals, VOCs, semivolatile organic compounds, pesticides, herbicides, organic lead
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling of surface discharge within unpaved areas
Drilling Method:	Hand auger
Reference Point:	Southwest corner of Building 650
<u>Hand Auger Boring Locations and Depths</u>:	H1: 329' N, 52' W (5 feet BGS)
	H2: 363' N, 11.5' W (5 feet BGS)
	H3: 297' N, 11.5' W (5 feet BGS)
Total Number of Locations:	3
Analytical Methods:	SW6010, SW8270, SW8080, SW8140, SW8150, HML 338, FVOC
Reference Point:	Northwest corner of Building 650
<u>Hand Auger Boring Locations and Depths</u>:	H4: 63.5' S, 11.5' W (5 feet BGS)
	H5: 32' S, 46' W (5 feet BGS)
	H6: 17' S, 11.5' W (5 feet BGS)
	H7: 17' S, 46' W (5 feet BGS)
	H8: 37.5' N, 11.5' W (5 feet BGS)
Total Number of Locations:	5
Analytical Method:	FVOC

TABLE 3.17-1. (Continued)

Reference Point:	Southwest corner of Building 650
Hand Auger Location and Depth:	H9: 8' S, 100' E (5 feet BGS)
Total Number of Locations:	1
Analytical Method:	FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.17-2. SAMPLING AND ANALYSIS MATRIX FOR SA 4

Sampling Specifications		Analytical method for Samples Collected in Depth Interval	
Depth Interval (ft. BGS)	Sample Horizon[a]	Hand Auger Borings H1-H3[c]	Hand Augei Borings H4-H9[d]
1 - 5	1[b]	SW6010 SW8080 SW8140 SW8150 SW8270 HML 338 FVOC	FVOC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Hand auger sample to be collected from 1 to 5 feet BGS.

[c] Boring locations for hazardous waste staging area at SA 4.

[d] Areal boring locations at SA 4.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

3.18 Study Area 8

Study Area 8 is located in the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of SA 8.

3.18.1 Site Description

Study Area 8 contains a 550-gallon underground storage tank (UST), located west of Kilzer Avenue and 4 feet east of Building 663. Building 663, a pump house, was constructed between 1955 and 1958 (Figure 3.18-1). The steel tank at SA 8 was installed in 1955 and has not been leak tested. Both leaded and unleaded gasoline have been stored in the tank during the past 35 years; either or both of the fuels potentially entered the soil if the tank leaked.

3.18.2 Previous Investigations

The tank location was verified during preparation of the final closure plan prepared during investigations in 1986, as summarized in the OU B Preliminary Assessment Summary Report (Radian, 1990a). The tank contained unleaded gasoline when the closure plan was prepared. Although the tank was recommended for closure, it has not yet been decommissioned and is being used to store gasoline.

A soil gas investigation of SA 8 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Two soil gas probes were installed and sampled during the soil gas investigation of SA 8. Results of the soil gas sampling indicate the presence of VOCs (total HVOCs or total AVOCs) in both probes at concentrations below the soil gas criteria established in Appendix A. Total HVOC and AVOC concentrations detected in both probes ranged from 25.9 to 27.2 ppbv and from 190 to 574 ppbv, respectively. Para-xylene was detected at 574 ppbv in the northern probe. However, the concentration is suspect and was qualified by QA/QC staff because of high baseline drift that occurred on the field gas chromatograph the day that the sample was analyzed. Therefore, results from the soil gas investigation of SA 8 indicate that soil gas concentrations are below established criteria for soil gas targets.

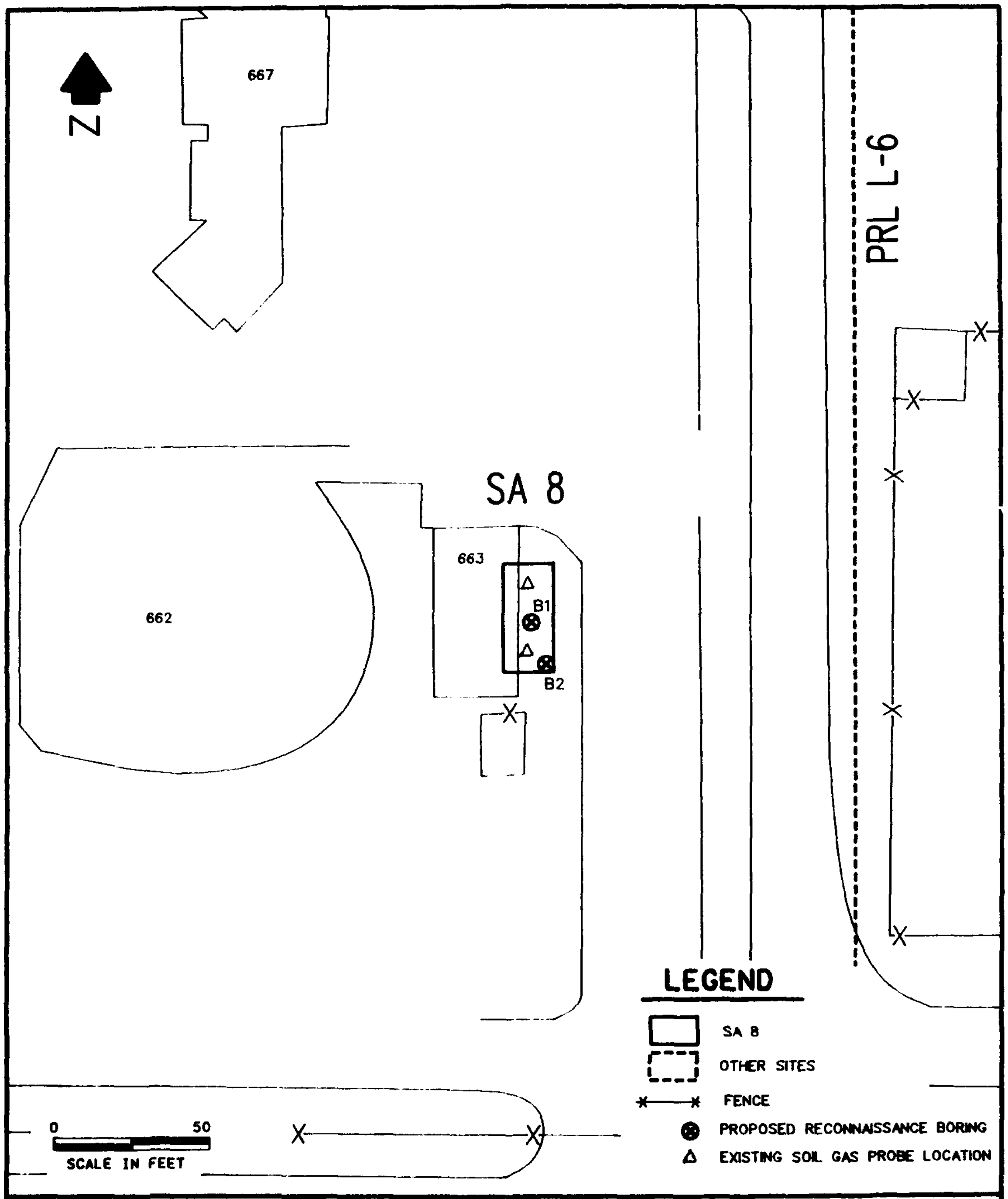

Figure 3.18-1. Site Features and Soil Boring Locations at SA 8.

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3.18.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SA 8 is to determine the presence of VOC or other contamination in the area. A total of two reconnaissance borings will be placed at SA 8 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Reconnaissance Borings. Two reconnaissance borings (B1 and B2) will be placed on either side of the UST at SA 8 (Figure 3.18-1). The tank will be probed prior to drilling to determine the depth of the tank bottom. Pipeline locations will be also be determined in the field using a pipe and cable locator and by consulting base Civil Engineering personnel. Samples will be collected to a minimum depth of 20 feet BGS. The contaminants of concern include volatile and extractable petroleum hydrocarbons, organic lead, and lead. Table 3.18-1 presents the *DQOs for the UST* at SA 8.

Table 3.18-2 presents the sampling and analysis matrix for all sampling locations at SA 8.

TABLE 3.18-1. DQOs FOR THE UNDERGROUND STORAGE TANK AT SA 8

Objective:	To determine if the soil adjacent to or beneath the underground storage tank is contaminated.
Source Description	
Source Type:	Potential leaks from underground storage tank and pipelines
Area of Characterization:	150 square feet
Approximate Years of Operation:	1955-1990
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	Volatile and extractable petroleum hydrocarbons, organic lead, lead
Sampling Methodology	
Lateral Spacing Basis:	Locations at end of tank and near pipeline connections
Drilling Method:	Power assisted split-spoon sampler
Reconnaissance Boring Locations and Depths:	B1: North end of tank, between tank and Building 663 (20 ft BGS) B2: South end of tank (20 ft BGS)
Total Number of Locations:	2
Analytical Methods:	SW8015/3550, SW8015/5030, HML 338, SW7421, FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.18-2. SAMPLING AND ANALYSIS MATRIX FOR SA 8

Sampling Specifications		Analytical Methods for Samples Collected at Depth Interval
Depth Interval (ft. BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B2[b]
0 - 20	1	HML 388 SW7421 SW8015/3550 SW8015/5030 FVOC
0 - 20	2	HML 388 SW7421 SW8015/3550 SW8015/5030 FVOC
0 - 20	3	FVOC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for the underground storage tank at SA 8.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

3.19 Study Area 9

Study Area 9 is located in the northeastern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities and physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of SA 9.

3.19.1 Site Description

Study Area 9 is located north and east of Building 684 (Figure 3.19-1). A review of aerial photographs indicates that all of SA 9 was used intermittently from 1946 to 1968 for storage of miscellaneous materials and for aircraft and vehicle parking. Study Area 9 is paved, except for an area of exposed soil in the southeast corner and a shallow drainage ditch along the eastern boundary. Building 684, built in approximately 1972, is an air freight terminal that receives and temporarily stores various hazardous and classified materials before they are distributed on base. Operations in Building 684 are not considered to be potential sources of soil contamination at SA 9 because materials received remain in original packaging while being stored inside the building; therefore, spillage is not believed to have occurred. A small exterior storage area on a concrete pad in the northern portion of SA 9 is used temporarily to store explosives. Runoff from SA 9 flows into the drainage ditch and to the storm drain near the eastern boundary of the study area.

3.19.2 Previous Investigations

In 1988, McClellan AFB EM performed a soil investigation in the area of exposed soil in the southeast corner of the site, in preparation for developing the land as a park. Two near-surface soil samples were collected and analyzed for VOCs, semivolatile organic compounds, and metals. Low levels of three different VOCs (trichlorofluoromethane, toluene, and xylenes) with a maximum concentration of 97 ppbv were detected in the soil samples; the source of this contamination has not been determined.

A soil gas investigation of SA 9 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Ten soil gas probes were

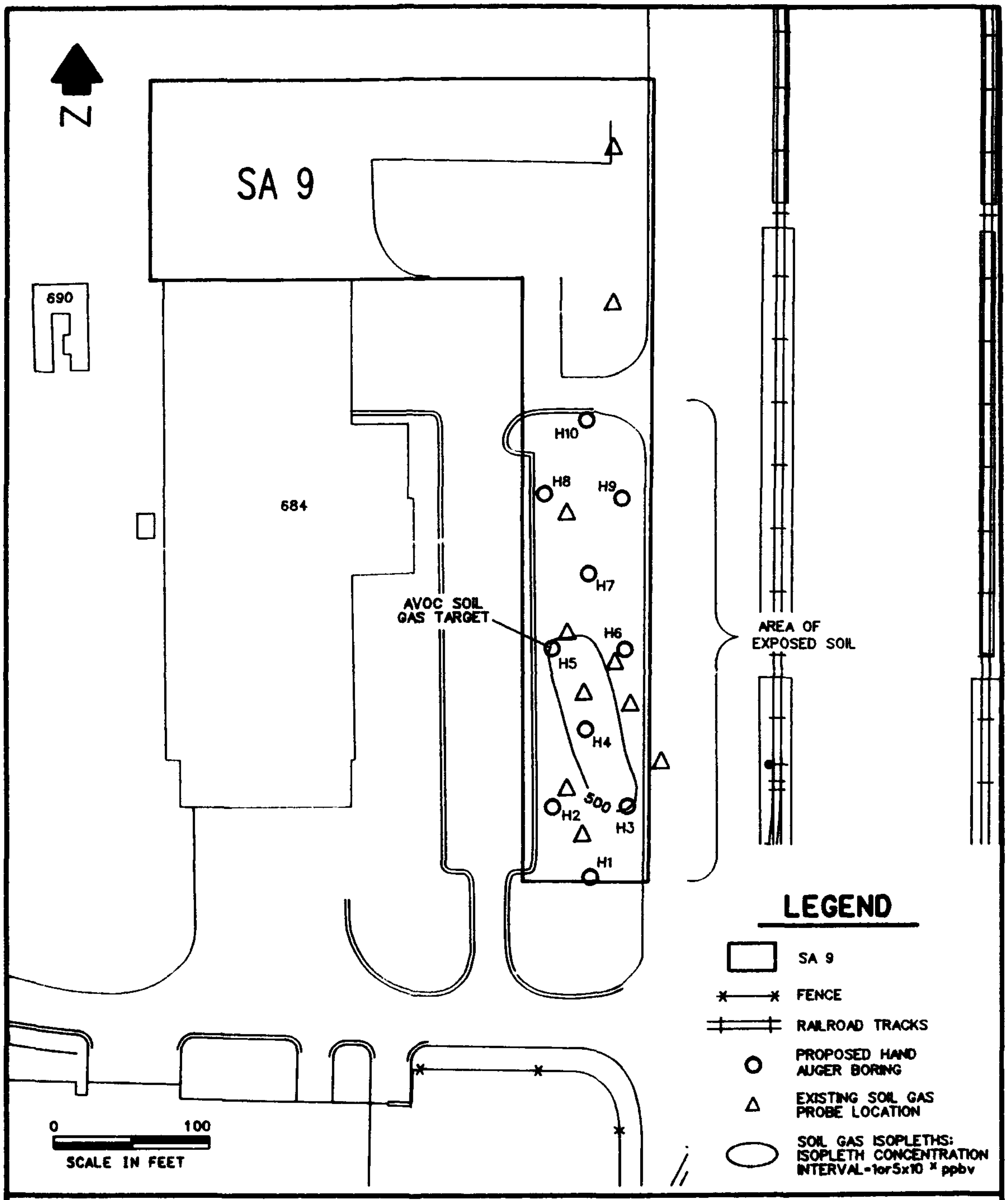

Figure 3.19-1. Site Features and Soil Boring Locations at SA 9.

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installed and sampled during the soil gas investigation of SA 9. Results of soil gas sampling indicate the presence of VOCs (total HVOCs or total AVOCs) in one of these 10 probes at concentrations that exceed the soil gas criteria established in Appendix A. Total HVOC concentrations detected in all of the 10 probes ranged from 2.1 to 112.9 ppbv. Total AVOC concentrations, detected in 3 of the 10 probes, ranged 304 to 1,705 ppbv. Results of the soil gas investigation at SA 9 indicate the presence of one soil gas target where total AVOC concentrations exceeded 1,000 ppbv. The location of this target is shown in Figure 3.19-1.

3.19.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SA 9 is to determine the presence of VOC or other contamination in the area. A total of 10 hand auger borings will be placed at SA 9 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Hand Auger Borings. Ten hand auger borings (H1 - H10) will be drilled to 5 feet BGS in a surface spill and drainage area in the eastern part of SA 9. The area is unpaved. These borings will be located within a triangular grid with a 50-foot spacing between locations. The contaminants of concern are VOCs. Table 3.19-1 lists the DQOs for the potential surface spill and drainage area at SA 9.

Table 3.19-2 lists the sampling and analysis matrix for all sampling locations at SA 9.

TABLE 3.19-1. DQOs FOR THE POTENTIAL SURFACE SPILL AND DRAINAGE AREA AT SA 9

Objective:	To determine the presence of contamination resulting from surface spills or drainage.
Source Description	
Source Type:	Surface spill and drainage area
Area of Characterization:	24,000 square feet
Phase:	1
Medium to be Sampled:	Soil
Contaminants of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	50-foot triangular grid for statistical sampling
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Northwest corner of Building 684
Hand Auger Boring Locations and Depths:	H1: 380' S, 154' E (5 ft. BGS)
	H2: 335' S, 123' E (5 ft. BGS)
	H3: 335' S, 175' E (5 ft. BGS)
	H4: 285' S, 154' E (5 ft. BGS)
	H5: 239' S, 123' E (5 ft. BGS)
	H6: 239' S, 175' E (5 ft. BGS)
	H7: 189' S, 154' E (5 ft. BGS)
	H8: 139' S, 123' E (5 ft. BGS)
	H9: 139' S, 175' E (5 ft. BGS)
	H10: 189' S, 154' E (5 ft. BGS)
Total Number of Locations:	10
Analytical Methods:	FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.19-2. SAMPLING AND ANALYSIS MATRIX FOR SA 9

Sampling Specifications		**Analytical Method for Samples Collected in Depth Interval**
Depth Interval (ft. BGS)	Sample Horizon[a]	Hand Auger Borings H1 - H10[c]
1 - 5	1[b]	FVOC
1 - 5	2[b]	FVOC
1 - 5	3	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Hand auger samples to be collected from 1 to 5 feet BGS.

[c] Boring locations for the potential surface spill and drainage area at SA 9.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

NS = Not sampled unless contamination continues below depth of previous sample.

3.20 Study Area 15

Study Area 15 is located in the northwestern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics of the site, and rationale for sampling methodology in Phase 1 of the remedial investigation of SA 15.

3.20.1 Site Description

Study Area 15 is the northern part of Storage Lot 10 (Figure 3.20-1). Storage Lot 10 has been paved with asphalt since approximately 1955. Prior to that time, the area was undeveloped. The area was originally used for aircraft parking, but has been used for storage of nonhazardous materials since the early 1960s. During 1969 and 1970, paints, solvents, and other chemicals were stored in the northwest section of Storage Lot 10. In 1970, the mixing of incompatible chemicals caused an explosion and fire in the northwest section of the lot. The release of chemicals during the fire is considered a potential contaminant source. Since the fire, chemicals have not been stored on Storage Lot 10.

3.20.2 Previous Investigation

A soil gas investigation of SA 15 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Four soil gas probes were placed and sampled for the soil gas investigation of SA 15. Results of soil gas sampling indicated the presence of total HVOCs in all of these four probes at concentrations that did not exceed the soil gas criteria established in Appendix A. Only HVOCs were detected and were found at concentrations ranging from 0.5 to 126 ppbv. The individual HVOC criterion of 100 ppbv was exceeded in one probe located at the northwest corner of the storage lot. However, the analyte's concentration is suspect and was qualified by quality assurance/quality control staff after evaluation of the data because: the field duplicate sample result for the same analyte was nearly one order of magnitude less (15.8 ppbv); calibration for the field gas chromatograph was outside control limits; and there was a high VOC background in the field laboratory on the day the sample was analyzed. In addition, results from adjacent probe samples show similar concentrations for this analyte ranging from 4.0 to 16.8 ppbv. Therefore, results of the soil gas data indicate there are no soil gas targets that require investigation during the OU B RI.

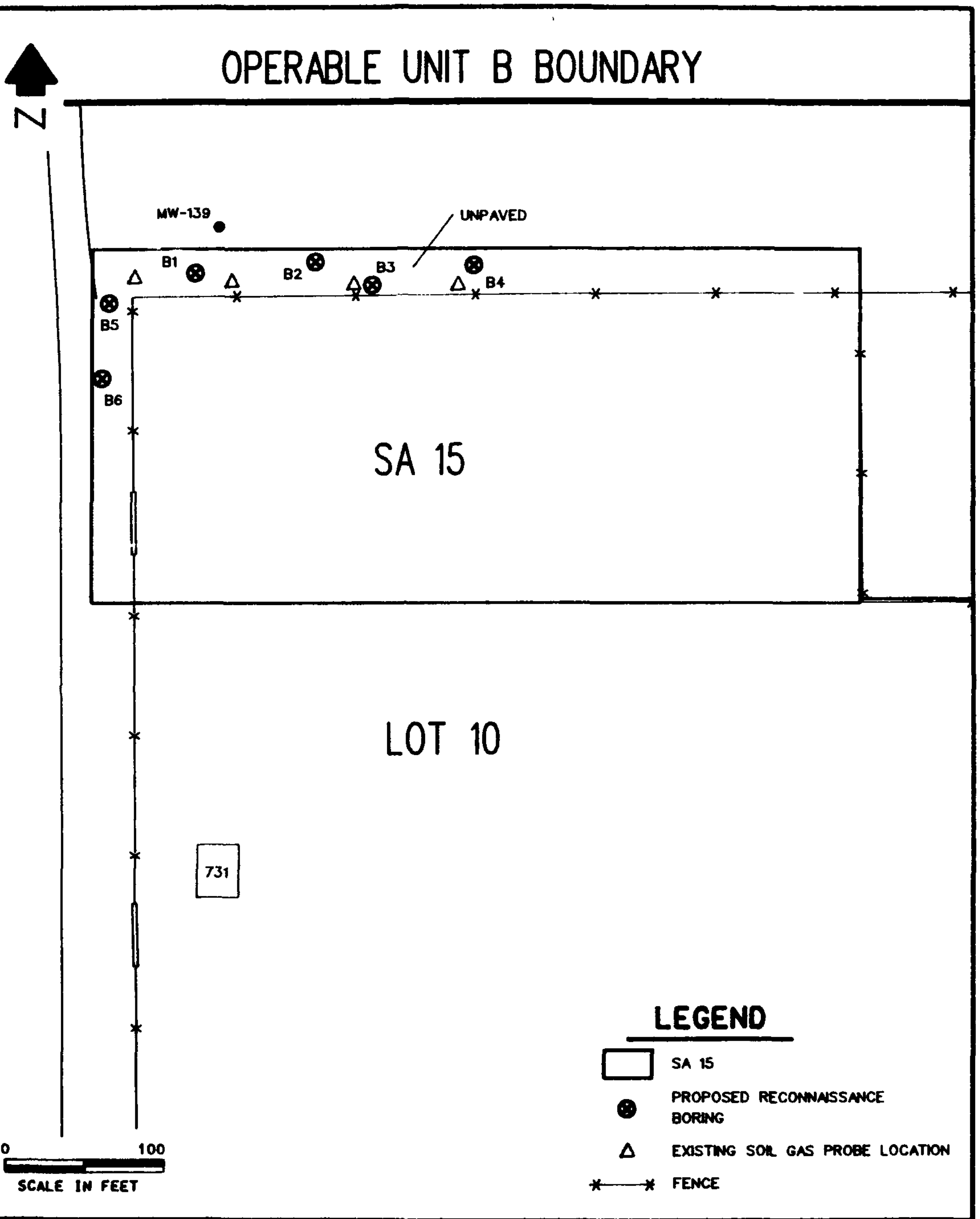

Figure 3.20-1. Site Features and Soil Boring Locations at SA 15.

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3.20.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SA 15 is to determine the presence of VOC or other contamination in the area. A total of six reconnaissance borings will be placed at SA 15 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Reconnaissance Borings. A total of six reconnaissance borings (B1 through B6) will be placed to investigate potential contaminant sources at this site. Employees with knowledge of SA 15 stated that the integrity of the asphalt pavement was maintained during the fire, and thus, provided a barrier to the vertical migration of contaminants to the soil (Radian, 1990a). Therefore, only unpaved areas that may have received runoff containing any released chemicals will be investigated. Runoff from this section of Storage Lot 10 flows in a northerly or westerly direction. Only the area immediately north and west of Storage Lot 10 is unpaved and potentially contaminated. The northern unpaved area extends 250 feet east and 20 feet north of the northwest corner of Storage Lot 10. The eastern unpaved area extends 150 feet south and 20 feet east of the northwest corner of Storage Lot 10.

Borings B1 through B6 will be sampled to determine if soil contamination resulted from chemical releases during the 1970 fire at Storage Lot 10. These borings will be located within a triangular grid using a 50-foot grid spacing. Borings will be sampled to a minimum depth of 20 feet. The contaminants of concern include metals, VOCs, semivolatile organic compounds, and extractable petroleum hydrocarbons because paints and solvents were reportedly stored at the site. Other contaminants of concern include dioxins and dibenzofurans, which may be present as residues from the burning of chlorinated solvents. Table 3.20-1 presents DQOs for the storage area at SA 15.

Table 3.20-2 presents the sampling and analysis matrix for all sampling locations at SA 15.

TABLE 3.20-1. DQOs FOR THE STORAGE AREA AT SA 15

Objective:	To determine the presence of soil contamination resulting from the 1970 fire at Storage Lot 10.
Source Description	
Source Type:	Uniform spill site
Area of Characterization:	5,000 square feet
Approximate Year of Operation:	1970
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Metals, VOCs, semivolatile organic compounds, extractable petroleum hydrocarbons, dioxins/dibenzofurans
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid for statistical sampling of a uniform discharge area
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	MW-139
Reconnaissance Boring Locations and Depths:	B1: 32′ S, 8′ E (20 feet BGS)
	B2: 25′ S, 65′ E (20 feet BGS)
	B3: 37′ S, 105′ E (20 feet BGS)
	B4: 27′ S, 170′ E (20 feet BGS)
	B5: 44′ S, 70′ E (20 feet BGS)
	B6: 94′ S, 70′ E (20 feet BGS)
Total Number of Locations:	6
Analytical Methods:	SW6010, SW8015/3550, SW8270, SW8280, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.20-2. SAMPLING AND ANALYSIS MATRIX FOR SA 15

Sampling Specifications		Analytical Methods for Samples Collected at Depth Interval
Depth Interval	Sample Horizon[a]	Reconnaissance Borings B1 - B6[b]
1 - 20	1	SW6010 SW8015/3550 SW8270 SW8280 FVOC
1 - 20	2	SW6010 SW8015/3550 SW8270 SW8280 FVOC
1 - 20	3	FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for the storage area at SA 15.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas 10 commonly detected VOCs, with in-field gas chromatogrpah, at 20, 40, 60, and 80 feet, and total depth of boring.

3.21 Study Area 29

Study Area 29 is located in the central portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of SA 29.

3.21.1 Site Description

Study Area 29 consists of Building 677 and four underground storage tanks (USTs) (Figure 3.21-1). Building 677 was constructed in 1961. Four different activities occur inside Building 677. A flow meter testing and calibration shop is located in the southern part of Building 677. JP-4 fuel and hydraulic fluids are used to test and calibrate the flow meters. Private contractors calibrate equipment throughout Building 677. Solvents are used during this process. Mercury is removed from manometers and put into hazardous waste containers in the west side of Building 677. Several mercury spills have been reported in the building (Jeffrey, personal communication, 1989). Radiation detectors are tested and calibrated in the northern part of Building 677. A solvent spray booth was also operated historically in the northwest corner of Building 677. Three 500-gallon and one 1,000-gallon steel USTs are located south of Building 677. One 500-gallon UST contains hydraulic fluid, one 500-gallon UST holds JP-4 jet fuel, and waste hydraulic fluid and jet fuel are stored in the remaining two USTs (one 500-gallon and one 1,000-gallon UST). The waste fluids are periodically pumped out of the tanks and taken to the Defense Reutilization and Marketing Office (DRMO). The building's floor is constructed of concrete and the building is surrounded by asphalt pavement on the north, east, and south sides and by gravel on the west side.

3.21.2 Previous Investigations

In 1986, EG&G Idaho leak tested each UST and prepared permit applications for each tank. All four USTs passed the leak tests (EG&G Idaho, 1987, Appendix F).

The OU B Soil Gas Investigation was conducted during 1990. One soil gas probe was installed and sampled during the soil gas investigation at the northeast corner of Building 677 as part of the investigation for SA 11. The total HVOC concentration

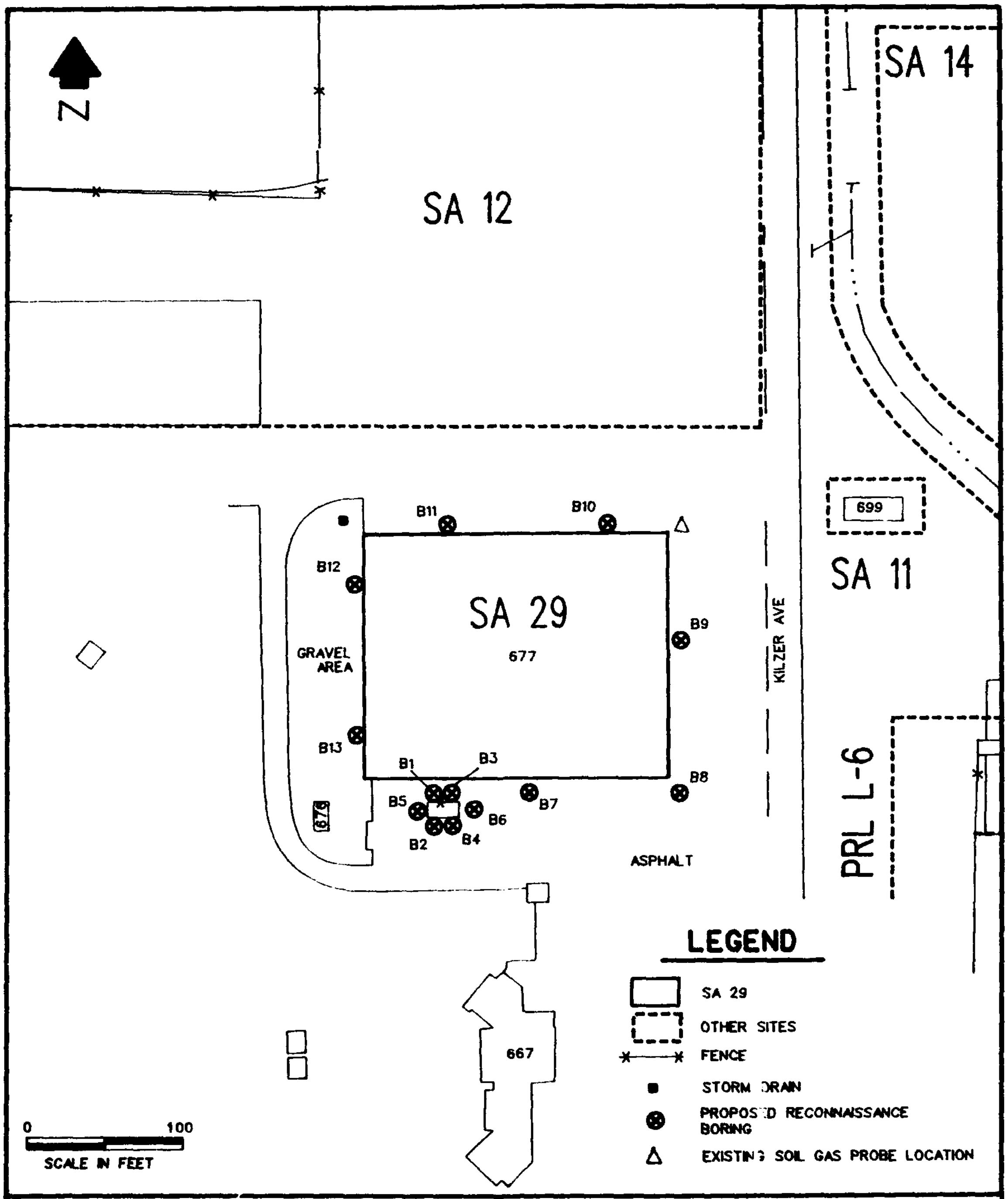

Figure 3.21-1. Site Features and Soil Boring Locations at SA 29.

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detected in the probe was 33.9 ppbv. Methanol was also detected at a concentration of 8,500 ppbv but resulted from contaminated sampling equipment. No AVOCs were detected. Results of the soil gas investigation indicate that there are no soil gas targets.

3.21.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SA 29 is to determine the presence of VOC or other contamination in the area. A total of 13 reconnaissance borings will be placed at SA 29 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Reconnaissance Borings. Six reconnaissance borings (B1 through B6) will be placed adjacent to the four USTs located in a fenced area south of Building 677 (Figure 3.21-1). Because the four tanks are adjacent to each other and are approximately 4 feet in diameter, borings will be placed at locations next to ends of two adjacent tanks (the borings will be offset approximately 3 feet from the center lines of two adjacent tanks). One boring will be placed next to the sides of the two outermost tanks. This array of reconnaissance borings will be adequate to assess leakage from the four tanks. Samples will be collected to a minimum depth of 20 feet BGS. The contaminants of concern include mercury, VOCs, and volatile and extractable petroleum hydrocarbons. Table 3.21-1 presents the DQOs for the USTs at SA 29.

Seven reconnaissance borings (B7 through B13) will be placed along the perimeter of Building 677 to detect soil contamination that may have resulted from activities in Building 677 (Figure 3.21-1). The borings will be located along the perimeter of Building 677 at 100-foot intervals or adjacent to potential sources within the building (e.g., solvent spray booth, manometer repair room, and flow meter calibration room). Samples will be collected to a minimum depth of 20 feet BGS. The contaminants of concern include mercury, VOCs, semivolatile organic compounds, and radionuclides. Table 3.21-2 presents the DQOs for soils surrounding Building 677 at SA 29.

Table 3.21-3 presents the sampling and analysis matrix for all sampling locations at SA 29.

TABLE 3.21-1. DQOs FOR THE FOUR UNDERGROUND STORAGE TANKS AT SA 29

Objective:	To determine if soil adjacent to or beneath the underground storage tanks is contaminated.
Source Description	
Source Type:	Potential leaks form underground storage tanks
Area of Characterization:	400 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Mercury, VOCs, volatile and extractable petroleum hydrocarbons
Sampling Methodology	
Lateral Spacing Basis:	Borings at ends of USTs
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	See below
Reconnaissance Boring Locations and Depths:	B1: At northern end of two western tanks (20 feet BGS)
	B2: At southern end of two western tanks (20 feet BGS)
	B3: At northern end of two eastern tanks (20 feet BGS)
	B4: At southern end of two eastern tanks (20 feet BGS)
	B5: 5 feet west of western most tank (20 feet BGS)
	B6: 5 feet east of eastern most tank (20 feet BGS)
Total Number of Locations:	6
Analytical Methods:	SW7471, SW8015/3550, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.21-2. DQOs FOR SOILS SURROUNDING BUILDING 677 AT SA 29

Objective:	To determine if soils have been contaminated from activities inside Building 677.
Source Description	
Source Type:	Surface spill
Area of Characterization:	34,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminants of Concern:	Mercury, VOCs, semivolatile organic compounds, radionuclides
Sampling Methodology	
Lateral Spacing Basis:	Distribution around perimeter of active building
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 677
<u>Reconnaissance Boring Locations and Depths</u>:	B7: 10' S, 100' E (20 feet BGS)
	B8: 10' S, 200' E (20 feet BGS)
	B9: 100' N, 210' E (20 feet BGS)
	B10: 170' N, 150' E (20 feet BGS)
	B11: 170' N, 50' E (20 feet BGS)
	B12: 130' N, 10' W (20 feet BGS)
	B13: 30' N, 10' W (20 feet BGS)
Total Number of Locations:	7
Analytical Methods:	SW7471, SW8270, SW9310, U.S. EPA 901.1, FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.21-3. SAMPLING AND ANALYSIS MATRIX FOR SA 29

Sample Specifications		Analytical Methods for Samples Collected in Depth Interval	
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B6[b]	Reconnaissance Borings B7 - B13[c]
0 - 20	1	SW7471 SW8015/3550 FVOC	SW7471 SW8270 SW9310 U.S. EPA 901.1 FVOC
0 - 20	2	SW7471 SW8015/3550 FVOC	SW7471 SW8270 SW9310 U.S. EPA 901.1 FVOC
0 - 20	3	FVOC FGC	FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Boring locations for the four underground storage tanks at SA 29.

[c] Boring locations for the soils surrounding Building 677 at SA 29.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

3.22 Special Study Area 2

Special Study Area 2 is located in the southern portion of OU B (Figure 3.0-1). The following subsections present a description of historical activities, physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of SSA 2.

3.22.1 Site Description

Special Study Area 2 has the shape of a triangle with one corner truncated by the base boundary; it is 1,450 feet long and averages 460 feet wide (Figure 3.22-1). The area is designated as an SSA in the OU B RI SAP because no potential sources of contamination were identified within it during preparation of Preliminary Assessments; however, tetrachloroethene (PCE) contamination has been detected in the groundwater below the western end of SSA 2. The special study area was extended easterly from the location of the wells where PCE was detected because the approximate groundwater flow direction in the area has been westerly to southwesterly for 40 to 50 years. An unidentified area to the east and upgradient is a probable location of the discharge point for the contamination in groundwater.

3.22.2 Previous Investigations

The VOC contamination in the A Geohydrologic Zone was detected in July 1989 and later sampling events at MW-150. Monitoring Well 150 is the shallowest screened well in a cluster of three wells (MW-150, MW-151, and MW-152) constructed in the western part of SSA 2, near the McClellan AFB boundary. The deeper wells in the cluster did not have confirmed PCE concentrations in samples collected during the July and December 1989 sampling events. In 1990, concentrations of PCE, 1,1,1-trichloroethane, and carbon tetrachloride were detected in MW-150. Tetrachloroethene was detected (25 μg/L) in the B zone well (MW-151), and TCE was detected (0.31 μg/L) in the C zone well (MW-152). In samples collected in July 1990, TCE was present in all three wells and exceeded the concentration of PCE in MW-151.

A soil gas investigation of SSA 2 was conducted in 1990 by Radian Corporation as part of the OU B Soil Gas Investigation. Thirty-one soil gas probes were

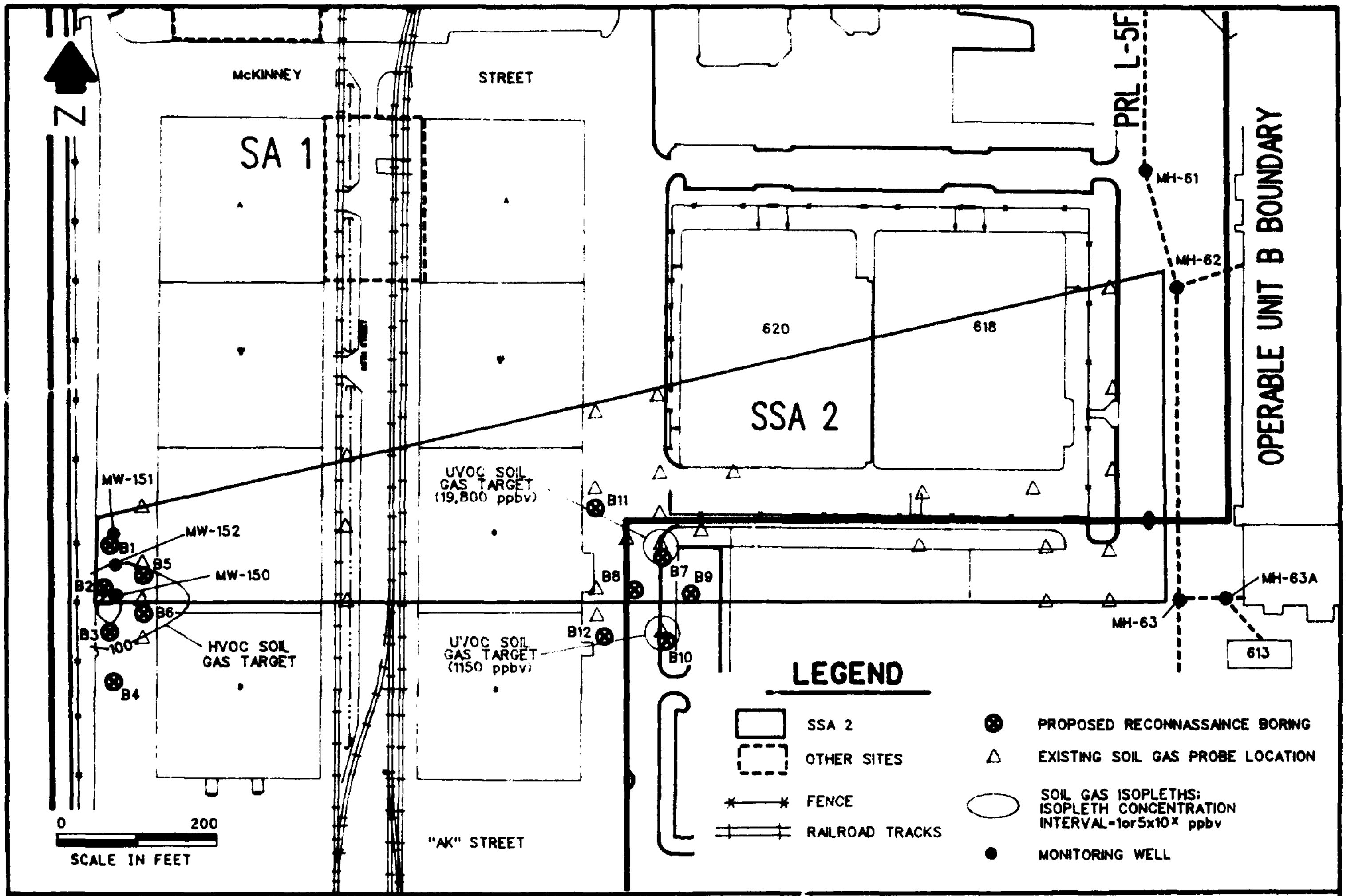

Figure 3.22-1. Site Features and Soil Boring Locations at SSA 2.

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installed and sampled during the soil gas investigation of SSA 2. Results of soil gas sampling indicate the presence of VOCs (total HVOCs or total UVOCs) in 3 of the 31 probes at concentrations that exceed the soil gas criteria established in Appendix A. Total HVOC concentrations, detected in all of the probes, ranged from 2.2 to 1,221 ppbv. Total UVOC concentrations, detected in 2 of the 31 probes, were 1,150 and 19,800 ppbv, respectively. Results of the soil gas investigation of SSA 2 indicate two areas that exceed the criteria for soil gas targets (Appendix A). One soil gas target had a soil gas concentration exceeding 1,000 ppbv total HVOCs. Two soil gas targets, in close proximity, had UVOC concentrations exceeding 1,000 ppbv. Locations of these soil gas targets are depicted in Figure 3.22-1.

3.22.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SSA 2 is to determine the presence of VOC or other contamination in the area. A total of 12 reconnaissance borings will be placed at SSA 2 to investigate potential contaminant sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

Reconnaissance Borings. Twelve reconnaissance borings (B1 through B12) will be located in a triangular grid within SSA 2 in areas of VOC-contaminated soil gas (Figure 3.22-1). Locations within the grid will be spaced at 50-foot intervals within the soil gas target areas. Outside of the soil gas target areas, spacing between borings will be approximately 100 feet. Samples from reconnaissance borings will be collected to a minimum depth of 20 feet BGS. The contaminants of concern are VOCs. Table 3.22-1 presents the DQOs for the areal borings at SSA 2.

Table 3.22-2 presents the sampling and analysis matrix for all sampling locations at SSA 2.

TABLE 3.22-1. DQOs FOR THE AREAL BORINGS AT SSA 2

Objective:	To determine if VOC contamination is present in the soil and to further characterize soil gas contamination.
Source Description	
Source Type:	Undetermined, indicated by soil gas
Area of Characterization:	55,000 square feet
Phase:	1
Media to be Sampled:	Soil/soil gas
Contaminant of Concern:	VOCs
Sampling Methodology	
Lateral Spacing Basis:	Triangular grid with 50-foot or 100-foot spacing between borings in and around soil gas target areas
Drilling Method:	Power assisted split-spoon sampler
Reference Point:	Southwest corner of Building 626D
Reconnaissance Boring Locations and Depths:	B1: 288' N, 73' W (20 feet BGS) B2: 238' N, 73' E (20 feet BGS) B3: 188' N, 73' W (20 feet BGS) B4: 138' N, 73' W (20 feet BGS) B5: 262' N, 23' W (20 feet BGS) B6: 212' N, 23' W (20 feet BGS)
Total Number of Locations:	6
Analytical Methods:	FVOC, FGC
Reference Point:	Northwest corner of Building 637
Reconnaissance Boring Locations and Depths:	B7: 10' S, 90' W (20 feet BGS) B8: 60' S, 120' W (20 feet BGS) B9: 60' S, 60' W (20 feet BGS) B10: 110' S, 85' W (20 feet BGS) B11: 54' N, 175' W (20 feet BGS) B12: 108' S, 175' W (20 feet BGS)
Total Number of Locations:	6
Analytical Methods:	FVOC, FGC

FVOC = Field volatile organic compound screening.
FGC = Field gas chromatograph screening of soil gas.

TABLE 3.22-2. SAMPLING AND ANALYSIS MATRIX FOR SSA 2

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval
Depth Interval (ft BGS)	Sample Horizon[a]	Reconnaissance Borings B1 - B12[b]
0 - 20	1	FVOC
0 - 20	2	FVOC
0 - 20	3	FVOC FGC

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

[b] Areal boring locations at SSA 2.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, with in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

FGC = Screening analysis of soil gas for 10 commonly detected VOCs, with in-field chromatograph, at 20, 40, 60, and 80 feet, and total depth of boring.

3.23 Special Study Area 3

Special Study Area 3 is the first mile of Magpie and Don Julio Creeks immediately outside the western boundary of McClellan AFB (Figure 3.23-1). The following subsections present a description of physical characteristics, previous investigations, and rationale for sampling methodology in Phase 1 of the remedial investigation of SSA 3.

3.23.1 Site Description

Magpie Creek is unpaved but channelized west of Patrol Road and exits McClellan AFB approximately 650 feet east of Raley Boulevard. Directly west of Raley Boulevard, Don Julio Creek converges with Magpie Creek, which then flows in a northwesterly direction (Figure 3.23-1). Aerial photographs indicate that the course of Magpie Creek was altered in the mid-1950s (Figure 3.23-1) to flow north of its former course. Magpie and Don Julio Creeks receive surface runoff from most of McClellan AFB.

3.23.2 Previous Investigation

Surface water and stream sediment samples were collected for analysis at 29 sampling points in drainages on McClellan AFB (Radian, 1990b), shown in Figure 3.23-2. Metals, cyanide, petroleum hydrocarbons, VOCs, semivolatile organic compounds, and low-level radionuclides were detected in sediment samples collected from Magpie Creek.

The surface water and stream sediment sampling and analysis was the initial effort in the Preliminary Pathways Assessment (PPA) (Air, Soil, and Surface Water) for McClellan AFB. The PPA was intended to be an extensive program of data collection and interpretation for the PRLs across McClellan AFB. The program was terminated after the surface water and stream sediment sampling efforts. The surface water and stream sediment data are presented in the Analytical Data Summary Report (Radian, 1990b) without interpretation of potential sources of the compounds detected.

No soil gas sampling was conducted along the course of Magpie Creek in SSA 3.

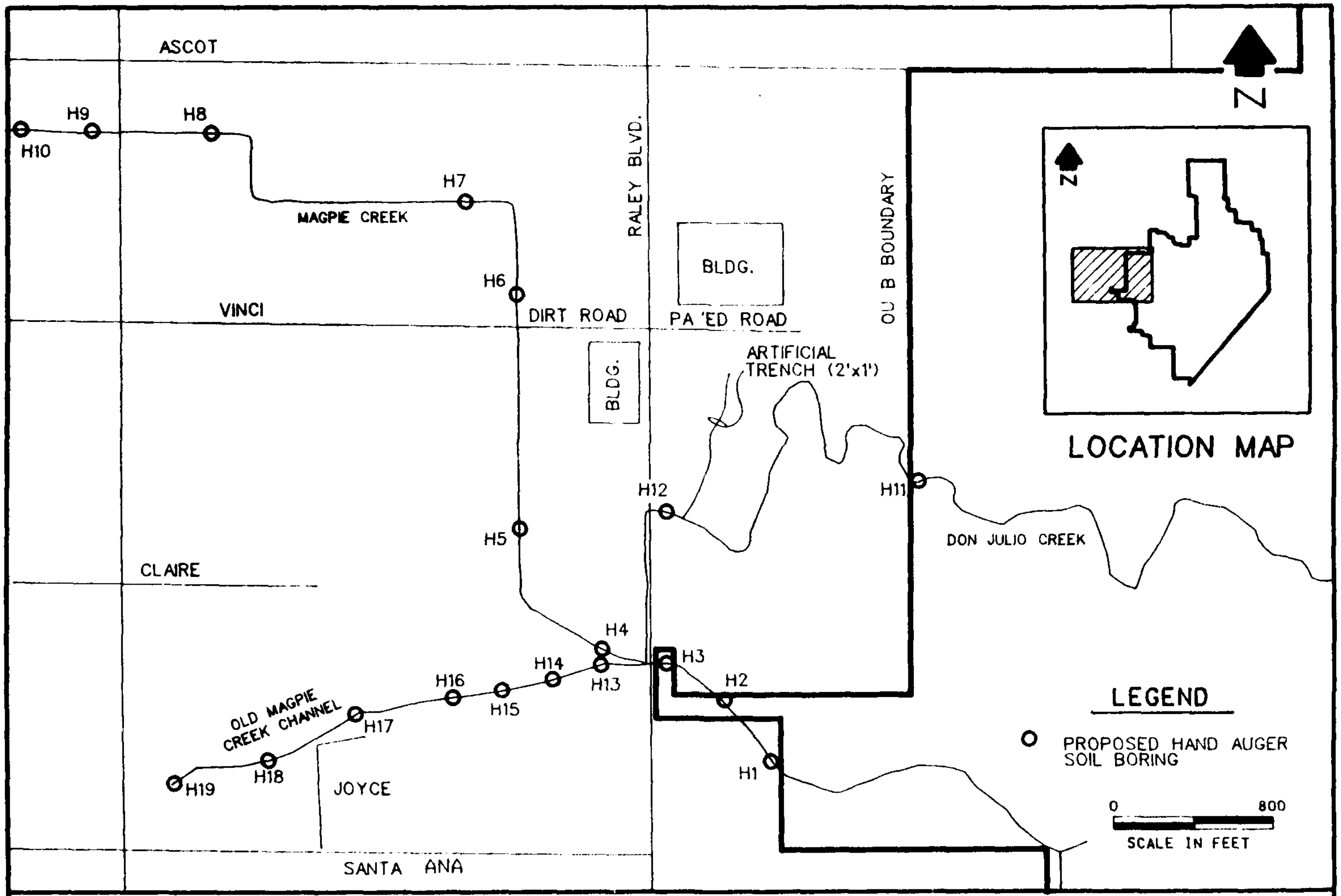

Figure 3.23-1. Site Features and Soil Boring Locations at SSA 3.

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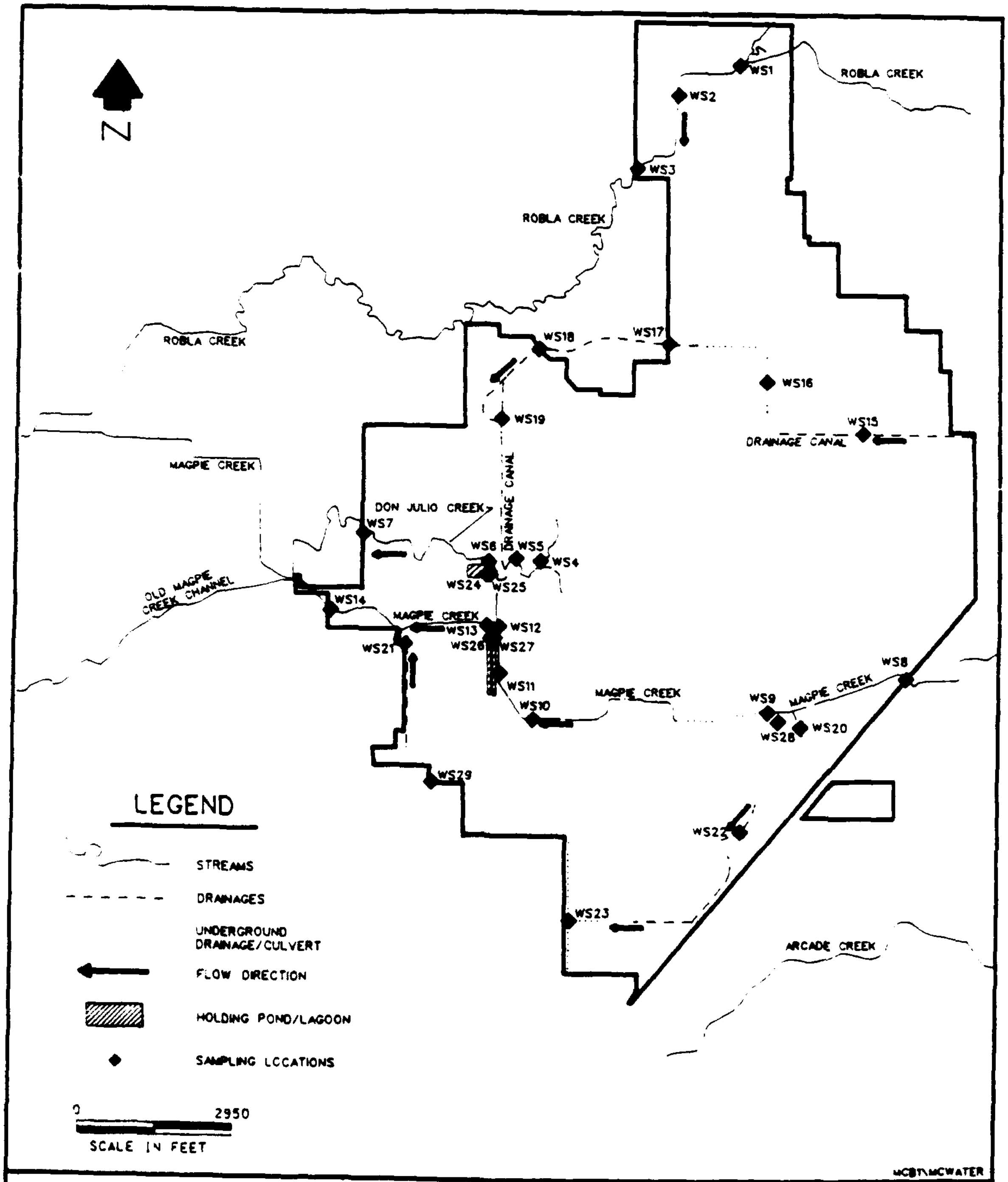

Figure 3.23-2. Surface Water and Sediment Locations January 1989.

3.23.3 Sampling Rationale

The objective of the Phase 1 Remedial Investigation of SSA 3 is to determine the presence of VOC or other contamination in the soils underlying the Magpie Creek within the area. A total of 12 hand auger borings will be placed at SSA 3 to investigate potential contamination sources at this site and to identify the greatest concentrations of contaminants present and points of discharge. If contamination is detected, additional remedial investigation efforts will be conducted in Phases 2 and 3 to determine the areal and vertical extent of contamination, to support the development of health risk assessments, and to obtain data for treatability studies and remedial alternative evaluation.

The fine-grainded deposits in hand auger soil borings will be sampled to determine if any contaminants transported by water flow in Magpie or Don Julio Creeks have penetrated the soil beneath and adjacent to Magpie Creek along one mile of its course immediately west of McClellan AFB.

Hand Auger Borings. Hand auger borings H1 through H12 will be used to sample sediments from the old and present creek channels. Four hand auger borings (H1 through H4) will be placed within 1,000 feet of the base boundary at intervals of approximately 250 feet along the present creek channel. Six hand auger borings (H5 through H10) will be placed 1,000 to 5,000 feet from the base boundary along the channel constructed in the 1950s. Hand auger borings (H11 and H12) will be placed along Don Julio Creek to determine if any contaminants have been transported by its water into Magpie Creek. Borings (H13 to H19) will be placed along the old channel from the point of divergence from the present channel. Samples from hand auger borings will be collected · ithin 50 feet of every confluence, including major runoff tributaries to the creek. Reconnaissance borings will be drilled as needed at points along both the present and the former Magpie Creek channels (Figure 3.23-1). These boring locations shall be selected on the basis of results of the hand auger sample analyses. Reconnaissance borings will be drilled in areas where organic compounds are detected and metals/radionuclides concentrations exceed background levels.

The contaminants of concern include VOCs, semivolatile organic compounds, volatile and extractable petroleum hydrocarbons, metals, mercury, cyanides, and low-level radionuclides because these contaminants were initially detected in surface water or sediment samples collected during the Radian investigation (Radian, 1990b). Table 3.23-1 presents the DQOs for the surface drainage area of SSA 3.

Table 3.23-2 presents the sampling and analysis matrix for all sampling locations at SSA 3.

TABLE 3.23-1. DQOs FOR THE SURFACE DRAINAGE AREA AT SSA 3

Objective:	To determine whether contaminants from McClellan AFB have penetrated the soil beneath and adjacent to Magpie Creek along one mile of its course immediately west of the base.
Source Description	
Source Type:	Surface drainage area
Area of Characterization:	79,200 square feet
Approximate Years of Operation:	1939 - present
Phase:	1
Media to be Samples:	Sediment
Contaminants of Concern:	VOCs, semivolatile organic compounds, volatile and extractable petroleum hydrocarbons, metals, mercury, cyanide, radionuclides
Sampling Methodology	
Lateral Spacing Basis:	Locations in creek bottoms at the confluence of major runoff tributaries to Magpie Creek
Drilling Method:	Hand auger
Reference Point:	Northwest corner of Building 781
<u>Hand Auger Boring Locations and Depths</u>:	(All borings drilled to 3 feet BGS) H1: At the base boundary along Magpie Creek H2: 400′ downstream of H1 H3: 400′ downstream of H2 H4: 400′ downstream of H3 H5: 1,000′ downstream of H4 H6: 1,200′ downstream of H5 H7: 250′ downstream of creek's bend H8: 1,600′ downstream of H7 H9: 50′ west of Dry Creek Boulevard along creek H10: 400′ downstream from H9 H11: Base boundary along Don Julio Creek H12: 75′ west of Raley Boulevard along Don Julio Creek H13: 250′ downstream from base boundary H14: 500′ downstream from base boundary H15: 750′ downstream from base boundary

(Continue

TABLE 3.23-1. (Continued)

Hand Auger Boring Locations and Depths (Continued):	H16: 1,000′ downstream from base boundary H17: 1,500′ downstream from base boundary H18: 2,000′ downstream from base boundary H19: 2,500′ downstream from base boundary
Total Number of Borings:	19
Analytical Methods:	SW8015/3550, SW8015/5030, SW8270, SW6010, SW7471, SW9010, SW9310, U.S. EPA 901.1, FVOC

FVOC = Field volatile organic compound screening.

TABLE 3.23-2. SAMPLING AND ANALYSIS MATRIX FOR SSA 3

Sampling Specifications		Analytical Methods for Samples Collected in Depth Interval
Depth Interval (ft BGS)	Sample Horizon[a]	Hand Auger H1 - H19
0 - 3	1[b]	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8270 SW9012 SW9310 U.S. EPA 901.1 FVOC
0 - 3	2[c]	SW6010 SW7471 SW8015/3550 SW8015/5030 SW8270 SW9012 SW9310 U.S. EPA 901.1 FVOC
0 - 5	3	NS

[a] Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contaminants, 4) at high FGC (≥50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between the surface and the total depth of boring.

[b] Hand auger samples to be collected from 0 to 3 inches BGS.

[c] Hand auger samples to be collected from 1 to 3 feet BGS.

FVOC = Screening analysis of soils for 10 commonly detected VOCs, within in-field gas chromatograph; samples with detected VOCs will be sent to off-site laboratory for SW8240 analysis.

NS = Not sampled unless there is physical evidence of contamination in previous sample.

3.24 Background Investigation

The objective of the background investigation is to determine the range of concentrations for naturally occurring elements and radionuclides within different lithologic strata that underlie OU B. The soils and underlying strata near McClellan AFB were formed from sediments deposited by streams and flood waters that flowed intermittently from the Sierra Nevada over millions of years. Because the sediment layers were deposited intermittently during periods of high rainfall or glacial melting, the types, size, and origin of the sediments are variable. Therefore, each sedimentary layer may potentially contain different concentrations of elements. Soils may contain radionuclides deposited from widespread atmospheric nuclear bomb testing in the 1950s and 1960s or from radioactive elements that occur naturally in soil particles.

To provide a representative location for background concentrations, a background location should be free of any artificial contaminants and contain sediments in strata that are generally similar to those underlying sites to be investigated in OU B. Proposed background soil borings for the OU B RI are located at four locations off-base and six locations on McClellan AFB (Figure 3.24-1). Aerial photographs indicate that the locations have historically changed from undeveloped grassland to their current status in the last 60 years; however, there is no evidence of industrial or disposal activities at any of the proposed background locations. The drilling of soil borings at off-base locations is contingent upon approval by the property owners. If the approval to drill cannot be obtained in the designated areas, alternate on-base locations may be required. The data quality objectives (DQOs) for background areas are presented in Table 3.24-1.

Ten soil borings will be drilled for collection of background samples. Four of the borings are proposed for undeveloped off-base locations. Borings will be located in those portions of the selected sites which are least disturbed by human activities. Locations will be selected away from roads, ditches, underground utilities (sewer lines and water lines), and surface depressions. Any evidence of construction debris, scrap metal, trash, or surface stains will disqualify a location from background drilling. Approximate boring locations are shown in Figure 3.24-1.

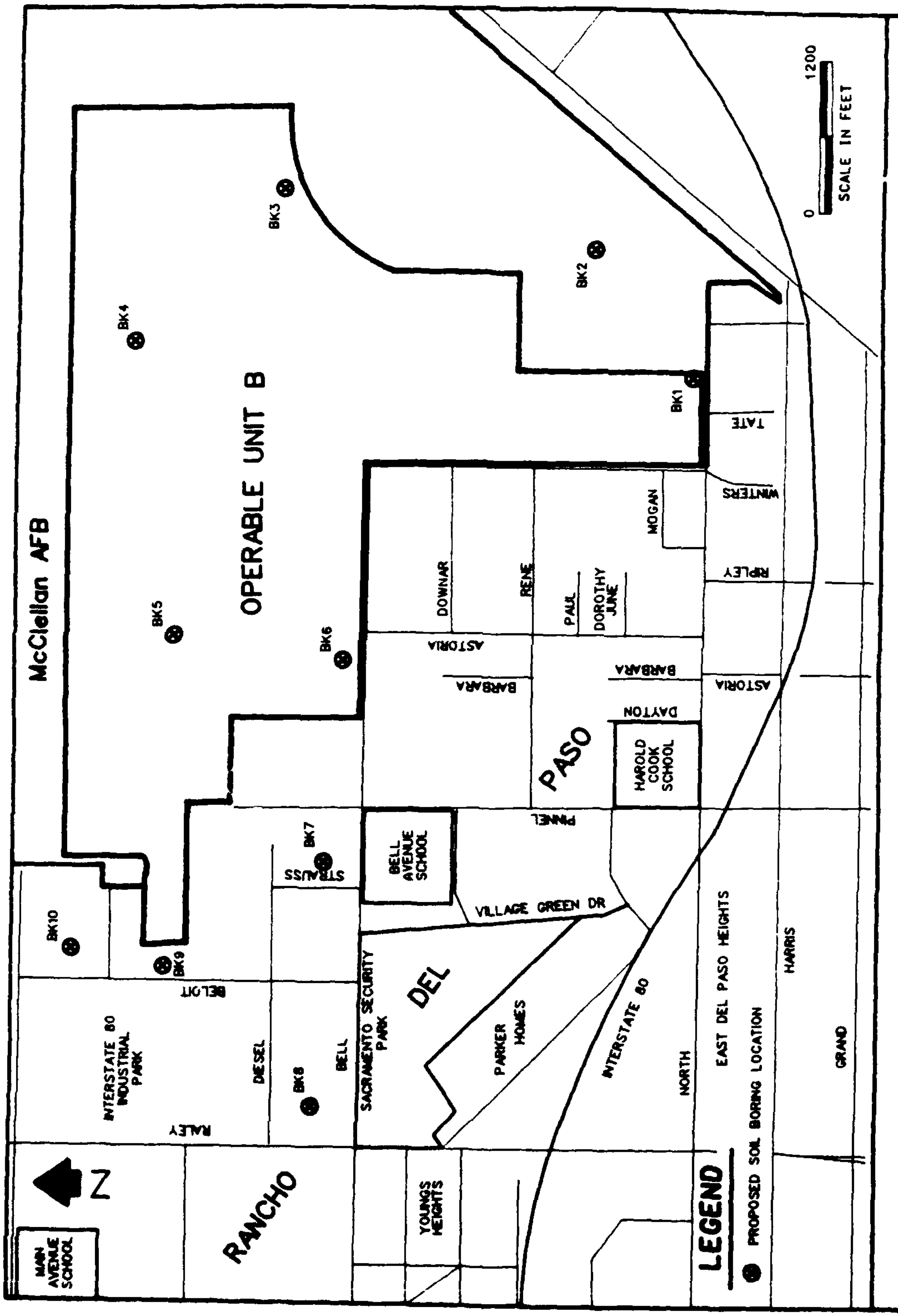

Figure 3.24-1. Map of Background Boring Locations.

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TABLE 3.24-1. DQOs FOR BACKGROUND AREAS

Objective:	To determine the variability of concentrations for naturally occurring inorganic species in common lithologic deposits that underlie OU B.
Area Description	
Type:	Background locations
Area of Characterization:	Approximately 39,300,000 feet square (900 acres)
Phase:	1
Contaminants of Concern:	Metals, mercury, pH, arsenic, gross alpha and beta particles, gamma emitters
Sampling Methodology	
Lateral Distribution:	Undeveloped locations with no evidence of previous residential, industrial, or disposal activity.
Sampling Method:	Power assisted split-spoon sampler
Sample Selection:	10 per boring[a]
Reference Point:	Refer to Figure 3.24-1
Boring Locations:	Refer to Figure 3.24-1 and Plate 1
Boring Depths:	90 feet BGS
Total Number of Locations:	10
Analytical Methods:	SW6010, SW7471, SW9045, SW7060, SW9310, U.S. EPA 901.1

[a] Sample horizons will be selected with the following criteria:

a) Sampling should be weighted such that the largest percentage is selected from the depth interval 1 to 20 feet BGS because this is the primary depth interval of concern.

b) After selecting samples from the upper 25-foot interval, select sample intervals from 25 to 90 feet. One sample per 15-foot depth interval is the suggested distribution. If thick coarse sand or gravel units are encountered, select sample from finer grained intervals at the top and bottom of the interval. This rationale will be used since contamination is thought to be associated with finer layers.

c) Sixty-five to seventy-five percent of the samples from a boring will be collected from fine-grained lithologic units (e.g., silty clays, sandy clays, clayey silts, silts, sandy silts, silty fine sands).

d) A fine-grained unit less than 1 foot thick will not be sampled unless it is the only fine-grained unit in a 25-foot interval.

e) Darkly colored (dark gray, green, or black) organic rich clays or silts should be sampled if they do not have a chemical odor, artificial discoloration, or a pH < 5.5 or pH > 9.5.

f) Quality Assurance/Quality Control (QA/QC) will include 10 percent field duplicates.

The six on-base locations were selected in the general areas indicated in Figure 3.24-1 and Plate 1. Aerial photographs were carefully reviewed to select on-base areas that had not been involved in base activities. The areas selected for the on-base borings are those where no Sites, Potential Release Locations, or Study Areas have been identified within 300 feet.

Borings will be drilled to approximately 90 feet, and split-spoon samples will be taken continuously in the boring. Ten samples will be selected from horizons identified in the field. Samples will be analyzed for metals, mercury, pH, arsenic, and radionuclides. The horizons to be analyzed as background samples will be selected after continuous samples have been collected from intervals of 20 feet to ensure that lithologic changes representative of the OU B study area are included in the analyses.

3.25 Summary of OU B RI Phase 1

A summary of sampling locations and an estimate of total numbers of samples to be analyzed by each method is presented in Table 3.25-1. The sampling locations in the table are the summation of Phase 1 soil scrape, hand auger, reconnaissance boring, and deep boring locations identified on site-specific maps and tables in Sections 3.1 to 3.23. The table is divided by Investigation Cluster, Sites, PRLs, SAs, and SSAs. Background sample locations are omitted from Table 3.25-1.

The number of samples listed for each method in Table 3.25-1 are estimates assuming that the minimum number of samples are collected for analysis at each sampling location. The number of samples actually submitted for analyses may increase if additional samples are taken at any location to characterize visible waste, discolored soil, odorous soils, high photoionization detector readings, or additional fine-grained soil layers underlying contaminated soils.

The actual numbers of analyses will be greater for each method because quality assurance-quality control (QA/QC) samples are not included in Table 3.25-1. The QA/QC samples are not shown in the table because their total numbers are contingent upon the total numbers of field samples that are collected as well as the number of days that sampling continues.

Samples collected for QA/QC during Phase 1 of the OU B RI will be determined during the course of the sampling. The collection of QA/QC samples for off-site laboratory analyses will be determined by the following guidelines.

- Field duplicates -- 10% of total samples collected for each method;
- Matrix spike/matrix spike duplicate pairs -- 5% of total samples collected for each method;
- Trip blanks -- 1 per off-site shipment, estimated to be a minimum of 4 samples per week, with samples submitted for volatile organic compounds (SW8240) and volatile petroleum compounds (SW8015/5030) analysis; and

- Ambient blanks -- 1 per geographic area sampled, estimated to be 3 samples per week with samples submitted for SW8240 and 8015/5030 analysis.

The collection of QA/QC samples for field screening analyses (PCBs, VOCs in soil, VOCs in soil gas) in on-site laboratories will be determined by the following guidelines.

- Field duplicates -- 5% of total samples collected for each method;
- Matrix spike/matrix spike duplicate pairs or surrogate spike and laboratory duplicate pairs -- 5% of total samples for each method;
- Ambient blanks -- 1 per day in field screening laboratory for VOCs in soil gas; and
- Confirmatory samples -- 5% of total samples submitted for field screening analyses of VOCs and any samples with peaks greater than 5 times the detection limit of the nearest calibrated compound that cannot be identified with the gas chromatograph will be submitted for volatile organic compound (SW8240) analysis; 100% of the field screening samples with detectable PCB compounds will be submitted for SW8080 analysis; and 5% of all samples collected for soil gas field screening will be submitted for TO-14 analysis.

INVESTIGATION CLUSTER	SAMPLE LOCATIONS	NUMBER OF ANALYSES BY METHOD											
Site, PRL, SA, SSA		TVPH SW5030	TEPH SW3550	PCB/Pest SW8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC
IC 1													
Site 36	RB-4	0	12	0	0	0	8	0	0	0	0	12	4
Site 36	DB-2	0	14	0	0	0	4	0	0	0	0	14	10
Site 47	RB-7	0	0	0	0	0	14	0	0	0	0	14	7
Site 47	DB-1	0	0	0	0	0	2	0	0	0	0	7	5
Site 47	HA-1	0	0	0	0	0	0	0	0	0	1	0	0
Site 48	RB-9	0	6	0	0	0	18	0	0	0	0	20	9
PRL L-5D	RB-8	0	24	0	0	0	16	0	24	0	0	24	8
IC 1 (Areal)	RB-33	0	99	0	0	0	66	0	0	0	0	99	33
IC 1 (Areal)	DB-2	0	14	0	0	0	4	0	0	0	0	14	10
IC 2													
PRL L-5A	RB-11	33	33	21	21	21	33	0	0	0	0	33	11
PRL L-5A	DB-1	3	7	0	0	0	3	0	0	0	0	7	5
PRL T-8	RB-8	24	24	0	0	0	0	0	0	0	0	24	8
PRL T-46	RB-5	15	15	0	0	0	13	0	0	0	0	15	5
PRL T-48	RB-10	38	38	0	0	0	30	0	0	0	0	30	18
SA-16	RB-6	22	22	0	0	0	4	0	0	0	0	18	10
SA-16	DB-1	3	3	0	0	0	3	0	0	0	0	3	1
IC 2 (Areal)	RB-15	45	45	0	0	0	45	0	0	0	0	45	15
IC 2 (Areal)	DB-3	21	12	0	0	0	9	0	0	0	0	18	15
IC 3													
Site S-4[illegible]	RB-9	0	27	18	18	18	18	0	0	0	0	27	9
Site S-49	DB-1	0	7	2	2	2	2	0	0	0	0	7	5
SA-3	RB-8	0	24	0	0	0	16	0	0	0	0	24	8
SA-3	DB-1	0	7	0	0	0	2	0	0	0	0	7	5
SA-10	RB-1	0	0	2	2	2	2	0	0	0	0	3	1
SA-17	RB-4	0	12	0	0	0	8	0	0	0	0	12	4
SA-17	HA-4	0	4	0	0	0	4	0	0	0	0	4	4
SA-19	RB-4	0	12	0	0	0	8	0	0	0	0	12	4
SA-19	HA-4	0	4	0	0	0	4	0	0	0	0	4	4
IC 3 (Areal)	RB-11	0	21	8	8	8	22	0	0	0	0	33	11
IC 4													
Site 30	RB-5	4	6	0	0	0	10	0	0	0	0	15	5
Site 30	DB-3	2	3	0	0	0	6	0	0	0	0	21	15
PRL L-6(south)	RB-7	0	0	0	0	0	14	0	21	0	0	21	7
IC 4 (Areal)	RB-9	0	0	0	0	0	0	0	0	0	0	27	9

NUMBER OF ANALYSES BY METHOD

NUMBER OF ANALYSES BY METHOD

tals 6010	Me Sw	?est)80	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045
		0	0	0	8	0	0	0	0	12	4	8	4	0	8	0	0	12
8		0	0	0	4	0	0	0	0	14	10	4	4	0	4	0	0	14
4		0	0	0	14	0	0	0	0	14	7	14	0	0	14	0	0	21
14		0	0	0	2	0	0	0	0	7	5	2	0	0	2	0	0	7
2		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0		0	0	0	18	0	0	0	0	20	9	18	4	0	18	0	0	27
18		0	0	0	16	0	24	0	0	24	8	16	16	0	16	0	0	24
16		0	0	0	66	0	0	0	0	99	33	66	66	0	66	0	0	99
66		0	0	0	4	0	0	0	0	14	10	4	4	0	4	0	0	14
4																		
		21	21	21	33	0	0	0	0	33	11	22	14	0	14	0	0	14
22		0	0	0	3	0	0	0	0	7	5	2	0	0	0	0	0	0
2		0	0	0	0	0	0	0	0	24	8	16	0	0	0	0	0	0
16		0	0	0	13	0	0	0	0	15	5	10	0	0	0	0	0	0
10		0	0	0	30	0	0	0	0	30	18	28	0	0	0	0	0	0
28		0	0	0	4	0	0	0	0	18	10	4	0	0	0	0	0	0
4		0	0	0	3	0	0	0	0	3	1	2	0	0	0	0	0	0
2		0	0	0	45	0	0	0	0	45	15	30	0	0	0	0	0	0
30		0	0	0	9	0	0	0	0	18	15	6	0	0	0	0	0	0
6																		
		18	18	18	18	0	0	0	0	27	9	18	18	0	0	18	0	0
18		2	2	2	2	0	0	0	0	7	5	2	2	0	0	2	0	0
2		0	0	0	16	0	0	0	0	24	8	16	0	0	0	0	0	0
16		0	0	0	2	0	0	0	0	7	5	2	0	0	0	0	0	0
2		2	2	2	2	0	0	0	0	3	1	2	2	0	0	2	0	0
2		0	0	0	8	0	0	0	0	12	4	0	0	0	0	0	0	0
0		0	0	0	4	0	0	0	0	4	4	0	0	0	0	0	0	0
0		0	0	0	8	0	0	0	0	12	4	8	0	0	0	0	0	0
8		0	0	0	4	0	0	0	0	4	4	4	0	0	0	0	0	0
4		8	8	8	22	0	0	0	0	33	11	22	8	0	0	8	0	0
22																		
		0	0	0	10	0	0	0	0	15	5	10	0	0	0	0	0	0
10		0	0	0	6	0	0	0	0	21	15	6	0	0	0	0	0	0
6		0	0	0	14	0	21	0	0	21	7	14	0	0	0	0	0	21
14		0	0	0	0	0	0	0	0	27	9	0	0	0	0	0	0	0
0																		

NUMBER OF ANALYSES BY METHOD

Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045	Alpha/Beta SW9310	Gamma EPA901.1
8	4	0	8	0	0	12	0	0
4	4	0	4	0	0	14	0	0
14	0	0	14	0	0	21	0	0
2	0	0	2	0	0	7	0	0
0	0	0	0	0	0	0	0	0
18	4	0	18	0	0	27	0	0
16	16	0	16	0	0	24	0	0
66	66	0	66	0	0	99	0	0
4	4	0	4	0	0	14	0	0
22	14	0	14	0	0	14	14	14
2	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
18	18	0	0	18	0	0	0	0
2	2	0	0	2	0	0	0	0
16	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
2	2	0	0	2	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
22	8	0	0	8	0	0	0	0
10	0	0	0	0	0	0	10	10
6	0	0	0	0	0	0	6	6
14	0	0	0	0	0	21	14	14
0	0	0	0	0	0	0	0	0

HA = Hand auger boring
SS = Soil scrape
RB = Reconnaissance boring
DB = Deep boring
TVPH = Total Volatile Petroleum Hydrocarbons
TEPH = Total Extractable Petroleum Hydrocarbons
PCB/Pest = Polychlorinated biphenyls/ organochlorine pesticides
Org-pest = Organophosphorus pesticides
CHL-pest = Chlorinated phenoxy acid herbicides
SVOC = Semivolatile organic compounds
Dioxin = Dioxin/furan compounds
Phenol = Phenol compounds
PNAs = Polynuclear aromatic compounds
PCB screen = PCB field screening laboratory analysis
FVOC screen = Field screening analysis of volatile organic compounds
Soil Gas FGC = Field screening analysis of soil gas
CN = Total cyanide
Organo lead = Organic lead compound
Alpha/Beta = Alpha and beta radioactivity
Gamma = Gamma radioactivity

Table 3.25-1.
Summary of Sample Analyses by Investigation Cluster, Site, PRL, SA, and SSA

INVESTIGATION CLUSTER	SAMPLE LOCATIONS	NUMBER OF ANALYSES BY METHOD												
Site, PRL, SA, SSA		TVPH SW5030	TEPH SW3550	PCB/Pest SW8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metals SW6010
IC 5														
Site 31	RB-5	10	14	0	0	0	14	1	0	1	5	19	9	14
PRL 29	SS-372	0	0	0	0	0	0	0	0	0	372	0	0	0
PRL P-2	RB-14	0	0	0	0	0	28	0	0	0	14	42	14	28
SA-12	RB-9	0	0	0	0	0	18	0	0	0	7	27	9	14
SA-12	DB-2	0	0	0	0	0	4	0	0	0	2	14	10	2
SA-12	HA-75	0	0	0	0	0	150	0	0	0	54	150	42	106
SA-12	SS-3349	0	0	0	0	0	0	0	0	0	3349	0	0	0
SA-13	SS-857	0	0	0	0	0	0	0	0	0	857	0	0	0
IC 6														
PRL T-60	RB-2	0	8	0	0	0	4	0	0	0	0	8	4	0
SA-5	RB-2	0	3	0	0	0	4	0	0	0	0	6	2	2
SA-6	RB-1	0	4	0	0	0	2	0	0	0	0	4	2	0
SA-6	DB-1	0	7	0	0	0	2	0	0	0	0	7	5	0
IC 6 (Areal)	RB-17	0	51	0	0	0	34	0	0	0	0	51	17	0
IC 6 (Areal)	DB-1	0	7	0	0	0	2	0	0	0	0	7	5	0
IC 7														
PRL L-5B	RB-22	0	66	0	0	0	44	0	66	0	44	66	22	44
PRL L-5B	DB-1	0	7	0	0	0	2	0	7	0	2	7	5	2
PRL L-6(north)	RB-13	0	0	0	0	0	26	0	39	0	0	39	13	26
PRL L-6(north)	DB-1	0	0	0	0	0	2	0	7	0	0	7	5	2
PRL P-9/SA14	RB-2	0	6	0	0	0	4	0	0	0	0	6	2	4
PRL P-9/SA14	DB-1	0	7	0	0	0	2	0	0	0	0	7	5	2
PRL P-9/SA14	HA-9	0	9	0	0	0	9	0	0	0	0	9	0	9
PRL S-5	RB-3	0	9	0	0	0	6	0	0	0	0	9	3	6
PRL S-34	RB-2	0	6	0	0	0	4	0	0	0	0	6	2	4
PRL S-35	RB-4	0	12	0	0	0	8	0	0	0	0	12	4	0
SA-7	RB-2	0	6	0	0	0	4	0	0	0	0	6	2	0
SA-11	RB-2	0	6	0	0	0	4	0	0	0	0	6	2	4
SA-18	RB-4	0	12	0	0	0	8	0	0	0	0	12	4	8
IC 7 (Areal)	RB-52	0	99	0	0	0	74	0	18	0	4	156	52	50
IC 7 (Areal)	DB-2	0	14	0	0	0	4	0	0	0	0	14	10	2
IC 8														
PRL L-5C	RB-3	9	9	0	0	0	6	0	6	0	3	9	3	6
PRL L-5C	DB-2	6	6	0	0	0	4	0	4	0	2	14	10	4

NUMBER OF ANALYSES BY METHOD

NUMBER OF ANALYSES BY METHOD

B/Pest W8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045	Alpha SW9
0	0	0	14	1	0	1	5	19	9	14	0	0	0	0	0	0	
0	0	0	0	0	0	0	372	0	0	0	0	0	0	0	0	0	
0	0	0	28	0	0	0	14	42	14	28	0	0	0	0	0	0	
0	0	0	18	0	0	0	7	27	9	14	0	0	0	0	0	0	
0	0	0	4	0	0	0	2	14	10	2	0	0	0	0	0	0	
0	0	0	150	0	0	0	54	150	42	108	0	0	16	0	0	16	
0	0	0	0	0	0	0	3349	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	857	0	0	0	0	0	0	0	0	0	
0	0	0	4	0	0	0	0	8	4	0	0	0	0	0	4	0	
0	0	0	4	0	0	0	0	6	2	2	0	0	0	0	2	0	
0	0	0	2	0	0	0	0	4	2	0	0	0	0	0	2	0	
0	0	0	2	0	0	0	0	7	5	0	0	0	0	0	2	0	
0	0	0	34	0	0	0	0	51	17	0	0	0	0	0	0	0	
0	0	0	2	0	0	0	0	7	5	0	0	0	0	0	0	0	
0	0	0	44	0	66	0	44	66	22	44	44	0	44	0	0	66	
0	0	0	2	0	7	0	2	7	5	2	2	0	2	0	0	7	
0	0	0	26	0	39	0	0	39	13	26	0	0	26	0	0	39	
0	0	0	2	0	7	0	0	7	5	2	0	0	2	0	0	7	
0	0	0	4	0	0	0	0	6	2	4	4	0	4	0	0	6	
0	0	0	2	0	0	0	0	7	5	2	2	0	2	0	0	7	
0	0	0	9	0	0	0	0	9	0	9	9	0	9	0	0	9	
0	0	0	6	0	0	0	0	9	3	6	0	0	0	0	0	0	
0	0	0	4	0	0	0	0	6	2	4	0	0	0	0	0	0	
0	0	0	8	0	0	0	0	12	4	0	0	0	0	0	0	0	
0	0	0	4	0	0	0	0	6	2	0	0	0	0	0	0	0	
0	0	0	4	0	0	0	0	6	2	4	0	0	0	0	4	0	
0	0	0	8	0	0	0	0	12	4	8	0	0	0	0	0	0	
0	0	0	74	0	18	0	4	156	52	50	18	0	26	0	8	39	
0	0	0	4	0	0	0	0	14	10	2	0	0	0	0	0	0	
0	0	0	6	0	6	0	3	9	3	6	9	0	6	0	0	6	
0	0	0	4	0	4	0	2	14	10	4	6	0	4	0	0	4	

NUMBER OF ANALYSES BY METHOD

Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045	Alpha/Beta SW9310	Gamma EPA901.1
14	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
108	0	0	16	0	0	16	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	0	0
2	0	0	0	0	2	0	0	0
0	0	0	0	0	2	0	0	0
0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
44	44	0	44	0	0	66	0	0
2	2	0	2	0	0	7	0	0
26	0	0	26	0	0	39	26	26
2	0	0	2	0	0	7	2	2
4	4	0	4	0	0	6	0	0
2	2	0	2	0	0	7	0	0
9	9	0	9	0	0	9	0	0
6	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
4	0	0	0	0	4	0	0	0
8	0	0	0	0	0	0	0	0
50	18	0	26	0	8	39	8	8
2	0	0	0	0	0	0	0	0
6	9	0	6	0	0	6	0	0
4	6	0	4	0	0	4	0	0

HA = Hand auger boring
SS = Soil scrape
RB = Reconnaissance boring
DB = Deep boring
TVPH = Total Volatile Petroleum Hydrocarbons
TEPH = Total Extractable Petroleum Hydrocarbons
PCB/Pest = Polychlorinated biphenyls/ organochlorine pesticides
Org-pest = Organophosphorus pesticides
CHL-pest = Chlorinated phenoxy acid herbicides
SVOC = Semivolatile organic compounds
Dioxin = Dioxin/furan compounds
Phenol = Phenol compounds
PNAs = Polynuclear aromatic compounds
PCB screen = PCB field screening laboratory analysis
FVOC screen = Field screening analysis of volatile organic compounds
Soil Gas FGC = Field screening analysis of soil gas
CN = Total cyanide
Organo lead = Organic lead compound
Alpha/Beta = Alpha and beta radioactivity
Gamma = Gamma radioactivity

Table 3.25-1.
Continued

INVESTIGATION CLUSTER	SAMPLE LOCATIONS	NUMBER OF ANALYSES BY METHOD												
Site, PRL, SA, SSA		TVPH SW5030	TEPH SW3550	PCB/Pest SW8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metals SW6010
PRL S-30	RB-2	0	0	0	0	0	4	0	0	0	0	6	2	4
IC 8 (Areal)	RB-31	3	3	0	0	0	2	0	2	0	1	93	31	2
Site 23														
Site 23	RB-21	0	8	0	0	0	42	24	0	0	0	63	21	42
Site 23	DB-2	0	4	0	0	0	4	2	0	0	0	14	10	4
PRL L-5F														
PRL L-5F	RB-32	0	0	0	0	0	70	0	0	0	0	96	32	64
PRL L-5G														
PRL L-5G	RB-8	16	16	16	4	4	16	0	16	0	0	24	8	16
PRL S-13														
PRL S-13	RB-56	0	8	32	72	72	112	0	0	0	80	168	56	112
PRL S-13	DB-2	0	0	4	0	0	4	0	0	0	0	14	10	4
PRL S-13	HA-54	0	0	0	0	0	8	0	0	0	108	108	0	8
PRL S-28														
PRL S-28	RB-3	0	0	0	0	0	9	0	0	0	0	9	3	6
PRL S-33														
PRL S-33	HA-10	0	10	0	0	0	10	0	0	0	0	10	0	10
PRL T-45														
PRL T-45	RB-3	9	9	0	0	0	6	0	0	0	0	9	3	6
SA-1														
SA-1	HA-2	0	0	0	0	0	0	0	0	0	0	4	0	0
SA-4														

NUMBER OF ANALYSES BY METHOD

NUMBER OF ANALYSES BY METHOD

CB/Pest SW8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045	Alpha, SW9
0	0	0	4	0	0	0	0	6	2	4	0	0	0	0	0	6	
0	0	0	2	0	2	0	1	93	31	2	3	0	2	0	0	2	
0	0	0	42	24	0	0	0	63	21	42	0	0	0	0	0	0	
0	0	0	4	2	0	0	0	14	10	4	0	0	0	0	0	0	
0	0	0	70	0	0	0	0	96	32	64	0	64	0	0	0	0	
16	4	4	16	0	16	0	0	24	8	16	16	0	16	0	0	24	
32	72	72	112	0	0	0	80	168	56	112	0	0	156	0	0	156	
4	0	0	4	0	0	0	0	14	10	4	0	0	6	0	0	6	
0	0	0	8	0	0	0	108	108	0	8	0	0	8	0	0	8	
0	0	0	9	0	0	0	0	9	3	6	0	9	0	0	0	0	
0	0	0	10	0	0	0	0	10	0	10	0	0	0	0	0	10	
0	0	0	6	0	0	0	0	9	3	6	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	

NUMBER OF ANALYSES BY METHOD

Gas	Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045	Alpha/Beta SW9310	Gamma EPA901.1
2	4	0	0	0	0	0	6	0	0
31	2	3	0	2	0	0	2	0	0
21	42	0	0	0	0	0	0	0	0
10	4	0	0	0	0	0	0	0	0
32	64	0	64	0	0	0	0	0	0
8	16	16	0	16	0	0	24	6	6
56	112	0	0	156	0	0	156	0	0
10	4	0	0	6	0	0	6	0	0
0	8	0	0	8	0	0	8	0	0
3	6	0	9	0	0	0	0	0	0
0	10	0	0	0	0	0	10	0	0
3	6	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

HA = Hand auger boring
SS = Soil scrape
RB = Reconnaissance boring
DB = Deep boring
TVPH = Total Volatile Petroleum Hydrocarbons
TEPH = Total Extractable Petroleum Hydrocarbons
PCB/Pest = Polychlorinated biphenyls/ organochlorine pesticides
Org-pest = Organophosphorus pesticides
CHL-pest = Chlorinated phenoxy acid herbicides
SVOC = Semivolatile organic compounds
Dioxin = Dioxin/furan compounds
Phenol = Phenol compounds
PNAs = Polynuclear aromatic compounds
PCB screen = PCB field screening laboratory analysis
FVOC screen = Field screening analysis of volatile organic compounds
Soil Gas FGC = Field screening analysis of soil gas
CN = Total cyanide
Organo lead = Organic lead compound
Alpha/Beta = Alpha and beta radioactivity
Gamma = Gamma radioactivity

**Table 3.25-1.
Continued**

INVESTIGATION CLUSTER Site, PRL, SA, SSA	SAMPLE LOCATIONS	TVPH SW5030	TEPH SW3550	PCB/Pest SW8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metal SW601
		NUMBER OF ANALYSES BY METHOD												
SA-4	HA-9	0	0	3	3	3	3	0	0	0	0	9	0	
SA-8														
SA-8	RB-2	4	4	0	0	0	0	0	0	0	0	6	0	
SA-9														
SA-9	HA-10	0	0	0	0	0	0	0	0	0	0	20	0	
SA-15														
SA-15	RB-6	0	12	0	0	0	12	12	0	0	0	18	6	1
SA-29														
SA-29	RB-13	0	12	0	0	0	14	0	0	0	0	39	13	
SSA-2														
SSA-2	RB-12	0	0	0	0	0	0	0	0	0	0	36	12	
SSA-3														
SSA-3	HA-12	12	24	0	0	0	24	0	0	0	0	12	0	2
TOTAL ANALYSES FOR RB		232	803	97	125	125	924	37	192	1	158	1559	539	79
TOTAL ANALYSES FOR DB		35	119	6	2	2	65	2	18	0	6	203	146	5
TOTAL ANALYSES FOR HA		12	51	3	3	3	212	0	0	0	163	330	50	16
TOTAL ANALYSES FOR SS		0	0	0	0	0	0	0	0	0	4578	0	0	
GRAND TOTAL		279	973	106	130	130	1201	39	210	1	4905	2092	735	101

NUMBER OF ANALYSES BY METHOD

NUMBER OF ANALYSES BY METHOD

EPH 3550	PCB/Pest SW8080	Org-pest SW8140	CHL-pest SW8150	SVOC SW8270	Dioxin SW8280	Phenol SW8040	PNAs SW8310	PCB Screen	FVOC Screen	Soil Gas FGC	Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	p SW9
0	3	3	3	3	0	0	0	0	9	0	3	0	0	0	0	3	
4	0	0	0	0	0	0	0	0	6	0	0	0	4	0	0	4	
0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	
12	0	0	0	12	12	0	0	0	18	6	12	0	0	0	0	0	
12	0	0	0	14	0	0	0	0	39	13	0	26	0	0	0	0	
0	0	0	0	0	0	0	0	0	36	12	0	0	0	0	0	0	
24	0	0	0	24	0	0	0	0	12	0	24	24	0	24	0	0	
803	97	125	125	924	37	192	1	158	1559	539	796	252	77	416	28	24	
19	6	2	2	65	2	18	0	6	203	146	52	20	0	26	2	2	
51	3	3	3	212	0	0	0	163	330	50	166	33	0	57	0	3	
0	0	0	0	0	0	0	0	4578	0	0	0	0	0	0	0	0	
973	106	130	130	1201	39	210	1	4905	2092	735	1014	305	77	499	30	29	

NUMBER OF ANALYSES BY METHOD

A	Metals SW6010	Mercury SW7471	Lead SW7421	CN- SW9012	Arsenic SW7060	Organo Lead HML338	pH SW9045	Alpha/Beta SW9310	Gamma EPA901.1
	3	0	0	0	0	3	0	0	0
	0	0	4	0	0	4	0	0	0
	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0
	0	26	0	0	0	0	0	14	14
	0	0	0	0	0	0	0	0	0
	24	24	0	24	0	0	0	24	24
	796	252	77	416	28	24	562	92	92
	52	20	0	26	2	2	66	8	8
	166	33	0	57	0	3	43	24	24
	0	0	0	0	0	0	0	0	0
	1014	305	77	499	30	29	671	124	124

HA = Hand auger boring

SS = Soil scrape

RB = Reconnaissance boring

DB = Deep boring

TVPH = Total Volatile Petroleum Hydrocarbons

TEPH = Total Extractable Petroleum Hydrocarbons

PCB/Pest = Polychlorinated biphenyls/ organochlorine pesticides

Org-pest = Organophosphorus pesticides

CHL-pest = Chlorinated phenoxy acid herbicides

SVOC = Semivolatile organic compounds

Dioxin = Dioxin/furan compounds

Phenol = Phenol compounds

PNAs = Polynuclear aromatic compounds

PCB screen = PCB field screening laboratory analysis

FVOC screen = Field screening analysis of volatile organic compounds

Soil Gas FGC = Field screening analysis of soil gas

CN = Total cyanide

Organo lead = Organic lead compound

Alpha/Beta = Alpha and beta radioactivity

Gamma = Gamma radioactivity

Table 3.25-1.
Continued

4.0 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions during remedial response activities (U.S. Environmental Protection Agency [U.S. EPA], 1987). In the three-phase approach to the Remedial Investigation (RI) for each site in Operable Unit (OU) B of McClellan Air Force Base (AFB), separate objectives are required for each of the three phases, and the objectives for each subsequent phase build upon the results of the previous phases. Because the level of detail and data quality needed will vary with the decision to be made with the data, DQOs were established to meet the requirements of the decisions. The general objectives and uses of the data for each phase are listed in Table 4-1.

A number of sites in OU B have had a variety of historical operations, each of which may have been a contaminant source. Because some sites may include several suspected sources, source-specific DQOs are presented along with the sampling plan for each site in Section 3.0. Site-specific DQOs are tailored to the phase under which the site is being investigated, the media that will be investigated, specific objectives at the site, contaminants of concern, and the sampling methodology that will be employed in selecting sample locations. The criteria used to establish specific DQOs are explained in the following sections.

4.1 Appropriate Analytical Levels

Analytical methods have been selected to provide data to evaluate the contaminants expected at each site. The selected methods are those accepted by the U.S. EPA for waste analyses (U.S. EPA, 1986b). Specific analytical methods are described in Section 5.0. The five analytical levels and uses of the data for each level are presented in Table 4-2. Levels 1 through 3 will be used in the Phase 1 investigation described in this Sampling and Analysis Plan (SAP); Levels 4 and 5 may be used in subsequent phases of the RI.

4.2 Contaminants of Concern

The contaminants of concern were identified in information collected in previous investigations. Depending on the specificity of the available information,

TABLE 4-1. OVERALL OBJECTIVES AND USES OF DATA FOR EACH RI PHASE

Phase	Objectives	Data Uses
1 - Contaminant Source Identification	Identify sources of soil, soil gas, and groundwater contamination at sites and confirm that no sources are present at sites without contamination.	Site characterization. Identification of sources.
2 - Site Characterization	Determine the extent of contamination at identified sources, migration pathways, and potential receptors.	Site characterization. Evaluation of alternatives. Engineering design. Health risk assessment.
3 - Remedial Alternative Evaluation	Identify remedial action alternatives and gather data to aid in evaluation of alternatives and selection of remedial action.	Evaluation of alternatives. Engineering design. Determination of cleanup levels. Feasibility Study.

TABLE 4-2. SUMMARY OF ANALYTICAL LEVELS

Analytical Level	Description	Data Uses
Level 1	Field screening or analyses using portable instruments. Results are often not compound specific and not quantitative, but results are available in real-time.	Health and safety monitoring. Site characterization.
Level 2	Field analyses using more sophisticated portable analytical instruments, generally in a mobile laboratory on site. Data generated are semi-quantitative to quantitative and may be compound-specific.	Site characterization. Evaluation of alternatives. Engineering design.
Level 3	Analyses typically performed in an off-site laboratory. Analyses generally use CLP-type procedures, but do not include the same level of validation or documentation procedures required of CLP Level 4 analysis.	Site characterization. Evaluation of alternatives. Engineering design. Health risk assessment.
Level 4	All analyses are performed in an off-site CLP analytical laboratory following CLPs. Level 4 is characterized by rigorous QA/QC protocols and documentation. It is typically used for confirmation of lower level data, and to obtain highly documented data.	Health risk assessment. Evaluation of alternatives. Engineering design.
Level 5	Analyses are generally non-standard methods. All analyses are performed in an off-site laboratory which may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits.	Health risk assessment.

CLP = Contract Laboratory Protocol
QA/QC = Quality Assurance/Quality Control

identified contaminants range from specific compounds to generic classes of industrial chemicals. If specific compounds were detected in previous field investigations, these analytes were added to the list of contaminants of concern. For some sites, particularly disposal sites, no information was available to identify potential contaminants that may have been handled. Where specific information was not available, the contaminants of concern were assumed to include any of the contaminants previously detected at McClellan AFB. Other contaminants that have not been detected in previous field investigations are considered contaminants of concern for certain sites. Notable among these are dibenzodioxins and dibenzofurans. Previous investigations may not have detected these compounds because the analytical detection limits in those investigations were greater than the levels of concern for these compounds.

4.3 Levels of Concern

The level of concern is defined as the concentration of a contaminant above which some action may be needed. For groundwater, federal or California Maximum Contaminant Levels (MCLs) are levels of concern. In addition, U.S. EPA National Ambient Water Quality Criteria to Protect Freshwater Aquatic Life serve as potential levels of concern for surface water. Although exact remedial action levels for contaminants in soil have not been determined, estimates have been made to ensure that analytical methods selected are accurate at levels of concern. Potential levels of concern for soils include Regional Water Quality Control Board (RWQCB) "designated levels" to protect groundwater and surface water or levels of concern based on health risk assessment. As work on each site progresses and more data become available, the levels of concern will be further refined and incorporated into phases of the RI. Levels of concern for soil and solid waste, and water listed in Tables 4-3 and 4-4, respectively, were determined based on the requirements of the various data uses, including risk assessment for human health and the environment. Two levels of concern are listed for soils, surface soils (0 to 20 feet BGS) and deep soils (greater than 20 feet BGS). The development of levels of concern is explained in the following sections.

4.3.1 Health Risk Assessment

Health-based levels of concern for the Health Risk Assessment (HRA) have been derived using intake algorithms published in the U.S. EPA's *Risk Assessment*

TABLE 4-3. LEVELS OF CONCERN FOR SOIL AND SOLID WASTE

	Level of Concern Risk Assessment (mg/kg)		RWQCB Designated Levels			
Chemical	Shallow Soil (0 to 20 ft BGS)	Deep Soil (20 ft to 95 ft BGS)	Protect Groundwater (mg/kg)	Protect Surface Water (mg/kg)	Practical Quantitation Limit (mg/kg)	Analytical Method
Acenaphthene	1,170	11,700	0.0028	0.0028	0.5	SW8270
Acenaphthylene	7.8	78	0.0028	NL	0.5	SW8270
Acetone	1,950	19,500	NL	NL	0.1	SW8240
Acetophenone	1,950	19,500	NL	NL	2.5	SW8270
Aniline	2,667	26,667	NL	NL	2.5	SW8270
Anthracene	7.8	78	0.0028	NL	0.5*	SW8270
Arsenic	19.5	195	500	500	30*	SW6010
Benzenamine, 4-chloro-	78	780	NL	NL	1	SW8270
Benzene	524	5,241	0.7	0.7	0.1	SW8240
Benzo[a]anthracene	9.1	91	0.0028	NL	0.01*	SW8310
Benzo[a]pyrene	1.3	13	0.0028	NL	0.02*	SW8310
Benzo[b]fluoranthene	9.44	94	0.0028	NL	0.01*	SW8310
Benzo[g,h,i]perylene	780	7,800	0.0028	NL	0.05*	SW8310
Benzo[k]fluoranthene	780	7,800	0.0028	NL	0.01*	SW8310
Butyl benzyl phthalate	3,900	39,000	NL	3	0.5	SW8270
Cadmium	9.75	97.5	100	5.5	2	SW6010
4-Chloro-3-methylphenol	97.5	975	3,000	NL	0.5	SW8270
Chlorobenzene	97.5	975	3	NL	0.1	SW8240
2-Chloroethyl vinyl ether	13.8	138	NL	NL	0.1	SW8240
Chloroform	187.6	1,876	0.19	0.19	0.1	SW8240
Chromium	--	--	500	110	3.5	SW6010
Chromium VI	0.011	0.11	500	110	2*	SW7196
Chrysene	300	3,004	0.0028	NL	0.1	SW8310
Cyanides (soluble cyanide salts)	390	3,900	200	52	20	SW9010
4,4'-DDT	45	447	0.00024	0.00024	0.02*	SW8080
Di-n-butyl phthalate	1,950	19,500	770	3	0.5	SW8270
Di-n-octyl phthalate	390	3,900	NL	3	0.5	SW8270
Dibenzo[a,h]anthracene	1.2	12	0.0028	NL	0.02*	SW8310
Dibenzofurans	1.95	19.5	NL	NL	0.0002	SW8280
1,2-Dichlorobenzene	780	7,800	10	10	0.5	SW8270
1,3-Dichlorobenzene	780	7,800	20	20	0.5	SW8270
1,4-Dichlorobenzene	3,900	39,000	0.3	0.3	0.5*	SW8270
1,1-Dichloroethane	1,950	19,500	20	NL	0.1	SW8240
1,1-Dichloroethene	12.67	126.7	0.033	0.033	0.1*	SW8240

(Continued)

TABLE 4-3. (Continued)

Chemical	Level of Concern Risk Assessment (mg/kg)		RWQCB Designated Levels		Practical Quantitation Limit (mg/kg)	Analytical Method
	Shallow Soil (0 to 20 ft BGS)	Deep Soil (20 ft to 95 ft BGS)	Protect Groundwater (mg/kg)	Protect Surface Water (mg/kg)		
1,2-trans-Dichloroethene	390	3,900	16	16	0.1	SW8240
Dichloromethane	1,170	11,700	0.19	0.19	0.1	SW8240
Diethyl phthalate	15,600	156,000	350,000	3	0.5	SW8270
2,4-Dimethylphenol	390	3,900	400	NL	0.5	SW8270
2,6-Dinitrotoluene	22.4	224	NL	NL	0.5	SW8270
Ethylbenzene	1,950	19,500	29	NL	0.1	SW8240
bis(2-Ethylhexyl)phthalate	390	3,900	4,200	3	0.5	SW8270
Fluoranthene	780	7,800	42	42	0.1	SW8310
Fluorene	780	7,800	0.0028	NL	0.1*	SW8310
Heptachlor epoxide	1.67	16.7	0.0002	NL	0.01*	SW8080
Hexachlorobutadiene	39	390	0.45	0.45	0.5	SW8270
2-Hexanone	117	1,170	NL	NL	0.1	SW8240
Indeno[1,2,3-cd]pyrene	5.7	57	0.0028	NL	0.03*	SW8310
Isophorone	37.1	371	5,200	5,200	0.5	SW8270
Lead	8.38	83.8	500	9.9	0.5	SW7421
Mercury	1.66	16.6	20	0.12	0.5	SW7470
Methyl ehtyl ketone	975	9,750	75	NL	0.1	SW8240
Methyl isobutyl ketone	390	3,900	NL	NL	0.1	SW8240
2-Methylnaphthalene	7.8	78	NL	NL	0.5	SW8270
Naphthalene	78	780	NL	620	0.5	SW8270
Nickel	390	3,900	134	134	4	SW6010
2-Nitroaniline	9.75	97.5	NL	NL	2.5	SW8270
Nitrobenzene	9.75	97.5	0.5	0.5	0.5	SW8270
N-Nitrosodi-n-propylamine	2.2	22	NL	NL	0.5	SW8270
N-Nitrosodiphenylamine	3,102	31,020	4.9	4.9	0.5	SW8270
PCB-1254	2.0	20	0.000079	0.000079	0.2*	SW8080
PCB-1260	2.0	20	0.000079	0.000079	0.2*	SW8080
Pentachlorophenol	126.7	1,267	30	1.74	1.5	SW8270
Phenanthrene	780	7,800	0.0028	NL	0.4*	SW8310
Phenol	11,700	117,000	300	300	0.5	SW8270
Pyrene	780	7,800	0.0028	NL	0.2*	SW8310
Selenium	58.5	585	100	100	0.5	SW7740
Styrene	506.7	5,067	140	NL	0.1	SW8240
1,1,2,2-Tetrachloroethane	78	780	0.17	0.17	0.1	SW8240

(Continued)

TABLE 4-3. (Continued)

Chemical	Level of Concern Risk Assessment (mg/kg)		RWQCB Designated Levels		Practical Quantitation Limit (mg/kg)	Analytical Method
	Shallow Soil (0 to 20 ft BGS)	Deep Soil (20 ft to 95 ft BGS)	Protect Groundwater (mg/kg)	Protect Surface Water (mg/kg)		
TCDD, 2,3,7,8-	0.00009	0.00099	1.3×10^{-8}	NL	0.0002*	SW8280
Tetrachloroethene	195	1,950	4	4	0.1	SW8240
Toluene	3,900	39,000	100	100	0.1	SW8240
1,2,4-Trichlorobenzene	25.5	255.4	NL	NL	0.5	SW8270
1,1,1-Trichloroethane	1,755	17,550	200	200	0.1	SW8240
1,1,2-Trichloroethane	78	780	0.6	0.6	0.1	SW8240
Trichloroethene	894.1	8,941	5	5	0.1	SW8240
Trichlorofluoromethane	3,900	39,000	0.19	0.19	0.1	SW8240
2,4,5-Trichlorophenol	1,950	19,500	1	NL	1.5*	SW8270
Vinyl chloride	51.7	517	2	NL	0.1	SW8240
Xylene (mixed)	1,657.5	16,575	620	NL	0.1	SW8240

* Lowest practical quantitation limit for method listed is greater than one of the levels of concern.

4,4'-DDT = 4,4'Dichlorodiphenyltrichloroethane
PCB = Polychlorinated biphenyls
TCD, 2,3,7,8- = 2,3,7,8-Tetrachlorodibenzodioxin
NL = No designated level given

TABLE 4-4. LEVELS OF CONCERN FOR WATER

Chemical	Level of Concern Risk Assessment for Water (µg/L)	California DHS MCLs & ALs[a] (µg/L)	U.S. EPA Freshwater Aquatic Life[b] (µg/L)	Practical Quantitation Limit (µg/L)	Analytical Method
Acenaphthene	2,100	NL[c]	NL	10	SW8270
Acenaphthylene	14	NL	NL	10	SW8270
Acetone	3,500	NL	NL	80	SW8240
Acetophenone	3,500	NL	NL	50	SW8270
Aniline	10	NL	NL	50*	SW8270
Anthracene	14	NL	NL	6.6	SW8310
Arsenic	35	50	190	5	SW7060
Benzenamine, 4-chloro-	140	NL	NL	20	SW8270
Benzene	9.4	1	NL	3*	SW8240
Benzo[a]anthracene	0.16	NL	NL	0.13	SW8310
Benzo[a]pyrene	0.024	NL	NL	0.23*	SW8310
Benzo[b]fluoranthene	17	NL	NL	0.18	SW8310
Benzo[g,h,i]perylene	1,400	NL	NL	0.76	SW8310
Benzo[k]fluoranthene	0.17	NL	NL	0.17	SW8310
Butyl benzyl phthalate	7,000	NL	NL	10	SW8270
Cadmium	17.5	10	0.55	5*	SW6010
4-Chloro-3-methylphenol	175	NL	NL	0.01	SW8270
Chlorobenzene	1.75	30	NL	5	SW8240
2-Chloroethyl vinyl ether	0.25	NL	NL	10*	SW8240
Chloroform	3.36	NL	NL	5	SW8240
Chromium	--	50	NL	30	SW6010
Chromium VI	0.02	NL	11	0.2*	SW7196
Chrysene	5.38	NL	NL	1.5	SW8310
Cyanides (soluble cyanide salts)	700	NL	5.2	20*	SW9010
4,4'-DDT	0.8	NL	0.001	0.1*	SW8080
Di-n-butyl phthalate	3,500	NL	NL	10	SW8270
Di-n-octyl phthalate	7,000	NL	NL	10	SW8270
Dibenzo[a,h]anthracene	0.021	NL	NL	0.3*	SW8310
Dibenzofurans	3.5	NL	NL	0.001	SW8280
1,2-Dichlorobenzene	1,400	130	NL	5	SW8270
1,3-Dichlorobenzene	1,400	130	NL	5	SW8270
1,4-Dichlorobenzene	11.3	5	NL	9	SW8270
1,1-Dichloroethane	3,500	5	NL	5	SW8010
1,1-Dichloroethene	0.23	6	NL	3*	SW8010

(Continued)

TABLE 4-4. (Continued)

Chemical	Level of Concern Risk Assessment for Water (μg/L)	California DHS MCLs & ALs[a] (μg/L)	U.S. EPA Freshwater Aquatic Life[b] (μg/L)	Practical Quantitation Limit (μg/L)	Analytical Method
1,2-trans-Dichloroethene	700	10	NL	5	SW8010
Dichloromethane	36.3	40	NL	5	SW8010
Diethyl phthalate	28,000	NL	NL	20	SW8270
2,4-Dimethylphenol	700	400	NL	0.01	SW8270
2,6-Dinitrotoluene	0.4	NL	NL	10*	SW8270
Ethylbenzene	3,500	680	NL	5	SW8240
bis(2-Ethylhexyl)phthalate	19.4	4	360	10*	SW8270
Fluoranthene	1,400	NL	NL	2.1	SW8310
Fluorene	1,400	NL	NL	2.1	SW8310
Heptachlor epoxide	0.03	0.01	0.0038	0.05*	SW8080
Hexachlorobutadiene	3.5	NL	NL	10	SW8270
2-Hexanone	210	NL	NL	50	SW8240
Indeno[1,2,3-cd]pyrene	0.1	NL	NL	0.43*	SW8310
Isophorone	0.66	NL	NL	10	SW8270
Lead	15	50	0.99	5*	SW7421
Mercury	2.97	2	0.012	2*	SW7470
Methyl ethyl ketone	1,750	NL	NL	50	SW8240
Methyl isobutyl ketone	700	NL	NL	50	SW8240
2-Methylnaphthalene	14	NL	NL	10	SW8270
Naphthalene	140	NL	NL	10	SW8270
Nickel	700	NL	73	40	SW6010
2-Nitroaniline	17.5	NL	NL	0.05	SW8270
Nitrobenzene	17.5	NL	NL	10	SW8270
N-Nitrosodi-n-propylamine	0.039	NL	NL	0.01	SW8270
N-Nitrosodiphenylamine	55.6	NL	NL	10	SW8270
PCB-1254	0.035	NL	0.014	1*	SW8080
PCB-1260	0.035	NL	0.014	1*	SW8080
Pentachlorophenol	2.27	30	5.7	30*	SW8270
Phenanthrene	1,400	NL	6.3	6.4*	SW8310
Phenol	21,000	5	NL	10	SW8270
Pyrene	1,400	NL	NL	2.7	SW8310
Selenium	105	10	5	5	SW7740
Styrene	907	NL	NL	5	SW8240
1,1,2,2-Tetrachloroethane	1,36	1	NL	5*	SW8010
TCDD, 2,3,7,8-	0.000002	NL	NL	0.001*	SW8280

(Continued)

TABLE 4-4. (Continued)

Chemical	Level of Concern Risk Assessment for Water (μg/L)	California DHS MCLs & ALs[a] (μg/L)	U.S. EPA Freshwater Aquatic Life[b] (μg/L)	Practical Quantitation Limit (μg/L)	Analytical Method
Tetrachloroethene	350	5	NL	3	SW8010
Toluene	7	100	NL	5	SW8240
1,2,4-Trichlorobenzene	45.8	NL	NL	10	SW8270
1,1,1-Trichloroethane	4.77	200	NL	5*	SW8010
1,1,2-Trichloroethane	1.40	32	NL	5*	SW8010
Trichloroethene	16.0	5	NL	3	SW8010
Trichlorofluoromethane	7	150	NL	10*	SW8240
2,4,5-Trichlorophenol	3,500	NL	63	50	SW8270
Vinyl chloride	0.93	0.5	NL	10*	SW8010
Xylene (mixed)	2,975	1,750	NL	0.005	SW8240

[a] California DHS Maximum Contaminant Level (MCL) or Action Level (AL) for drinking water supply.

[b] U.S. EPA National Ambient Water Quality Criteria to Protect Freshwater Aquatic Life; lowest criteria value listed is shown (taken from Marshack, 1991).

* Lowest practical quantitation limit for the method listed is greater than one of the levels of concern.

4,4′-DDT = 4,4′-Dichlorodiphenyltrichloroethane
PCB = Polychlorinated biphenyls
TCDD, 2,3,7,8- = 2,3,7,8-Tetrachlorodibenzodioxin
NL = No designated value given

Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A) (U.S. EPA, 1989b). These Levels of Concern (HRA) were established utilizing conservative assumptions. The use of conservative assumptions was necessary because site-specific applicable or relevant and appropriate requirements (ARARs) have not been established for McClellan AFB. In addition, these assumptions were used because the risk assessment has not been performed, and specific information pertaining to contact frequency and duration, contact intimacy, and contaminant distribution has not fully been established. Algorithms for incidental oral ingestion and direct dermal contact were used to calculate Levels of Concern (HRA) using reference doses (RfDs) or risk-specific doses (RSDs) for soils. The algorithm for drinking water was used to derive levels of concern for water, and inhalation algorithms were used for the air pathway. The derivation of all Levels of Concern (HRA) is explained in Appendix B.

When deriving levels of concern for the OU B RI from U.S. EPA intake algorithms, certain assumptions were made. These general assumptions include a 1.0×10^{-4} risk level for carcinogens for soil and a 1.0×10^{-6} risk level for water,, an adult body weight of 70 kilograms (kg), a life span of 70 years, an exposure frequency of 365 days/year, and an average exposure duration of 9 years (U.S. EPA-recommended average residence time). For noncarcinogenic compounds, the "acceptable daily intake" value is used. The assumption of 1.0×10^{-4} risk level of carcinogens in soil is based on the discussion of cumulative carcinogenic site risk in a U.S. EPA Memorandum dated 22 April 1991 (OSWER Directive 9355.030). Another assumption is that the fraction ingested from contaminated media (versus not contaminated media), which corresponds to the "FI" factor in the algorithms, is assumed to be 100 percent. An exception to this last assumption is for soil (incidental ingestion and skin contact) where contact with soil at a depth of 20 feet or greater is assumed to be no greater than 10 percent (i.e., FI = 0.1). Because of this reduced potential for contact, deep soils have Levels of Concern (HRA) that are 10 times greater than those for shallow soils. Media-pathway-specific assumptions are described in Appendix B.

4.3.2 Levels of Concern (HRA)

The Levels of Concern (HRA) are not intended to represent Health Risk Assessments for soils or groundwater in OU B. The values listed in the table will be used only as indicators of soil or water concentrations that may require remedial actions. They are potential "action levels" for specific contaminants. After Phase 2 data are collected for sources of contaminants, full baseline risk assessments considering all contaminants, all pathways, and all potential receptors will be conducted.

4.3.3 Practical Quantitation Limits

Levels of concern for site characterization were derived from the estimated practical quantitation limits (PQLs) of methods that provide rapid, cost-effective analyses for a broad spectrum of contaminants. For example, levels of concern for volatile and semivolatile organic contaminants were derived from the limits of quantitation for the gas chromatography/mass spectrometry (GC/MS) methods (U.S. EPA Methods SW8240 and SW8270, respectively). Tables 4-3 and 4-4 list the contaminants of concern, the estimated PQLs, and the analytical method on which the PQL is based.

The analytical methods to be used in Phase 1 of the OU B RI were selected because they are the standard analytical methods with estimated PQL values below most Levels of Concern (HRA). Only one method (for the analysis of 2,3,7,8-tetrachlorodibenzodioxin) has an estimated PQL greater than the Level of Concern (HRA) for shallow soils. Eleven methods have estimated PQLs greater than the Level of Concern (HRA) for drinking water. Because the Phase 1 sampling effort will be focused on source areas in which contaminants are likely to occur at higher concentrations, the standard methods and their estimated PQLs listed in Tables 4-3 and 4-4 are considered adequate to meet the objectives of Phase 1. Prior to Phase 2 sampling, the analytical methods and estimated PQLs will be reviewed to determine if methods with lower PQLs are needed to determine extent and assess risks to human health or the environment.

4.3.4 Designated Levels to Protect Surface Water and Groundwater

Designated levels to protect surface water and groundwater (Marshack, 1986) are listed in Table 4-3 for comparison with Levels of Concern (HRA) and PQLs. The designated levels for total concentrations in a solid are presented for consideration as potential, preliminary action levels for soils remediation. It is unlikely that the designated levels listed will be applicable or relevant and appropriate to soils at McClellan AFB. Remedial action levels will be determined in the feasibility study for OU B.

4.3.5 U.S. EPA National Ambient Water Quality Criteria

National Ambient Water Quality Criteria are established by U.S. EPA under the Clean Water Act. They are intended to protect freshwater and marine aquatic life, as well as human health and welfare. Criteria for the protection of freshwater aquatic life presented in "A Compilation of Water Quality Goals", prepared by Jon Marshack, Central Valley Regional Water Quality Control Board (February 1991) were selected as potential level of concerns for surface water in Table 4-4. The criteria are presented in the table for comparison with Levels of Concern (HRA) and PQLs. The applicability or relevance and appropriateness of these criteria to surface water at McClellan AFB have not been determined.

4.3.6 Background Soil and Groundwater Quality

Background soil and groundwater quality have not been established for McClellan AFB. Background concentrations of inorganic species and radionuclides that occur naturally in soils beneath McClellan AFB will be determined in the Background Investigation (Section 3.24). Background groundwater quality will be determined by sampling and analysis of a number of monitoring and water supply wells that are located to the north, northeast, and east of McClellan AFB. Historical data for groundwater flow directions indicate that groundwater has flowed to the west or southwest for at least the last 50 years. Therefore, groundwater flowing past wells located to the north, northeast, and east has been upgradient from and unaffected by any contaminants entering groundwater from McClellan AFB. Analytical data for soils and water will be used to define the expected ranges of background soil and groundwater quality that would be present without the effects of activities at McClellan AFB. The RI data can then be compared to the estimated background ranges to evaluate the potential effects of identified sources on groundwater quality.

4.4 Data Quality Parameters

The primary indicators of data quality are the PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters. Quality assurance objectives for the McClellan AFB Installation Restoration Program are discussed in Section 4.0 of the Quality Assurance Project Plan (QAPP) (Radian, 1990c), and data assessment procedures are discussed in Section 13.0 of the QAPP. These objectives and procedures are applicable to the OU B RI sampling and analysis. The basis for assessing PARCC parameters is discussed in the following subsections.

4.4.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions (U.S. EPA, 1987). Specifically, it is a quantitative measure of the variability of a group of measurements compared to the average value of the measurements. The overall precision of measurement data is a combination of sampling and analytical factors. Analytical precision objectives for the contaminants of concern are discussed in the QAPP (Radian, 1990c). Precision objectives are based on the precision routinely attained using the analytical procedures for each matrix, as assessed by analyzing laboratory replicates and spike duplicates. Sampling precision is unique to each site and matrix, and specific sampling precision goals have not been set; however, sampling precision will be determined by collecting and analyzing collocated or field replicate samples and by analyzing laboratory replicates. Precision measurements will be compared to the criteria given in QAPP Section 4.0, where applicable. Precision criteria are currently being revised for the analytical laboratories selected to analyze OU B RI samples.

4.4.2 Accuracy

Accuracy is a measure of the random and systematic error (bias) in a measurement system and includes components of sampling and analytical errors. Sources of error include the sampling process, field contamination, preservation techniques, sample handling, sample matrix, sample preparation, and analytical techniques. Analytical accuracy may be assessed through the use of laboratory blanks, matrix spikes, and performance evaluation samples. Analytical accuracy goals for the contaminants of concern are listed in the QAPP (Radian, 1990). Specific sampling accuracy objectives have not been set; however, sampling accuracy will be assessed from results for field/trip blanks and performance evaluation samples. Accuracy measurements will be compared to the criteria given in QAPP Section 4.0, where applicable. Accuracy criteria are currently being revised for the analytical laboratories selected to analyze OU B RI samples.

4.4.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the true concentrations or characteristics of the study area (U.S. EPA, 1987). The representativeness criterion is best satisfied by proper selection of sampling locations and collection of a sufficient number of samples. For this RI, sampling locations have been selected using random systematic sampling grids, simple random locations, or by judgmental evidence such as existing data or site observations. Results from these different sampling strategies may serve specific objectives. For example, sampling strategies that incorporate a random component into the selection of sampling locations allow statistical inferences to be made about site characteristics. On the other hand, selecting locations based on judgmental evidence is an efficient method for obtaining worst-case information relevant to a health risk assessment scenario and providing confirmation of contamination. Specific rationale for selection of sampling locations for each site is explained in Section 3.0. A general description of the use of systematic grids is described in Appendix A, Section A3.0.

4.4.4 Completeness

Completeness is defined as the percentage of valid data reported compared to the total number of samples collected for analysis. Valid data are determined during the data assessment process and are data that satisfy the quality assurance objectives. Completeness is determined after precision and accuracy are calculated for the actual data set. The objective of completeness for all measurement parameters and all sample matrices is 95 percent.

4.4.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard sampling, analytical, and quality control procedures, and standard and comprehensive reporting formats will ensure data of known data quality, and therefore, comparability with other data of known quality.

5.0 SAMPLING EQUIPMENT AND PROCEDURES

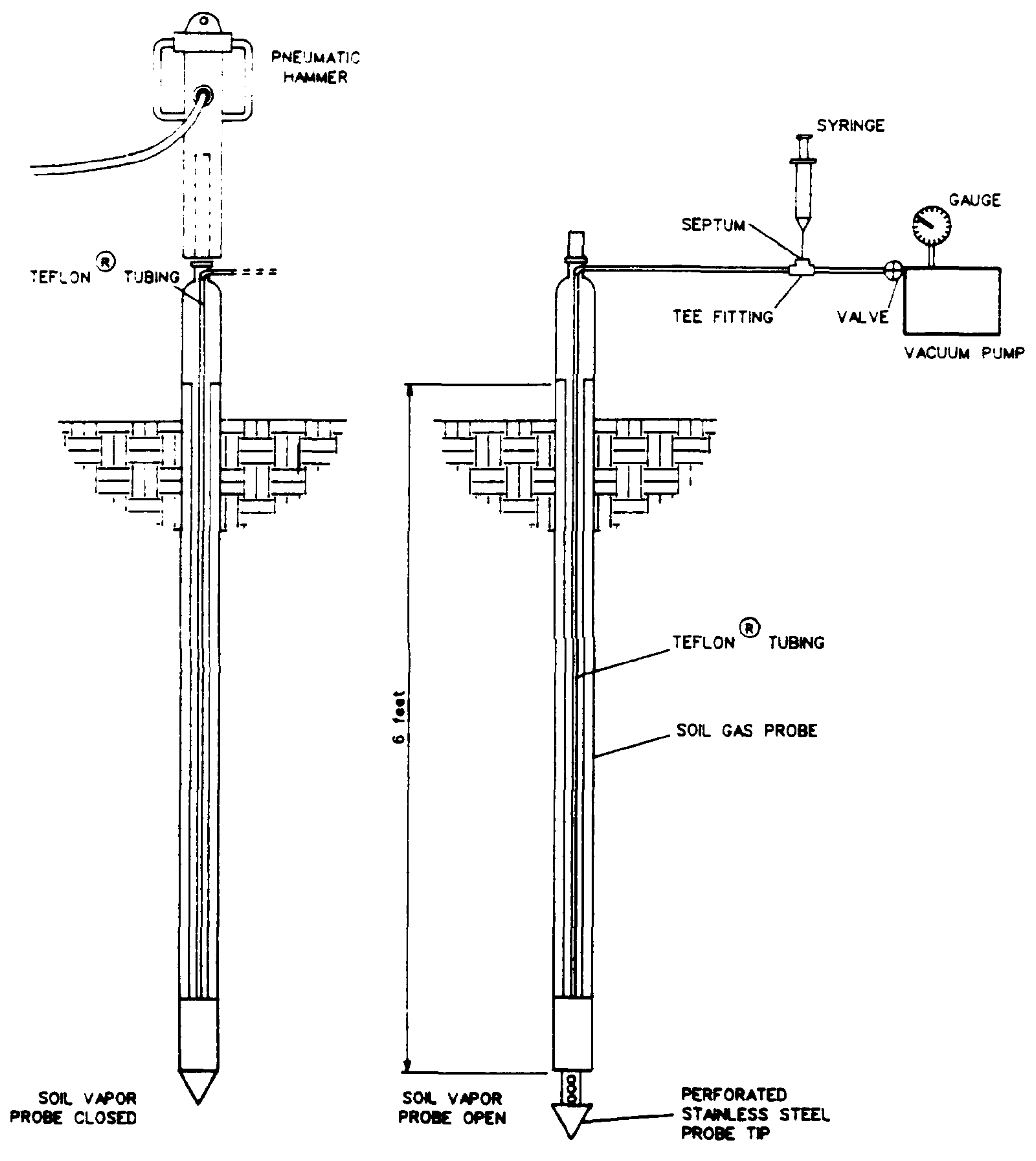
This section contains detailed descriptions of sampling equipment and procedures to be followed during the field investigation of Operable Unit (OU) B at McClellan Air Force Base (AFB) that are not described in the McClellan AFB Quality Assurance Project Plan (QAPP) (Radian, 1990c). Sampling equipment and procedures to be followed in the OU B Remedial Investigation (RI) that are described in Section 5.0 of the QAPP are referenced to the appropriate subsection of the QAPP.

5.1 Soil Gas

Soil gas samples will be collected during the OU B RI to further define the areal and vertical extent of volatile organic compound (VOC) soil gas contamination and to target areas of VOC-contaminated soil. The areal extent of VOC-contaminated soil gas in near surface soils was previously characterized during the OU B Soil Gas Investigation. During the remainder of the RI, soil gas samples will be collected at depths of 15 to 95 feet below ground surface (BGS) within soil borings drilled using a power driven sampler.

The soil gas sample collection system to be used consists of a soil gas probe, a vacuum pump and gauge, Teflon® tubing, and a glass sampling syringe. The probes used for collecting soil gas samples consist of hollow rods constructed of chrome/ molybdenum steel alloy attached to a perforated stainless steel retractable probe tip (Figures 5-1 and 5-2). Teflon® tubing extends from the retractable probe tip through the inside of the rod and exits at the top. A vacuum pump is used to evacuate the Teflon® tubing so that a representative soil gas sample can be collected. The vacuum gauge is used to ensure that the appropriate vacuum is applied and that the tubing is free of obstructions. Glass syringes are used to collect the soil gas samples. For quality assurance needs and detailed speciation of contaminants present in soil gas, samples will also be collected using evacuated stainless steel canisters.

With the exception of the equipment used to drive the soil gas probes into the ground, the procedures for collecting soil gas samples from shallow soils and deep soils are very similar. In shallow soils, probes will be driven a maximum of 6 feet into the ground using a pneumatic hammer (Figure 5-1). At depths greater than 6 feet, a



PROBE BEING DRIVEN

PROBE DURING SAMPLING

Figure 5-1. Surface Soil Vapor Sampling Apparatus.

DO2 PROBE 12/12/90

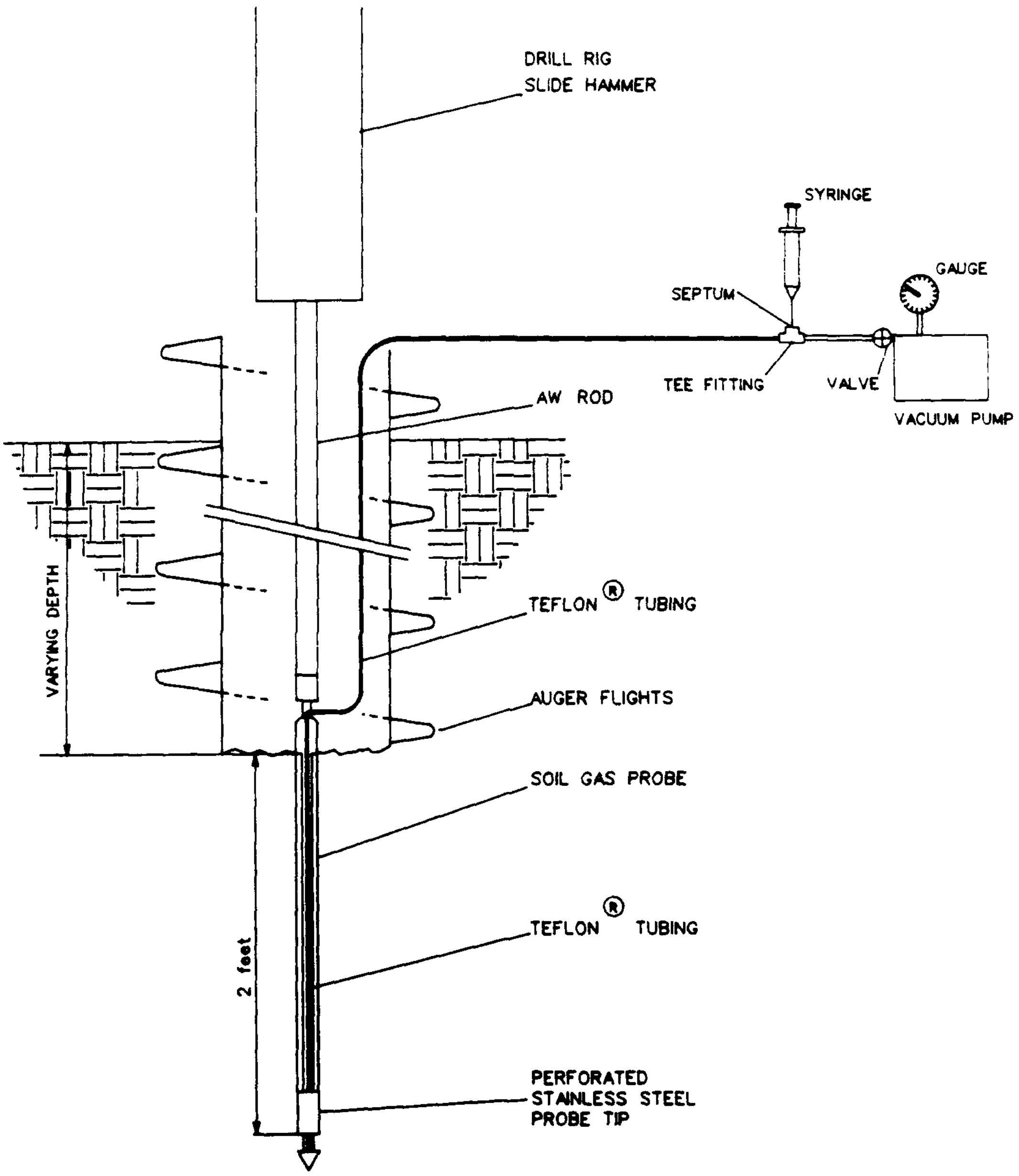


Figure 5-2. Downhole Soil Vapor Sampling Apparatus.

DO2 PROBE 12/12/90

power driven sampler (sonic drill rig, hollow-stem auger drill rig) will be used to drill to the appropriate depth. At the required depth, the 140-pound slide hammer attached to the rig (or the sonic drive unit itself) will be used to drive the soil gas probe to a depth 2 feet beyond the auger head (Figure 5-2).

Once the probe is driven to the required depth, it is retracted a minimum of 3 inches to open the perforated probe tip to the soil. The vacuum pump is then attached and used to purge three to five tubing volumes prior to sample collection. Syringes equipped with hypodermic needles are then used to collect the soil gas sample through a septum attached to the Teflon® tubing. A detailed description of syringe and canister sampling procedures is provided in Tables 5-1 and 5-2, respectively.

Syringe samples will be analyzed on site using a gas chromatograph (GC) equipped with an electron capture detector (ECD), a flame ionization detector (FID), and a photoionization detector (PID) as discussed in Appendix A of the McClellan AFB QAPP. Stainless steel canister samples will be sent to an off-site laboratory for analysis by U.S. Environmental Protection Agency (U.S. EPA) Method TO-14.

5.2 Soil Boring Methodology

The following subsections present a summary of drilling and sampling procedures to be used during subsurface soil sample recovery performed as part of the OU B RI. A detailed description of these methods can be found in Section 5.0 of the QAPP.

5.2.1 Drilling Methods

Soil borings will be drilled and sampled using a drill rig equipped with sonic drive heads and core samplers. The sonication (sonic) drilling method used in conjunction with a core sampler provides a more efficient method of drilling boreholes and collecting relatively undisturbed continuous core samples without producing drill cuttings.

The sonication drilling method employs a sonic drill head that advances the drill stem into the soils by vibration. The drill head produces vibrations normal to the

TABLE 5-1 DETAILED SOIL GAS SYRINGE SAMPLING PROCEDURES

1. Obtain "digging" permits through McClellan AFB Civil Engineering/Environmental Management (CE/EM).

2. Measure probe locations on the ground surface and locate on the site map (probe locations will be measured from existing surveyed control points [wellheads or building corners]).

3. Initiate field data sheet/chain-of-custody form.

4. Lay plastic sheeting over site and set up probe driving equipment at sampling location.

5. If paved, drill through pavement using a rotary hammer or rock drill.

6. Retrieve a decontaminated probe and tip and assemble.

7. Purge Teflon® tubing with vacuum pump for 3 to 5 minutes (7 to 10 for downhole samples).

8. Drive surface probes 6 feet below ground surface (BGS) (3 feet minimum, if resistance is encountered). Drive downhole probes 2 feet past auger head. If obstruction is encountered, contact Radian Project Director immediately.

9. Retract probe 2 to 3 inches to expose perforations in probe tip.

10. Attach Teflon® tubing coming out of the probe to vacuum pump intake with Swagelok® fitting.

11. Turn on vacuum pump and test vacuum (should be 5 to 27 inches of mercury). If vacuum is greater than 27 inches of mercury, retract probe another 2 to 3 inches while pulling vacuum until less than 27 inches of mercury is obtained; otherwise, relocate probe after consulting with Radian Project Director.

12. Purge 3 to 5 tubing volumes of soil gas (see evacuation curve for evacuation time required).

13. Shut off pump valve and insert syringe hypodermic needle into sampling port septum in tubing.

(Continued)

TABLE 5-1. (Continued)

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14. Purge syringe a minimum of three times before collecting sample by extracting 40 to 50 milliliters (mL) of soil gas into the syringe, removing syringe from the septum, and injecting it into a photoionization detector (PID) to get a real-time reading on the soil gas.

15. Collect sample by withdrawing 40 to 50 mL of soil gas into syringe, close mininert valve on the syringe to isolate sample, and remove from septum.

16. Cover syringe with black foam tubing; label sample with sample control number and complete chain-of-custody form. Give sample and data sheet/chain-of-custody form to a Radian Sample Runner.

17. Extract probe with jack and fill/patch hole.

18. Purge Teflon® tubing with the vacuum pump 3 to 5 minutes (7 to 10 for downhole samples). If real-time PID readings exceed 5 parts per million by volume (ppmv), then tubing should be replaced.

19. Mark locations with field tag and flagging or paint.

21. Perform the following decontamination steps on probes/tips between probe locations:

- Unclog perforations in the probe tip;
- Wash probe with laboratory-grade detergent;
- Steam clean probe (inside and outside);
- Rinse probe with drinking water and reagent water; and
- Rinse probe tip with methanol and cyclohexane.

TABLE 5-2 DETAILED SOIL GAS CANISTER SAMPLING PROCEDURES

1. Retrieve a pre-cleaned and certified 2.8 or 6 liter stainless steel canister for sampling.

2. Attach the canister to the sampling manifold by means of a 1/4-inch Teflon® line with 1/4-inch stainless steel Swagelok® nuts and ferrules on either end.

3. Attach the canister to the manifold at the tee, which contains a nut and septum for syringe sampling.

4. Attach the Teflon® line directly to the manifold and the side arm of the canister.

5. Attach the vacuum pressure gauge to the top arm of the canister and open the valve briefly to record the initial pressure (P_1). P_1 should be < -27 inches of mercury. Record this on chain-of-custody form.

6. Purge the manifold with soil gas and allow to return to ambient pressure. Collect the canister sample by opening the side valve one turn and leaving it open for 3 seconds. Then close the side valve and check the canister pressure by opening the top valve briefly and reading the vacuum gauge.

7. If the gauge reads <-7 inches of mercury, crack the side valve to allow more soil gas into the canister. The final canister pressure should be between -2 and -7 inches of mercury. Record this on the chain-of-custody form.

8. Cap the top and side valves of the canister with 1/4-inch Swagelok® caps to protect against leaking valves.

9. Record the canister number and sampling location on the chain-of-custody form.

ground surface by rotating (9,000 revolutions per minute) two, 50-pound counterweights. Operational frequency is between 70 and 150 Hz. At optimum frequencies (between 120 and 150 Hz), the drill head produces approximately 30,000 pounds of downward/upward force. The drill head, attached to the bottom of the drill stem, moves downward by breaking cohesive forces in soils or rock with vibrations. A core sampler or a solid drive point can be attached to the bottom of the drill stem to collect core samples or drill to a desired sampling depth. Soil is either forced into the split-spoon sampler or is forced aside as the drill stem is advanced. In hardpan or bedrock, a carbide tipped bit is attached to the bottom of the drill stem, and the drill stem is rotated to cut through the material.

Borings will be drilled to a maximum depth of 95 feet BGS or the water table surface where designated. Prior to drilling at each location, all drilling equipment that has been in contact with soil will be thoroughly cleaned using high pressure steam.

5.2.2 Sampling Methods

Two sampling methods can be utilized in conjunction with the sonication drilling method. Both sampling methods provide relatively undisturbed representative samples and minimize the loss of volatile constituents. The sampling methods are: 1) continuous coring system, and 2) surface drop hammer or wireline downhole drop hammer sampling.

Continuous coring will be conducted using a wireline or rod system. With the wireline system, a five-foot long split-spoon sampler is lowered down the hollow opening of the drill stem and latched into place. The bottom of the sampler is set in place flush with the bottom of the drive head and advances with the drill stem as it moves downward. If a rod system is employed, the split-spoon sampler may also be pushed ahead of the drill stem to collect undisturbed soil samples. As the drill stem is advanced downward, soil and/or rock are forced up into the split-spoon sampler. After the desired interval has been cored, the split-spoon sampler is retrieved. The sampler may either be lined with 2.5-inch diameter sleeves (3- or 6-inch long stainless steel or brass), or a split-spoon "dry core" (no sleeves) sampler may be used. If the dry core sampler is used, samples to be submitted for analysis will be collected at the surface.

Continuous coring with the rod system can be used to recover from 5- to 20-foot long cores. A solid (not split) core sampler is lowered down an open borehole or down the hollow opening of an outer casing and vibrated into the soil. As the core barrel is advanced downward, soil and/or rock are forced up into the core barrel. After the core barrel has been driven to the desired depth, the outer casing is vibrated down around the core barrel until the bottom of the outer casing is at the same depth as the bottom of the core barrel. Once at the surface, the core is extruded from the sampler. Samples are then collected at the surface.

The surface drop hammer system normally utilizes an 18 to 24-inch long split-spoon sampler to collect core samples. The drop hammer sampler, lined with sleeves, 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 drill rig is dropped repeatedly, driving the sampler approximately 18 inches into the ground. Blow counts are measured every 6 inches to determine the physical characteristics of the material encountered. Fifty blow counts is considered formation refusal. If 50 blows are counted for a 6-inch interval, the sampler is removed and the drill stem is advanced through the material. A 140-pound drive hammer mounted above the drop hammer sampler, but inside the drill stem, may also be used for driving the sampler into the ground.

The split-spoon samplers will be decontaminated by 1) washing in a detergent and potable water solution using a brush, 2) rinsing with potable water, and 3) rinsing with deionized reagent water. The split-spoon samplers used with the rod system will be decontaminated using high pressure steam.

Decontamination of the rear portions of the rig (decontamination of the entire rig is generally not needed), drill pipe, bits, and tools shall be accomplished using a high pressure steam between drilling sites.

Stainless steel sleeves will be decontaminated using the procedures described in the McClellan AFB QAPP, Section 5.2.4.

5.2.3 Sample Selection Criteria

Soil samples will be selected from various depths in order to characterize soil contamination. A minimum of three samples will be selected for analysis between the surface and 20 feet BGS in a boring. Specific sampling horizons will be determined using the following general criteria:

- Sample selection will begin adjacent to or beneath the shallowest potential discharge depth; sampling will continue to the pre-selected total depth of the boring or to a depth interval 5 feet below the greatest discharge depth at the location (e.g., bottom of a tank or sump) or to the base of observed waste or contamination, whichever is greater.

- Representative samples will be collected in soil containing observed waste or obvious contamination.

- Representative samples will be collected from soil intervals in which PID readings are ≥50 parts per million by volume (ppmv); and samples may be collected from intervals with PID readings of 20 to 49 ppmv if the readings are 10 times greater than other readings in the boring.

- Representative samples will be collected from intervals with discolored soils or chemical odors.

- Representative samples will be selected from fine-grained (clay, silt, or fine sand) layers 1 foot or greater in thickness that are observed in core collected from depths between potential discharge points and the total depth of the boring.

- In borings located adjacent to, or as stepouts from, borings in which contaminants were previously detected, samples will be collected from layers at the same depth and 10 to 20 feet below the depth at which contaminants were previously detected; these samples will be collected from the fine-grained deposits in the intervals.

The following steps will be performed during soil sampling:

1. Retrieve the split-spoon sampler from the boring after the desired depth interval has been penetrated.

2. Open the split-spoon sampler longitudinally so the relatively undisturbed and representative samples can be logged and measured for percent recovery.

3. Screen the core with a PID at sleeve ends or any identifiable fine-grained or discolored horizons. If the sampler is lined with sleeves, split the sleeves apart and screen each sleeve end using a PID. If the PID reading is ≥50 ppmv, go to Step 4. If the PID reading is <50 ppmv, go to Step 5.

4. If the core is not sleeved, sleeve the desired sample interval by pushing a sleeve of smaller diameter than the core into the center of the core. Cover the sleeve selected for sampling with Teflon® tape and a plastic cap and leave sufficient sample for lithologic description. Label the sleeve, place it in a Ziploc® bag, and place the bag in a cooler maintained at 4°C for storage and shipping.

5. If the PID reading is <50 ppmv, go to next break in core and repeat Steps 3 and 4.

6. If there are no PID readings greater than 50 ppmv, and none are 10 times greater (20 to 49 ppmv) than previously screened core, evaluate the core interval for evidence of waste, discoloration, and odors. Select sample intervals and follow the procedure described in Step 4.

7. Choose samples from fine-grained layers of at least 1 foot in thickness that lie below intervals containing waste, discoloration, odors, or other evidence of contamination. Follow procedure described in Step 4.

8. If there is no physical indication of contaminants in the core interval, but the depth interval was contaminated in a previous boring located within a radius of 50 feet, select the finest grained layer for sampling. Follow procedure described in Step 4.

9. If there are no physical indications of contaminants and contaminants were not previously detected in borings near this location, select a maximum of three samples from 0 to 20 feet BGS and a maximum of four samples from 20 to 95 feet BGS from fine-grained layers. Follow procedure described in Step 4.

10. After all samples have been selected for analysis, core samples will be described according to the Unified Soil Classification System (USCS) and recorded on the lithologic log. Cores will be measured for the percent of sample recovery.

11. Samples submitted for analyses will be placed in coolers containing bagged ice (double-bagged) maintained at 4°C; field data sheets and chain-of-custody forms will be prepared; coolers will be sealed with custody seal tape; and samples will be shipped to the laboratory for analyses.

5.2.4 Borehole Abandonment

At the completion of each borehole, the borehole will be grouted to the surface by pumping a neat cement mixture of Type I Portland cement, 4 pounds of powdered nonbenificated bentonite, 8 gallons of water, and one 96-pound sack of cement. The amount of bentonite added to the cement shall be weighed using a scale and provisions will be made to meter the water. Bentonite will be thoroughly mixed with water, producing a "lump-free" mixture prior to adding cement. The grout will be mixed using a mechanical mixer and weighed using a mud scale. The final grout mixture should weigh approximately 13 to 14 pounds per gallon. In 20-foot borings, the entire drill string will be pulled from the borehole, and a tremie pipe with a minimum inside diameter of 2 inches will be lowered to the bottom of the boring. As the grout is pumped, the tremie will be positioned such that it will be below the top of the grout in the boring. Borings greater than 20 feet will be grouted through the annulus of the drill stem in place of a tremie pipe. The bottom of the drill pipe will always be positioned below the top of the grout seal to prevent possible "caving" from overlying formation. The volume of grout required to seal a borehole will be calculated using the following formula:

$$V = (3.14) * (r)^2 * (L) * (7.48 \text{ gallons/ft}^3)$$

where:

V = Volume of borehole in gallons;
r = Inside radius of borehole in feet; and
L = Total depth of borehole to be grouted in feet.

All measurements and actual versus calculated grout volumes will be recorded on the field logs.

5.2.5 Storage and Disposal of Cuttings

During drilling operations where cuttings are produced, soil cuttings and drilling muds will be monitored for organic vapors, placed in steel, plastic lined, 55-gallon drums or 20-cubic-yard capacity roll-off bins for temporary storage. Results of field organic vapor analyzer readings and chemical analyses for soil samples collected in borings will be used to determine proper management of the cuttings. Chemical analyses of drilling mud samples will be used to determine their management.

The handling, transportation, storage, treatment, and/or disposal of drill cuttings and drilling muds will be described in the McClellan AFB Soils and Debris Management Plan. The plan, which will be developed in conjunction with the U.S. EPA and California Department of Health Services (DHS), will provide the guidance for managing contaminated and uncontaminated soils or muds generated in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities, including Remedial Investigations. The Soils and Debris Management Plan will be presented and discussed prior to the beginning of drilling in Phase 1.

5.2.6 Recordkeeping

Refer to the McClellan AFB QAPP Section 5.2.6 for a discussion of records that will be kept during drilling and sampling activities. Additional or revised forms are shown in Figures 5-3 through 5-6. Field personnel will complete the following forms:

Supervising Rig Geologist (SRG)

- **Time and Materials Log.** Summary of time spent to perform specific tasks associated with drilling and type/quantity of materials used by the subcontractor (McClellan AFB QAPP, Section 5.2.6).
- **Daily Field Report.** Summary of important events and observations pertaining to drilling and sampling (McClellan AFB QAPP, Section 5.2.6).
- **Daily Field Notebook.** Detailed daily log of activities associated with the project.
- **Soil Sample PID Reading Data Sheet.** Organic vapor measurements of soil samples will be logged on this data sheet (Figure 5-3).

Assistant Rig Geologist (ARG)

- **Log of Drilling Operations.** Lithology, color, moisture content, grain size, visual soil contamination (discoloration), and other pertinent drilling information will be recorded on this form (Figure 5-4). The log will also describe methods and materials used to abandon and seal each boring. Refer to the McClellan AFB QAPP Section 5.2.6 for a detailed description of the information that will be recorded on this form. The format to be used for lithologic descriptions is shown below:

FIGURE 5-3

Boring:___________
Date:___________

SOIL SAMPLE PID READING DATA SHEET

Depth (ft)	PID Reading (ppmv)	Sample Number	Notes
.25			
.5			
.75			
1.0			
1.25			
1.5			
1.75			
2.0			
2.25			
2.5			
2.75			
3.0			
3.25			
3.5			
3.75			
4.0			
4.25			
4.5			
4.75			
5.0			
5.25			
5.5			
5.75			
6.0			
6.25			
6.5			

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FIGURE 5-4.

Boring #: ____________

LOG OF DRILLING OPERATIONS

Page ___ of ___

PROJECT OU B RI LOCATION McClellan Air Force Base
TOTAL DEPTH ________ START DATE ________________ FINISH DATE ________________
GEOLOGIST ________________ APPROVED BY ________________________ R.G.# ________
DRILLING COMPANY ________________ DRILLER ________________________
DRILLING METHOD ________________ EQUIPMENT ________________________
DRILL BIT TYPE AND SIZE ____
BORING LOCATION (ST. ADDRESS OR DESCRIPTION)____________________________

Depth Below Surface (ft)	Sample Interval	Maximum PID PPM/Foot	Time (Military)	Lithologic Description Color, Texture, Moisture, etc.	Drilling Notes
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					

NOTES
PID = Photoionization Detector
PPM = Parts Per Million

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FIGURE 5-5.
OU B SOIL AND SEDIMENT SAMPLE DATA SHEET HAND AUGER AND SOIL BORING SAMPLES

Boring ID____________________

Date______/______/______

IC ID____________________

Samplers______/______/______

Site ID____________________

Cooler ID____________________
(field cooler)

____
(shipping cooler)

Location Measurements: Reference Point____________________
(MW Number or Bldg. Number & Corner)

________Ft. N, S, E, or W

________Ft. N, S, E, or W

________Ft. N, S, E, or W

________Ft. N, S, E, or W
(circle direction)

Field Sample ID	Blind Sample ID	Beginning Depth	Ending Depth	Time	Max PID

Comments:

Analyses Required (circle one or more): SW6010, SW7060, SW7196, SW7421, SW7471, SW7740, SW3550/SW8015, SW5030/SW8015, SW8040, SW8080, SW8140, SW8150, SW8240, SW8270, SW8280, SW8310, SW9012, SW9045, SW9060, SW9310 (E900.1), E901.1, E607, HML338, ASTM D2216-80, ASTM D2434-68, ASTM D2435-80, ASTM D422-68, ASTM D854-83, E600/M4-82-20, Fish Toxicity

Field Sample ID	Blind Sample ID	Beginning Depth	Ending Depth	Time	Max PID

Comments:

Analyses Required (circle one or more): SW6010, SW7060, SW7196, SW7421, SW7471, SW7740, SW3550/SW8015, SW5030/SW8015, SW8040, SW8080, SW8140, SW8150, SW8240, SW8270, SW8280, SW8310, SW9012, SW9045, SW9060, SW9310 (E900.1), E901.1, E607, HML338, ASTM D2216-80, ASTM D2434-68, ASTM D2435-80, ASTM D422-68, ASTM D854-83, E600/M4-82-20, Fish Toxicity

Field Sample ID	Blind Sample ID	Beginning Depth	Ending Depth	Time	Max PID

Comments:

Analyses Required (circle one or more): SW6010, SW7060, SW7196, SW7421, SW7471, SW7740, SW3550/SW8015, SW5030/SW8015, SW8040, SW8080, SW8140, SW8150, SW8240, SW8270, SW8280, SW8310, SW9012, SW9045, SW9060, SW9310 (E900.1), E901.1, E607, HML338, ASTM D2216-80, ASTM D2434-68, ASTM D2435-80, ASTM D422-68, ASTM D854-83, E600/M4-80-82-80, Fish Toxicity

EML initials/date:__________

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FIGURE 5-6.
OU B SOIL GAS SAMPLE DATA SHEET
SURFACE AND DOWNHOLE PROBE SAMPLES

Location ID____________ Date____/____/____

IC ID____________ Samplers____/____/____

Site ID____________ Cooler ID____________ (field cooler)

____________ (shipping cooler)

Location Measurements:

Reference Point____________ (MW Number or Bldg. Number & Corner)

Surface Condition: Asphalt, Concrete, Soil, Other (circle one)

______Ft. N, S, E, or W ______Ft. N, S, E, or W

Rainfall in last 24 hours? N____ Y____

______Ft. N, S, E, or W (circle direction) ______Ft. N, S, E, or W

(Approximate amount____________)

Sample Method **(circle one)**: Downhole, slide hammer hole, hand auger hole, hand driven, pneumatic, hydraulic, well

PID Readings (ppmv): Pre________ Max________ Post________

Apparent Moisture **(circle one)**: dry, moist, saturated

Detector Tube N____ Y____

Backfill material **(circle one)**: soil, concrete, bentonite, other ____

ORIGINAL SAMPLE

Blind ID:____________

Field Sample ID:____________

Syringe Number:____________

Sampling Probe Number:____________

Sampling Time:____________

Depth of Sample:____________feet

Attempts to sample:____________

Vacuum:____________(-) inch Hg

Evacuation Time:____________sec.

Purge Volume:____________liter

Sample Volume:____________cc

FIELD DUPLICATE SAMPLE

Blind ID:____________

Field Sample ID:____________

Syringe Number:____________

Sample Volume:____________cc

Sampling time:____________

CANISTER SAMPLE:

Blind ID:____________

Field Sample ID:____________

Canister Number:____________

Initial Canister Vacuum:____________

FinalCanisterVacuum:____________

CANISTER DUPLICATE SAMPLE:

Blind ID:____________

Field Sample ID:____________

Canister Number:____________

Initial Canister Vacuum:____________

FinalCanisterVacuum:____________

073091/jlh

EML Initials/Date________

Clayey Sand: 10YR 5/8, yellowish brown, fine to medium, well rounded to subrounded, quartz, chert, mafics, about 3% pebbles (5-11mm), milky quartz. Clay acts as a binder, clay separates easy, low plasticity, (SC).

Sand: 10YR 5/4, yellowish brown, fine to coarse, well rounded to subrounded, quartz, mica, feldspar, volcanics, mafics, (SW).

Silty Clay: 10YR 6/4, light yellowish brown, low plasticity. Minor sand, medium hardness, breaks easily, very fine, quartz, mafics, (CL).

Field Technician #1

- **Soil and Sediment Sample Data Sheet.** All information pertinent to soil sample collection and analysis will be recorded on this data sheet (Figure 5-5).

- **Soil Gas Sample Data Sheet.** All information pertaining to soil gas sampling will be recorded on this data sheet (Figure 5-6).

Field Technician #2

- **Photoionization Detector Screening Data Sheet.** Health and safety PID measurements will be recorded on this sheet. Measurements will be taken from inside the drill stem following each connection and in the breathing zone (McClellan AFB QAPP, Section 5.2.6).

- **Direct Reading Indicator Tube Field Data Sheet.** Health and safety direct reading indicator tubes measurements will be recorded on this data sheet. Measurements of the borehole head and breathing zone may be required (McClellan AFB QAPP, Section 5.2.6).

5.2.7 Responsibilities

Two geologists and two field technicians will be assigned to each sonication drill rig to assure that boreholes are logged consistently and accurately and that sample integrity is maintained. Field personnel will have the following responsibilities:

Supervising Rig Geologist (SRG)

- Supervises drilling, sampling, and borehole abandonment activities.
- Is the point of contact for all drilling and sampling activities between Radian and the driller.
- Acts as on-site Health and Safety Officer when the Radian Industrial Hygienist is not present.
- Screens soil samples with PID.
- Inspects samples for physical evidence of contamination.
- Determines percent recovery of the cored interval.
- Makes decisions regarding sample selection for analyses based on lithology, PID measurements, and visual inspection.
- Keeps daily log of operations in field notebook, complete daily field reports, time and material log, and soil sample PID reading data sheet.

Assistant Rig Geologist (ARG)

- Describes soil cores.
- Records other pertinent information on drilling log form (e.g., PID readings, discoloration, odor, and waste observed).

- Records intervals from which samples were taken for analysis, including soil gas analyses.
- Prepares field notes and well logs for entry into geologic database.
- Records percent recovery of the core.
- Records methods, measurements, and materials used in borehole abandonment.
- Labels core boxes and places cores in boxes.
- Assists SRG in making field decisions regarding drilling, sampling, etc.

Field Technician #1

- Covers sleeves with Teflon® tape and plastic caps.
- Completes Soil Sample Data Sheets.
- Places sample labels on sample containers that will be submitted for analyses.
- Assists SRG/ARG in performing downhole soil gas sampling.
- Completes Soil Gas Sample Data Sheets.
- Assists in handling and breakdown of core barrel following removal from the borehole.
- Assists in packaging of samples for laboratory shipment.

Field Technician #2

- Performs health and safety monitoring measurements in the immediate work zone and at the top of the drill pipe following each "core run" using a PID.
- Completes health and safety PID Screening and Directed Reading Indicator Tube data sheets.
- Extracts core from sleeves.
- Decontaminates stainless steel sleeves and sampling tools (e.g., core sampler).
- Decontaminates other miscellaneous sampling equipment.
- Assists in handling and breakdown of core barrel following removal from the borehole.
- Assists in packaging of samples for laboratory shipment.

5.3 Surface Soils/Sediment Sampling

The following sections describe the sampling methodology that will be used during the OU B RI for surface soils and sediments.

5.3.1 Surface Soil Sampling

Surface soil samples will be collected by hand augering and surface scraping at each sampling location as described in Section 5.7 of the McClellan AFB QAPP. Modifications to the sampling procedures that differ from descriptions in the McClellan AFB QAPP are described below.

Hand Auger Sampling

Hand augers will be equipped with 2-inch, 3-inch, and 4-inch diameter cylindrical stainless steel bits. Soil samples will be collected using a smaller diameter bit than the one used to drill the boring to the sample depth; this will help to assure that contaminated soil from above the sample depth does not contaminate the sample. The hand auger will be lowered slowly into the borehole and care will be taken to prevent any soil disturbance inside the borehole. The soil will then be collected as described in Section 5.7 of the McClellan AFB QAPP. If additional samples are to be collected from deeper soil horizons, a larger diameter hand auger bit will be used to ream out the previously sampled interval and bore down to the next sample depth.

5.3.2 Sediment Sampling

Sediment samples will be collected from dry streambeds and drainage ditches by surface scraping, hand augering, and core sampling. These procedures are detailed in Section 5.7 of the McClellan AFB QAPP. Sediment samples will be collected in stream channels and drainage ditches that have water in them using the polyvinylchloride (PVC) tube method, as described in Section 5.8 of the McClellan AFB QAPP.

5.4 Surface Water

Surface water samples will be collected by direct submersion of the sampling containers into the water to be sampled, as described in Section 5.6 of the McClellan AFB QAPP. Samples will be collected in such a manner as to prevent cross contamination; background samples are collected first, the furthest downstream samples are collected next, and then upstream samples located toward the source or discharge point are collected last.

The samples are collected by hand from the midpoint of each stream or drainage, or from the edge of the pond or lagoon. Where insufficient water depth is present to submerge the sample containers, a decontaminated bucket or Teflon® beaker will be used to collect water. The water will be immediately transferred to the sample containers.

Surface water samples may also be obtained using a continuous automatic sampler. With a continuous sampler, an intake probe is secured at the sampling point and the sampler is preprogrammed to collect either individual or composite samples at designated times throughout the day.

Depth of water, temperature, pH, and specific conductance will be measured at each sampling location and noted on field sheets.

In addition to the documentation specified in the McClellan AFB QAPP, the following records will also be maintained:

- Width, depth, and flow rate of streams;
- Surface water conditions;
- The location of any discharge pipes, sewers, or tributaries; and
- The date and amount of most recent rainfall event.

Quality assurance samples will be collected in accordance with procedures described in the McClellan AFB QAPP, Section 10.0.

5.5 Groundwater Samples

Two sets of groundwater samples will be collected from wells installed during the OU B RI. The first set of samples will be collected immediately following well development using a Teflon® bailer. The second set of samples will be collected at a minimum of one month after the first sample set using either a submersible pump and Teflon® bailer or a sampling vehicle equipped with a modified suction side sampler. At a minimum, all samples collected will be analyzed by SW8010, SW8020, and SW6010. Other samples will be collected and analyzed by appropriate methods based on the fate and transport of contaminants identified at a site. All groundwater sample collection, transport, recordkeeping, and analyses will follow procedures described in Section 5.0 of the McClellan AFB QAPP.

Additional groundwater samples will be collected during source investigations to determine if a site is contributing contaminants to groundwater using a Hydropunch® sampler. The Hydropunch® II is a downhole groundwater sampling device with dimensions of approximately 1-1/2 inches wide by 5 feet long and is constructed of stainless steel and Teflon®. The sampler is pointed at one end and has an anvil head at the other. The sampler is used to collect representative groundwater samples while drilling from inside the drill tools.

During the OU B RI, the Hydropunch® sampler will be used to determine if soil contamination identified beneath a site is impacting groundwater quality. Soil borings will be deepened to the water table where soil contamination to 95 feet is identified. The Hydropunch® will then be driven with the aid of the rig downhole slide hammer to a minimum of 5 feet past the drill bit (geologic conditions permitting) and retracted 6 inches to allow groundwater to enter the sample chamber. The sampler will then be retrieved to the surface where the samples will be decanted. Due to the size of the sample chamber, a limited number of samples can be collected. However, at a minimum, a sample will be collected for analysis by SW8010.

5.6 Monitoring Well Drilling, Installation, and Development

Up to 20 monitoring wells will be installed during the OU B RI to determine if a site is impacting groundwater quality and to gather additional geologic and hydrologic data. Wells will be installed in monitoring zones A through E as previously defined in the OU B Groundwater Remedial Investigation (Radian, 1990d). Specific locations of these wells will be determined as the RI progresses and will be coordinated with California DHS and U.S. EPA representatives. All wells will be installed using either sonication, hollow-stem auger, air rotary, or mud rotary methods. Specific descriptions of these drilling methods and procedures that will be followed for well drilling activities are described in the McClellan AFB QAPP, Section 5.2.

Pilot holes will be drilled and geophysically logged in areas where additional information is needed to assist in the determination of subsurface geologic conditions such as thickness, lithology, and relative permeability of stratigraphic units. Electrical resistivity, spontaneous potential, gamma ray, and caliper surveys are the borehole geophysical methods that will be used. Resistivity logs will consist of point, short-normal (16-inch) and long-normal (64-inch) configurations. All geophysical measurements will be collected digitally to allow scale adjustments to be made prior to hard copy reproduction. The geophysical logs will be used in conjunction with the borehole lithology logs to define depths for placement of well screens, filter packs, and bentonite seals. Descriptions of borehole geophysical methods to be employed are included in the McClellan AFB QAPP.

Wells will be constructed of 4-inch diameter Type 304 stainless steel well screen and casing from total depth to the water table surface. Wells greater than 190 feet deep will be completed with 4-inch diameter, Schedule 5 low carbon steel blank casing from the water table to ground surface. Conversely, wells less than 190 feet deep (A and B zone wells) will be completed with Schedule 40 PVC blank casing from the water table to ground surface. Additional information regarding the procedures to be followed and materials to be used during the drilling, installation, completion, and development of monitoring wells and associated recordkeeping are described in the McClellan AFB QAPP, Sections 5.2 and 5.3.

Cuttings and fluids generated during drilling activities will be containerized on site, sampled as appropriate, and disposed of in accordance with applicable procedures determined by McClellan EM.

5.7 Aquifer Tests

Both single and multiple well aquifer tests and single well slug tests will be performed during the OU B RI. The number, types, and locations of tests to be conducted will be determined as the RI progresses and will be coordinated with regulatory agency representatives. Data collected from single and multiple well aquifer tests will be analyzed using the Papadopulos and Cooper Method (1967) as described by Kruseman and DeRidder (1983). Slug test data will be analyzed using the Bouwer and Rice Method (1989). A description of these methods and procedures to be followed for conducting these tests are outlined in the McClellan AFB QAPP, Section 5.3.

5.8 Surface Geophysical Surveys

Surface geophysical surveys will be conducted to locate nine underground storage tanks within OU B. Surveys to be conducted include ground penetrating radar (GPR) and magnetometry.

Ground penetrating radar is an effective method for obtaining a profile of subsurface features and conditions. Ground penetrating radar obtains a reflective profile of subsurface conditions by emitting short duration electromagnetic pulses from a transducer into the ground and monitoring portions of the signal reflected back to the surface by different materials. Since materials differ in their ability to hold an electric charge, varying amounts of the signal are relayed back to the surface. Ground penetrating radar surveys will be conducted using a SIR 3 GPR system or its equivalent.

Magnetometer surveys consist of measuring variations in the earth's magnetic field. Measurement of the magnetic gradient can be used to locate buried ferrous objects such as tanks, pipelines, and metallic debris.

Magnetometer surveys will be conducted using a Geometrics model 856AG proton precession magnetometer/gradiometer or its equivalent. The magnetometer has two sensors and an electronics package. The magnetometer can collect both total field data and vertical gradient data. The magnetometer can discriminate to 0.2 gammas in a total field of 40,000 to 60,000 gammas. Magnetic readings are stored in memory with the time of day, station numbers, and line numbers of the readings.

Magnetometer and GPR surveys will be conducted along predetermined crossing transects based on a grid established for each site. The spacing of the grid will be based on information regarding the approximate dimensions of the tanks to be located so that minimum grid spacing is equal to the minimum dimension of the tank to be located.

6.0 SAMPLE HANDLING AND ANALYSIS

The Operable Unit B Remedial Investigation (OU B RI) will use established sample handling procedures, sample custody procedures, sample documentation forms, calibration procedures, and analytical methodology described in the McClellan Air Force Base (AFB) Quality Assurance Project Plan (QAPP) (Radian, 1990c). Section 6.0 of the QAPP contains detailed sample custody procedures. Section 8.0 of the QAPP contains specific information on:

- Method detection limits (MDLs);
- Laboratory standards and reagents;
- Extraction methods;
- Analytical methods;
- Real-time portable analyzers; and
- Air analyzers.

Methodology concerning sample handling, documentation, and analysis is summarized in the following subsections. Any additions or modifications to the analytical methods outlined in the QAPP are also discussed below. A discussion of QA/QC procedures and methodology to be followed by mobile field laboratories is also presented.

6.1 Sample Preservation

Once the sample has been collected, it must be stored and preserved to maintain the chemical and physical properties that it possessed at the time of collection. All samples will be placed in containers, preserved, stored, and held according to U.S. Environmental Protection Agency (U.S. EPA) protocol (or other Air Force Occupational and Environmental Health Laboratory [AFOEHL]-approved) procedures. Each analytical method has different requirements; these are listed in Table 6-1 (page 6-26). Sample bottles are precleaned by the manufacturers according to U.S. EPA protocols; stainless steel sleeves are cleaned according to methods described in the QAPP prior to use.

6.2 Sample Custody

Sample custody procedures provide a mechanism to ensure the integrity of the sample from collection to data reporting and to maintain appropriate documentation of information concerning sample collection and handling.

6.2.1 Documentation Procedures

Documentation procedures for the OU B RI will follow those prescribed in Section 6.0 of the McClellan AFB QAPP, including field records, sample master log book, and chain-of-custody procedures. Sample collection forms are also included in Section 6.0 of the McClellan AFB QAPP.

6.2.2 Chain-of-custody Procedures

After samples are collected and documented in the sample log, a chain-of-custody form will be completed. This form accompanies the samples to the laboratory, and a copy is retained in the project file. Team members collecting the samples are responsible for the care and custody of the samples until they are transferred or dispatched to the laboratory. When transferring samples, the individuals relinquishing and receiving the sample will sign, date, and note the time on the record. This record documents sample possession from collection to the laboratory sample control center.

When the samples are received in the laboratory, the sample control officer will verify the chain-of-custody form against the sample containers received. If any discrepancies are observed, they will be recorded on the chain-of-custody form and the appropriate sampling team leader will be notified to correct the problem. The condition of the samples is also noted during the sample check-in process. A laboratory chain-of-custody record is then initiated by sample control, using the electronic Sample and Analysis Management System (SAM®). Further discussion of the SAM® system and custody procedures are contained in Section 6.2 of the McClellan AFB QAPP.

6.3 Sample Packaging and Transport

All sample shipments will be accompanied by the chain-of-custody record, which identifies the shipment contents. The shipping containers will be secured with chain-of-custody seals for transportation to the laboratory. Chain-of-custody procedures will be followed during transportation.

Sample packaging requirements for hazardous materials involving interstate transport are defined in the 40 Code of Federal Regulations (CFR) 49, Chapter 1, Part 171. These requirements outline in detail the proper classification procedures for the hazardous materials transportation that will be used to transport any samples identified as hazardous or potentially hazardous.

Packaging procedures to be used are specified in Section 6.0 of the McClellan AFB QAPP. All samples will be handled in a manner that ensures they arrive at the laboratory intact, at the proper temperature, and free of external contamination.

6.4 Analytical Methods and Calibration

The analytical methods to be used during the OU B RI are listed in Table 6-1. Most method and calibration procedures are outlined in the *McClellan AFB QAPP* and are not discussed here. Soil gas methods, methods not included in the QAPP, and modifications of those methods included in the QAPP are discussed below.

6.4.1 Soil Vapor Analyses

Two types of soil vapor analyses may be performed during the OU B RI; analysis of soil vapor by gas chromatograph (GC) in the field, and canister analysis by gas chromatography/mass spectrometry (GC/MS) in the laboratory.

Field GC Analysis

The on-site analysis of soil vapor (or gas) samples is a rapid screening procedure that provides same-day feedback to sampling personnel. The method is designed to detect a limited number of volatile organic compounds (VOCs) that have been identified in previous analyses of soil and water samples from sites in OU B.

Soil gas samples will be analyzed using a Hewlett Packard 5890 Series II GC with electron capture detector (ECD) and photoionization detector (PID). A 250-microliter, gas-tight syringe will be used to remove an aliquot from the sampling syringe and inject it into the GC. A "Y" splitter on the detector side of the GC column will allow simultaneous detection of halogenated compounds (ECD) and aromatic compounds (PID) with a single injection. Due to its low sensitivity on the ECD, vinyl chloride will be quantitated using the PID.

The GC/ECD will be calibrated weekly with gas standards containing 1,2-dichloroethene, chloroform, 1,1,1-trichloroethane, trichloroethene, carbon tetrachloride, and tetrachloroethene. The calibration standards for these compounds will cover the range of 10 to 100 parts per billion (ppb). Detection limits on the ECD range from 0.2 ppb for tetrachloroethene to 3 ppb for 1,2-dichloroethene.

The GC/PID will be calibrated weekly with gas standards containing vinyl chloride, benzene, toluene, o-xylene, and p-xylene. The calibration standards for these compounds will cover the range from 50 ppb to 500 ppb. The GC/PID has a detection limit of 10 ppb for benzene, and 50 ppb for vinyl chloride.

Canister Analysis by GC/MS

Canister samples will be collected at selected soil gas sampling locations for more detailed laboratory analysis and compound speciation. The canister analysis methods specify collecting air samples in an evacuated stainless steel canister, and subsequently analyzing them by GC/MS methods. The GC/MS methods are based on the U.S. EPA Compendium Method TO-14.

The organic compounds from the soil gas sample are concentrated at cryogenic temperatures and then thermally desorbed onto a GC/MS capillary column for separation and analysis. Each peak is identified and quantitated by comparing it to a list of 39 priority pollutant compounds or by searching the National Bureau of Standards (NBS) GC/MS library. The 39 compounds and the MDLs for each compound are listed in Table 6-2.

The GC/MS system is calibrated weekly. The multipoint calibration standards are at concentrations of approximately 1, 10, and 30 parts per million by volume (ppmv).

TABLE 6-2. CANISTER METHOD TO-14 DETECTION LIMITS FOR PRIORITY POLLUTANT COMPOUNDS BY GC/MS

Compound	MDL (ppbv)
Benzene	1.0
Benzyl chloride	1.0
Bromomethane	1.0
Carbon tetrachloride	1.0
Chlorobenzene	1.0
Chloroethane	1.0
Chloroform	1.0
Chloromethane	1.0
1,2-Dibromomethane	1.0
1,2-Dichlorobenzene	1.0
1,3-Dichlorobenzene	1.0
1,4-Dichlorobenzene	1.0
1,1-Dichloroethane	1.0
1,2-Dichloroethane	1.0
cis-1,2-Dichloroethene	1.0
1,2-Dichloropropane	1.0
cis-1,3-Dichloropropene	1.0
trans-1,3-Dichloropropene	1.0
Ethyl benzene	1.0
4-Ethyltoluene	1.0
Freon 11	1.0
Freon 12	1.0
Freon 114	1.0
Hexachlorobutadiene	1.0
Methyl chloroform	1.0
Methylene chloride	1.0
Styrene	1.0
1,1,2,2-Tetrachloroethane	1.0
Tetrachloroethene	1.0
Toluene	1.0
1,2,4-Trichlorobenzene	1.0
1,1,2-Trichloroethane	1.0
Trichloroethene	1.0
Trichlorotrifluoroethane	1.0
1,2,4-Trimethylbenzene	1.0
1,3,5-Trimethylbenzene	1.0
Vinylidene chloride	1.0
Vinyl chloride	1.0
Xylene, total	1.0

MDL = Method detection limit.
ppbv = Parts per billion by volume.

6.4.2 Soil and Water Analysis

The following analytical methods and detection limits used in the OU B RI are described in Section 8.3 of the McClellan AFB QAPP:

- Halogenated VOCs (SW8010);
- Volatile Petroleum Hydrocarbons (SW5030/modified SW8015);
- Extractable Petroleum Hydrocarbons (SW3550/modified SW8015);
- Phenols (SW8040);
- Aromatic VOCs (SW8020);
- Pesticides and Polychlorinated Biphenyls (SW8080);
- GC/MS VOCs (SW8240);
- GC/MS Semivolatile Organic Compounds (SW8270);
- Dioxins and Dibenzofurans (SW8280);
- Cyanides (SW9010);
- Metals (SW6010);
- Arsenic (SW7060);
- Hexavalent Chromium (SW7196);
- Lead (SW7421);
- Mercury (SW7470 and SW7471);

- Selenium (SW7740);
- Anions (U.S. EPA Method 300);
- Alkalinity (U.S. EPA Method 310.1);
- pH (U.S. EPA Method 150.1/SW9045);
- Total dissolved solids (U.S. EPA Method 160.1);
- Temperature (U.S. EPA Method 170.1);
- Conductance (U.S. EPA Method 120.1);
- EP Toxicity (SW1310); and
- Nitrogen, Nitrite - Nitrate (U.S. EPA Method 353.2).

Those methods not outlined in the McClellan AFB QAPP or variations of the methods found in the QAPP are described below.

CADHS/HML Method 338
Organic Lead Compounds

Organic lead compounds in soil and water samples are analyzed using the California Department of Health Services Hazardous Materials Laboratory (CADHS/HML) Method 338. The typical minimum detection limit is 0.8 milligrams per kilogram (mg/kg) for soil samples and 0.2 milligrams per liter (mg/L) for water samples. Organic lead compounds are extracted from the water or soil samples with xylene. The organic lead in the extract is reacted with iodine and tri-capryl methyl ammonium chloride. Methylisobutylketone is then added. The concentration of lead in the solution is determined by atomic absorption spectrometry.

A multipoint calibration curve is generated using a blank and four calibration standards of organic lead containing xylene, iodine, tri-capryl methyl ammonium chloride, and methylisobutylketone. The correlation coefficient for the linear regression equation must exceed 0.995 to be acceptable. A quality control check sample of leaded gasoline is analyzed before and after samples are run. Agreement within ± 20 percent of the expected value is required; otherwise, a new calibration curve must be generated.

U.S. EPA Method 607
Nitrosamines

Nitrosamines are measured in soil and water using a modified U.S. EPA Method 607. The sample is extracted with methylene chloride using either a sonication extraction method for soils or a separator burner extraction for water samples. The methylene chloride extract is washed with dilute hydrochloric acid to remove free amines, dried, and concentrated to a volume of 2.0 milliliters. The extract is transferred to a pre-rinsed florisil and anhydrous sodium sulfate column. Diphenylamine is removed by eluting the column with an ethyl ether/pentane mixture. Nitrosamines are then eluted with an acetone/ethyl ether mixture and methanol is added to the eluate. Following concentration, the extract is analyzed by GC with a nitrogen-phosphorous detector. The detection limit for n-nitrosodiphenylamine in water is 0.8 micrograms per liter (μg/L).

A calibration curve is prepared with three calibration standards. A mid-level standard is run daily. If the response factor for that daily standard differs from the initial calibration response factor by more than ± 15 percent, a new calibration curve must be prepared.

U.S. EPA Method 600/M4-82-20
Polarized Light Microscopy (PLM) Asbestos

Asbestos in soil is analyzed by U.S. EPA Method 600/M4-82-020 using PLM. The soil sample is dried and coarsely ground, then viewed through a stereo-microscope to assure the soil has been ground to a uniform size. The individual fibers are identified with a polarized light microscope. The concentration of asbestos in the soil sample is determined by comparison with three different standard concentrations.

The method is calibrated with three different concentrations of asbestos standards--0.1 percent, 0.25 percent, and 0.5 percent by weight. The detection limit for this method is 0.1 percent by weight.

Real-Time Radioactivity Meter

The Victoreen Thyac III survey meter or equivalent will be used as a screening tool to help determine the location for the collection of samples that will be analyzed for gross alpha and beta radioactivity or gamma-emitting radionuclides. The meter is a pulse-count ratemeter with a power supply. With the appropriate detector probes, it acts as a survey meter for alpha, beta, and gamma radiation. Its range of operation is 0 to 80,000 counts per minute or 0 to 20 milliroentgen per hour.

U.S. EPA Method 900.0
Gross Alpha and Gross Beta Radioactivity for Soil Samples

Gross alpha and gross beta radioactivity are determined by U.S. EPA Method 900.0. Between 50 and 100 milligrams of soil is placed in a planchet and 16M nitric acid is added. The planchet is placed on a hotplate and heated. During the heating, two to three more portions of 16M nitric acid are added. The sample is dried, cooled, and counted in a gas-proportional counter.

Between 50 and 100 milligrams of each of the orange and white solid material is removed from the vials and placed in a planchet. These are dried in a desiccator overnight. The samples are counted in a gas-proportional counter. A second count of these samples is done with a piece of paper, 8.41 milligrams per square centimeter (mg/cm^2), placed between the sample and counter to absorb alpha and low-energy beta particles. This allows an approximation of low-energy beta emitters, such as carbon-14. The detection limit for gross alpha radioactivity is approximately 5 picocuries/gram (pCi/g) and 2.5 pCi/g for gross beta radioactivity.

U.S. EPA Method 901.1
Gamma Emitting Radioactivity for Soil Samples

A portion of the soil sample is dried, passed through a 60 mesh sieve, weighed, and mixed with a binder. The mixture is placed in a dye and compressed to 40,000 pounds per square inch (psi). The resulting pellet is then wrapped and counted using a lithium drifted germanium detector (Ge[Li]). The counting efficiency for this geometry is compared to the efficiency determined for a standard (known) radionuclide activity. The detection limit for gross gamma radioactivity is approximately 0.01 pCi/g. The results of the analysis include the energy emitted and define the isotope associated with that energy.

SW8310
Polynuclear Aromatic Hydrocarbons (PAHs)

SW8310 is used to determine the concentration of certain PAHs in groundwater and wastes. SW8310 provides high performance liquid chromatographic (HPLC) conditions for the detection of ppb levels of certain PAHs. Samples are analyzed by direct injection. Detection is by ultraviolet (UV) and fluorescence detectors. Method Detection Limits are listed in Table 6-3.

For initial calibration, standards at five concentration levels are prepared by dilution of stock standards with acetonitrile. The average calibration factor is acceptable if the relative standard deviation (RSD) does not exceed 20 percent. Daily calibration checks are acceptable if the difference between the daily response versus the initial (multipoint) response does not exceed ± 15 percent.

SW8140
Organophosphorus Pesticides

SW8140 is a GC method used to determine the concentration of various organophosphorus pesticides. Prior to analysis, appropriate sample extraction techniques are used. Both neat and diluted organic liquids are analyzed by direct injection. A 2- to 5-μL aliquot of the extract is injected into a GC, and compounds in the GC effluent are detected with a flame photometric detector.

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. Any compounds tentatively identified in the primary analysis are confirmed on a second GC column. The instrument is calibrated at a minimum of five concentrations. Concentration of the components in a standard varies depending on the response of the compounds in the analytical system and minimum RSD/r_2 acceptance criterion for calibration. A daily single-point calibration check must agree within ± 15 percent of the initial multipoint response or the instrument is recalibrated. Method Detection Limits are listed in Table 6-4.

TABLE 6-3. SW8310 POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs) METHOD DETECTION LIMITS[a]

Compound	Retention Time (min)	Column Capacity Factor (k′)	MDL (μg/L) UV	MDL (μg/L) Fluorescence
Naphthalene	16.6	12.2	1.8	
Acenaphthylene	18.5	13.7	2.3	
Acenaphthene	20.5	15.2	1.8	
Fluorene	21.2	15.8	0.21	
Phenanthrene	22.1	16.6		0.64
Anthracene	23.4	17.6		0.66
Fluoranthrene	24.5	18.5		0.21
Pyrene	25.4	19.1		0.27
Benzo(a)anthracene	28.5	21.6		0.013
Chrysene	29.3	22.2		0.15
Benzo(b)fluoranthene	31.6	24.0		0.018
Benzo(k)fluoranthene	32.9	25.1		0.017
Benzo(a)pyrene	33.9	25.9		0.023
Dibenzo(a,h)anthracene	35.7	27.4		0.030
Benzo(ghi)perylene	36.3	27.8		0.076
Indeno(1,2,3-cd)pyrene	37.4	28.7		0.043

[a] HPLC conditions: Reverse phase HC-ODS Sil-X, 5 micron particle size, in a 250-mm x 2.6-mm I.D. stainless steel column. Isocratic elution for 5 min using acetonitrile/water (4.6) (v/v), then linear gradient elution to 100 percent acetonitrile over 25 min at 0.5 mL/min flow rate. If columns having other internal diameters are used, the flow rate should be adjusted to maintain a linear velocity of 2 mm/sec.

TABLE 6-4. SW8140 GAS CHROMATOGRAPHIC CONDITIONS AND MDLs FOR ORGANOPHOSPHOROUS PESTICIDES[a]

Compound	GC Column[b]	Retention Time (min)	MDL (μg/L)
Azinphos methyl	1a	6.80	1.5
Bolstar	1a	4.23	0.15
Chlorpyrifos	2	6.16	0.3
Coumaphos	1a	11.6	1.5
Demeton-O	1a	2.53	0.25
Demeton-S	1a	1.16	0.25
Diazinon	2	7.73	0.6
Dichlorvos	1b,3	0.8, 1.50	0.1
Disulfoton	1a	2.10	0.20
Ethoprop	2	3.02	0.25
Fensulfothion	1a	6.41	1.5
Fenthion	1a	3.12	0.10
Merphos	2	7.45	0.25
Mevinphos	1b	2.41	0.3
Naled	3	3.28	0.1
Parathion methyl	2	3.37	0.03
Phorate	1a	1.43	0.15
Ronnel	2	5.57	0.3
Stirophos (Tetrachlorvinphos)	1b,3	8.52, 5.51	5.0
Tokuthion (Prothiofos)	1a	3.40	0.5
Trichloronate	1a	2.94	0.15

[a] Development of Analytical Test Procedures for Organic Pollutants in Wastewater; Report for U.S. EPA Contract 68-03-2711 (in preparation).

[b] See Sections 4.2.1 and 7.2 of SW-846 Volume 1B for column descriptions and conditions (U.S. EPA, 1986b).

SW8150
Chlorinated Herbicides

SW8150 is a GC method for determining certain chlorinated acid herbicides. Spiked samples are used to verify the applicability of the chosen extraction technique to each new sample type. The esters are hydrolyzed with potassium hydroxide, and extraneous organic material is removed by a solvent wash. After acidification, the acids are extracted with solvent and converted to their methyl esters using diazomethane as the derivatizing agent. After excess reagent is removed, the esters are determined by GC equipped with an ECD. The results are reported as acid equivalents. Method Detection Limits are listed in Table 6-5.

The external standard quantitation method will be used to quantitate all herbicides. Any compounds tentatively identified in the primary analysis will be confirmed on a second GC column. The GC/ECD will be calibrated at a minimum of five concentrations. The 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 or the instrument is recalibrated.

SW8015 Modified
Non-Halogenated VOCs

Gasoline and volatile aromatics, benzene, toluene, xylenes and ethyl benzene (BTXE), are analyzed by the direct purge technique described in SW5030 followed by a modified approach to SW8020 and SW8015. Either 5 milliliters of water or 5 grams of soil/sludge is placed in the purge and trap sparge vessel. In the case of soil/sludge, 5 milliliters of reagent grade VOC-free water is also added to the sparger. Analysis is carried out on a GC equipped with an inlet splitter, two fused silica megabore columns, and FIDs and photoionization detectors (PIDs). The BTXE components are confirmed on a second GC column of dissimilar phase and retention characteristics. Method Detection Limits are listed in Table 6-6.

Calibration of the GC is achieved via the external standard technique using a minimum of five concentration levels. The average calibration factor is used if the

TABLE 6-5. SW8150 METHOD DETECTION LIMITS[a]

Analyte	Water (μg/L)	Soil[b] (μg/kg)
2,4-D	0.50	50
2,3,5-TP (SILVEX)	0.10	10
2,4,5-T	0.10	10

[a] Sensitivity of the method depends on the level of interferences rather than instrumental limitations. Typical waste samples may have higher MDLs and may require additional clean-up techniques.

[b] Detection limits for soil are based on the extraction of 10 g of soil and are approximately 100 times those for water. In some cases, lower detection limits may be achieved by extracting 30 g of sample.

TABLE 6-6. SW8015, MODIFIED TOTAL PETROLEUM HYDROCARBONS METHOD DETECTION LIMITS

Analyte	Method Detection Limit Water (µg/L)	Soil[a] (µg/kg)
Benzene	0.5	0.5
Toluene	0.5	0.5
Total Xylenes	0.5	0.5
Ethyl Benzene	0.5	0.5
Gasoline	50	50
Total extractable petroleum hydrocarbons	50	5000

[a] Soil BTXE and gasoline are analyzed via direct soil sparging of 5 g sample.

[b] Detection limit for total extractable petroleum hydrocarbons are based on the extraction of 10 g of soil and are approximately 100 times that for water.

RSD for the calibration factors at each level does not exceed 20 percent; otherwise, linear regression is used. The working calibration factor is verified on each working day by analyzing a single-point calibration standard. If the response for the single-point calibration standard varies from the predicted response by more than ± 15 percent, a new multipoint calibration factor will be generated. A quality control (QC) check standard consisting of the mid-level standard is run at the beginning of every working day and after every 10 samples. The system is considered out-of-control if the response varies by more than 15 percent.

U.S. EPA Method 9060
Total Organic Carbon

Total organic carbon is measured using a carbonaceous analyzer by quantitatively converting the organic carbon in a sample to carbon dioxide, which is measured by an infrared detector.

A multipoint calibration curve is generated daily, prior to sample analysis, using a blank and a minimum of three standards. Potassium hydrogen phthalate is used for total carbon measurements and sodium carbonate/bicarbonate is used for inorganic carbon measurements. The correlation coefficient for the calibration equation must exceed 0.995. A QC check sample is analyzed after every 10 samples; recovery must be within ± 10 percent of the expected value.

U.S. EPA Method 504
1,2-Dibromoethane

This method is applicable to the determination of 1,2-dibromoethane (EDB) and 1,2-dibromo-3-chloropropane (DBCP) in finished drinking water and unfinished groundwater. Thirty-six milliliters of sample is extracted with 2 milliliters of hexane. Two microliters of the extract is then injected into a GC equipped with a linearized ECD for separation and analysis. Aqueous calibration standards are extracted and analyzed in an identical manner as the samples in order to compensate for possible extraction losses. Method Detection Limits for both compounds are 0.01 μg/L.

At least three calibration standards are needed. One should contain EDB and DBCP at a concentration near to, but greater than, the MDL for each compound;

the other two should be at concentrations that bracket the range expected in samples. For example, if the MDL is 0.01 μg/L, and a sample expected to contain approximately 0.10 μg/L is to be analyzed, aqueous standards should be prepared at concentrations of 0.02 μg/L, 0.10 μg/L, and 0.20 μg/L.

ASTM D422-63 (Reapproved 1972)
Standard Method for Particle-Size Analysis of Soils

This method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μm (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μm is determined by a sedimentation process using a hydrometer.

ASTM D854-83
Standard Test Method for Specific Gravity (Bulk Density) of Soils

This test method covers the determination of the specific gravity of soils by means of a pycnometer. When the soil is composed of particles larger than the No. 4 (4.75 mm) sieve, the method outlined in Test Method C127 shall be followed. When the soil is composed of particles both larger and smaller than the No. 4 sieve, the sample shall be separated on the No. 4 sieve and the appropriate test method used on each portion. The specific gravity value for the soil shall be the weighted average of the two values. When the specific gravity value is to be used in calculations in connection with the hydrometer portion of Method D422, it is intended that the specific gravity test be made on that portion of the soil which passes the No. 10 (2.00 mm) sieve.

ASTM 2216-80
Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures

This method covers the laboratory determination of the water (moisture) content of soil, rock, and soil-aggregate mixtures by weight. The practical application in determining the water content of a material is to determine the mass of water removed by drying the moist material to a constant mass in a drying oven controlled at 110 ± 5°C and to use this value as the mass of water in the test specimen. The mass of material remaining after oven-drying is used as the mass of solid particles.

ASTM 2434-68 (Reapproved 1974)
Standard Method for Permeability of Granular Soils (Constant Head)

This method covers the determination of the coefficient of permeability by a constant-head method for the laminar flow of water through granular soils. The procedure is to establish representative values of the coefficient of permeability of granular soils that may occur in natural deposits as placed in embankments, or when used as base courses under pavements. In order to limit consolidation influences during testing, this procedure is limited to disturbed granular soils containing not more than 10 percent soil passing the 75 μm (No. 200) sieve ASTM D2435-80.

The method requires that an element of soil be restrained laterally and axially loaded in increments with a constant stress being applied until all of the excess pore water pressures have dissipated for each increment. During the compression process, measurements of decreases in the sample height are made and these data are used to compute the parameters that describe the relationship between effective stress and void ratio or strain and describe the rate at which compression can occur.

ASTM D2435-80
Standard Method for One-Dimensional Consolidation Properties

The method requires that an element of soil be restrained laterally and axially loaded in increments with a constant stress being applied until all of the excess pore water pressures have dissipated for each increment. During the compression process, measurements of decreases in the sample height are made and these data are used to compute the parameters that describe the relationship between effective stress and void ratio or strain and describe the rate at which compression can occur.

Method for Measurement of Soil Vapor Humidity

There is no standard method for the measurement of relative humidity in soil vapor. The basic method described by Chiou and Shoup (1985) will be used to determine humidity in downhole soil gas samples. The method requires the measurement of the mass of water vapor adsorbed on magnesium perchlorate powder when a soil gas sample of known volume flows across the powder in a glass tube

TABLE 6-7. PHYSICAL PROPERTIES/CHARACTERISTICS TESTS

Physical Test	Test Method
Grain Size Distribution	ASTM D422-63
Bulk Density	ASTM D854-831
Soil Moisture	ASTM 2216-80
Hydraulic Permeability	ASTM 2434-68
Consolidation Properties	ASTM 2435-80
Soil Vapor Humidity	Method of Chiou and Shoup (1985)
Porosity	Calculated from particle and bulk densities

closed to the atmosphere. The weight change of the magnesium perchlorate indicates the mass of water in the volume of the soil gas sample.

Method for Estimation of Porosity

There is no standard method for the measurement of porosity(n). The value, n, for a sample will be obtained from the relation:

$$n = 1 - \frac{\rho_b}{\rho_s}$$

ρ_b = bulk density of sample obtained from ASTM
ρ_s = particle density, assumed to be 2.65 grams/cubic centimeter

Values of porosity calculated from the relation will provide sufficient accuracy for use in migration models.

6.5 Internal Quality Control (QC)

Internal QC measures for the OU B RI are outlined in Sections 10.1 and 10.2 of the McClellan AFB QAPP. Those pertinent to the OU B RI are:

- Quality control check samples at the required frequency for each method;
- Reagent blanks at the frequency of one per day for each method/ instrument and/or one per extraction batch;
- One ambient blank for each site location or study area where VOCs are suspected;
- One trip blank for each day samples are collected for VOC analyses;
- Matrix spike/matrix spike duplicates at the frequency of 5 percent of samples analyzed for each method where spikes are performed;
- Laboratory duplicates at the frequency of 10 percent of samples analyzed for each method where matrix spikes are not required;

- Field duplicates at the frequency of 10 percent of samples collected for each method; and
- Surrogate spike recoveries for each sample, blank, matrix spike, duplicate, and standard where surrogates are required in the analytical method.

Internal QC measures for the field GC analysis are not included in the QAPP, and therefore, are discussed here. Field duplicate syringes will be collected and injected for 10 percent of all soil gas samples. In addition, duplicate injections will be made on the GC at a frequency of 20 percent. If results from the duplicate injections do not agree within ± 30 percent of the mean, then corrective action will be taken on the GC before resuming the analysis of soil gas samples.

A QC check sample will be run at the end of each day to determine if instrument drift is within normal limits. If the drift exceeds ± 50 percent, then the data for that day will be marked with a qualifier and the GC system checked for sensitivity before resuming work the following day.

6.6 Field Laboratory Analytical Procedures

Two field laboratories will be established to screen soil samples for volatile organic compounds (VOCs) and polychlorinated biphenyls (PCBs). Because these will be screening procedures, the analytical procedures will be similar to those performed in a fixed laboratory, but the QC acceptance criteria and QC sample/analysis frequency requirements will be relaxed somewhat, consistent with the objectives for use of screening-level sample results. The objective of performing the screening-level analyses is to determine the relative concentrations of selected or indicator compounds to obtain information needed to direct field work and decision making on a real-time (or close to real-time) basis. The screening results will also be used to identify locations for collection of samples for analysis in a fixed laboratory. The general analytical and QC procedures are described here, and will be incorporated into the McClellan AFB QAPP. The procedures will be presented in detail in Standard Operating Procedures (SOPs) developed by the selected subcontractors.

The following general procedures will be followed for screening analysis of soil samples for PCBs and VOCs.

- Modifications of U.S. EPA SW846 test methods will be followed for both VOC (Methods 8010/8020) and PCB (Method 8080) on-site screening of soil samples. The precision and accuracy QC limits have been widened to reflect the expected capabilities of field screening laboratories as specified below. A written SOP from the field analysis subcontractor will be reviewed by Radian quality assurance (QA) personnel before field sampling activities begin. The instrumentation dedicated to each on-site analysis task will be specified and reviewed concurrent with the SOP review.

- Ten VOCs that occurred most frequently in previous analyses of soil from OU B are included on the field laboratory analyte list. These are vinyl chloride, total 1,2-dichloroethene, chloroform, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, benzene, toluene, para- and meta-xylenes, and ortho-xylene. The analyte list for Method 8080 will include only the seven PCB compounds (no pesticides). All unidentified peaks greater than 100 μg/kg will be quantitated using the response factor for the calibrated compound with the nearest retention time.

- A method detection limit (MDL) study will be performed on site prior to field sample analysis, using the same instrumentation and procedures that will be used for the field samples. Seven replicate samples at concentrations near the expected detection limit will be carried through all steps in the analytical procedure. The raw data for the MDL study will be reviewed by Radian QA personnel prior to submittal of field samples. Detection limits for VOCs will be equal to or less than 20 μg/kg in soil samples. For PCBs, detection limits will be equal to or less than 100 μg/kg.

- Initial multipoint calibrations will consist of at least three standard mixtures of varying concentrations. Calibration concentrations will be discussed at the beginning of field analysis efforts. The acceptance criterion for each multipoint calibration is a relative standard deviation of less than or equal to 20 percent or, if linear regression is used to calculate concentrations of analytes in the samples, a correlation coefficient of at least 0.995. Samples will only be analyzed after a valid multipoint calibration curve has been developed and reviewed by Radian QA personnel.

- A mid-level calibration check standard containing all analytes for VOCs (Methods 8010/8020), and at least one PCB analyte for Method 8080 will be analyzed at the beginning of each analysis batch or day that a multipoint calibration is not performed. All analytes in the check standard will be within ±20 percent of the true value before sample analysis proceeds for VOCs and ±30 percent for PCBs.

- A mid-level QC check sample will be analyzed at a frequency of 10 percent for VOCs and 5 percent for PCBs including one at the end of each analysis batch or day on each instrument. The calibration check will be within ±30 percent of the predicted or theoretical value and all compounds must elute within the retention time windows specified in the SOP. Corrective actions, specified in the SOP, will be taken if the criteria are not met.

- A reagent blank will be analyzed daily following calibration and prior to analysis of field samples. All analytes will be below the laboratory-derived detection limits.

- Either matrix spike/matrix spike duplicate pairs or surrogates and laboratory duplicates will be analyzed at a frequency of 5 percent (the surrogates will be added to all samples, blanks, standards). The spike or surrogate recoveries will be within the 50 to 150 percent range. The relative percent difference between laboratory or matrix spike duplicates will be less than or equal to 30 percent. Corrective action may include re-extraction, reanalysis following instrument maintenance, and/or analysis of a QC check standard. In cases where reanalysis is not possible or matrix effects are apparent, report flags may be placed next to the result.

- At least 5 percent of the samples submitted to the on-site lab will be field duplicate samples. Field blanks will also be submitted if applicable. These QC samples will be submitted with sample identification numbers that cannot be distinguished from normal field samples, i.e., they will be "blind" sample numbers.

- A system blank will be run, if possible, following samples with analyte concentrations above the calibration range, or after any sample where carryover is suspected. The analyte concentration in the system blank will be less than three times the laboratory-derived detection limit before analysis of field samples continues. If a blank cannot be analyzed, the following sample will be reanalyzed for any positive "hits" which are lower in concentration than the previous high-level sample.

- An instrument logbook will be maintained on a real-time basis. The logbook will include, at a minimum, the calibration standards and samples analyzed in chronological order, dilution factors, date, analyst's initials, instrument maintenance, comments which may affect the reported result, problems encountered, and any corrective actions taken.

- Radian QA personnel will review all raw data, logbooks, final reports, and chain-of-custody forms at least every other day for the first week after the task has begun. Any problems or discrepancies between the actual procedure and the Statement of Work (SOW) for the subcontractor will be discussed with the field analyst (or supervisor, if necessary) and resolved. If problems are encountered, all raw data will be reviewed until Radian is satisfied that the problems are resolved. Following the initial week, QA personnel will review all raw data at a frequency of 10 percent. The frequency will be increased if problems continue to occur.

- Radian QA personnel will review all final reports at least weekly to assure that the frequency of the QC samples and the quality assurance objectives specified in the SOW are met. Reports will also be checked for completeness and consistency (i.e., proper units, correct sample identification number, report flags and comments when applicable, dilution factors, etc.).

- Radian QA personnel will have access to the laboratory at any time the analysts are present. Radian QA personnel will observe sample analysis during the first week of the task to assure that specified procedures are being performed. At least one technical systems audit and one in-depth data quality audit (in conjunction with the raw data review described above) will be performed during the first half of the task period. A report will be written that summarizes the audit process, results, and recommendations for corrective action.

- Approximately 5 percent of the field samples analyzed for VOCs at the on-site laboratory will be sent to a fixed laboratory for confirmation by Method 8240 analysis. The results from the fixed laboratory will have a dual purpose. First, the analyte results will be compared to the on-site laboratory results for qualitative and quantitative confirmation. At least one sample from each site will be sent to a fixed laboratory to confirm positive results or absence of contamination. Second, unidentified peaks greater than 100 μg/kg (estimated) from the on-site results will be identified and quantitated when analyzed using Method 8240.

- All field samples which contain PCBs above the detection limit will be sent to a fixed laboratory for confirmation.

TABLE 6-1. SAMPLE STORAGE AND PRESERVATION REQUIREMENTS

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
ORGANIC COMPOUNDS					
Halogenated Volatile Organic Compounds (VOCs)	SW8010	14 days	250 mL widemouth glass jar with Teflon® lined cap or stainless steel sleeve[b]; Three 40-mL glass vials with Teflon® seals[c]	None	4°C
Volatile Petroleum Hydrocarbons	SW8015/5030 Modified	14 days	250 mL widemouth glass jar with Teflon® lined cap or stainless steel sleeve[b]; Three 40-mL glass vials with Teflon® seals[c]	None[b]; 1:1 HCl to pH <2[c]	4°C
Extractable Petroleum Hydrocarbons	SW8015/3550 Modified[b] SW8015/3505 Modified[c]	14 days until extraction, 40 days after extraction	250 mL widemouth glass jar with Teflon® lined caps or stainless steel sleeve[b]; 1 L glass bottle[c]	None	4°C

(Continued)

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
ORGANIC COMPOUNDS (Continued)					
Phenols	SW8040	14 days until extraction[b], 40 days after extraction[b,c]	250 mL widemouth glass jar with Teflon® lined cap or stainless steel sleeve[b];	None	4°C
		7 days until extraction[c]	1 L glass bottle[c]		
Organochlorine Pesticides and Polychlorinated Biphenyls	SW8080	14 days until extraction[b], 40 days after extraction[b,c];	250 mL widemouth glass jar with Teflon® lined cap or stainless steel sleeve[b];	None	4°C
		7 days until extraction[c]	1 L glass bottle with Teflon® seals[c]		
VOCs	SW8240	14 days	250 mL widemouth glass jar with Teflon® lined cap or stainless steel sleeve[b];	None[b]	4°C
			Three 40-mL glass vials with Teflon® seals[c]	1:1 HCl to pH <2[c]	4°C

(Continued)

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
ORGANIC COMPOUNDS (Continued)					
Semivolatile Organic Compounds	SW8270	14 days until extraction[b], 40 days after extraction[b,c]; 7 days until extraction[c]	250 mL glass jar with Teflon® lined cap or stainless steel sleeve[b]; 1 L glass bottles with Teflon® seals[c]	None	4°C
Dioxins and dibenzofurans	SW8280	30 days maximum	250 mL glass jar with Teflon® liners[b]; 1 L glass bottle with Teflon® seal[c]	None	4°C
Non-Halogenated VOCs	SW8015/5030 modified	14 days	120 mL widemouth glass jar with Teflon® lined cap[b]; 40 mL glass vial with Teflon® seals[c];	None	4°C
Polynuclear Aromatic Hydrocarbons	SW3650/8310	14 days until extraction, 40 days after extraction	250 ml. widemouth glass jar with Teflon® lined cap[b]	None	4°C
		7 days until extraction	1 L. glass bottle[c]	None	4°C

Continued

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
ORGANIC COMPOUNDS (Continued)					
Organophosphorus Pesticides	SW3550/8140	7 days until extraction, 40 days after extraction	250 mL widemouth glass jar with Teflon® lined cap[b]; 2.5 L Amber glass jar[c]	pH 5.9	4°C
Chlorinated Phenoxy Acid Herbicides	SW8150	7 days until extraction, 40 days after extraction	250 mL widemouth glass jar with Teflon® lined cap[b]; 2.5 L Amber glass jar[c]	None	4°C
Total Organic Carbon	SW9060	28 days	120 mL widemouth glass jar with Teflon® lined cap[b];	None[b]	4°C
			125 mL polyethylene bottle[c]	HCL or H_2SO_4 to pH < 2[c]	4°C
1,2-Dibromoethane	U.S. EPA 504	28 days	Two 40 mL glass vials w/Teflon® seals[c]	None	4°C

Continued

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
ORGANIC COMPOUNDS (Continued)					
Nitrosamines	U.S. EPA 607	7 days until extraction, 40 days after extraction	250 mL widemouth glass jar with Teflon® lined cap[b];	None	4°C
			2.5 L Amber glass jar[c]	.008% $Na_2S_2O_3$[c]	Dark
INORGANIC COMPOUNDS/ANALYTES					
ICP (Metals)	SW6010	6 months	250 mL glass jar or stainless steel sleeve[b];	None[b]	4°C
			500 mL polyethylene bottle[c]	1:1 HNO_3 to pH <2[c]	4°C
Arsenic	SW7060	6 months	250 mL widemouth glass jar or stainless steel sleeve[b];	None[b];	4°C
			500 mL polyethylene bottle[c]	1:1 HNO_3 to pH <2[c]	4°C
Chromium VI	SW7196	24 hours	250 mL widemouth glass jar or stainless steel sleeve[b];	None	4°C
			Polyethylene or glass bottles[c]		

(Continued)

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
INORGANIC COMPOUNDS/ANALYTES (Continued)					
Lead	SW7421	6 months	250 mL widemouth glass jar or stainless steel sleeve[b];	None[b];	4°C
	SW7421	6 months	500 mL polyethylene bottle[c]	1:1 HNO_3 to pH <2[c]	4°C
Mercury	SW7470	28 days	500 mL polyethylene bottle[c];	1:1 HNO_3 to pH <2[c];	4°C
	SW7471	28 days	250 mL widemouth glass jar or stainless steel sleeve[b]	None	4°C
Cyanide	SW9010	14 days	250 mL widemouth glass jar or stainless steel sleeve[b];	None;	4°C
			Polyethylene or glass bottles[c]	NaOH to pH >12[c]	4°C
Soil pH	SW9045	Analyze as soon as possible	250 mL glass jar	None	4°C

(Continued)

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
INORGANIC COMPOUNDS/ANALYTES (Continued)					
pH[c]	SW9040	Field test	500 mL polyethylene bottle[c] or directly from bailer	None	None
Gross alpha, beta	U.S. EPA 900.0	6 months	250 mL glass jar with Teflon®-lined lid[b] Glass or polyethylene bottle[c]	1:1 HNO_3 to pH <2[c];	4°C
Gamma emitters	U.S. EPA 901.1	6 months	250 mL glass jar with Teflon®-lined lid[b] Glass or polyethylene bottle[c]	None[b]	4°C
Organic Lead Compounds	HML 338	14 days until extraction, 30 days after extraction	250 mL glass jar with air-tight, Teflon®-lined lid[b]; 500 mL glass bottle with air-tight lids[c]	None	4°C
PLM asbestos[b]	U.S. EPA 600/ M-4-82-020	None	250 mL widemouth jar or Ziploc® plastic bag[b]	None	None

Continued

TABLE 6-1. (Continued)

Reference Parameter	Method(s)	Holding Time	Container(s)[a]	Preservation Requirements	Storage Requirements
INORGANIC COMPOUNDS/ANALYTES (Continued)					
Selenium	SW7740	6 months	500 mL polyethylene bottle	HNO_3 to pH $< 2^c$	4°C
Anions	U.S. EPA 300	28 days	500 mL polyethylene bottle	None	4°C
Nitrogen-Nitrite-Nitrate	U.S. EPA 353.2	28 days	250 mL widemouth glass jar[b]		4°C
			250 mL polyethylene bottle[c]	H_2SO_4 to pH < 2	
Alkalinity	U.S. EPA 310.1	14 days	250 mL polyethylene bottle	None	4°C
Total Dissolved Solids	U.S. EPA 160.1	7 days	250 mL polyethylene bottle	None	4°C
Temperature	U.S. EPA 170.1	Analyze Immediately	2 L polyethylene bottle	None	Analyze Immediately
Conductivity	U.S. EPA 120.1	28 Days	250 mL widemouth glass jar	None	4°C
			250 mL polyethylene bottle		
EPA Toxicity	SW1310				

[a] All containers are pretreated and cleaned before purchased by the laboratory.

(Footnotes for Table 6-1 continued on next page)

OUBRISAP/082891/jlh

TABLE 6-1. (Continued)

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[b] = For soil samples only.
[c] = For water samples only.

PLM = Polarized light microscopy.
U.S. EPA= U.S. Environmental Protection Agency.
HML = California Department of Health Services Hazardous Materials Laboratory.

NOTE: Sample containers for gas phase samples, air canisters, sorbent tubes, or filters are stored at ambient temperatures, and treated according to method specifications.

7.0 HEALTH AND SAFETY PLAN

The current McClellan Air Force Base (AFB) Health and Safety (H&S) Plan (Radian, 1989) was revised for the Operable Unit B Remedial Investigation Sampling and Analysis (OU B RI SAP) Plan. The revision of the current H&S Plan addresses health and safety issues resulting from: work activities required; employee practices and procedures; and chemical contaminants and physical hazards which may be encountered based on the current available information. A copy of the OU B RI Health and Safety Plan is included in Appendix C.

8.0 SCHEDULE

This section presents and discusses the schedule for the Operable Unit B Remedial Investigation (OU B RI) field and reporting activities. The duration of individual field activities are approximate; results of individual site investigations or unforeseen field conditions may reduce or increase the length of these activities. A graphic schedule of field and reporting activities for the OU B RI is presented in Figure 8-1.

As shown in Figure 8-1, field activities to be conducted during the OU B RI will include surface geophysical surveys; a background investigation; subsurface soil and soil gas sampling; installation and sampling of additional groundwater monitoring wells; and surface soil, stream sediment, and surface water sampling. The results of field activities will be reported through bimonthly data summaries. Progress meetings with the regulatory agencies will occur monthly.

8.1 Schedule of Field Activities

Field activities for the OU B RI are currently scheduled to begin in May 1991 with surface geophysical surveys.

Approximately one month into the RI, a background study will be conducted. Samples will be collected and analyzed from uncontaminated areas on McClellan Air Force Base (AFB) and off base to establish baseline concentration values for inorganic analytes. This activity will take approximately one month to complete. Baseline concentration values for metals and radionuclides will then be determined and compared to concentrations of metals and radionuclides detected at a site to determine if the metals or radionuclides detected are naturally occurring or a result of releases to the environment.

Following the background study, subsurface soil and soil gas sampling for Phase 1 will begin. Power-assisted soil sampling equipment (sonication and/or hollow-stem auger drill rigs) will be used to support this activity. It is anticipated that this activity will take up to five months to complete.

Task Name	Start Date
OPERABLE UNIT B REM. INV.	16-Jan-91
PROJECT START	16-Jan-91
PROJECT PLANNING AND PREP	16-Jan-91
FIELD INVESTIGATION	28-May-91
SURFACE GEO-PHYSICAL SURVEYS	28-May-91
BACKGROUND INVESTIGATION	31-Jul-91
SURFACE SOIL GAS SURVEY	12-Aug-91
SOIL SAMPLING	1-Oct-91
SEDIMENT SAMPLNG	1-Nov-91
MONITORING WELLS	24-Jan-92
SURFACE WATER SAMPLING	31-Jan-92
AQUIFER TESTING	22-Apr-92
REPORTS	2-Sep-91
DATA MANIPULATION	2-Sep-91
DATA SUMMARY REPORTS	1-Oct-91
DATA SUMMARY REPORT	1-Oct-91
DATA SUMMARY REPORT	2-Dec-91
DATA SUMMARY REPORT	6-Feb-92
DATA SUMMARY REPORT	1-Apr-92
DATA SUMMARY REPORT	1-Jun-92
DATA SUMMARY REPORT	30-Jul-92
MAPPING/DATA PLOTTING	1-Oct-91
TECHNICAL MANAGEMENT	16-Jan-91

16-Jan-91	29-Sep-92
16-Jan-91	16-Jan-91
16-Jan-91	16-Sep-91
28-May-91	30-Jun-92
28-May-91	30-Aug-91
31-Jul-91	30-Aug-91
12-Aug-91	10-Sep-91
1-Oct-91	30-Jun-92
1-Nov-91	8-Nov-91
24-Jan-92	22-Apr-92
31-Jan-92	5-Feb-92
22-Apr-92	29-May-92
2-Sep-91	29-Sep-92
2-Sep-91	29-Sep-92
1-Oct-91	29-Sep-92
1-Oct-91	29-Nov-91
2-Dec-91	5-Feb-92
6-Feb-92	31-Mar-92
1-Apr-92	29-May-92
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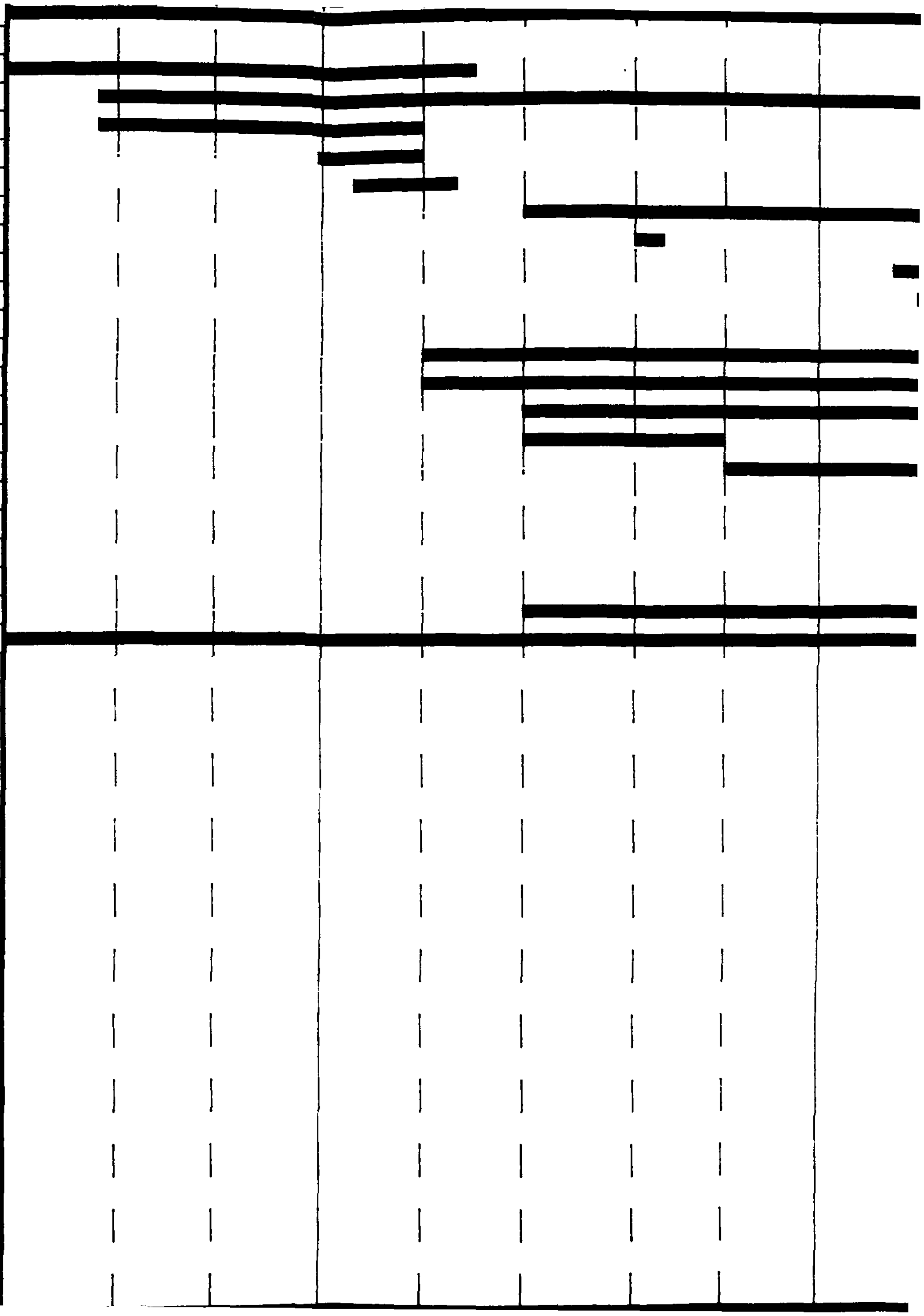
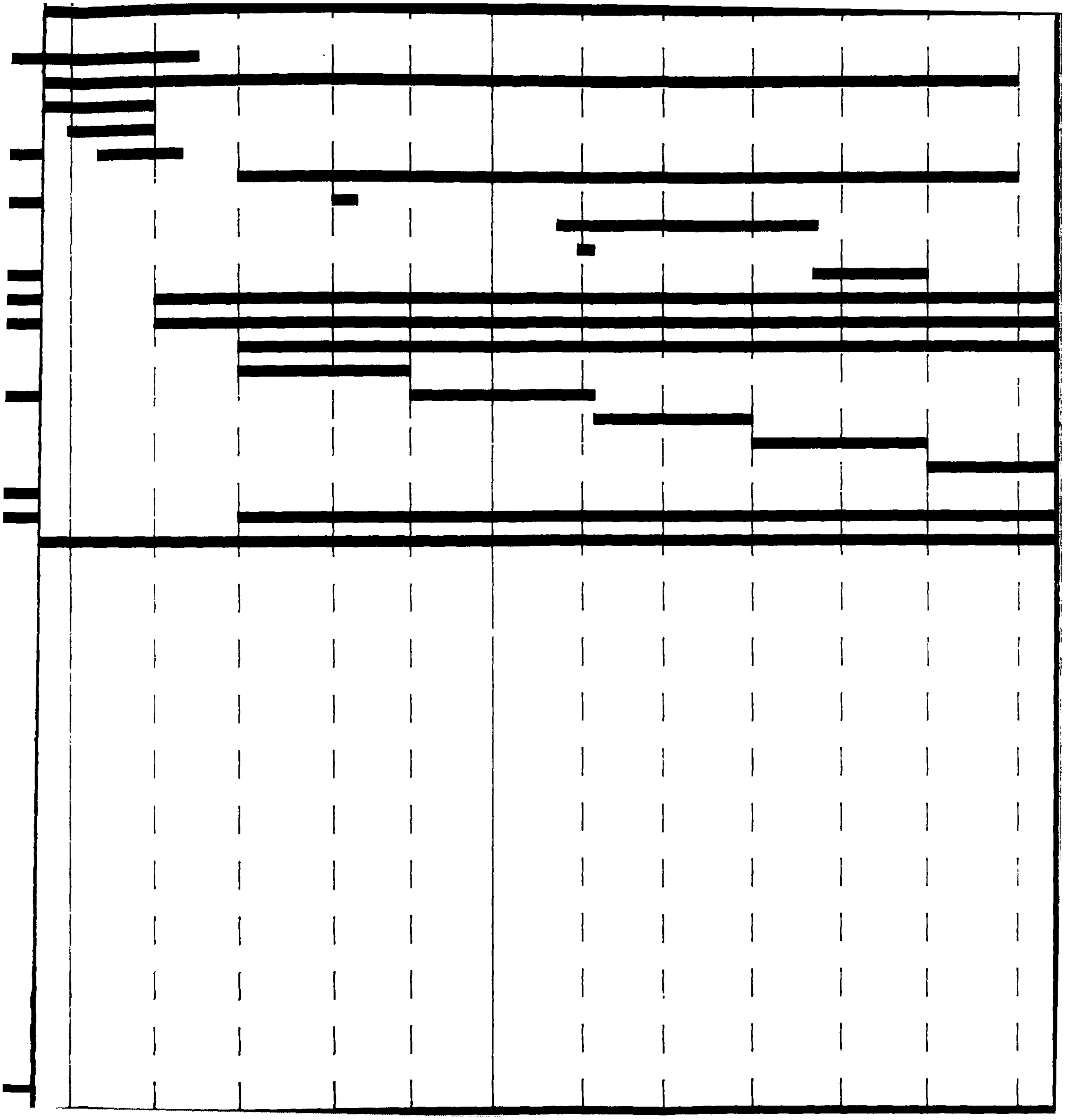
30-Jul-92	29-Sep-92
1-Oct-91	29-Sep-92
16-Jan-91	29-Sep-92





Sampling of surface soils and surface waters will start in November 1991 and is anticipated to take approximately six months to complete. Additional monitoring wells will be installed as part of the OU B RI to gain additional data to characterize the groundwater flow regime and extent of groundwater contamination in OU B and to confirm whether a particular site is contributing contaminants to groundwater. It is anticipated that up to 20 wells will be installed as part of this effort over a two-month period. Aquifer tests will also be conducted for the wells to help determine aquifer characteristics.

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APPENDIX A

Remedial Investigation Decision Process

A1.0 PURPOSE AND STRUCTURE OF THE REMEDIAL INVESTIGATION DECISION PROCESS

A remedial investigation (RI) will be conducted in Operable Unit (OU) B of McClellan Air Force Base (AFB). The purpose of the RI is to identify, characterize, and assess contaminants released to the environment in OU B that require remedial action. Because McClellan AFB has been included in the National Priorities List (NPL), the RI will be conducted in accordance with U.S. Environmental Protection Agency's (U.S. EPA) *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act) (1988). That guidance document provides only general descriptions for the RI activities to be conducted. Specific methods and procedures to be used in the site characterization are not provided in the guidance because they will vary widely from site to site. Therefore, the sampling and analysis plan for a CERCLA site must describe specific procedures. The specific sampling and analysis method and procedures for the OU B RI are described in Sections 3.0, 4.0, and 5.0. However, the criteria for sampling and analysis decisions that must be made during the RI are described in this Appendix. The criteria for RI decision making are included in the Remedial Investigation Decision Process.

A1.1 Purpose

The purposes for establishing an RI Decision Process for the OU B RI are to:

- Establish a logical, repeatable methodology for making decisions on sampling and analysis during the course of the field investigation;
- Streamline the RI to make the most effective use of resources;
- Assure the attainment of Data Quality Objectives (DQOs) for Site Characterization, Baseline Risk Assessment, and Remedial Alternative Evaluation; and

- Provide the framework for the sampling and analysis strategies for all potentially affected media: soil, soil gas, surface water, and groundwater.

A logical repeatable methodology for decision making is necessary for the OU B RI because of the complexity of the investigation and the need to formulate consistent decisions for each of the diverse sites to be investigated. The RI will evaluate 53 individual sites[1] at which contaminants may have been released to soils or surface water and through those media to groundwater, soil gas, or stream sediments.

Because the OU B RI must thoroughly evaluate all contaminant sources that pose potential health risks or degrade the environment in the entire geographic area of OU B, the RI must proceed smoothly and efficiently from site to site and from source discovery to contaminant extent determination to remedial alternative evaluation. The RI decision process is intended to ease the transition between investigation phases among the sites. The process is designed to systematize the decision-making process with data compiled for each site such that labor, equipment, and supplies are used effectively to find and remediate contaminants.

The RI decision process is designed to meet the requirements of the DQOs. The process defines the flow of data from collection to evaluation to decision making in each phase. If the data for a site are insufficient and do not meet objectives in one phase, the decision may be made to resample at the site. When data are adequate for the objectives, the investigation will move to the next phase if the process indicates that a decision can be made. The criteria for decision making were established to meet requirements of site characterization, risk assessment, and remedial alternative evaluation before the RI field investigation is completed. The process will assure that the field data required to complete the feasibility study (FS) for remedial actions in OU B will be available at the completion of RI field work.

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[1] Throughout this work plan, the word "site" is used as a geographical reference to a building, the place an activity occurred, or an area under investigation in OU B. The words "site," "location," or "area" have been used interchangeably as geographic references. The word "site" is not intended to imply the confirmed presence of soil or graoundwater contamination; such a reference would be to "Site."

It is evident from data collected prior to the OU B RI that contaminants are present in the soil, soil gas, surface water, and groundwater in OU B. The RI decision process addresses contaminants in each of those media to provide a comprehensive and integrated assessment of contaminant sources and distribution. With that assessment, remedial actions may be designed that will address all media containing contaminants that pose health risks or degrade of the environment.

A1.2 Structure of RI Decision Process

Operable Unit B includes 53 sites that consist of: Sites, where contaminants have been confirmed to be present in soils; Potential Release Locations (PRLs), where contaminants are suspected to be present but have not been confirmed; and Study Areas, where historical or ongoing operations or practices pose the potential for contaminant discharge to the environment. These sites are distributed over the 340-acre southwest portion of McClellan AFB and an off-base area that receives surface drainage from McClellan AFB (Figure A1-1). The characterization of any one site cannot efficiently be completed before initiating the characterization of the next. Analytical, geologic, and other physical data, required to evaluate a site for remedial action, must be compiled, evaluated for their validity and quality, set into a framework, and analyzed before the decision to conduct additional sampling or to stop sampling can be made. To proceed efficiently through the characterization for all 53 sites, division of the field investigation was warranted.

Three divisions have been identified in the decisions that must be made for any site during the OU B RI. The three divisions of decision making, expressed as questions, are:

- Does the site being evaluated contain an area of contamination that is a "source" of contamination and what is the nature of the contamination?

- What are the extent, migration pathways, and potential effects that could result from exposure to the contamination?

- What are the remedial alternatives that should be considered to control migration and limit exposure to the contamination?

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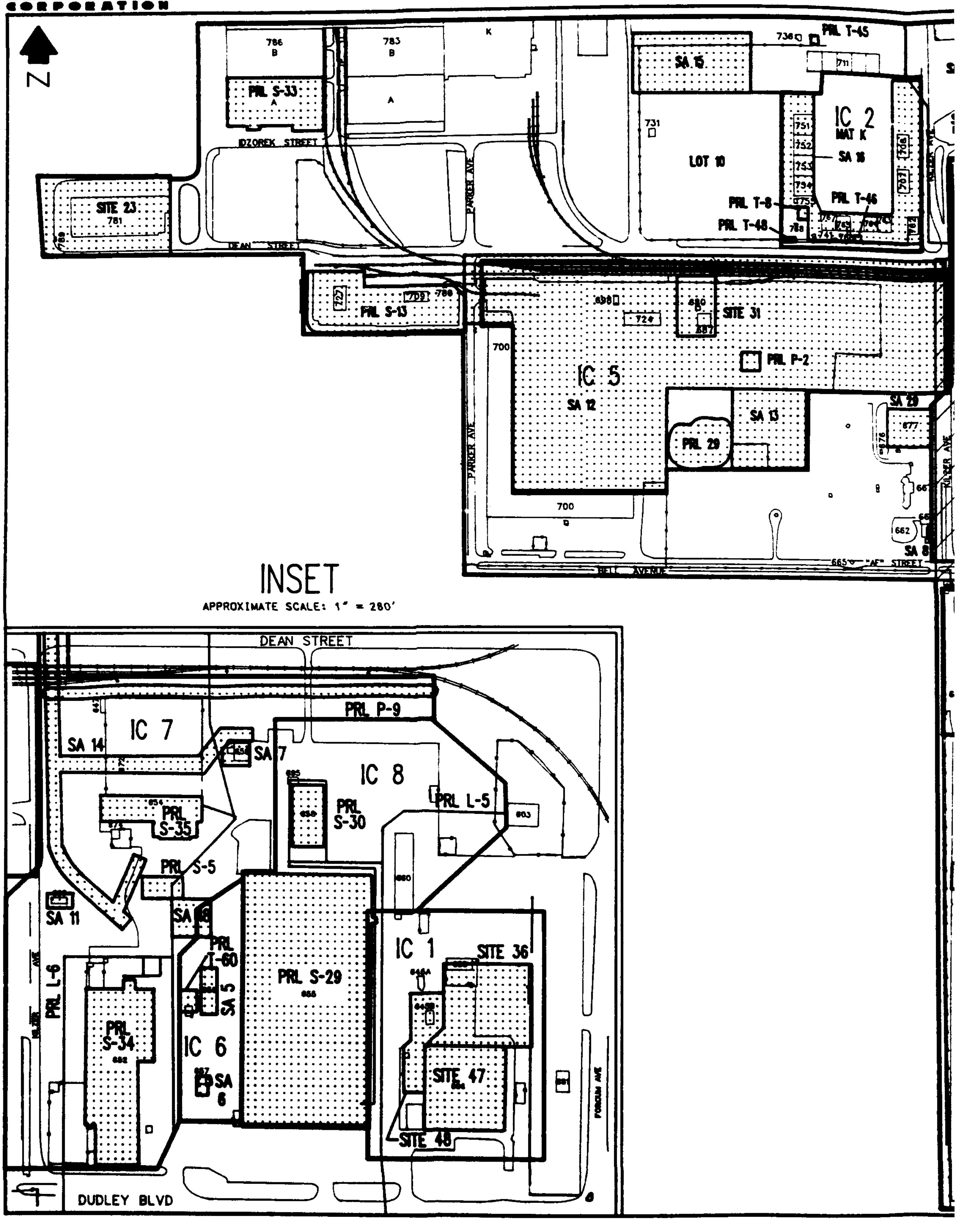

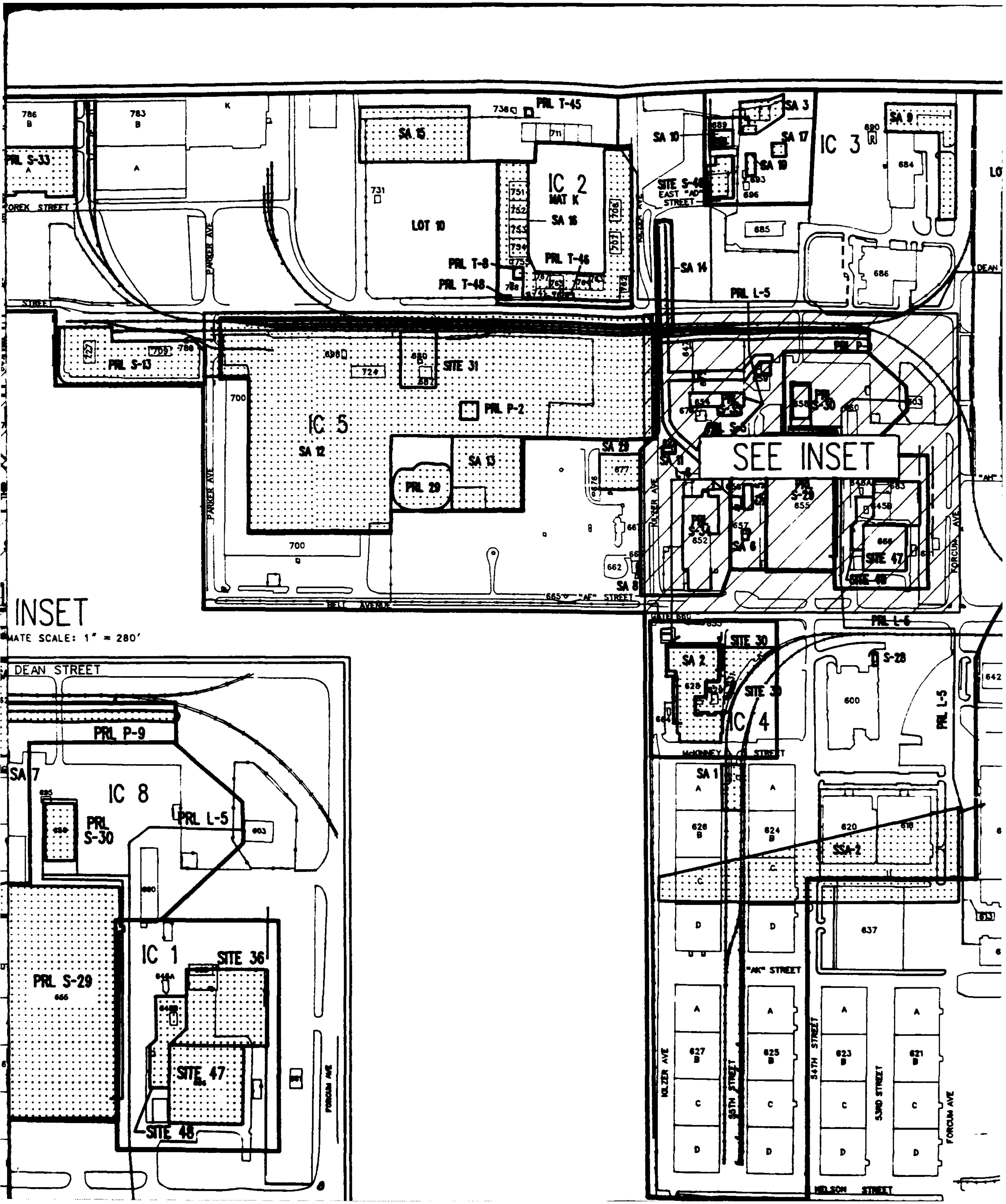

PRL S-33
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SA 9
IC 3
SITE S-46
EAST "AD" STREET
SA 14
PRL L-5
DEAN
PRL S-13
SITE 31
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SA 12
SA 13
PRL 29
SA 23
SA 11
SA 8
PRL P-
PRL S-30
SEE INSET
PRL S-29
PRL S-34
SA 6
SITE 47
SITE 48
665 "AF" STREET
BELT AVENUE
PRL L-6
SITE 30
SA 2
SITE 39
IC 4
S-28
McKINNEY STREET
SA 1
SSA-2
PRL L-5
"AK" STREET
IOLZER AVE
55TH STREET
54TH STREET
53RD STREET
FORCUM AVE
NELSON STREET
PARKER AVE
"AH"
OREK STREET
STREET
INSET
MATE SCALE: 1" = 280'
DEAN STREET
PRL P-9
SA 7
IC 8
PRL S-30
PRL L-5
IC 1
SITE 36
PRL S-29
SITE 47
SITE 48
FORCUM AVE
786 B
783 B
K
A
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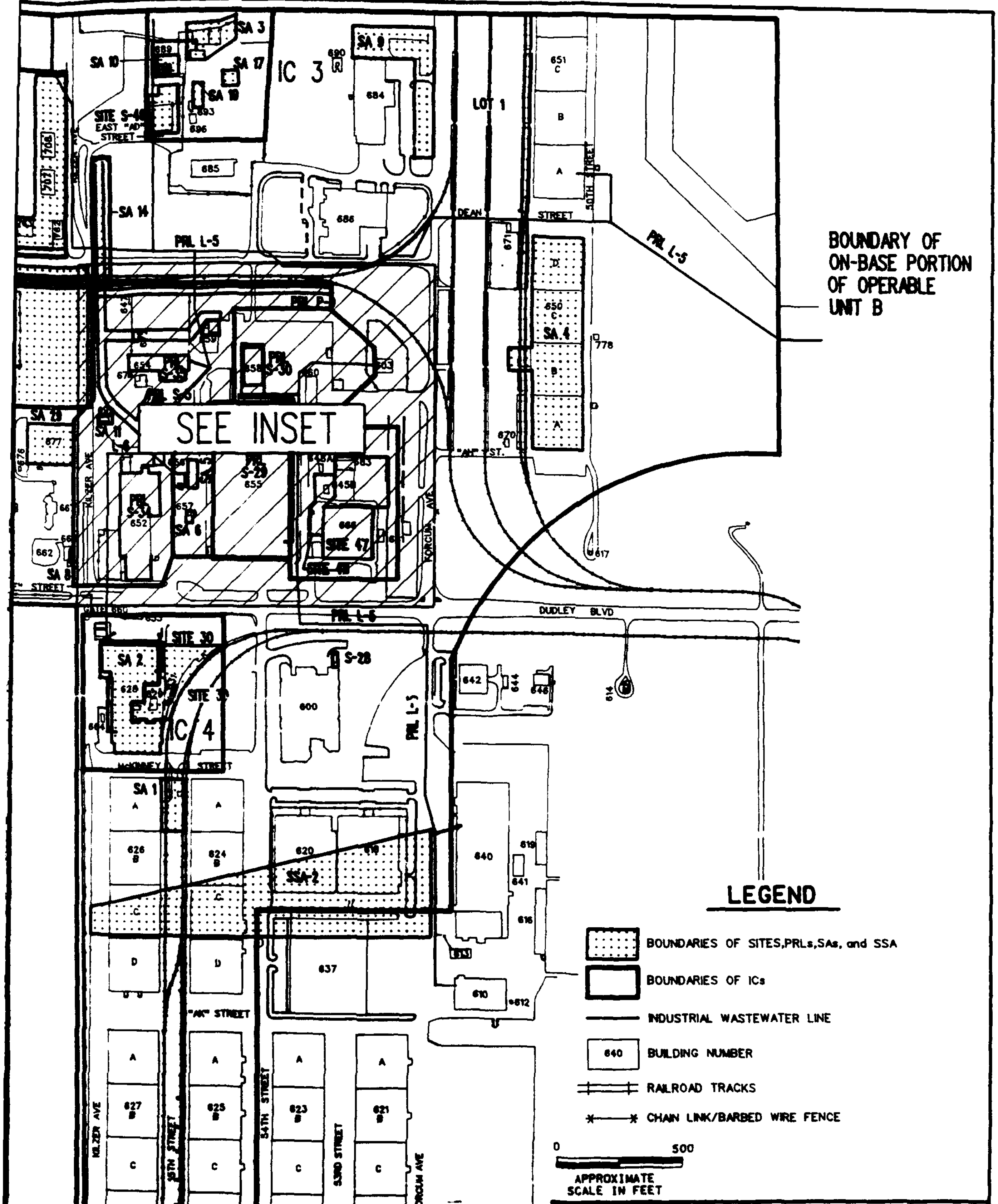

Figure A1-1. Locations of Sites, PRLs, SAs, SSA and ICs in OU B.

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The three basic divisions of decision making are points with which to divide the characterization of each site. Each decision-making point must be preceded by a phase of data collection, organization, and evaluation. The phases of data collection and evaluation followed by decision making provide a basic structure for the RI.

Because the decisions to be made and the data to be collected differ in each phase of the RI, the RI decision process is divided into three phases, which are:

- Phase 1 -- Source Identification;
- Phase 2 -- Extent Determination; and
- Phase 3 -- Remedial Alternative Evaluation.

The RI decision process is an information handling process that continues through and between the phases of the RI. The process can be illustrated as a flow diagram relating the phases of the RI (Figures A1-2, A1-3, and A1-4). Basic information and data available for a site enter the process from Preliminary Assessment/Site Inspection (PA/SI) summary reports and previous groundwater investigations in OU B at the starting point in the Site Characterization (Figure A1-2). The PA/SI information allows a site to be preliminarily categorized (Section A3.0), prior to planning Phase 1.

On the basis of information obtained in the PA/SI, the Operable Unit B Groundwater Remedial Investigation (OUBGRI), and the Groundwater Sampling and Analysis Program (GSAP), each of the 53 sites was placed in one of three categories, Suspected Source, Undefined Discharge, or Soil Gas Target before DQOs were established for Phase 1 and subsequent phases of the RI. The DQO development process is explained in Section 4.0, and DQOs that apply to Phase 1 are listed for specific sites in Section 3.0. The DQOs establish the collection methods, quantity, and quality of data needed to reach decisions in each RI phase.

When DQOs are established and the quality of data that can enter the decision process is determined, the information for each site flows through sampling and analysis strategy steps, implementation steps, data evaluation, and decision points in Phase 1 (Figures A1-2 and A1-3). When sufficient data are compiled to reach a decision regarding the absence or presence of contamination at the site, it will be determined if the area of contamination is a source of potential exposure or migration. After the

Phase 1: Source Identification

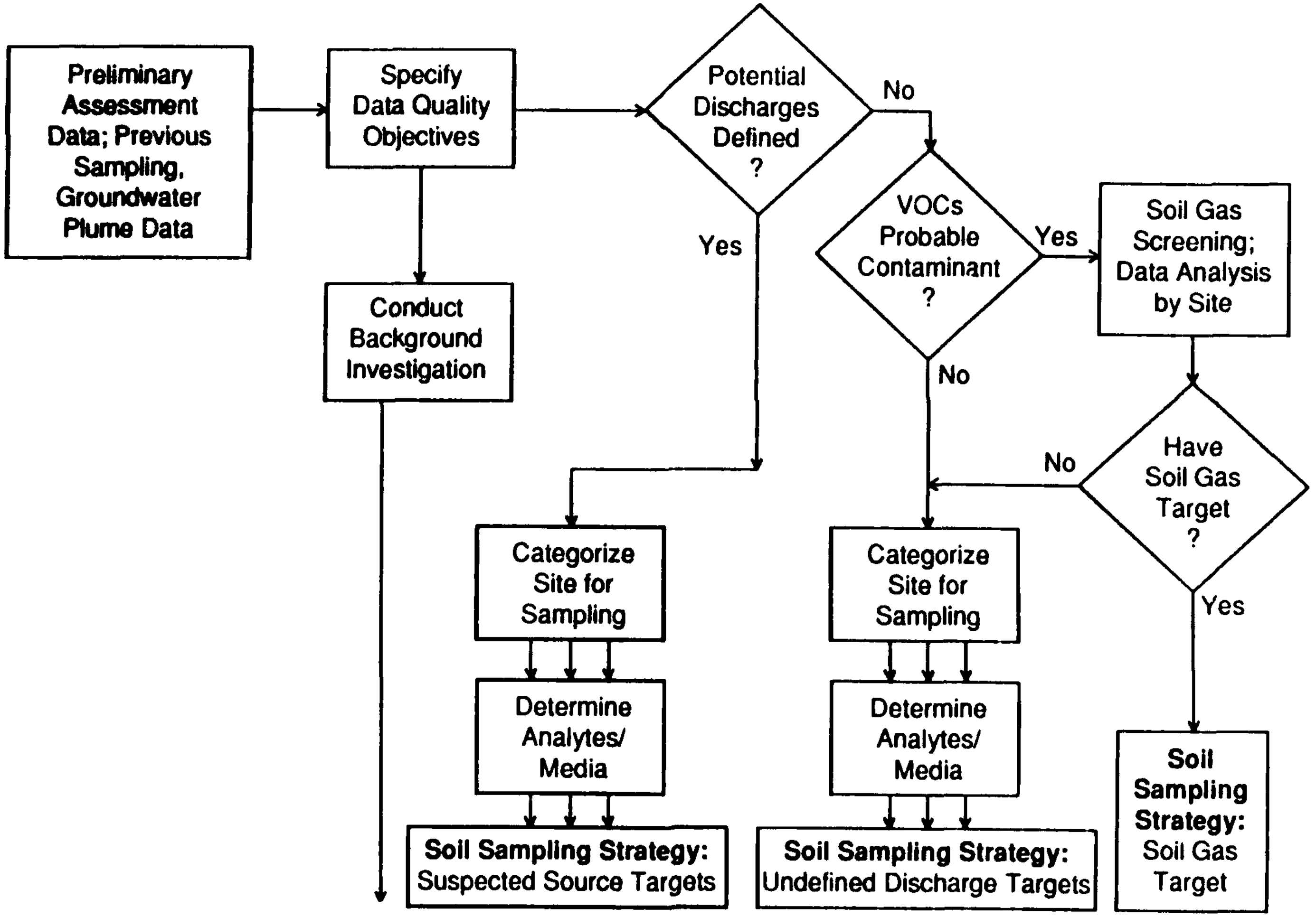

Figure A1.0-2. Remedial Investigation Decision Process Flow Diagram for Phase 1.

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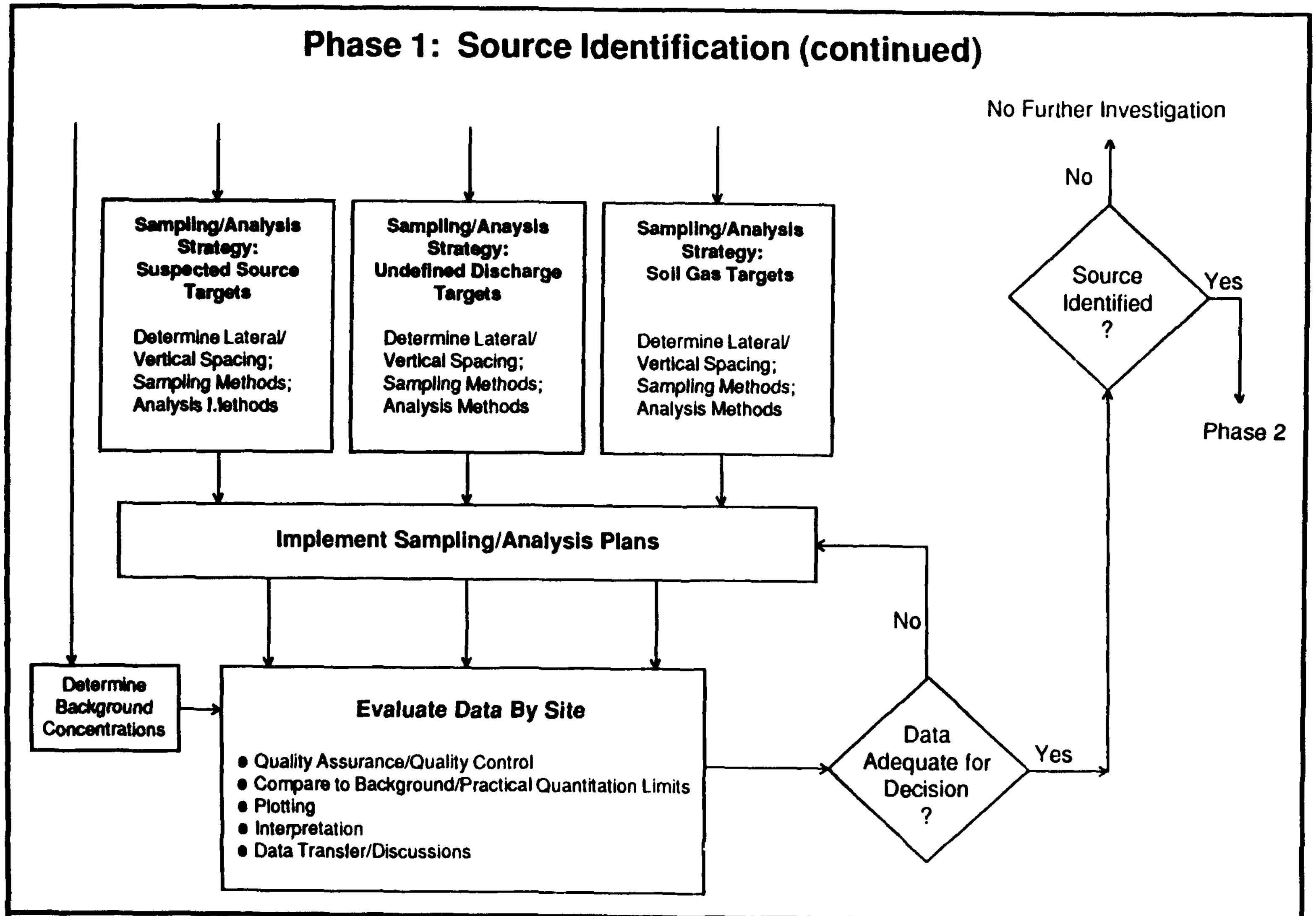

Figure A1.0-3. Remedial Investigation Decision Process Flow Diagram for Phase 1. (Continued)

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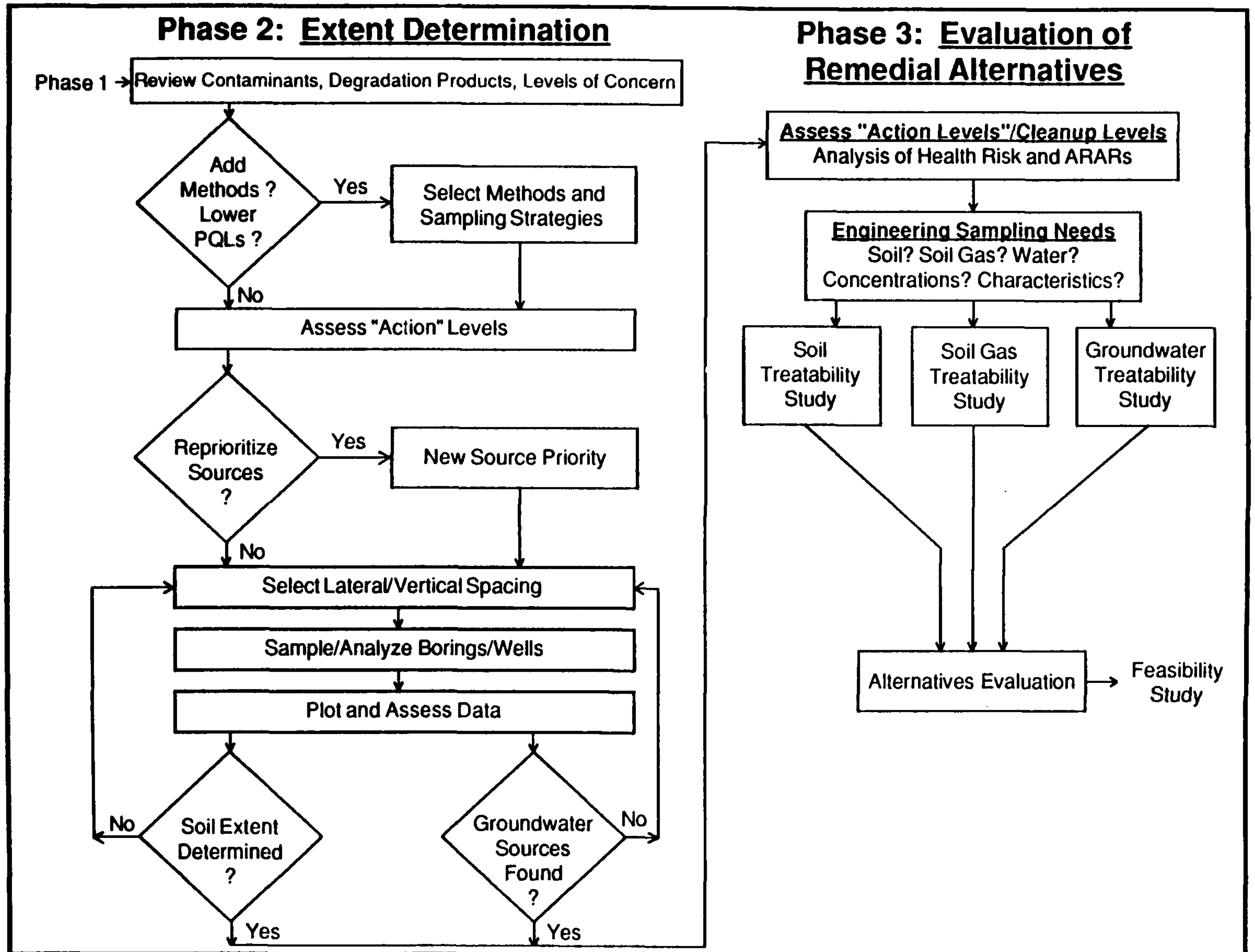

Figure A1.0-4. Remedial Investigation Decision Process Flow Diagram for Phase 2 and Phase 3.

decision is made, the information flows either to a storage file because no further investigation is required or to Phase 2 because the extent and migration potential of contamination must be determined.

The information compiled for a site that enters Phase 2 proceeds through the evaluation and planning process for Phase 2 sampling, analysis, data assessment, and decision making. Sampling, analysis, and data assessment in Phase 2 may be repeated at any site until the data are adequate to reach the decision that a source is likely to require remedial action and remedial alternatives must be evaluated. When the decision is made, the information flows to Phase 3. For those sites that are likely to require remedial action because one or more compounds exceed "action levels," the data compilation for FS reporting, such as treatability studies, will be initiated.

In Phase 3, information that has been compiled for a site during Phase 1 and Phase 2 is evaluated to estimate cleanup levels on the basis of health risk, environmental degradation, or Applicable or Relevant and Appropriate Requirements (ARARs). Following that determination, the data will be assessed to determine if sampling is required for additonal analyses or for treatability studies. These analyses or treatability studies will supply the data needed to evaluate feasibility of remedial alternatives in the OU B RI/FS report.

The details of the RI Decision Process and the criteria established for sampling, analysis, and evaluation are described in Section 3.0. Two important data collection steps that occur early in Phase 1 of the RI are the Soil Gas Investigation and the Background Investigation for OU B. The Soil Gas Investigation results are described in Section A2.0 of this Appendix. The Background Investigation is described in Section 3.24 as a site-specific sampling plan.

A2.0 SOIL GAS INVESTIGATION

A soil gas investigation was conducted at forty-one sites in Operable Unit (OU) B of McClellan AFB from September to December 1990. The investigation was a site screening step for Phase 1 of the Site Characterization of the Remedial Investigation (RI); however, it was conducted prior to preparation of the OU B RI Sampling and Analysis Plan (OU B RI SAP) to provide data for the location of Phase 1 soil borings shown in Section 3.0 of this Sampling and Analysis Plan (SAP).

The OU B Soil Gas Investigation was intended to screen sites for the presence of volatile organic compounds (VOCs) in soil gas prior to collection of soil samples. Screening of sites for concentrations of VOCs in soil gas was performed to attain three objectives, which were to:

- Identify areas of VOC contamination in soil gas, thereby placing sites in the Soil Gas Target category for the Remedial Investigation (RI) Decision Process;
- Provide data for placement of soil borings at Soil Gas Targets in Phase 1 of the OU B RI; and
- Provide data that may, for certain sites or areas within sites, limit the intensity of investigation for VOC contamination in soils.

Soil gas sampling and analysis is an appropriate method for screening sites in OU B prior to soil sampling because:

- The vapor phase of VOCs from VOC-containing liquid phases in the soil will enter and migrate in soil gas;
- VOCs are the contaminants which have been most frequently detected in soil or groundwater beneath OU B; and
- Historical discharge points for VOC liquids or waste waters containing VOCs may have also been discharge points for wastes containing other contaminants.

The following sections describe the Soil Gas Sampling Strategy (Section A2.1), Sampling and Analysis Methods (Section A2.2), Soil Gas Validation Study Results (Section A2.3), and Soil Gas Data Interpretation (A2.4).

A2.1 Sampling Strategy

Forty-one sites, including Sites, Potential Release Locations (PRLs), Study Areas (SAs), and Special Study Areas (SSAs) were investigated in the OU B Soil Gas Investigation. Soil gas probe locations are indicated in the site-specific plans, Section 3.0; some probe locations were selected in the field on the basis of initial soil gas analyses to further identify and define the lateral extent of VOC contamination in soil gas. Rationale for soil gas probe placement at the different types of sites within OU B may be found in Section A2.1.4, Soil Gas Sampling Strategy.

A number of previously identified Sites, PRLs, and SAs that will be investigated in the OU B RI were not included in the Soil Gas Investigation because: VOCs are not contaminants of concern at those sites on the basis of site history (PRL 29 and SA 13); the sites were not assessable for probe emplacement (PRLs T-48 and T-60); or the site is being investigated as part of another site (PRL S-30).

A2.1.1 VOC Behavior in Soil Gas

Soil gas screening in the OU B Soil Gas Investigation served two purposes: first, it targeted areas with VOC contamination in the soil, and second, analyses of samples aided in selecting soil sampling locations in Phase 1 of the RI.

Interpretation of the soil gas investigation results was based on the following assumptions: in the clays, silts, and silty sands in the vadose zone beneath OU B, liquids containing VOCs that enter the soil will be retained in a fraction of the soil pore volume as residual liquid beneath the discharge point; the total amount of liquid-phase VOCs in a soil volume is likely to be greater beneath the discharge point and decrease with horizontal distance from the discharge; the liquid-phase VOCs in the soil pores will partition into the vapor phase at a relatively steady rate and enter soil gas; VOCs in soil gas will tend to remain in the vapor phase in the vadose zone; and the principal mechanisms of VOC migration are diffusion and density-driven migration.

The nature and conditions of the shallow soil zone, lying between surface and 20 feet BGS, where most VOC discharges have occurred, have a significant impact on the behavior of liquid- and vapor-phase VOCs. The geologic information for the central portion of OU B (see Conceptual Model, Section 2.7) where most of the industrial operations and potential discharge of VOCs are located, indicates that shallow soil zone consists of clays, silts, and silty sands. The parameters of porosity, hydraulic and vapor permeability, soil bulk density, and natural organic carbon content are not constant through the zone in central OU B. However, they are likely to fall within a range of values that allow predictions on VOC behavior to be made. Furthermore, much of the soil surface in the central portion of OU B is covered with pavement that impedes the loss of soil gas to the air and limits the potential infiltration and vertical migration of surface liquids (rainfall or contaminated wastewater). Typical VOC discharge points in OU B are leaky underground tanks, sumps, and pipelines. Therefore, soil areas overlain with pavements and foundations having low permeabilities act as a trapping layer to limit the upward or lateral movement of soil gas in the shallow soil zone that would result from direct contact with the atmosphere. Naturally formed, less permeable layers in and below the shallow soil zone slow the lateral and downward migration of liquids containing VOCs. Because of these conditions in the shallow soil zone, both liquid- and vapor-phase VOCs will tend to spread laterally at a slow rate from discharge points.

Because the soils in the shallow soil zone are generally fine-grained, they have porosities (soil pore percentage of total volume) of 40 to 60 percent. Discharged liquids may occupy approximately 10 percent of this volume as residual moisture that will be held on soil grains indefinitely. The remainder of the soil pore volume (35 to 55 percent) will be occupied by soil gas containing water vapor, air, natural volatile hydrocarbons, and contaminant VOCs that have entered the vapor phase. Liquids discharged into the shallow soil zone that contain contaminants will move through the pores if there is sufficient hydraulic or gravitational forces acting upon them. When these forces decrease to less than tensional forces in the vadose zone, hydraulic flow stops. Locally, at the discharge points of pipeline, tank, or sump leaks, hydraulic forces may have been acting almost continuously throughout the historical operation of an industrial facility in OU B. At locations where movement resulting from hydraulic and gravitational forces becomes less than tensional forces, the movement of VOCs may have continued in soil gas. Because of their volatility, VOCs will enter and move in soil gas as vapor molecules.

The behavior of VOCs in soil pores containing both soil gas and contaminated liquid is determined by the physical properties of each VOC, the concentration of the VOC in the liquid, and the relative humidity of the soil gas (Falta, et al., 1989). Physical properties affecting the exchange of VOCs between liquid and gas and the movement of VOCs in soil gas are listed in Table A2-1. The physical properties of the VOCs detected most frequently in soil gas and groundwater beneath OU B (trichloroethene [TCE], tetrachloroethene [PCE], and 1,2-dichloroethene [1,2-DCE]) are similar. Therefore, the behavior of specific VOCs in soils near discharge points in OU B is largely controlled by the concentrations of specific VOCs in soil and the soil conditions.

Vapor-phase VOCs may move by the mechanisms of diffusion, soil gas advection, and gravity-driven migration. Soil gas movement that would be enhanced by direct contact with the atmosphere and fluctuations in the water table is limited beneath much of the central part of OU B because of pavement above the soil surface and minor changes (1.5 to 2 foot decrease and 1 foot average rebound) in water levels annually. The movement of VOCs by diffusion through soil gas occurs even when most of the soil gas volume is immobile. Diffusion will occur in any direction that VOC vapor can migrate, but the movement is always in a direction away from greater VOC concentrations in soil gas. Density-driven migration may occur when the saturation of VOC vapor in a soil pore reaches a density at which it differs sufficiently with density of the soil gas in the pores above or below it. For the VOC compounds listed in Table A2-1, all gas densities are greater than the density of dry air in soil gas. Therefore, the VOC compounds detected in soil gas in OU B will migrate downward because of the greater density of the VOC vapor at saturation; if present, lighter hydrocarbon VOCs, such as gasoline components, will migrate upward. Density-driven VOC migration may generate advection in otherwise immobile soil gas (Falta, et al., 1989).

Under conditions that exist in the industrial, central portion of OU B, VOCs entering the shallow soil zone from discharge points migrated in the liquid phase into soil pores of clay, silt, or silty fine sand layers.

Even though the liquids could not penetrate rapidly through the fine-grained soils, it is unlikely that they spread widely because horizontal permeability is also low in the soils. In the shallow soil zone beneath OU B, there is no available evidence

TABLE A2-1. PHYSICAL PROPERTIES OF SOME SOIL GAS CONTAMINANTS AT McCLELLAN AFB

Chemical	Molecular Weight[a], M (g/mole)	Vapor Pressure[a], V_p (kPa[c])	Saturated Vapor Conc.[a], C_g (kg/m^3)	Gas Density[a], D_g (kg/m^3)	Organic Carbon, K_{oc} (cm^3/g)	Henry's Law Coefficent[b], H (dimensionless)
Benzene	78.1	12.7	0.40	1.42	83[a]	0.22
trans-1,2-Dichloroethene	96.9	43.5	1.7	2.37	59[b]	0.333
Toluene	92.1	3.8	0.14	1.27	140[a]	0.26
1,1,1-Trichloroethane	133.4	16.5	0.89	1.87	113[a]	0.95
Trichloroethene	131.4	9.9	0.52	1.538	150[a]	0.37
Tetrachloroethene	165.8	2.5	0.17	1.31	364[b]	0.54

[a] Falta et al., 1989
[b] Schwille, 1988
[c] at 25°C

that channels of higher permeability deposits exist. Therefore, it can be assumed that the hydraulic conductivity of soils beneath most discharge points is less locally consistent (variation of one order of magnitude or less).

The liquids containing VOCs that were released in one discharge event would migrate downward with time. A fraction of the liquid would have remained as residual moisture in the soil pores. From the residual liquid in the pores, VOCs would enter the soil gas phase in the pores of soils around the discharge point. The VOCs present on soil particles would enter the soil gas phase in proportion to their concentration on the soil particles times Henry's Law Constant divided by bulk density times organic partition coefficient. In the vapor state, the VOCs beneath OU B would again have mobility to move, for the most part, by diffusion and density-driven vertical migration. By the diffusion process, VOC molecules would migrate from the greatest concentration in the pores near the discharge point, outward in response to a concentration gradient. Because the gas density of VOCs detected most commonly in OU B soil gas are greater than normal soil gas density, the principal mechanism of upward or lateral VOC migration is diffusion. Therefore, lower VOC concentrations would be detectable above or laterally away from a discharge point, and the source of the VOC in the gas would lie in the direction of increasing concentration, near the original discharge.

Density-driven migration would move VOCs downward through lighter soil gas away from a shallower source. This mechanism of migration would be effective in removing a large percentage of VOCs, over a time period, from soil pores where they would otherwise be immobilized, without additional vertical liquid migration.

The use of soil gas sampling to identify VOC contaminant source areas is contingent on the ability to detect VOCs at greater concentrations in one probe compared to probes at other locations and to track increases in concentration toward the higher concentration that would be expected in the soil at the contaminant's discharge point. To track soil gas contaminants toward more concentrated sources, criteria for decisions on follow-up soil gas and soil sampling were established for use in the field.

Although soil gas sampling and analysis are most applicable for identifying sources of VOC contamination that are likely to enter the vapor phase in soil gases, the technique is also applicable to identifying sources of other soil contaminants. Volatile organic compounds in soil gas may be indicators of metal or semivolatile organic compound contaminant sources because the volatile compounds have had widespread use in industrial processes at McClellan AFB. There is evidence from preliminary assessments and previous investigations that VOCs were stored, handled, and disposed along with metals or semivolatile wastes in some operations. One example is the plating shop wastes from Building 666 (Site 47). Therefore, the tracking of VOC concentrations in soil gas used in conjunction with soil sampling may identify contaminant sources for VOCs, metals, and semivolatile organic compounds in soils.

However, lack of conclusive data indicating VOC contamination at a particular site will not necessarily eliminate the need for soil borings at that site in Phase 1 of the RI. At some sites, the liquid contaminants discharged may not enter the soil gas at detectable concentrations, for example, semivolatile organic compounds. The soil gas investigation provides target areas for soil boring placement on large sites where VOC contaminants are likely to be present.

A2.1.2 Soil Gas Decision Levels

To use the soil gas analytical data to identify contaminant sources in OU B, soil gas decision levels were established for use in the field. These soil gas decision levels were used to decide when additional probes were needed to track a soil gas plume.

Independent soil gas concentration criteria were established for two groups of VOCs. The criterion for halogenated VOCs (e.g., TCE, PCE, and 1,2-DCE) was 50 micrograms per liter (μg/L), or parts per billion by volume (ppbv), of any one compound as measured by a field electron gas detector (ECD). In other words, if the concentration of a halogenated compound detected in soil gas was equal to or greater than 50 ppbv, additional soil gas samples were taken. This criterion was derived from the relationship between VOC contaminant concentration in the soil gas resulting from a VOC contaminant concentration adsorbed on soil particles. The relationship is shown by:

$$C = \frac{C_{soil}\,H}{D_B\,K_D}$$

where:

C_{soil} = Concentration of VOC adsorbed on soil (in ppb);

H = Henry's Law constant for the VOC;

D_B = Soil bulk density, or average particle density (2.65 g/cm^3) x (1 - porosity [average estimated for shallow OU B soils, 0.40]);

K_D = Soil partition coefficient (150 cm^3/g for TCE) x organic carbon fraction (0.001 estimated for OU B soils); and

C = Concentration of VOC in gas (ppbv).

Substituting appropriate values representative of TCE and approximate soil conditions in OU B, a concentration of 32 ppb of TCE adsorbed on soil would yield a soil gas concentration of 50 ppbv. This concentration of TCE or similar VOCs in soil is a very conservative concentration to use as an indicator of proximity to a contaminant source. A TCE concentration of 50 ppbv or less in soil gas, indicates that the soil particles adjacent to the sample probe intake may have adsorbed TCE at a concentration no greater than 32 ppb. Concentrations of adsorbed VOCs on soils may be much lower than 32 ppb or nondetectable if the VOC in soil gas has migrated from some distance to the probe location.

The decision level used for aliphatic and aromatic VOCs in the soil gas investigation was 500 ppbv. This level is based in part on the sensitivity of the flame ionization detector (FID) to aliphatic and aromatic VOCs. The field gas chromatograph instrument with FID could not accurately detect those VOCs at less than 500 ppbv. This detection level and the decision level based on it are adequate to detect a concentration of 300 ppb benzene adsorbed on soil grains, which is also a conservative value for soil concentrations near a contaminant source.

The soil gas decision level concentrations were used throughout the OU B soil gas investigation to determine if stepout sample probe locations were required. Results of the validation study for soil gas, Section A2.3, indicated that VOC concentrations may be much lower or nondetectable in soil samples collected at locations were VOC concentrations in soil gas were 1000 ppbv or more. Therefore, the soil gas decision level to be used for locating soil sample locations has been increased for Phase 1 of the RI.

A2.1.3 Soil Gas Sampling Decisions

Decisions on the need for additional soil gas measurements, or for speciation of the soil gas, were made during the field effort, on the basis of the soil gas decision levels. To expedite decision making, most soil gas samples were analyzed at a temporary laboratory located within two miles of the sampled sites.

Additional soil gas measurements were taken at stepout locations when the soil gas concentration of any one compound exceeded the soil gas decision levels. These stepout sampling locations were used to develop a soil gas target area on the site.

In order to identify halogenated or aliphatic/aromatic compounds that were measured at 100 to 1000 times the soil gas decision level, soil gas samples were collected in stainless steel canisters. The canister samples were analyzed in the laboratory by gas chromatography/mass spectrometry (GC/MS) to identify the unknown compound. Canister samples for analysis by GC/MS were also collected at three percent of all probe locations to confirm the on-site GC analysis. All canister samples were analyzed at an off-site laboratory.

A2.1.4 Soil Gas Sampling Strategy

The diversity of physical characteristics of sites in OU B required multiple strategies for placing initial soil gas probes. Some sites have more than one potential source, e.g., tanks, pipelines, known spill areas, or a ditch running across it; other sites have no defined potential source area. Selection of sampling locations for the sites, therefore, required a variety of sampling strategies. Strategies that were used for placing initial soil gas probes at groups of sites with similar characteristics were:

- For open areas that are unpaved, or where pavement is 4 inches thick or less, soil gas probes were located at the intersections of grid lines evenly spaced at 100-foot intervals, with a minimum of four locations per site.

- For paved open areas where the paving is greater than 4 inches thick, probes were placed around the perimeter of the pavement or concrete such that there were a minimum of one probe per side less than 100 feet long, two probes per side between 100 feet and 200 feet long, and one additional probe for every additional 100 feet in length.

- For buildings or building foundations, probes were placed as for paved open areas (i.e., around the perimeter).

- For tanks where the tank location was known, two probes, one at either end of the tank, were placed as close to the edge of the tank as possible. The probes were driven to a depth equal to the bottom of the tank, if possible.

- For tanks for which the tank location was unknown or uncertain, probes were placed along grid lines spaced 100 feet apart in the general area of the tank.

- For ditches, probes were placed at any identifiable or probable influent locations, at any confluences with other ditches or drainages, at any areas of lower elevation along the ditch that might tend to collect contaminants, and at 100-foot intervals between the other types of locations.

- For untested sections of underground pipelines, probes were placed at 50-foot intervals along the pipeline.

Large open areas, whether paved or unpaved, were investigated in several passes of the site. During the initial pass, probes were placed at every second intersection of each grid line to obtain baseline soil gas data for the site. If VOCs were detected in the initial pass, smaller areas in which there is an indication of potential contamination were sampled at each grid line intersection in subsequent sampling. At narrow sites, probe locations were offset from one another, rather than simply placed along a straight line.

For sites in OU B where previous investigations have indicated no evidence or suspicion of VOC contamination (for example, where the only contaminant of concern is polychlorinated biphenyls [PCBs]), no soil gas samples were collected during this screening investigation. Those sites will be investigated under the undefined source category in Phase 1 of OU B RI.

Data from these initial probes guided the placement of stepout probes. See Section A2.1.3 (above), Soil Gas Sampling Decisions.

A2.2 Sampling and Analysis Methods

Sampling procedures used in the Operable Unit (OU) B Soil Gas Investigation are those described in the McClellan Air Force Base (AFB) Quality Assurance Project Plan (QAPP) (Radian, 1990c) or are described in Sections 5.0 and 6.0 of this OU B RI Sampling and Analysis Plan (SAP).

The following analytical methods were used in the OU B Soil Gas Investigation. They are described in Section 8.3 of the McClellan QAPP (Radian, 1990c):

- Pesticides and Polychlorinated Biphenyls (SW8080);
- GC/MS VOCs (SW8240);
- GC/MS Semivolatile Organic Compounds (SW8270);
- Dioxins and Dibenzofurans (SW8280);
- Metals (SW6010);
- Mercury (SW7471); and
- Soil pH (SW9045).

A2.3 Validation Study

The use of soil gas sampling and analysis to identify areas of VOC contamination in soil and to provide data for locating soil borings is based upon the properties of VOC contaminants, conditions in the soil, and the movement of the VOC vapor in soil gas in the time period after discharge to the soil. Prior to the OU B Soil Gas Investigation, there had been no previous investigation with systematic soil sampling and gas chromatographic analyses to locate contaminant source areas. Similar investigations, documented in the literature, indicated that the results of these investigations are dependent upon site-specific soil and groundwater conditions (Silka, 1988; Marrin and Kerfoot, 1988; Smith, et al., 1990). Therefore, a validation study was conducted to demonstrate that soil gas could be used as a remote indicator of VOC contamination in the soil beneath OU B.

A2.3.1 Site Selection

For the validation study, two sites with known concentrations of VOC contamination and differing soil conditions were selected. Sites with previously identified VOC contaminants in soil were selected for the validation study because, without identified locations of VOC concentrations in soils, the source of the VOC vapor could require extensive drilling. Although four sites in OU B had been drilled and sampled sufficiently to identify VOC soil contamination, only one, Site 23 (Figure A2-1), was known to have a concentration of VOC in soil that would increase the potential for successful validation. One boring (23WSB02) drilled at Site 23 (Figure A2-2) yielded samples with concentrations of VOCs (toluene and xylene) greater than 1,000 μg/kg (McLaren, 1986a). The other sites in OU B with the confirmed presence of VOC in soil (Sites 47 and 48 and PRL 36) have much lower concentrations. Another site with relatively high (500 μg/kg or greater) concentrations of VOCs confirmed in soil was found in OU A, approximately 1400 feet southeast of the OU B boundary (Figure A2-1); Boring 24CWS09 at Site 24 had 760 μg/kg of total xylenes and 140 μg/kg of toluene detected in a soil sample (Figure A2-3). Site 24 was also favorable for soil gas validation because it is located at least 1,000 feet from any other potential source of soil contamination, and part of the site is unpaved, allowing for testing of soil gas behavior where no cover exists to prevent loss of vapor to the atmosphere.

A2.3.2 Soil Gas Sampling

Previously drilled borings that had the greatest concentrations of VOCs in soil at each site were established as the central boring of the soil gas validation study. Soil gas samples were to be withdrawn and analyzed from four initial probe locations spaced at 50-foot radial distances to the north, south, east, and west from the soil boring location. If obstructions (buildings or utilities) prevented the location of a soil probe at

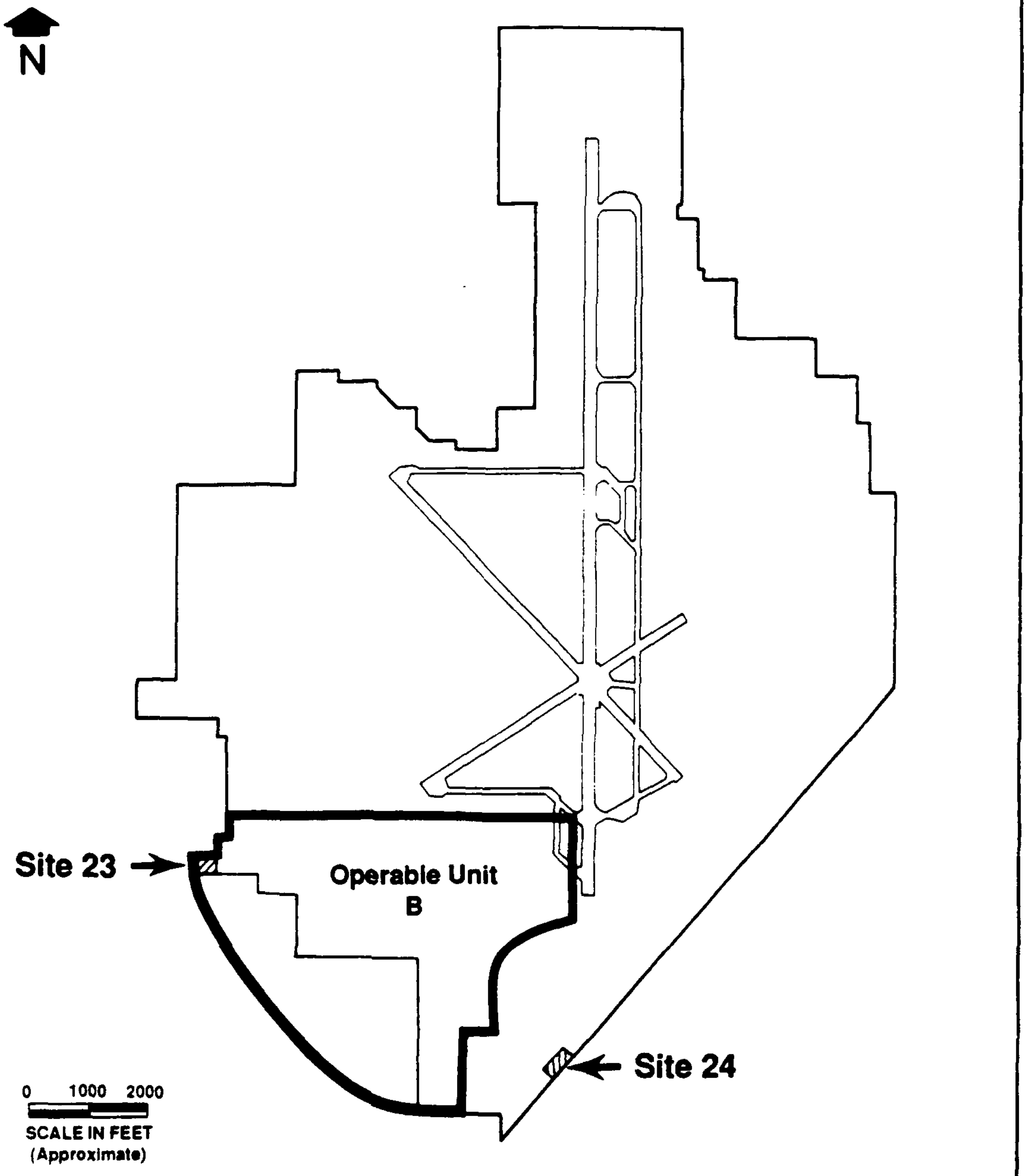

Figure A2-1. Sites Selected for Soil Gas Validation.

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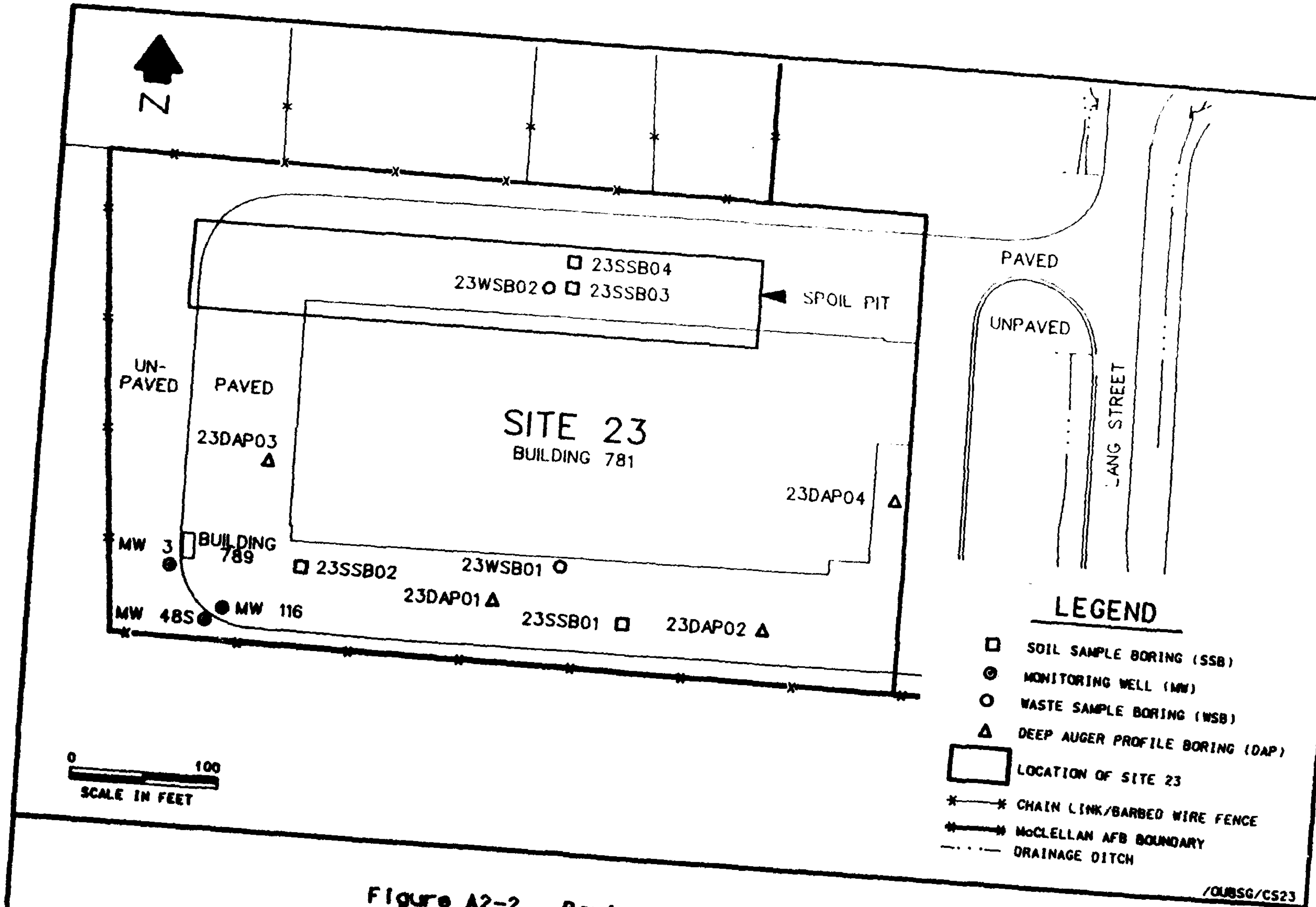
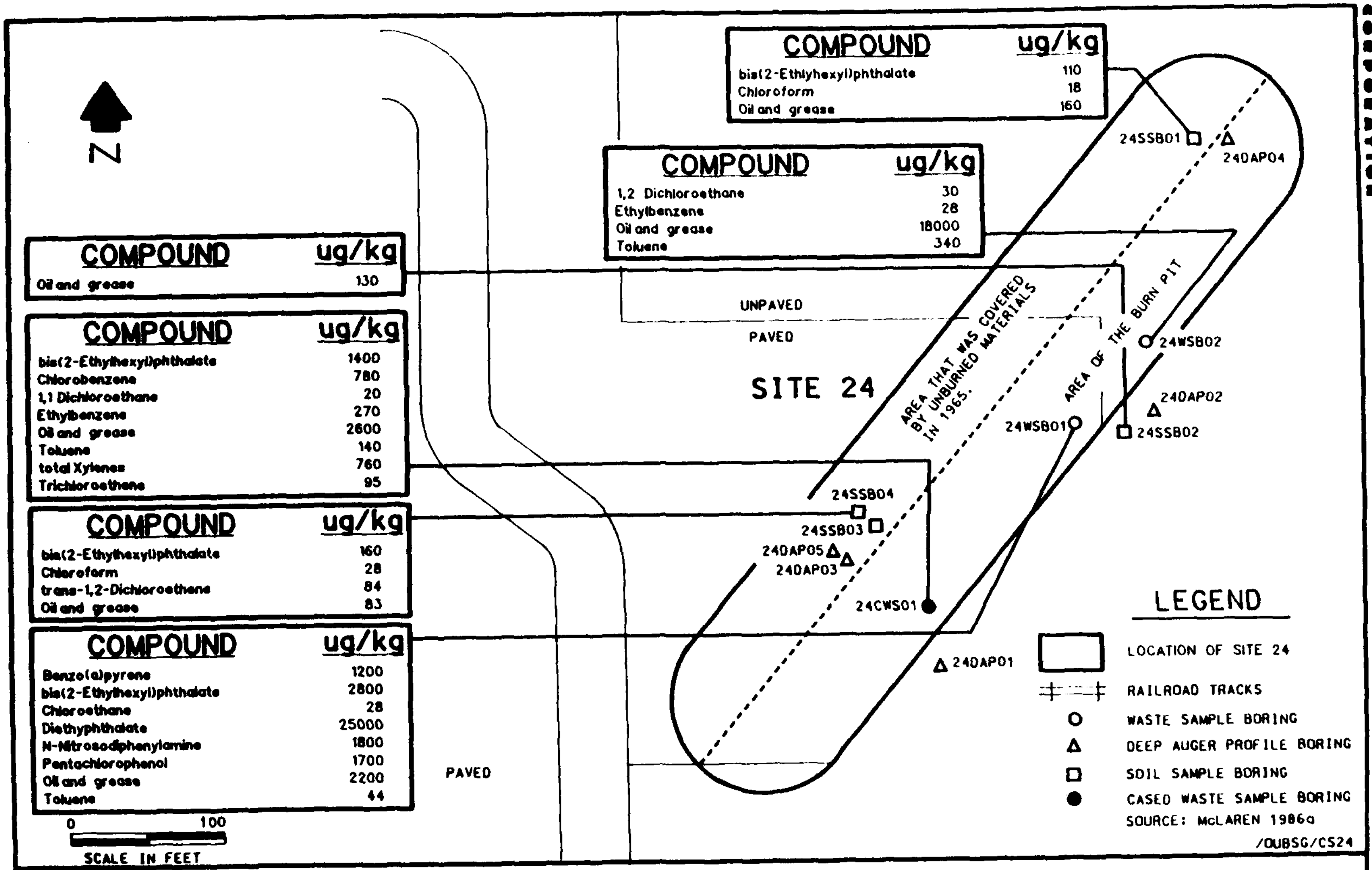


Figure A2-2. Boring Locations for Site 23.



COMPOUND	ug/kg
bis(2-Ethlyhexyl)phthalate	110
Chloroform	18
Oil and grease	160

COMPOUND	ug/kg
1,2 Dichloroethane	30
Ethylbenzene	28
Oil and grease	18000
Toluene	340

COMPOUND	ug/kg
Oil and grease	130

COMPOUND	ug/kg
bis(2-Ethylhexyl)phthalate	1400
Chlorobenzene	780
1,1 Dichloroethane	20
Ethylbenzene	270
Oil and grease	2600
Toluene	140
total Xylenes	760
Trichloroethene	95

COMPOUND	ug/kg
bis(2-Ethylhexyl)phthalate	160
Chloroform	28
trans-1,2-Dichloroethene	84
Oil and grease	83

COMPOUND	ug/kg
Benzo(a)pyrene	1200
bis(2-Ethylhexyl)phthalate	2800
Chloroethane	28
Diethyphthalate	25000
N-Nitrosodiphenylamine	1800
Pentachlorophenol	1700
Oil and grease	2200
Toluene	44

Figure A2-3. Maximum Level of Compounds Detected In and Around Site 24.

the 50-foot distance in one direction, the probe was placed at a lesser radial distance. Because of an obstruction, the soil probe south of the central boring at Site 23 was relocated a radial distance of 10 feet to the south from the boring.

As the samples from the initial probes around the central boring at each site were analyzed, additional probe locations were added as stepouts if the analytical results for any analyte exceeded the predetermined decision criteria. The central borings and soil gas probe locations sampled at Site 23 and Site 24 are shown in Figures A2-4 and A2-5, respectively. The initial probe locations at each site are indicated by the numbers 01 to 04 as the last two digits in the probe location identifier. Probe locations south of Building 781 at Site 23 (Figure A2-4) are not "stepouts" resulting from analyses near the central boring; they are probe locations selected to complete the soil gas screening for Site 23. However, the results of the analyses from probes south of the building were used to determine validation soil boring locations.

Soil gas samples were taken from the probes at Sites 23 and 24 at 4 to 6 feet below ground surface (BGS). Samples were submitted for GC analysis (Section A2.2). A total of 32 soil gas probes were sampled at each site. Results of the analyses were used in the preparation of soil gas concentration isopleth maps and in the selection of locations for soil borings to collect soil samples for validation. Maps with isopleths for total aromatic VOCs and total halogenated VOCs for each site are shown in Figures A2-6, A2-7, A2-8, and A2-9.

A2.3.3 Soil Boring Sampling

Soil boring locations for validation sampling and analysis were selected at each site on the basis of two criteria. One boring was to be drilled and sampled adjacent to at least one probe location that had a high concentration of VOCs, and one was to be drilled adjacent to a probe with a low concentration of VOCs. At Site 23, three soil boring locations were selected adjacent to probes that were considered to have VOC "highs" (total VOCs greater than 1,000 ppbv) and three were selected adjacent to VOC "lows" (total VOCs less than 100 ppbv) (Figures A2-6 and A2-7). At Site 24, two soil boring locations were selected adjacent to probes with VOC highs, and two were selected adjacent to VOC lows (Figures A2-8 and A2-9).

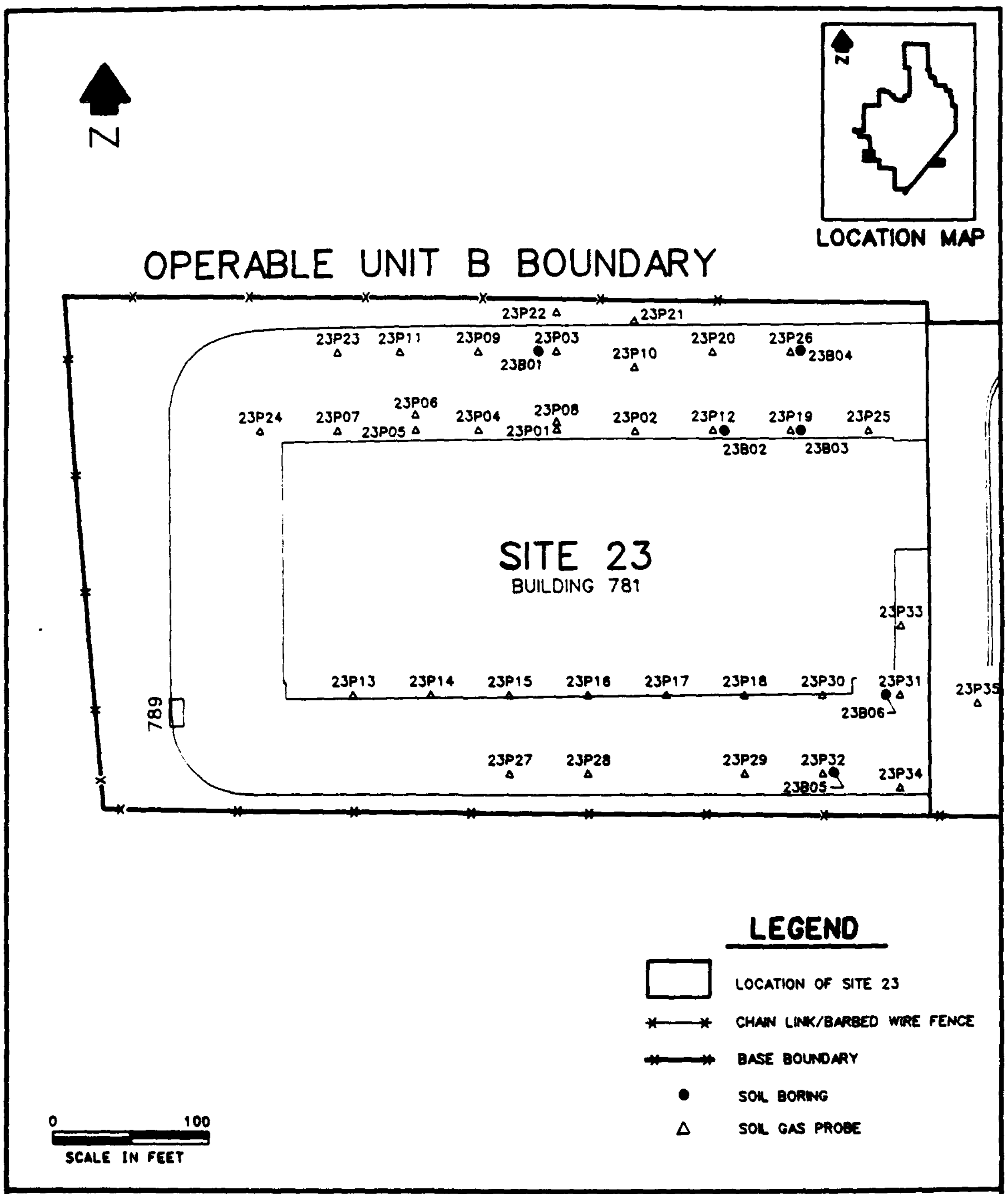


Figure A2-4. Soil Gas Sampling and Soil Boring Locations at Site 23.

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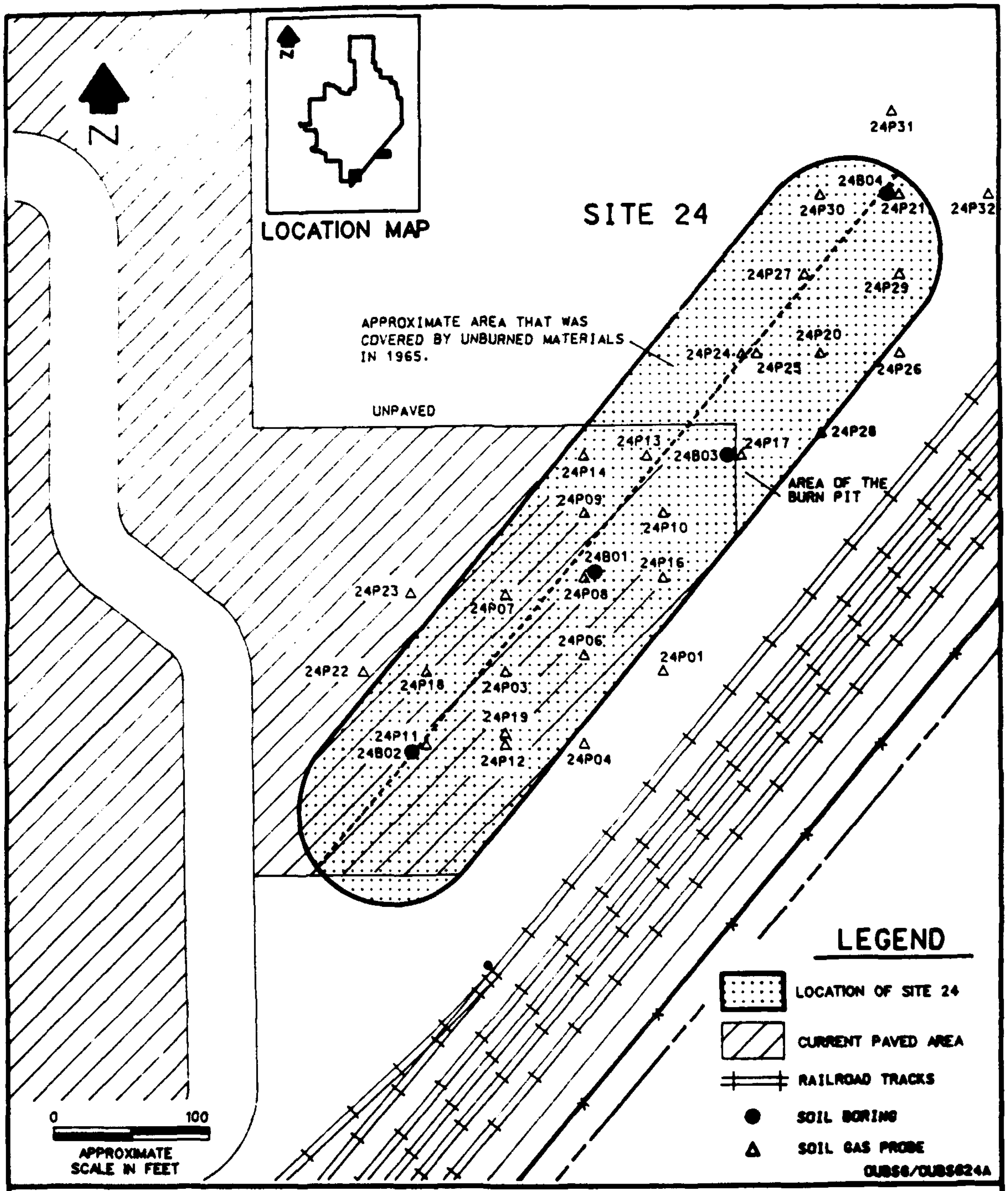

Figure A2-5. Soil Gas Sample Locations at Site 24.

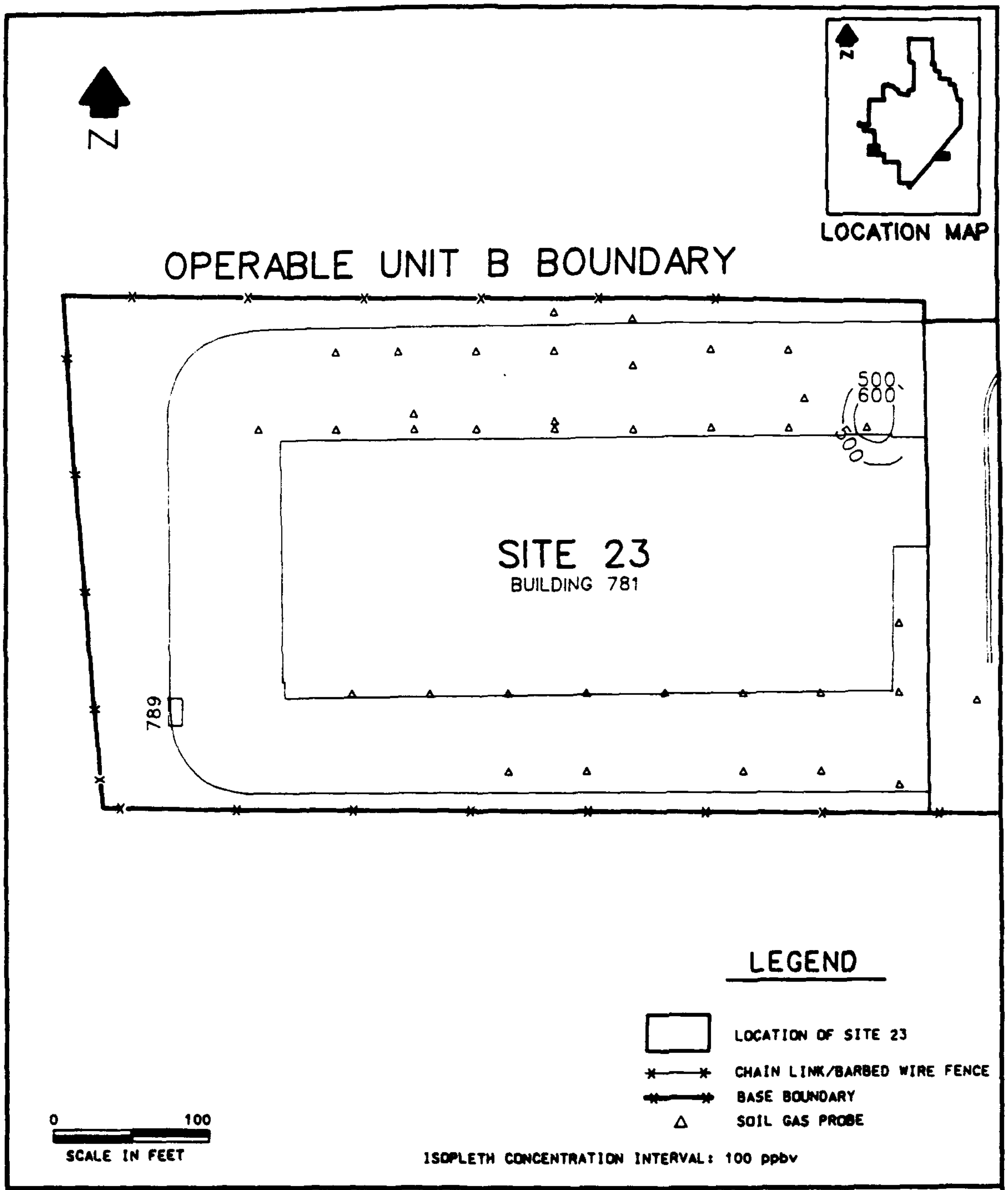

Figure A2-6. Isopleth Map of Total Aromatic Volatile Compounds at Site 23.

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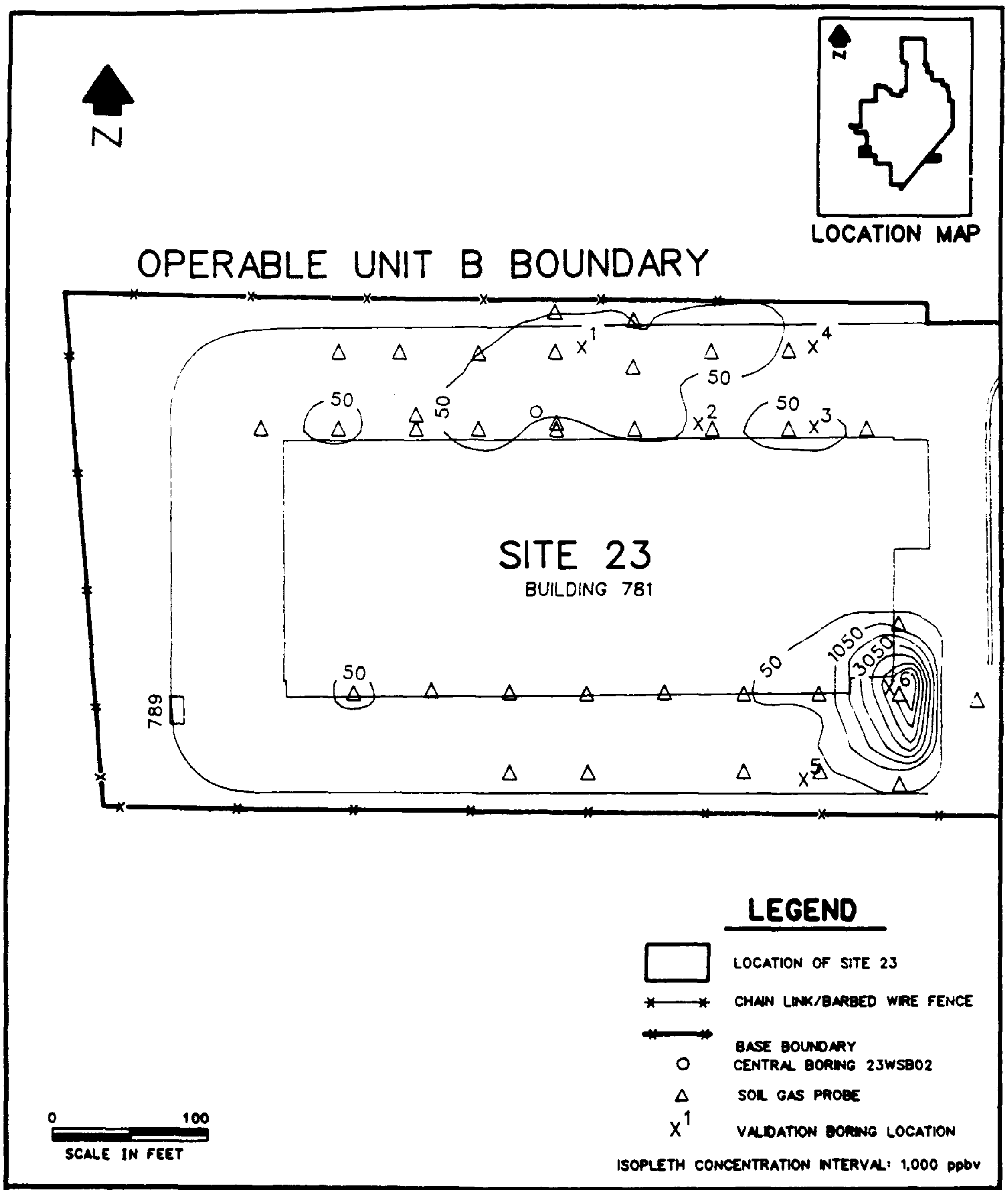

Figure A2-7. Isopleth Map of Total Halogenated Volatile Organic Compounds at Site 23.

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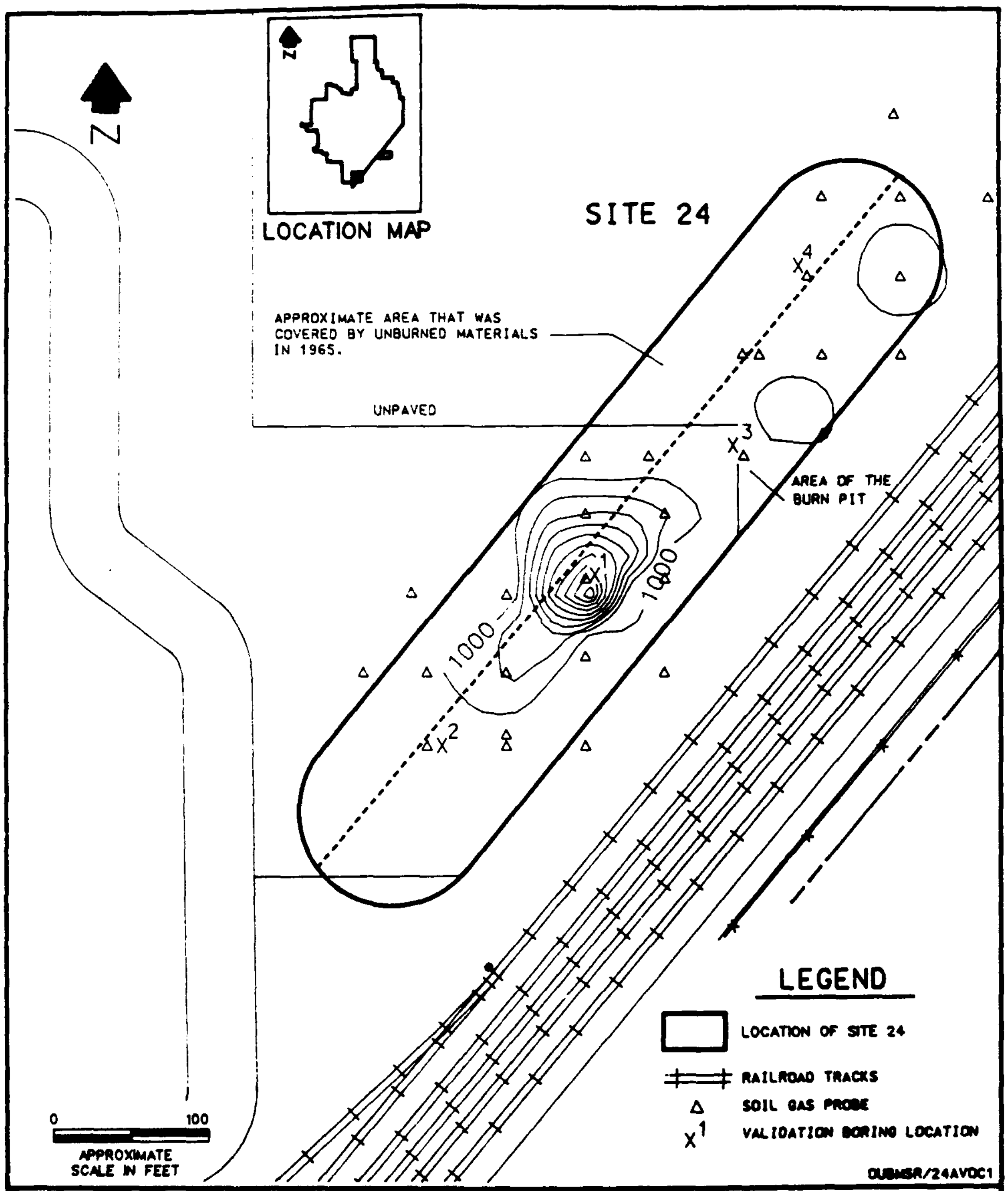

Figure A2-8. Isopleth Map of Total Aromatic Volatile Organic Compounds at Site 24.

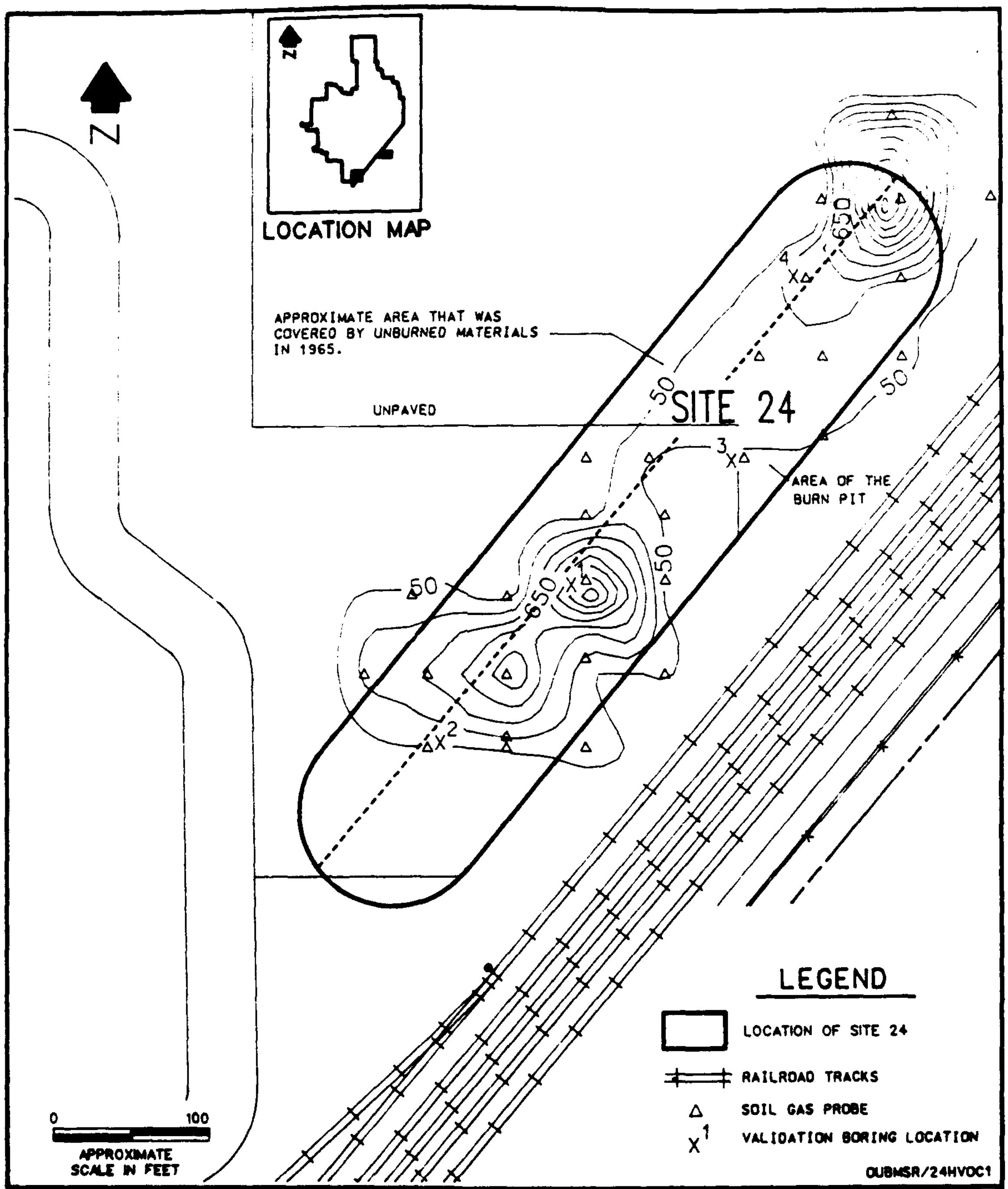

Figure A2-9. Isopleth Map of Total Halogenated Volatile Organic Compounds at Site 24.

Samples were collected in each validation boring for analysis of VOCs in soil gas and in soils at several depths. Although soil samples were collected and analyzed for VOCs and other compounds at depths from 6 to 79 feet in soil borings, the analytical data from soil samples collected from depths greater than 10 feet should not be compared with shallow soil gas measurements. The deposits below each validation site include sands, silts, and clays. Silts and clays impede the vertical migration of soil gas because they have low permeability. Therefore, contaminants detected in soil samples may be compared to VOCs in soil gas detected in samples taken at similar depths in the boring, but not with soil gas samples taken more than 6 vertical feet away.

Soil and soil gas concentrations are listed by site, boring number, and depth in Tables A2-2 and A2-3, beginning on page A2-28. Only compounds that were detected in at least one soil sample are listed in the tables. In addition to VOC analyses, soil samples in each boring were sampled for semivolatile organic compounds, metals, organochlorine pesticides, PCBs, and dioxin compounds. Full analytical results from Site 24 will be reported in the OU A Summary Report that is being prepared.

A2.3.4 Validation Results

At Site 23, the validation boring that was to be drilled at the location with highest total VOC concentration was drilled at Location 2 (Figure A2-6) adjacent to probe 23P03. Analysis of the sample from the probe yielded greater than 8,000 ppbv in total aromatic VOC concentrations. However, after drilling of the boring, the aromatic VOC concentrations were found to be relatively high in analytical blanks run on the field gas chromatograph along with samples from 23P03 and nearby locations. Therefore, the aromatic VOC concentrations detected in soil gas samples on the northern portion of Site 23 are inaccurate, and Boring 2 was drilled at a location with a low soil gas concentration.

Site 23

Borings 1 and 6 were drilled in locations at Site 23 where the highest concentrations of total halogenated VOCs were detected (Figure A2-7). At Boring 1, total VOCs in near surface soil gas were approximately 320 ppbv. Boring 1 had halogenated VOCs in three of the five soil samples collected from 8 to 71 feet BGS. Trans-1,2-dichloroethene (5.5 μg/kg) and TCE (22 μg/kg) were detected at 8 feet and at

18 feet (1,2-DCE = 1.2 μg/kg; TCE = 8.2 μg/kg); 4-methyl-2-pentanone (34 μg/kg) and 1,1,1-trichloroethane (4.9 μg/kg) were detected at 49 feet. Trichloroethene was detected in soil gas samples at 8, 32, 49, and 71 feet (Table A2-1).

Boring 6 was drilled adjacent to the location at which 7,500 ppbv of PCE was detected in soil gas at 4 feet BGS. The VOCs, PCE, TCE, and 1,2-DCE, were detected in soil gas samples from depths of 8, 20, 48, and 69 feet. No VOCs were detected in any of the six soil samples collected from 6 to 69 feet in the boring.

Borings 3, 4, 5, and inadvertently, 2, were drilled at locations where total VOC concentrations at 4 to 6 feet were relatively low (less than 150 ppbv), but detectable. No VOCs were detected in soil samples collected just below the depth of soil gas samples. However, ethylbenzene (2.4 μg/kg) and total xylenes (9.9 μg/kg) were detected in a soil sample collected at a depth of 49 feet in Boring 1.

Site 24

Four soil borings were drilled at Site 24 (Figures A2-8 and A2-9). Borings 1 and 4 were drilled adjacent to locations where soil gas analyses indicated VOC highs (greater than 2,000 ppbv total halogenated VOCs). Borings 2 and 3 were drilled adjacent to soil gas "lows" (less than 50 ppbv total VOCs).

Boring 1 was drilled and sampled to a depth of 67 feet BGS. Soil gas sampled in a probe driven to 6 feet BGS had a concentration of 988 ppbv total VOCs, which consisted of 1,2-DCE, TCE, chloroform, 1,1,1-TCA, and PCE, and 511,000 ppb total xylenes. The soil sample taken 3 feet below the soil gas probe depth contained TCE (4.6 μg/kg). Each of the five soil samples and a duplicate collected at depths of 9, 16, 24, 41, and 64 feet in the boring had detectable concentrations of 1,2-DCE, TCE, and/or chlorobenzene. Total concentrations of VOCs in soil gas samples increased to greater than 998,000 ppbv at 24 feet and decreased below that depth (Table A2-2).

Boring 4 was drilled adjacent to the probe location that had the greatest concentration (5,314 ppbv) of total VOCs on Site 24. A compound that could not be identified by the gas chromatographic instrument and TCE represented 99 percent of the concentration in the soil gas. In a soil sample collected 2 feet below the soil gas probe sample, no VOCs were detected. The concentration of TCE (1,490 to 18,600 ppbv) and total VOCs increased downward in soil gas samples in the boring from 8 feet to 53 feet. The VOCs, 1,1-DCA, TCE, and trans-1,2-DCE, were detected in soil samples from 61 and 75 feet.

Boring 2 was drilled adjacent to a soil gas probe location with a low concentration of 7 ppbv total VOCs. Toluene was measured at a concentration less than the detection limit at 9 feet. A sample taken at 53 feet had a concentration of 5.9 μg/kg 1,2-DCE. Total VOCs were detected in all downhole soil gas analyses and were greatest (21,000 ppbv) at 78 feet BGS.

In Boring 3 at Site 24, no VOCs were detected in soil samples collected at 5, 14, 34, 44, and 69 feet BGS. The soil gas probe adjacent to the boring location yielded a sample with 27 ppbv total VOCs. Soil gas concentrations in the boring were the greatest (6,842 ppbv total VOCs) at 69 feet.

A2.4 Data Interpretation

The results of the soil gas validation study led to several observations regarding VOCs in the vadose zone beneath two locations in and near OU B:

- High concentrations of VOCs were not found in soil samples collected beneath shallow soil gas sample locations where the highest VOC concentrations occurred;

- Specific VOCs detected in a near-surface sampling point were present in the soil gas samples taken at greater depths and may be detectable 60 to 80 vertical feet below the point; however, concentrations detected at greater depths may be lesser or greater than near surface concentrations;

- Concentrations of VOCs were low or nondetectable in soil samples collected at depths beneath shallow soil gas samples containing total VOC concentrations less than 100 ppbv;

- Very high horizontal gradients in soil gas concentrations exist at a number of the sites; VOC concentrations may increase by a multiple of 1,000 over 50 linear feet between sampling points;
- Areas of uncovered soils (e.g., Boring 4, Site 24) may retain soil gas concentrations of several thousand ppbv at depths as shallow as 3 feet; and
- Lithologies of deposits beneath each of the validation sites consist of silts with interbedded sands and clays; many of the soil and soil gas samples were taken in silt deposits, and there is no recognizable relationship between VOC concentrations and lithology.

The data obtained in the validation study were not subjected to statistical analysis because of the relatively small sample size and large number of nondetectable concentrations. In each of the six borings drilled near soil gas sampling locations that yielded less than 100 ppbv, VOC concentrations occurred at less than detectable levels in soil samples collected 2 to 30 feet below the soil gas sample. Volatile organic compound concentrations were much lower than expected in soil samples collected beneath soil gas sampling locations that had concentrations greater than 1,000 ppbv. Only four soil samples from the shallow soils (5 to 20 feet BGS) in two borings contained detectable VOCs. There was a general correlation between high VOCs in soil gas and the presence of VOCs on soil and low VOCs in soil gas and the absence of detectable VOCs on soil in 6 of the 10 validation boring locations. The data suggest that false positive results (high VOC concentrations in shallow soil gas when VOCs are not detectable on soils) are more likely to occur than false negative results (low VOC concentrations in shallow soil gas when VOC concentrations are present in soils). When both validation study results and previous soil sampling results (McLaren, 1986c) are combined, the soil gas targets developed from the shallow soil gas sampling enclose the areas in which VOC concentrations have been detected on soils. Each boring in which a shallow soil sample has had detectable concentrations of VOCs is 100 feet or less from the center of a soil gas target defined by the 100 ppbv isopleth for halogenated VOCs (HVOCs) or the 500 ppbv isopleth for aromatic VOCs (AVOCs).

Although there is general correlation between the presence or absence of VOC concentrations in soil gas and the presence or absence of VOC concentrations in soils at the two validation sites, there is some uncertainty regarding soil gas interpretations because of the lack of correlation between the types and concentrations of VOCs detected in soil gas and in soil samples at locations where both were detected. The lack of VOC type and concentration correlation indicates that VOCs have migrated laterally in soil gas from source areas. There is uncertainty in the soil gas results because there is potential that a VOC source in soils would not be detected by VOC concentrations in soil gas samples. That uncertainty was not supported by the results of the validation study because contaminants were not detected in soils below gas sample points which had less than 100 ppbv of VOCs. However, to alleviate some of the uncertainty that a false negative soil gas result occurs within OU B, the locations of soil sample borings in the area of Soil Gas Targets will be placed within a statistical grid.

In the OU B RI, the area within Soil Gas Targets will be evaluated with reconnaissance borings placed in a grid with a 50-foot spacing between locations. In a limited area outside of identified Soil Gas Targets, borings will be placed in a grid with a spacing of 100 feet between borings. Each of the reconnaissance borings in and adjacent to Soil Gas Targets will be analyzed for VOCs in soil and in soil gas samples.

The results of shallow soil gas sampling will be used within the OU B RI to identify general areas of VOC contamination in soils. These areas will be identified by the sum of the concentrations of all HVOCs detected equal to or greater than 100 ppbv, the sum of the concentrations of all AVOCs equal to or greater than 500 ppbv, or the concentration of one HVOC or UVOC equal to or greater than 100 ppbv. Analytical results from soil and soil gas samples collected in sample location grids within and outside of the targets will be used to identify source areas. On the basis of data collected in the validation study and in literature discussing the behavior of soil gas, the grid sampling and analysis should alleviate uncertainty regarding the detection of VOC sources with shallow soil gas sample analytical data.

TABLE A2-2. CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL AND SOIL GAS SAMPLES FROM VALIDATION BORINGS, SITE 23

	BORING #01 SAMPLE DEPTH					
Analytes Detected	6 feet	8 feet	18 feet	32 feet	49 feet	71 feet
	Concentrations in μg/kg					
Soil[a]						
Chlorobenzene	NS	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND
trans 1,2-DCE	NS	5.5 J	1.2 J	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	4.9 @	ND
TCE	NS	22 @	8.2 @	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	NS	ND	ND	ND	34 @	ND
	Concentrations in parts per billion by volume					
Soil Gas[b]						
trans 1,2-DCE	316.0	ND	ND	ND	ND	ND
TCE	1.9	32	ND	10	29	14
PCE	0.2	ND	ND	ND	12	ND
Chloroform/1,1,1-TCA[c]	4.7	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND
Xylenes	ND	ND	ND	ND	ND	ND
Unknown (VOCs)	ND	ND	ND	ND	ND	ND

(Continued)

TABLE A2-2. (Continued)

Analytes Detected	BORING #02 SAMPLE DEPTH						
	4 feet	7 feet	17 feet	26 feet	49 feet	63 feet	70 feet
	Concentrations in μg/kg						
Soil[a]							
Chlorobenzene	NS	ND	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND	ND
trans 1,2-DCE	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	2.4 J	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	9.9 @	ND	ND
	Concentrations in parts per billion by volume						
Soil Gas[b]							
trans 1,2-DCE	11.3	ND	ND	11	ND	ND	29
TCE	0.4	7	ND	ND	12	ND	ND
PCE	1.5	ND	ND	ND	10	ND	ND
Chloroform/1,1,1-TCA[c]	3.2	ND	ND	ND	16	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Toluene	Q	ND	ND	ND	ND	ND	ND
Xylenes (Total)	Q	ND	ND	ND	890	ND	ND
Unknown (VOCs)	ND	ND	ND			ND	

(Continued)

TABLE A2-2. (Continued)

Analytes Detected	BORING #03 SAMPLE DEPTH						
	6 feet	8 feet	19 feet	34 feet	44 feet	54 feet	67 feet
	Concentrations in μg/kg						
Soil[a]							
Chlorobenzene	NS	ND	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND	ND
trans 1,2-DCE	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND	ND
	Concentrations in parts per billion by volume						
Soil Gas[b]							
trans 1,2-DCE	26.8	ND	ND	ND	ND	11	ND
TCE	96.5	32	ND	ND	ND	ND	ND
PCE	2.2	ND	ND	ND	ND	ND	ND
Chloroform/1,1,1-TCA[c]	5.4	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Toluene	Q	ND	ND	ND	ND	ND	ND
Xylenes (Total)	Q	ND	ND	ND	ND	ND	140
Unknown (VOCs)	ND	ND	ND	ND	912		

(Continued)

TABLE A2-2. (Continued)

	BORING #04 SAMPLE DEPTH					
Analytes Detected	6 feet	10 feet	16 feet	35 feet	40 feet	54 feet
	Concentrations in $\mu g/kg$					
Soil[a]						
Chlorobenzene	NS	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND
trans 1,2-DCE	NS	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND
	Concentrations in parts per billion by volume					
Soil Gas[b]						
trans 1,2-DCE	5.4	ND	ND	ND	ND	ND
TCE	0.4	15	ND	8	ND	ND
PCE	1.6	ND	ND	3	ND	ND
Chloroform/1,1,1-TCA	1.8	ND	ND	2	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
Toluene	Q	ND	ND	ND	ND	ND
Xylenes (Total)	Q	ND	ND	ND	ND	ND
Unknown (VOCs)	ND	ND	ND	ND	465	ND

(Continued)

TABLE A2-2. (Continued)

	BORING #05 SAMPLE DEPTH						
Analytes Detected	6 feet	8 feet	20 feet	33 feet	58 feet	67 feet	76 feet
	Concentrations in μg/kg						
Soil[a]							
Chlorobenzene	NS	ND	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND	ND
trans 1,2-DCE	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND	ND
	Concentrations in parts per billion by volume						
Soil Gas[b]							
trans 1,2-DCE	6.2	ND	ND	ND	ND	ND	ND
TCE	2.0	ND	ND	ND	ND	ND	ND
PCE	11.6	4280	ND	ND	ND	ND	ND
Chloroform/1,1,1-TCA[c]	1.5	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
Xylenes (Total)	Q	ND	ND	ND	ND	ND	ND
Unknown (VOCs)	ND	ND	ND	ND	ND	ND	ND

(Continued)

TABLE A2-2. (Continued)

	BORING #06 SAMPLE DEPTH					
Analytes Detected	6 feet	6 feet	8 feet	12 feet	20 feet	28 feet
	Concentrations in $\mu g/kg$					
Soil[a]						
Chlorobenzene	NS	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND
trans 1,2-DCE	NS	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND
	Concentrations in parts per billion by volume					
Soil Gas[b]						
trans 1,2-DCE	ND	ND	ND	ND	ND	ND
TCE	73.4	ND	3200	ND	5070	40.6
PCE	7410.0	ND	14	ND	18.8	ND
Chloroform/1,1,1-TCA[c]	78.3	ND	ND	ND	14.8	ND
Benzene	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND
Xylenes	ND	ND	ND	ND	ND	ND
Unknown (VOCs)	ND	ND	ND	ND	ND	ND

(Continued)

TABLE A2-2. (Continued)

	BORING #06 SAMPLE DEPTH (Continued)		
Analytes Detected	39 feet	48 feet	69 feet
	Concentrations in μg/kg		
Soil[a]			
Chlorobenzene	ND	ND	ND
1,1-DCA	ND	ND	ND
trans 1,2-DCE	ND	ND	ND
Ethylbenzene	ND	ND	ND
1,1,1-TCA	ND	ND	ND
TCE	ND	ND	ND
Xylenes	ND	ND	ND
	Concentrations in parts per billion by volume		
Soil Gas[b]			
trans 1,2-DCE	ND	ND	ND
TCE	ND	254	46.9
PCE	ND	73.9	ND
Chloroform/1,1,1-TCA[c]	ND	ND	ND
Benzene	ND	ND	ND
Toluene	ND	ND	ND
Xylenes	ND	ND	ND
Unknown (VOCs)	ND	ND	ND

[a] Soil analyses performed by SW8240.

[b] Soil gas analyses performed by field gas chromatograph include eight analytes.

[c] Compounds coelute.

@ Estimated concentration, less than five times the detection limit.
ND = Not detected
NS = Not sampled
J = Detected at less than the reported detection limit.
Q = Data qualifed; concentrations detected in blanks or affected by drift of baseline.

TABLE A2-3. CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL AND SOIL GAS SAMPLES FROM VALIDATION BORINGS, SITE 24

	BORING #01 SAMPLE DEPTH							
Analytes Detected	6 feet	9 feet	16 feet	24 feet	24 dup	41 feet	56 feet	64 feet
	Concentrations in µg/kg							
Soil[a]								
Chlorobenzene	NS	ND	ND	830	930	4.7 J	NS	22 J
1,1-DCA	NS	ND	ND	ND	ND	ND	NS	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND	NS	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND	NS	ND
TCE	NS	4.6 @	15	ND	ND	ND	NS	ND
Xylenes	NS	ND	ND	ND	ND	ND	NS	ND
trans-1,2-DCE	NS	ND	18 @	ND	ND	5.0 J	NS	720
	Concentrations in parts per billion by volume							
Soil Gas[b]								
trans 1,2-DCE	30.7	ND	57	41	NS	122	46	95
TCE	850.0	949	46	23	NS	439	11	7
PCE	33.0	ND	7	6	NS	21	1	1
Chloroform/1,1,1-TCA[c]	74.6	128	13	8	NS	14	9	ND
Benzene	ND	ND	ND	8,990	NS	2,889	ND	ND
Toluene	ND	ND	ND	8,365	NS	4,535	ND	1
Xylenes (Total)	511,000 Q	340	ND	358,425	NS	54,897	2,055	391
Unknown (VOCs)	ND	ND	103,570	480,390	NS	28,374	ND	ND

(Continued)

TABLE A2-3. (Continued)

Analytes Detected	BORING #02 SAMPLE DEPTH 6 feet	9 feet	16 feet	28 feet	53 feet	78 feet
	Concentrations in μg/kg					
Soil[a]						
Chlorobenzene	NS	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND
Toluene	NS	3.5 J	ND	ND	ND	ND
trans 1,2-DCE	NS	ND	ND	ND	5.9 J	ND
	Concentrations in parts per billion by volume					
Soil Gas[b]						
trans 1,2-DCE	5.3	69	233	150	23	4.4
TCE	1.2	391	2	43	23	12,625
PCE	0.6	6	1	2	ND	10
Chloroform/1,1,1-TCA[c]	1.2	42	8	6	ND	182
Benzene	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND
Xylenes (Total)	ND	ND	ND	ND	ND	ND
Unknown (VOCs)	ND	ND	ND	ND	ND	8,220

(Continued)

TABLE A2-3. (Continued)

	BORING #03 SAMPLE DEPTH					
Analytes Detected	6 feet	5 feet	14 feet	34 feet	44 feet	69 feet
	Concentrations in $\mu g/kg$					
Soil[a]						
Chlorobenzene	NS	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	ND	ND
Ethylbenzene	NS	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	ND	ND
Xylenes	NS	ND	ND	ND	ND	ND
	Concentrations in parts per billion by volume					
Soil Gas[b]						
trans 1,2-DCE	2.6	14	NS	NS	ND	ND
TCE	10.4	10	NS	NS	ND	3,350
PCE	7.5	7	NS	NS	ND	10
Chloroform/1,1,1-TCA	6.2	6	NS	NS	ND	57
Benzene	ND	6	NS	NS	ND	ND
Toluene	ND	6	NS	NS	ND	ND
Xylenes (Total)	ND	6	NS	NS	105	985
Unknown (VOCs)	ND	6	NS	NS	ND	2,440

(Continued)

TABLE A2-3. (Continued)

Analytes Detected	BORING #04 SAMPLE DEPTH 6 feet	8 feet	18 feet	31 feet	61 feet	75 feet
	Concentrations in μg/kg					
Soil[a]						
Chlorobenzene	NS	ND	ND	ND	ND	ND
1,1-DCA	NS	ND	ND	ND	5.8@	14 @
Ethylbenzene	NS	ND	ND	ND	ND	ND
1,1,1-TCA	NS	ND	ND	ND	ND	ND
TCE	NS	ND	ND	ND	100	280
Xylenes	NS	ND	ND	ND	ND	ND
trans-1,2-DCE	NS	ND	ND	ND	5.4 J	6.9 J
	Concentrations in parts per billion by volume					
Soil Gas[b]						
trans 1,2-DCE	10.9	97	130	ND	ND	NS
TCE	2280.0	1,490	6,800	7,100	18,600	NS
PCE	4.0					NS
Chloroform/1,1,1-TCA	19.3	ND	8	ND	6	NS
Benzene	ND	7	29	27	ND	NS
Toluene	ND	ND	ND	ND	ND	NS
Xylenes (Total)	ND	ND	ND	ND	ND	NS
Unknown (VOCs)	3000.0	ND	ND	ND	ND	NS
		ND	ND	ND	40,900	

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[a] Soil analyses performed by SW8240.

[b] Soil gas analyses performed by field gas chromatograph include eight analytes.

[c] Compounds coelute.

@ Estimated concentration, less than five times the detection limit.

ND =Not detected

NS = Not sampled

J = Detected at less than the reported detection limit.

Q = Data qualifed; concentrations detected in blanks or affected by drift of baseline.

A3.0 PHASE 1: SOURCE IDENTIFICATION

Phase 1 of the Remedial Investigation (RI) in Operable Unit (OU) B has two objectives:

- To determine the presence or absence of contaminants above background concentrations in soil, soil gas, and surface water at sites, or portions of sites, that have not previously been investigated; and
- To reach the decision that a source of contaminants exists at the site and the extent of contamination, migration pathways, and potential health and environmental impacts from the source must be determined.

If neither of the objectives is met, the site may be recommended for no further investigation. If contamination is detected but no source is found, additional investigation will be conducted in the RI to locate the source of the contaminants.

Methods of investigation that will be used in Phase 1 are:

- Surface geophysics to locate underground tanks or pipelines;
- Soil gas sampling in shallow soils;
- Soil sampling at depths from 0.25 to 95 feet;
- Subsurface soil gas sampling in soil borings;
- Surface water sampling in drainages and creeks; and
- Chemical and physical analyses of soil.

The process to be followed in taking any site in OU B through Phase 1 is outlined in a series of decision points, within criteria for site categorization, sample spacing, analytical methods, sample collection, data validation, data analysis, and source identification. Sites that have identified sources will proceed to Phase 2 in Section A4.0.

A3.1 Phase 1: RI Decision Process

Phase 1 is initiated with a categorization of the sites to be investigated. Sites are placed in categories on the basis of Preliminary Assessments/Site Inspection information.

Site categorization is the first decision point in Phase 1 (Figure A1-2). The criteria for categorization are:

- If a potential contaminant discharge point (such as an underground tank, a sump, pipeline cracks, or a drain for chemical runoff) has been identified in previous investigations and no soil gas investigation was conducted within 100 feet of the potential discharge point, the location is a Suspected Source Target; sites may have one or more Suspected Source Targets;
- If a site or portion of a site has no identifiable discharge points but may have received multiple discharges of non-volatile organic compound (VOC) contaminants from container spills or surface runoff, the location is an Undefined Discharge Target; and
- If a soil gas investigation was conducted at this site, evaluate data under Soil Gas Investigation Criteria.

Soil Gas Investigation Criteria:

- If VOC concentrations in any near-surface sampling point is greater than 100 parts per billion by volume (ppbv) total halogenated volatile organic compounds (HVOCs), or greater than 500 ppbv total aromatic volatile organic compounds (AVOCs), sampling locations will be selected under Lateral Spacing Criteria for Soil Gas Targets;
- If VOC concentrations at all sampling locations or in an array of sampling locations at a site are less than 100 ppbv total HVOCs or less than 500 ppbv total AVOCs and AVOC or other contaminant

discharge point is suggested by previous information, sampling locations will be selected under Lateral Spacing Criteria for Undefined Discharge Targets.

A3.2 Lateral Spacing Criteria

The initial Phase 1 sampling locations are selected on the basis of previous investigation data, including the Soil Gas Investigation data and the physical setting of the site. Lateral Spacing Criteria are separated into three general categories: Suspected Source Targets, Undefined Discharge Targets, and Soil Gas Targets (Table A3-1) and are used to determine the locations of samples to be collected in Phase 1. Sampling points shown in Section 3.0 are for Phase 1 only and are based on the Lateral Spacing Criteria. The distribution of all Phase 1 boring locations proposed within the boundaries of OU B is shown in Plate 1. All sampling points shown in figures are approximate. Access to specific sampling points may be limited by the working space needed for drilling equipment, by aboveground or belowground utilities not identified on plan maps, or by Air Force activities or operations that must be conducted.

Lateral spacing criteria for specific site categories are outlined in the following sections. The criteria are intended to be directives for the selection of sampling points; however, logistical factors (stated above), worker health and safety, and good scientific judgement will be considered in selection of sampling points in the field.

A3.2.1 Suspected Source Targets

These are target areas selected on a site because there is potential for subsurface discharge from a sump, aboveground tank, underground tank, or identified crack or break in an underground pipeline or trench and because soil gas sampling for VOCs is not possible or inappropriate (e.g., diesel fuel, fuel oil, or polychlorinated biphenyls [PCB] holding tanks and pipelines). The criteria are:

- Targets inside an active building or mat area:
    - For exposed trenches, sumps or drains, have liquids removed or flow stopped; examine bottom for cracks, seams, or

TABLE A3-1. DESCRIPTION OF LATERAL SPACING CRITERIA CATEGORIES

Category	Description
Suspected Source Targets	
- Underground	Potential discharge points are below-grade or underground facilities or equipment. Examples include underground sumps, tanks, pipelines, and trenches.
- Aboveground	Potential discharge points are aboveground liquid containment facilities. Examples include concrete equalization tanks, metal storage tanks, and aboveground sumps.
Undefined Discharge Targets	
- Uniform Areas of Contamination	Potential discharges resulted in a relatively uniform distribution of contamination due to either large spills of uniform concentrations or frequent small spills over the entire site. Examples include wastewater overflow areas, ash disposal sites, and small container storage areas.
- Nonuniform Areas of Contamination	Potential discharges occured at one or more discrete areas of contamination within a larger area of no or lesser contamination. Examples include areas of occasional spills and known areas of contamination that lack field reference points by which to locate the source.
- Surface Drainage Areas	Areas containing surface waters or sediments that potentially received liquid contaminants directly from surface discharges or from rainwater runoff. Examples include creeks, drainage ditches, and intermittent streams.
Soil Gas Target	Potential discharge areas were identified during the Soil Gas Investigation as areas within soil gas concentration isopleths.

corrosion; determine if foundation can be cored to allow placement of hand auger boring to sample soils below selected cracks or seams; collect samples, if possible.

  - For covered pipelines or tanks, recommend pressure testing; determine if foundation can be cored to allow placement of hand auger boring to sample soils below selected locations; collect samples, if possible.

  - If borings are not feasible, sample soils at depth below bottom of pipeline or tank at nearest outside location; evaluate groundwater for contaminants in the nearest, accessible downgradient location.

- Targets outside of active building or mat area:
  - Pretested pipelines: locate borings within 5 feet of previously identified cracks or leaks, but distance between borings should not be less than 25 feet.

  - Untested pipelines: locate borings along untested sections, with focus on joints and bends, but distance between boring should not be less than 25 feet.

  - Underground tanks: If tank is in place and less than 5,000 gallons, select one boring location at each end of tank.

    If tank is in place and has a capacity equal to or greater than 5,000 gallons, select four boring locations around tank; select points of pipe connection, soil discoloration, or one on each side and one at each end of tank.

  - Undefined steel tank or pipeline locations: conduct surface geophysical survey, magnetometer, or ground penetrating radar to determine location and size, then locate borings as indicated for identified pipelines and tank locations.

- Removed tanks:
  - -- If tank has been removed and contaminants were detected in soil samples below the tank or soils were not tested, select two boring locations along the long axis of a tank that contained 5,000 gallons or less; and two borings along the long axis of larger tanks.

- Aboveground Tanks:
  - -- Small tanks, 6 to 8 feet in longest dimension: determine direction of overland flow of liquid if tank leaked or discharged; locate drainage collection points, depressions, or ditches that may have received liquid discharge; locate one boring at each potential collection point with a maximum of four borings.

A3.2.2 Undefined Discharge Targets

Sites or portions of sites and Investigation Clusters (ICs) included in this category are former chemical waste storage areas, potential disposal sites, and surface drainages at which one or more discharges may have occurred but in non-specific, undefined areas. The sites in this group include locations at which PCBs, semivolatile organic compounds, metals, and to a lesser extent, VOCs. This category is used for sites at which VOCs are not expected to be contaminants of greatest concern or at which a soil gas sampling was conducted and no locations meet Soil Gas Target criteria.

Within the category of Undefined Discharge Targets, there are three subcategories identified: Uniform Areas of Contamination, Nonuniform Areas of Contamination, and Surface Drainage Areas. The following sections described the methodology used for determining lateral sample spacing within each subcategory of targets. Lateral spacing determinations within each subcategory differ as a result of the potential distribution of contaminants. The potential distribution of contaminants within subcategories was determined from documentation of historical practices at each site.

Uniform Areas of Contamination

Systematic sampling was chosen for a number of the sites in OU B because it is easily implemented under field conditions and provides for uniform coverage of the site, which may provide more accurate statistical estimates such as mean concentrations. In a systematic sampling design, a single point is chosen at random, then sampling occurs at equidistant intervals thereafter (Gilbert, 1987, p. 89). For this investigation, intervals were chosen using two-dimensional grids superimposed on the site. The sampling grids were constructed according to published methods (U.S. EPA, 1989a), using either a square or triangular grid depending on the geometry of the site.

Systematic triangular grids were constructed as follows. First, a site reference point was identified by which field sampling personnel would be able to measure sampling locations. Second, a site coordinate system was defined based on measurements from the site reference point. A point was selected on one of the coordinate axes using a statistically random procedure and two rays were drawn at 60 and 120 degrees to the coordinate axis from this initial point. Finally, the grid was constructed by drawing lines parallel to each of the original rays at increments equal to the calculated grid spacing.

Systematic square grids were also constructed using X and Y coordinates overlaid on a map of the sample area. An initial point was selected from within the sampling area by a statistically random procedure. Using this initial location as the intersection of two grid lines, additional grid lines were drawn parallel to the coordinate axes at increments equal to the calculated grid spacing.

The grid spacing *G* was calculated from the desired number of sampling locations *n*, which is based on site-specific conditions, and the size of the sampling area *A* such that for square grids:

$$G = (A / n)^{1/2}$$

and for triangular grids:

$$G = (A / 0.866\, n)^{1/2}$$

A minimum of four locations will be sampled for each area of 1,000 to 10,000 square feet on a site that is categorized as a uniform area of potential contamination. For sites less than 1,000 square feet in area, one to four locations may be selected contingent upon site conditions and access to all portions of the area. For areas greater than 10,000 square feet, one location will be added for each additional 10,000 square feet of area to be investigated. For unusually shaped sample areas, the geometry of the area may have affected the number of sample points. In addition, if previous analytical data exist from representative locations, the total number of sampling locations may be reduced by the number of previous soil borings.

Prior information for some sites indicates that contamination may not have been distributed uniformly over the entire area, but that subareas, or *strata*, within the site may be homogeneous. For these sites, each stratum will be sampled using an independent sampling strategy that may differ from other strata in the density of sampling points, the choice of analytical methods, or procedures in choosing sampling locations. This independent treatment of subareas is referred to as *stratified sampling.*

Similarly, small and unusually shaped sites may result in a systematic grid that does not sample the site uniformly. These sites will also be sampled using a stratified sampling method where the strata will be evenly spaced and one or more sampling location will be selected from within each strata using a statistically random procedure. This hybrid approach is referred to as *simple random stratified sampling.*

Nonuniform Areas of Contamination

The sampling objective at some sites is not to estimate the average concentration of a contaminant but to determine whether localized areas of contamination are present. The method used for locating areas of contamination was adapted from Gilbert (1987, pp. 119-131).

First, certain assumptions were made regarding the size and shape of the area of contamination. In general, the shape of the area of contamination was assumed to be circular or elliptical. For subsurface targets, this applies to the projection of the target to the surface. All assumptions made for each site are explained in Section 3.0, Site-Specific Sampling Plans.

Second, a systematic rectangular or triangular grid was constructed for locating areas of contamination, using a method similar to that described above for uniform areas of contamination. However, for nonuniform areas, the grid spacing *G* was obtained using nomographs describing the relationship between grid spacing, the size and shape of an area of contamination and the acceptable risk β of missing the area of contamination with the specified grid spacing (Gilbert, 1987, pp. 119-125). For this sampling and analysis plan, the acceptable risk of missing an area of contamination is 0.1, which corresponds to 90 percent confidence of finding an area of contamination if in fact one exists in the study area.

For detecting one circular area of contamination, the distance between lines in the sampling grid, or grid spacing *G*, was calculated for each site using the formula:

$$G = \frac{R}{k}$$

where *R* is the estimated radius in feet of the area of contamination, and $k = 0.495$ for a triangular grid and 0.952 for a 2:1 rectangular grid (Gilbert, 1987, pp. 122 and 124).

For sites where contaminant discharges may have occurred, but specific discharge areas cannot be identified, the objective is to determine if contamination exists. For these sites, the sampling strategy was to design a triangular grid with grid spacing *G* and a confidence level of 90 percent for detecting all areas of contamination of a specified size and shape. The triangular grid will be sampled with a spacing equal to the value G. The probability of missing *all* areas of contamination (P_n) in the grid can be calculated from:

$$P_n = P_1^n$$

where *n* is the assumed number of areas of contamination in the study area and P_1 is the probability of missing one area of contamination using the same grid spacing. For example, from the nomographs in Gilbert, the probability P_1 of missing one 10-foot-diameter area of contamination is 0.62 using a grid spacing of 10.1 feet; therefore, if five areas of contamination occurred randomly within the study area, the probability P_5 of missing all five areas of contamination would be:

$$(0.62)^5 = 0.09,$$

which corresponds to a 91 percent probability of detecting at least one of the five areas of contamination.

If contamination is detected in *any* of the samples from the sampling, indicating that waste handling activities have resulted in contamination at the site, stepout sampling will be conducted in Phase 2 from triangular grid rows. At the completion of the Phase 2 sampling, there will be 90 percent probability that the location of all areas of contamination of a specified size and shape have been identified within the study area.

Surface Drainage Areas

Surface drainage areas are ditches, creeks, and intermittent streams that potentially received discharges of wastes directly from facilities and/or from sediments transported by surface runoff. Sampling locations within OU B will include open drainage ditches that direct runoff to the north toward Magpie Creek or to the south and off-base toward Arcade Creek.

- For drainages: 1) Collect surface water samples from flowing runoff or standing water in low points in the drainage within 24 hours of a rain event; one sample must be taken at points where drainage exits McClellan AFB property and at 500-foot intervals along drainages in OU B; if no flowing surface water is observed in the drainage during a 12-month period, surface water sampling is not necessary; and 2) Also collect sediment samples from low points where surface water collects after surface waters have dissipated.

Although Magpie Creek does not flow through OU B, the portion of the creek that flows west of McClellan AFB will be sampled as Special Study Area 3 in the OU B RI. The same basic strategy will be used for Magpie Creek as for other surface drainages, but no surface water samples will be taken. Only one mile of the creek bed downstream of the base boundary will be sampled.

- Magpie Creek Drainage: stream sediments will be sampled at a minimum of four locations within 1,000 feet of the base boundary at approximately 250-foot intervals, and six locations will be sampled from 1,000 to 5,000 feet of the base boundary.

- Locations to be selected are surface water collection points, confluences, and storm drain discharge points; hand augers will be used to collect sediment samples to a depth of 3 feet.

A3.2.3 Soil Gas Targets

Soil Gas Targets are indicators of VOC contamination that occurs in soil gas. They represent areas of subsurface contamination. Although VOC contamination may migrate in soil gas from the original discharge point, Soil Gas Targets are sampled on the assumption that VOCs in soil gas have not migrated more than 100 feet laterally from discharge points. For sites which have been sampled for VOC concentrations in soil gas in shallow soils, the lateral spacing of sampling points is determined by the area enclosed by approximate isopleths of VOC concentrations.

Isopleth lines have been drawn for sites at which soil gas concentrations exceeded 100 ppbv HVOCs or 500 ppbv AVOCs in at least two sampling locations (see isopleths in figures for Site-Specific Sampling Plans, Section 3.0). Isopleths for adjoining sites have been connected if sampling locations were equal to or less than 100 feet. The area within the 100 ppbv or 500 ppbv isopleths is a Soil Gas Target. In locations where only one sample location exceeded the criteria, the location alone is considered a Soil Gas Target. The lateral spacing of soil sampling points in targets is determined by the following:

- Place sampling points in a triangular grid, with a 50- to 60-foot spacing between points, in the entire area of the target;

- At least one sampling point should be placed within the isopleth representing the highest VOC concentration;

- Incorporate any sampling points placed at Suspected Source Targets (Section A3.2.2) into the grid if they also fall within the target area;

- At locations where a soil gas target is represented by only one sampling point, place a probe within 10 feet of the target;

- Outside of soil gas targets, place sampling points in a triangular grid with a spacing of 100 feet between soil gas targets on the same site that are equal to or less than 500 feet apart; if other soil gas targets are greater than 500 feet away, create a "buffer zone" of sampling locations, stepping outward approximately 100 feet in each direction from the outer isopleth of the soil gas target (utilize any Suspected Source Target borings in the sampling locations in the buffer zone).

The lateral distribution of sampling points within Soil Gas Targets was based on the methods of Gilbert (1987) for statistically based sampling, to locate a contaminated area. The assumptions used in applying the method are: the acceptable risk of missing an area of contaminated soil is 10 to 20 percent, the area of VOC-contaminated soil that is of concern has a radius of 25 feet or more, and the area is approximately circular. Using the curves and method of calculation from Gilbert (1987), sampling spacing in the grid should be 55 feet. A grid spacing of 50 to 60 feet, allowing for underground utilities and other field conditions, will be considered adequate to evaluate Soil Gas Targets. A grid spacing of 100 feet will be used outside of Soil Gas Targets because the potential for the presence of VOC discharge point outside of the targets is considered less.

A3.3 Vertical Spacing Criteria

After the Lateral Spacing of sampling points for a site is determined, the vertical spacing will be determined. Four methods of vertical sampling are available in Phase 1: surface scrapes, hand auger borings, reconnaissance borings, and deep borings. The method selected at a location is dependent on the depth of sampling required. The selection of vertical sampling points is site-specific and can be modified to increase the number of samples taken in the field during sampling activities.

The depth of sampling in Phase 1 is dependent on the approximate mobility (migration potential) and potential exposure pathways identified for contaminant species that may be present in soils. The sampling methods and sample horizon criteria for Phase 1 are:

- Low mobility contaminants (PCBs, inorganic compound solids, semivolatile organic compounds, asbestos) that may have been potentially discharged to surface soils and have a potential direct contact or airborne particulate exposure pathway. Sample with surface scrapes to a maximum depth of 3 inches (0.25 feet).

- Mobile contaminants (VOCs, fuel hydrocarbons, phenols) and less mobile contaminants (soluble inorganic and radionuclide species, semivolatile compounds) that may have been discharged to surface soils and that have potential to enter groundwater or soil ingestion pathway. Sample, with hand auger borings, in horizons from 1 to 5 feet BGS.

- Mobile contaminants that may have migrated from surface discharge in infiltrating rainwater or subsequent liquid waste discharge or from subsurface discharge points (tanks, sumps, pipeline leaks), and that have potential to enter the groundwater or soil ingestion pathway. Sample, with power assisted split-spoon samplers in reconnaissance borings, in horizons from 1 to approximately 20 feet BGS.

- Mobile contaminants that may have migrated from surface or subsurface discharge points, that have been detected below 30 feet BGS in previous sampling, and that have potential to enter the groundwater pathway. Sample, with power assisted split-spoon samplers in deep borings, in horizons from 20 to 95 feet BGS.

- Mobile and volatile contaminants that may migrate in the soil gas to the air or groundwater pathways from surface or subsurface discharges. Sample soil gas in reconnaissance or deep borings at approximate depths of 20, 40, 60, 80, and total depth.

In reconnaissance and deep borings, the horizons selected for sampling will not be pre-selected.

Soil samples will be selected from various depths in order to characterize soil contamination. A minimum of three horizons will be sampled for analysis between the surface and 20 feet BGS in reconnaissance or deep borings. A minimum of four horizons will be sampled between 20 feet and 95 feet BGS in deep borings. Specific sampling horizons will be determined using the following general criteria:

- Sample selection will begin adjacent to or beneath the shallowest potential discharge depth; sampling will continue to the pre-selected total depth of the boring or to a depth interval 5 feet below the greatest discharge depth at the location (e.g., bottom of a tank or sump) or to the base of observed waste or contamination, whichever is greater;

- Representative samples will be collected in soil containing observed waste or obvious contamination;

- Representative samples will be collected from soil intervals in which photoionization detector (PID) readings are ≥ 50 ppmv; and samples may be collected from intervals with PID readings of 20 to 49 ppmv if the readings are 10 times greater than other readings in the boring;

- Representative samples will be collected from intervals with discolored soils or chemical odors;

- Representative samples will be selected from fine-grained (clay, silt, or fine sand) layers 1 foot or greater in thickness that are observed in core collected from depths between potential discharge points and the total depth of the borings; and

- In borings located adjacent to, or as stepouts from, borings in which contaminants were previously detected, samples will be collected from layers at the same depth and 10 to 20 feet below the depth at which contaminants were previously detected; these samples will be collected from the fine grained deposits in the intervals.

A3.4 Analytical and Depth Matrix

A matrix table has been developed for each site-specific sampling and analysis plan. The matrix summarizes the criteria for analytical methods and the depths of sample collection for each site. Analytical methods were selected on the basis of the types of contaminants suspected in each potential source area and the sensitivity of the various methods for detecting the suspected contaminants. The analytical methods that will be used for the suspected contaminants in OU B are presented in Table A3-2.

The depth intervals indicated for sample collection are also based on the types of contaminants suspected in the area of characterization and their likelihood of migrating through the soil and subsurface deposits in OU B. Because one objective of Phase 1 is to locate the source of contaminants at a site, samples will be taken at depths in which the highest concentration of suspected contaminants are likely to be found. Factors that govern contaminant movement through soils include the adsorptive capacity of the soil and the affinity of the contaminant for soil particles relative to its solubility in percolating water. Figure A3-1 generalized depth intervals for selection of analytical methods; it is a guide for Phase 1 sampling based on the vertical migration capability of contaminant groups under the generalized subsurface conditions that exist beneath OU B. Vertical migration potential of contaminants at each site cannot be determined prior to Phase 1 drilling.

Decisions on sampling made with the matrix are based on observations made in the field. Table A3-3 presents the approximate depth intervals from which samples will be taken for each analytical method.

A3.4.1 Acids and Bases

The concentration of acids and bases will be measured using pH measurements. Several components of the soil matrix act to reduce any extreme values of pH in the soil, including cation exchange sites, soil organic matter, aluminum hydroxides and oxides, and carbonates (Dragun, 1988, pp. 198-200). The net result is that the highest concentrations of acids and bases are likely in the interval nearest the source. Therefore, all intervals between 1 and 20 feet below the source will be sampled and analyzed for pH when acids or bases are suspected contaminants.

TABLE A3-2. ANALYTICAL METHODS FOR SUSPECTED CONTAMINANT TYPES IN SOIL

Suspected Contaminant	8010	8015/ 5030	8015/ 3550	8040	8080	8240	8270	8280	6010	7421	7471	9010	HML338	9045	7060	PLM, Asbes	9310
Acids														✓			
Asbestos																✓	
Bases														✓			
Burn residues							✓	✓									
Cyanide												✓					
Fuels and oils		✓	✓														
Organic Lead													✓				
Metals									✓		✓						
Other SVOs							✓										
Paints			✓			✓			✓								
PCBs					✓												
Pesticides					✓					✓					✓		
Phenols				✓													
Radionuclides																	✓
Solvents, halogenated in water	✓					✓											
Solvents, mixed						✓											
Unknown compounds						✓	✓		✓								

EPA 8010 = Halogenated VOCs
EPA 8015/5030 = Volatile TPH
EPA 8015/3550 = Extractable TPH
EPA 8040 = Phenols
EPA 8080 = Pesticides/PCBs
EPA 8240 = GC/MS VOCs
EPA 8270 = GC/MS Semivolatile organics
EPA 8280 = Dioxins/dibenzofurans
EPA 6010 = Metals
EPA 7421 = Lead
EPA 7471 = Mercury
EPA 9010 = Cyanide
HML 338 = Organic lead
EPA 9045 = pH
EPA 7060 = Arsenic
PLM Asbes = Asbestos
EPA 9310 = Alpha and beta emitters

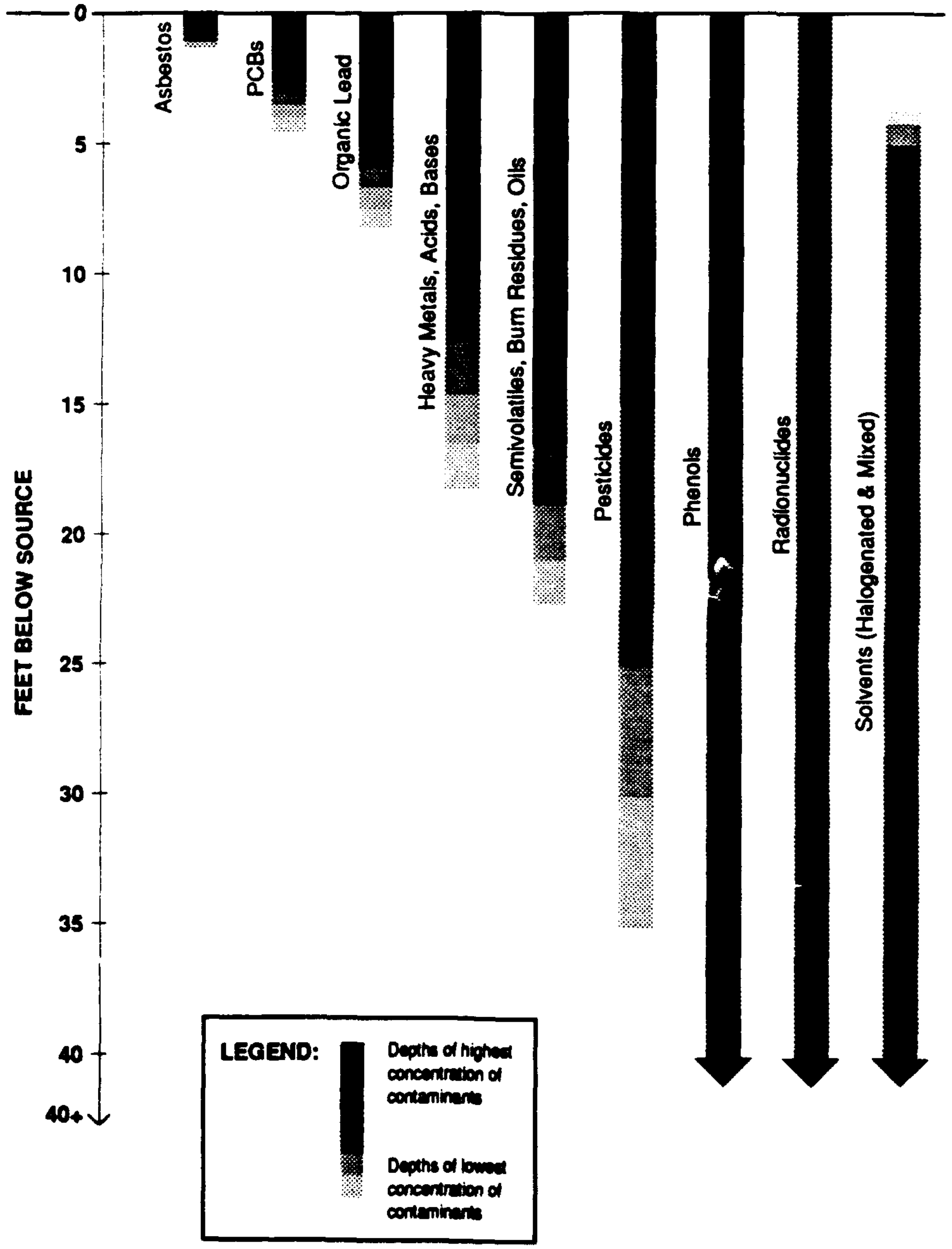

Figure A3-1. Sampling Depth Intervals for Contaminant Groups (Based On Vertical Migration Potential).

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TABLE A3-3. SAMPLING MATRIX OF ANALYTICAL METHODS AND DEPTHS FOR SOIL AND SOIL GAS

Analytical Method	Depth Interval Below Surface (feet)				
	0.25	1-5	5-10	10-20	20-95
SW6010	S	A	A	--	--
SW7196,7421,7471	S	A	A	--	--
SW8015/3550	--	A	A	P	P
SW8015/5030	--	A	A	A	A
SW8020/FVOC	--	A	A	A	A
SW8040	--	A	A	A	A
SW8080/FPCB	S	P	--	--	--
SW8240/FVOC	--	A	A	A	A
SW8270	S	A	A	--	--
SW8280	S	A	A	A	--
SW9010	--	--	A	A	A
SW9045	--	A	A	--	--
SW9310	S	P	P	P	P
U.S. EPA 901.1	S	P	P	P	P
FGC	--	--	--	C	C
HML 338	--	A	A	A	--
PLM Asbestos	S	--	--	--	--

S = Collect and analyze sample if location was unpaved during period of contaminant use, storage or discharge.
A = Collect and analyze sample.
C = Collect soil gas sample and analyze for VOC concentration.
P = Collect and analyze soil sample if physical evidence suggests contaminant discharge or discoloration.

SW8015/5030 = Volatile PH
SW8015/3550 = Extractable PH
SW8040 = Phenols
SW8080 = Pesticides/PCBs
SW8240 = GC/MS VOCs
SW8270 = GC/MS Semivolatile organics
SW8280 = Dioxins/dibenzofurans
SW6010 = Metals
SW7421 = Lead
FVOC = Screening for VOC with field gas chromatograph
FPCB = Screening for PCBs with field gas chromatograph

SW7196 = Hexavalent chromium
SW8020 = Aromatic VOCs
SW7471 = Mercury
SW9010 = Cyanide
SW9045 = pH
SW7060 = Arsenic
SW9310 = Gross α, β
U.S. EPA 901.1 = γ Emitters
FGC = Soil gas analysis by field gas chromatograph
HML 338 = Organic lead
PLM Asbestos = Asbestos

A3.4.2 Asbestos

Asbestos is an insoluble fibrous mineral. It is measured by microscopic examination for the presence of the characteristic shape of the asbestos mineral. The highest concentrations of asbestos in soils from a surface source are likely to be within 0.25 feet of the source. Asbestos samples will be taken at greater depths only if asbestos materials are evident in debris penetrated during drilling.

A3.4.3 Burn Residues

A historical waste disposal practice at McClellan AFB was to burn refuse or waste materials in pits to reduce their volume. The ash and residues remaining from this practice may contain hazardous compounds. The compounds present depend on the original material burned and the combustion conditions. Typically, these residues contain ash (consisting of metal oxides) and polynuclear aromatics resulting from incomplete combustion of the wastes. If chlorinated solvents were part of the original waste material, polychlorinated dibenzodioxins and furans may also be present. In general, these residues are relatively insoluble in percolating water, have high affinities for organic carbon in the soil matrix, and tend to remain near their source (Dragun, 1988, pp. 243-250). Therefore, at sites where burn residues are suspected, samples will be taken in the depth interval from surface to 20 feet BGS.

A3.4.4 Cyanide

Cyanide compounds were used in metal cleaning and plating operations at OU B. Cyanide compounds are reactive and form many different compounds and complexes with soil minerals, resulting in a decrease in cyanide concentrations with depth. Furthermore, soluble cyanide compounds decompose in oxidizing environments, and are not likely to exist in high concentrations near the soil surface. Therefore, cyanide will not be analyzed at depths less than 5 feet BGS or more than 55 feet below the source.

A3.4.5 Volatile Petroleum Hydrocarbons

Fuels that were used in OU B include jet fuels and gasoline, and consist of volatile and semivolatile compounds. As a group, these compounds have relatively low water solubilities, high affinities for soil organic carbon, and tend to remain near their source (Dragun, 1988, pp. 243-250). Volatile components such as benzene, toluene, and xylenes are present in fuels. These volatile compounds have water solubilities equivalent to halogenated organic compounds. Where these compounds are suspected of being present, samples will be taken at the same depths as halogenated VOCs.

A3.4.6 Metals

Although metals compounds are a diverse group, some general characteristics can be described regarding their potential to migrate. The mobility of metals is limited by the solubility product of cationic and anionic species in percolating wastewater or rainwater. Because heavy metals commonly form insoluble precipitates with a number of anionic species at neutral or alkaline pH, and are attracted to solid minerals and organic compounds in soils, these metals tend to remain near their source and not migrate with percolating water (Lindsay, 1979). Therefore, metals will be analyzed in the intervals from surface to 10 feet where metal contaminants are suspected.

A3.4.7 Organic Lead

Organic lead compounds, particularly tetraethyl lead, are contained in leaded gasoline. Organic lead compounds are volatile, insoluble in water, and tend to remain near the source of gasoline. Samples for organic lead analyses will be collected at locations where leaded gasoline may have been stored.

A3.4.8 Extractable Petroleum Hydrocarbons

Oils used in OU B include lubricating oils, machining oils, and hydraulic fluids. These oils have relatively high viscosities, low vapor pressures (i.e., have low volatility), low solubility in percolating water, and tend to remain near their source. Therefore, soil samples will be collected for extractable petroleum hydrocarbon analysis in the interval from 1 foot to 10 feet BGS where oils are suspected.

A3.4.9 Other Semivolatile Organic Compounds

Unspecified semivolatile compounds are a heterogeneous class of compounds with a wide range of physical characteristics. However, in general, they have relatively low water solubilities, low vapor pressures, and have a tendency to remain near their source (Dragun, 1988, pp. 243-250). Therefore, soil samples will be collected in the interval from surface to 10 feet BGS where these compounds are suspected.

N-Nitrosodiphenylamine

N-nitrosodiphenylamine is a semivolatile compound that has been reportedly detected in soils at OU B in previous investigations. The source of this compound is unknown. However, since this N-nitrosodiphenylamine is indistinguishable from the more common diphenylamine in the analytical method U.S. EPA Method 8270, the possibility exists that diphenylamine, and not the more toxic N-nitrosodiphenylamine, is actually the compound present in the soils at OU B. Therefore, when N-nitrosodiphenylamine is detected in future analyses using U.S. EPA Method 8270, the same soil sample will be analyzed by U.S. EPA Method 607 with a Florisil cleanup to distinguish between the two compounds.

A3.4.10 Paints

Paints may contain heavy metal pigments (e.g., lead and cadmium), solvents, and other semivolatile compounds. The metal compounds and semivolatile compounds tend to remain near their source (as discussed above), whereas solvents are more soluble and tend to migrate to greater depths. Therefore, soil samples taken at potential sources of paint contamination will be collected and analyzed in the interval from surface to 20 feet BGS; deeper intervals will be sampled if soil gas results are above the soil gas decision criteria, as discussed above. (In Figure A3-1, paints are not listed separately, but rather are broken down into their components of concern: metals, other semivolatile compounds, and solvents.)

A3.4.11 Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls have historically been found in insulating oils in electrical equipment. These compounds have very low water solubilities, are strongly adsorbed onto soil particles, and tend to remain near their source. Therefore, soil samples will be collected and analyzed in the interval from surface to 5 feet BGS. If VOCs are detected in soil samples in the area where PCBs are detected, subsequent sampling will be conducted at depths of 10 and 15 feet for PCB analyses. Deeper sampling is warranted because PCB mobility may be increased by the VOCs.

A3.4.12 Pesticides

Pesticides are a heterogeneous class of compounds with a wide range of physical characteristics, including vapor pressure, water solubilities, and migration tendencies. Therefore, the compounds will be analyzed in all samples in all intervals from surface to 20 feet BGS at sites where potential sources of pesticide contamination exists.

A3.4.13 Phenols

Phenols are relatively soluble in percolating water, but have relatively low vapor pressures, making soil gas screening an unreliable indicator of their presence. Therefore, if phenols are suspected contaminants, soil samples will be collected for analysis at all intervals from 5 feet below the source to groundwater.

A3.4.14 Radionuclides

Radionuclides from classified research projects are suspected contaminants at some sites at OU B. Because specific isotopes that may have been used are unknown, it is not possible to predict the intervals with the maximum concentration of these contaminants. However, field survey equipment are reliable indicators of alpha (α), beta (β), and gamma (γ) radiation, and will be used in the field to screen samples for the presence of radioactive contamination. If field screening indicates samples are above background radiation levels, samples will be analyzed by the appropriate laboratory methods.

A3.4.15 Solvents

Solvents have been used extensively at McClellan AFB for degreasing, cleaning, and other industrial applications. Solvents contain VOCs that have relatively high solubilities in water, have moderate tendencies to adsorb on soil particles, will enter soil gas in their vapor phase, and have potential to migrate to groundwater. Therefore, soil gas results will be used to decide which depths will be analyzed for VOCs and whether drilling will continue to greater depths, as described above.

A3.4.16 Unidentified Compounds

Because specific compounds could not be identified, specific depths of maximum contamination cannot be predicted. Therefore, at selected sites where a variety of contaminants may have been used or stored, samples from each interval to a depth of 15 feet below a potential source will be analyzed for heavy metals (U.S. EPA Method 6010) and semivolatile compounds (U.S. EPA Method 8270) to determine if any previously identified analytes in those groups are present. Unidentified VOCs will be screened by U.S. EPA Method 8240 analyses.

A3.5 Field Sampling and Analysis

Implement the sampling and analysis program that was determined by the decision process. After samples are taken and analyses are performed at a site, the Phase 1 decision process continues with data analysis;

- Go to Integrated Data Analysis Criteria.

A3.6 Integrated Data Analysis Criteria

Several types of data will be generated at each site in OU B during Phase 1: field observations, lithologic descriptions, waste descriptions, organic vapor analyzer readings, field gas chromatograph data for soil gas, and laboratory analytical data. Before Phase 1 decisions can be made, the data must be adequately evaluated through a procedure that integrates all of the data for the site. The procedure will evaluate the quality of the data and provide a methodology to reduce the data for effective decision making. Data from the field and laboratory will both be taken through the steps of evaluation.

A3.6.1 Quality Assurance/Quality Control (QA/QC)

- Level I data from the field: pertinent field observations (e.g., odors, equipment behavior), lithologic descriptions, waste descriptions, field organic vapor analyzer readings, field radiation readings, and sample collection depths will be screened for quality by geologic field supervisor and California Registered Geologist prior to entry in database.

- Level II data: soil gas concentrations and moisture content from field gas chromatograph laboratory will be reviewed by designated QA/QC specialist for conformance with Level II standards prior to entry in database.

- Level III data: laboratory analytical data for sites and background study area reviewed by QA/QC specialist for conformance with Level III standards prior to entry in database.

A3.6.2 Entry in Database

- Enter unqualified lithologic and field data into geologic database for graphics generation; go to Data Plotting.

- Enter all analytical data in principal database; flag qualified data.

A3.6.3 Compare Data to Background and Practical Quantitation Limits (PQLs)

- Statistical evaluation: determine means, ranges, and standard deviation for analytes from background study area.

- Screen development: prepare screen of Background values and Practical Quantitation Limits for comparison with site data.

- Site data comparison: compare site analytical data to Background/PQL screen.

A3.6.4 Data Plotting

- Geologic plotting: prepare geologic cross sections through site with soil borings deeper than 6 feet; prepare surface lithologic map of site if borings are less than 6 feet deep.

- Sample distribution plotting: prepare sample map of lateral sample data; add analytical data to cross sections; prepare isopleth maps for data exceeding background and PQL values.

A3.7 Phase 1 Decision Criteria

Field and analytical data for Phase 1 sampling at a site have been checked for quality, entered into the database, compared with background and PQLs, and plotted. The data can be evaluated with the following Phase 1 decision criteria.

A3.7.1 Soil Gas Target Data

- Soil sample data from site or adjacent site indicate a source of VOC contaminants in soil gas target area; go to Final Phase 1 Decision.
- Soil sample data from site or adjacent site do not indicate a source of VOC contaminants in soil gas target area; return to A3.5, Field Sampling and Analysis to offset borings in soil gas target.

A3.7.2 Suspected Source, Non-Soil Gas Targets or Surface Drainage

- In active buildings and mats: sample data or other data indicate a contaminant source, recommend a corrective action to the Air Force that will eliminate future discharge.
- Outside of buildings and mats: contaminants detected above Background or PQLs are contained within the boundaries of the site; go to Final Phase 1 Decision.

A3.7.3 Final Phase 1 Decision

- Contaminant concentrations in soil or water samples from site are below Background or PQL values for analytes expected at site; move site data to storage file; recommend no further action at site.

- Contaminant concentrations from site exceed Background or PQL values; advance site and data to Phase 2.

A4.0 PHASE 2: EXTENT DETERMINATION

Sites or portions of sites in Operable Unit (OU) B that enter Phase 2 after the Final Phase 1 Decision have concentrations of contaminants in soil or surface water that exceed Background or Practical Quantitation Limits (PQLs) and may be considered contaminant sources or source areas. In Phase 2, all information available for sites from Preliminary Assessments/Site Investigations (PA/SI), OU B Groundwater Remedial Investigation (OUBGRI), and Groundwater Sampling and Analysis Program (GSAP), and Phase 1 field programs flow to decision points in the Remedial Investigation (RI) Decision Process. The criteria established at each decision point are intended to attain the objectives of Phase 2.

The Phase 2 objectives are:

- Determination of the horizontal and vertical extent of contaminants in soil, soil gas, and groundwater that have originated at source areas in OU B;
- Identification of potential contaminant migration pathways from sources to groundwater, surface water, or air;
- Identification of sources of the contaminants migrating in groundwater beneath OU B that lie outside of the boundaries of OU B;
- Definition, with 80 percent or greater probability, the volume of soil containing contaminants in a source area;
- Characterization of exposure pathways and preliminary human health or environmental risks resulting from contaminant magnitude and extent in a source area; and
- Preliminary evaluation of remedial alternatives that may be applicable to the contaminant source.

The flow of information for each site through the decision process for Phase 2 is illustrated in Figure A1-4. Decision point criteria are explained in the following sections.

A4.1 Contaminant Review Criteria

- Review Phase 1 analytical data for contaminants detected above Background or PQLs; determine if any were unexpected (e.g., volatile organic compounds [VOCs] in polychlorinated biphenyls [PCB] storage area; metals in VOC spill area).

- For detected contaminants in sources: assess associated or degradation species not previously analyzed (e.g., dioxin compounds, hexavalent chromium, polyaromatic hydrocarbons); assess any differences in migration behavior and potential health risk from associated or degradation species.

- Sampling strategy: refine sampling strategy, and health and safety plan for associated or degradation species of concern.

- Analysis strategy: review analytical methods and PQLs for each analyte detected or potentially present to determine if methods with lower PQLs are required to evaluate soils or water concentrations with respect to action levels or Levels of Concern for health risk or environmental degradation.

A4.2 Lateral Spacing Criteria

- Review site and source grouping: group adjacent sites or sources for more efficient sampling if similar contaminants are detected near common boundaries; site or source group is considered the source area through Phase 2 protocol.

- First Phase 2 stepout locations: to determine extent of contamination in the volume of soil extending outward from a sample location or cluster of locations containing contaminants exceeding

Background or PQL values; for all stepouts, do not select Phase 2 locations in active buildings.

- For Undefined Discharge Targets, select soil sample locations at points half the distance to the nearest sample locations which had no detectable contaminants; go to Vertical Sampling Criteria.
- For Soil Gas and Suspected Source Targets, select sample locations at 50-foot radial distances in directions away from Phase 1 locations at which contaminants were detected; incorporate all Phase 1 and 2 sample locations in the source area into a triangular array; sample soils at a maximum of four locations at a 50- to 60-foot distance from any Phase 1 boring in the first Phase 2 stepout sampling; go to Vertical Spacing Criteria.

- Subsequent Phase 2 stepouts: if analyses of Phase 2 stepout samples indicate presence of contaminants exceeding Background or PQL values, repeat the following until contaminants are below Background or PQL in samples or specified distance limits are reached or if the only available stepout locations are in active buildings:
  - For Undefined Discharge Targets, select a sample location 75 percent of the distance from the Phase 2 boring that contained contaminants and the nearest sample location with no detectable contaminants. If the distance from the previous Phase 2 sample location to the new location is 10 feet or less, do not sample; go to Extent Determination. If greater than 10 feet, go to Vertical Spacing Criteria.
  - For Soil Gas and Suspected Source Targets, select sample locations at 75-foot radial distances away from those Phase 2 borings containing samples with contaminants; incorporate sample locations in the source area or the nearest adjacent

source area into the sample array; if a previously sampled Phase 1 or Phase 2 sampling point is less than 75 feet away, do not select a sample in that direction; go to Vertical Spacing Criteria.

A4.3 Vertical Spacing Criteria

The criteria for vertical sample spacing in Phase 2 are generally consistent for all targets or source types. The criteria are based upon the need to define vertical penetration of contaminants and potential migration pathways. Criteria are divided by the sampling interval in which the previous contaminants were detected above Background or PQLs in the most recent sampling event. The Vertical Spacing Criteria may be used several times during Phase 2 to determine vertical extent of contamination at a source. In all sample locations, sample any waste or any soils penetrated during sampling that have physical characteristics indicating contaminants.

- Surface Scrape Locations: collect and analyze scrapes at stepout locations indicated by lateral spacing criteria; at a location adjacent to the scrape location with the greatest level of contaminant on the site, drill a boring to 5 feet; collect a minimum of two samples from any fine-grained (silt, clay, fine sand) layers from 0.5 feet to total depth.

- Hand Auger Locations: collect and analyze samples from fine-grained layers in the same depth interval that contaminants were detected in the previous boring and an additional deeper interval in all stepout locations indicated by lateral spacing criteria; at locations adjacent to hand auger borings in which contaminants were detected above 1 foot of the bottom of the boring, drill a boring to 20 feet BGS and sample fine-grained layers greater than 1 foot in thickness between the total depth of the hand auger boring and the total depth of the Phase 2 boring.

- Reconnaissance and Deep Boring Locations: collect and analyze samples from fine-grained layers greater than 1 foot in thickness in the same depth interval that contaminants were detected in the previous boring and fine-grained layers in intervals 10 to 20 feet deeper, in all stepout locations indicated by the lateral spacing criteria; at locations adjacent to Phase 1 or Phase 2 20- to 90-foot borings in which contaminants were detected at the bottom of the boring, drill a deeper boring, but not greater than 95 feet BGS or into saturated soils, and sample fine-grained layers to determine the depth of contaminant penetration; below 95 feet BGS, sample only groundwater by Hydropunch® or monitoring well methods.

A4.4 Analysis and Depth Matrix

The contaminants that were detected or analyzed for Phase 1 (Section A3.4) will also be the focus of analyses in Phase 2. However, Level IV and Level V methods which are rigorous QA/QC standards may be required to meet Data Quality Objectives (DQOs) for risk assessment. Groundwater sampling and analysis will be conducted in Phase 2 to determine if contaminants detected in soil or soil gas have reached groundwater.

- Soil Gas Contaminants: samples will be collected and analyzed for eight VOCs at depths of 20 feet and each soil sampling point prescribed by the Phase 2 Vertical Spacing Criteria, at any site where VOCs were detected in soil samples in Phase 1.

- Soil Contaminants: samples collected at depths prescribed by the Phase 2 Vertical Spacing Criteria will be analyzed for contaminants detected in the nearest Phase 1 or Phase 2 boring; additional analyses may be requested if unexpected wastes, discolored soil, or odorous soils are penetrated in Phase 2.

- Soil Physical Properties: samples will be collected for determination of physical properties in selected samples in sources where vertical migration of contaminants to groundwater must be considered and where remedial alternatives will be contingent upon the properties; analyses to determine total organic carbon content, soil moisture content, hydraulic permeability, porosity, bulk density, specific gravity, and grain size distribution will be performed on samples from selected depths at a source where soil remediation is suggested by the magnitude and extent of contamination.

- Groundwater Sampling: samples will be analyzed by U.S. EPA Methods appropriate for detection of contaminants that are present in the soil or soil gas beneath sources; analyses will be performed on samples from Phase 2 borings or monitoring wells to identify source areas at which vertical contaminant migration has resulted in groundwater contamination.

A4.5 Field Sampling and Analysis

Field sampling and analyses may consist of several visits to some source areas in OU B during Phase 2. After initial stepout samples are collected and analyzed, it may be necessary to return to some source areas for second or third rounds of stepout sampling to determine the extent of contamination in the soil, soil gas, or groundwater that has migrated from sources. After each round of stepout sampling and analysis, decisions will be made in data analysis before additional sampling is planned.

- If analyses of stepout samples indicate valid concentrations greater than Background or PQL values, return to subsequent Phase 2 stepouts under Lateral Spacing Criteria.

- If analyses of stepout samples indicate valid concentrations less than Background or PQL values established for analytes, proceed to Integrated Data Analysis Criteria.

A4.6 Integrated Data Analysis Criteria

The procedure described for Phase 1 Integrated Data Analysis (Section A3.6) will be followed with some modification in Phase 2. The modifications are more rigorous quality assurance/quality control (QA/QC) and additional analytical levels for risk assessment and geostatistical analysis of data. The steps of Phase 2 data analysis and modifications from Phase 1 are described in the following sections.

A4.6.1 Quality Assurance/Quality Control

- Level I through Level III data analysis as described in Phase 1 (Section A3.6.1).

- Level IV data: rigorous QA/QC and data validation with methodology for small concentrations of contaminants.

A4.6.2 Entry in Database

- Enter lithologic and field data into geologic database for graphics generation; go to data plotting.

- Enter all analytical data into principal database; flag qualified data.

A4.6.3 Comparison to Background and PQL

- Source area data comparison: compare analytical data to background/PQL screen developed in Phase 1; if none of the samples from the most recent sampling exceed Background or PQL or if no additional sampling locations are possible (e.g., location in active buildings or mats or location enters the sample array of an adjacent site), go to data plotting.

- Source area data comparison: if samples exceed Background or PQLs at one or more locations in the area, return to subsequent Phase 2 stepouts under Lateral Spacing Criteria to determine additional sampling locations.

A4.6.4 Data Plotting/Spatial Geostatistics

- Geologic plotting: prepare geologic cross sections through source areas with soil borings deeper than 6 feet; prepare surface lithologic map of site if borings are less than 6 feet deep.

- Sample distribution plotting: prepare sample map of lateral sample data; add analytical data to cross sections; prepare isopleth maps for data exceeding background and PQL values.

- Spatial geostatistical analysis:

  -- For source areas with a lateral array of sample locations with contaminants exceeding Background or PQLs, conduct a probability-spatial analysis to determine the area that has an 80 percent probability of containing contaminants (see Flatman, et al., 1985).

  -- For sources with vertical array of sample locations with contaminants exceeding Background or PQLs, conduct a probability-spatial analysis to determine the subsurface area that has an 80 percent probability of containing contaminants.

  -- Proceed to Phase 2 Decision Criteria.

A4.7 Phase 2 Decision Criteria

Decisions that must be made before a source proceeds to Phase 3 result from preliminary evaluation of pathways of exposure, human health risks, and environmental impacts of the contaminants detected. Only those sources which have a 50 percent or greater probability of requiring remedial action should proceed to Phase 3. The decision to remediate any site containing contaminants will be made after alternatives are evaluated in the Feasibility Study (FS). However, preliminary assessment of the need for remedial action can be made by comparing Phase 1 and Phase 2 data with preliminary action levels. The criteria that are the bases for the assessment are described in the following sections.

A4.7.1 Groundwater Criteria

Because a number of groundwater samples collected beneath OU B have had differing suites of contaminants, source areas located upgradient from the detected groundwater contaminants must be evaluated for their potential past or ongoing impact on groundwater. All source areas with mobile contaminants detected at below 1 foot BGS will be assessed for potential future impacts on the groundwater pathway.

- Groundwater-source contaminant comparison: from a plot or table of vertical contaminant distribution data for a source, identify contaminants detected in soils, soil gas, or groundwater at depths of 35 feet or greater; from these contaminants, identify Migration Indicator Contaminants (MICs), a listing of contaminants, degradation products, and relative concentrations, for the source; compare the MIC list to contaminants detected in groundwater samples from the nearest downgradient well in the A (shallowest) Geohydrologic Zone (it is important that compared groundwater samples are taken from points within the same waterbearing zone and that flow directions are known).

  -- If two or more of the contaminants on the MIC list have been detected in the nearest downgradient A zone well at concentrations having a similar relationship of concentrations (e.g., TCE > 1,2-DCE > 1,1-DCA) and contaminants in groundwater upgradient from the source area have a dissimilar contaminant relationship or occur in lower concentrations, the source area can be considered a "tentative source of groundwater contaminants"; any source area that is a tentative source will proceed to Phase 3.

  -- If the MICs listed for soil, soil gas, or groundwater at 75 feet or greater beneath a source area are different than those in the nearest downgradient well or occur in a dissimilar relationship of concentrations compared to analyses of samples from the well, the source area is a "potential future source of groundwater contaminants"; the construction of a new monitoring well should be considered if the nearest well is not within 100 feet of the source area, not located on a flow direction downgradient from the highest contaminant concentrations in the source area, or not screened in the A monitoring zone; after well construction and sampling, the potential future source will proceed to Phase 3.

-- If the contaminants migrating in groundwater cannot be associated with MICs for any investigated source area lying along the flowpath of groundwater, or if contaminant concentrations increase in groundwater upgradient along the flowpath, it will be necessary to track contaminant concentrations upgradient to their sources by careful location of monitoring wells along groundwater flow directions projected upgradient from identified sources in OU B. The tracking of contaminants may continue beyond the boundaries of OU B to adjacent operable units or geographic areas. Potential sources identified by tracking an OU B plume to its origin will be considered for evaluation in accordance with Phase 1 and Phase 2 procedures.

A4.7.2 Potential Action Levels

- Deep soil contaminant distribution: from the plot of contaminant distribution data for the source area, identify any contaminants occurring in the depth range of 20 to 95 feet BGS:

  -- Compare soil contaminant concentrations to Levels of Concern for Health Risk Assessment (HRA) for deep soils in Table 4-3; if any concentrations detected in soil samples exceed the Levels of Concern (HRA) concentration, the source will proceed to Phase 3.

  -- If contaminant concentrations are less than Levels of Concern (HRA) for deep soils, contaminant transport modeling calculations will be performed with contaminant and physical property data applicable to the source area; if calculations from the transport modeling indicate the source area is unlikely to result in groundwater concentrations exceeding Levels of Concern (HRA) for groundwater or

Maximum Contaminant Levels (MCLs) in Table 4-4, the source area will not proceed to Phase 3; however, all Phase 1 and Phase 3 data will be evaluated for health and environmental risk factors in the RI/FS report.

  - If the calculations from contaminant transport modeling indicate groundwater concentrations could exceed Levels of Concern (HRA) or MCLs for groundwater, the source area will proceed to Phase 3.

- Shallow soil contaminant distribution: from the plot of contaminant distribution data for the source, identify contaminants occurring in the depth range from 0 to 20 feet BGS:

  - Compare the contaminant concentrations detected to Levels of Concern (HRA) for shallow soils in Table 4-3; if the contaminants detected in soil samples exceed the Levels of Concern (HRA), the site will proceed to Phase 3.

  - If the contaminants detected in soil samples do not exceed Levels of Concern (HRA), the site will not proceed to Phase 3, but all contaminant concentration data will be evaluated for health and environmental risk factors in the RI/FS report.

A4.7.3 Soil Gas Criteria

- Soil gas contaminant distribution: from the plot of soil gas concentrations obtained in near surface and downhole probe samples, determine the approximate volume and concentration of soil gas in the source area:

  - If soil concentrations have a mean concentration of 1,000 ppbv or less total VOCs in a soil volume of 200,000 cubic feet or less in a source area, the source area will not proceed to Phase 3; however, the concentration of VOCs that may migrate to the air pathway will be determined through surface flux measurements; the data obtained will be evaluated for health and environmental risk factors in the RI/FS report.

  - -- If soil gas concentrations have a mean concentration greater than 1,000 ppbv total VOCs in a soil volume of 200,000 cubic feet or greater, the source area will proceed to Phase 3.

A4.7.4 Surface Water/Stream Sediment Criteria

- From a plot of contaminant distribution in creeks and drainages: identify any surface water stream sediment samples in which contaminant concentrations exceed Ambient Water Quality Standards to Protect Freshwater Aquatic Life or Federal or California Maximum Contaminant Levels (MCLs) for drinking water.

- If contaminants detected in the creek or drainage equal or exceed any of the Ambient Water Quality Standards or MCLs, the location of the sample, the portion of the creek or drainage extending downgradient from the sample point, and the source of the water will proceed to Phase 3.

  - -- If surface water samples did not exceed the Ambient Water Quality Standards or MCLs, the site will not proceed to Phase 3, but data will be evaluated for health or environmental risk factors in the RI/FS report.

  - -- If stream sediment sample concentrations equal or exceed Levels of Concern (HRA) for shallow soils, the course of the stream where the samples were taken will proceed to Phase 3.

  - -- If stream sediment sample locations are less than Levels of Concern (HRA) concentrations, the site will not proceed to

Phase 3; however, the data will be evaluated for health and environmental risk factors in the RI/FS report.

A5.0 PHASE 3: REMEDIAL ALTERNATIVE EVALUATION

In Phase 3, information obtained during Phase 1 and Phase 2 for each source or groundwater volume that is preliminarily identified for remediation is evaluated to estimate remedial action and cleanup levels on the basis of potential health risk and Applicable or Relevant and Appropriate Requirements (ARARs). Following that evaluation, the data for each source will be assessed to determine if they are sufficient to evaluate remedial alternatives and prepare accurate risk assessments. If they are not, additional data will be collected during Phase 3.

The objective of Phase 3 sampling and analysis of this remedial investigation is to collect additional data for an accurate characterization of the potential risk and an evaluation of engineering alternatives that may be applied to the sources or contaminated groundwater. The following description of Phase 3 activities is not amenable to the decision criteria format of Phases 1 and 2.

A5.1 Preliminary Risk Assessment and ARAR Evaluation

With the data from each source containing contaminated groundwater, a preliminary baseline risk assessment will be conducted to evaluate the degree of risk that contaminants pose for human health and the environment. The preliminary risk assessment will be performed in accordance with the *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual* (U.S. EPA, 1989b) and with U.S. EPA Region IX - Risk Assessment Guidance (1990). However, risk assessment results obtained in Phase 3 will undergo additional evaluation prior to completion of the Remedial Investigation/Feasibility Study (RI/FS) report.

Preliminary cleanup levels for contaminants in soil, soil gas, surface water, and groundwater will be developed in part from the risk assessment results. Potential receptors and exposure pathways for on-base and off-base populations will be evaluated. Future uses of the land area in Operable Unit (OU) B will also be considered in the development of cleanup levels.

Contaminant concentrations in all media will also be evaluated in terms of ARARs. All promulgated requirements that affect contaminants and remedial activities on federal facilities will be evaluated. The ARARs identified for the OU B remedial actions will be reviewed with the agencies that have signed the Interagency Agreement (1990).

When preliminary cleanup levels for sites, groups of sites, or groundwater in OU B have been identified, remedial alternatives that will attain the cleanup levels can be selected and evaluated.

A5.2 Remedial Alternatives

Because the OU B RI/FS will be performed concurrently, development of alternatives is an interactive process in which potential alternatives and remediation goals are continually refined as additional information from the RI becomes available (U.S. EPA, 1989b). Specific data requirements for the development of remedial alternatives include a determination of the volumes or areas of waste or media that need to be addressed, the chemical-specific information on the waste constituents, and information necessary to identify those remedial action alternatives that would be effective for the contaminants and media of concern.

A5.2.1 Additional Volume Determination

An evaluation of remedial alternatives requires a detailed comparative analysis of several criteria, including analysis of the implementability and cost of each alternative. For an accurate evaluation of these criteria, specific information is necessary regarding the volume or areas of waste, contaminated soil, soil gas, or groundwater that needs to be addressed. Preliminary volume and area determinations will be based on results of Phase 1 and Phase 2. However, additional information may be required as specific remedial alternatives are refined. Any additional volume and area information required will be obtained in limited sampling during Phase 3.

A5.2.2 Waste Constituent Determination

Although results of Phase 1 and Phase 2 will be used to identify hazardous constituents of media that need to be addressed, other constituents or characteristics of the media affect the feasibility of specific remedial alternatives. As remedial alternatives are developed, specific data needs may be identified that must be answered before further refinement of remedial alternatives can proceed. These data needs will be satisfied by limited sampling during Phase 3 for chemical or physical analysis. Specific test methods will be specified as remedial alternatives are identified.

A5.2.3 Treatability Studies

Treatability studies are conducted to provide sufficient data to allow treatment alternatives to be fully developed and evaluated and to reduce cost and performance uncertainties for treatment alternatives to acceptable levels. Because data requirements depend on the specific treatment technologies and contaminants and matrices of concern, the results of Phase 1 and Phase 2 site characterization will influence the types of data required during Phase 3. Treatability studies may be conducted on soil, soil gas, or groundwater.

A data gathering procedure closely related to treatability studies is aquifer testing. To evaluate the velocity of contaminant migration and to determine the design of remedial action, aquifer parameters for the zones containing contaminated groundwater will be needed. The parameters will be obtained by pump testing or slug testing in wells constructed for monitoring or for extraction.

After the volume, wastes, and treatability for the site have been characterized from existing data or Phase 3 sampling, no additional sampling at the site will be done. Decisions in Phase 3 will be based on the results of previous sampling and analysis. Therefore, a sampling decision protocol is not needed in the latter part of Phase 3.

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APPENDIX B

Derivation of Levels of Concern for Health Risk Assessment

B1.0 DERIVATION OF LEVELS OF CONCERN FOR HEALTH RISK ASSESSMENT

Definition of levels of concern for contaminants is necessary in a Remedial Investigation (RI) to assure that the quality of data collected is adequate to determine if a remedial action is required. The "action levels," the contaminant concentration ranges above which a remedial action may need to be taken, may be determined at a site by promulgated applicable or relevant and appropriate requirements (ARARs). However, ARARs at McClellan Air Force Base (AFB) have not been defined. An action level for specific contaminants is not required before starting a site characterization; however, an approximation is necessary to ensure that analytical methods to be used are sufficiently accurate. Based on the assumption that remedial actions for sites at McClellan AFB will be determined by Health Risk Assessments (HRAs), levels of concern have been estimated to meet the HRA requirements. Levels of concern estimated to meet those requirements are referred to here as "Levels of Concern (HRA)." In Section 4.0 of this Operable Unit B Remedial Investigation Sampling and Analysis Plan (OU B RI SAP), the Levels of Concern (HRA) are listed for comparison with Maximum Concentration Levels (MCLs) for drinking water and maximum contaminant levels for the protection of freshwater aquatic species.

Health-based levels of concern for the HRA have been derived using intake algorithms published in the U.S. Environmental Protection Agency's (U.S. EPA's) *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (U.S. EPA, 1989b). These Levels of Concern (HRA) were established utilizing conservative assumptions. The use of conservative assumptions was necessary because site-specific ARARs have not been established for McClellan AFB. In addition, these assumptions were used because the risk assessment has not been performed, and specific information pertaining to contact frequency and duration, contact intimacy, and contaminant distribution has not fully been established. Algorithms for incidental oral ingestion and direct dermal contact were used to calculate Levels of Concern (HRA) using reference doses (RfDs) or risk-specific doses (RSDs). The algorithm for drinking water was used to derive levels of concern for water, and inhalation algorithms were used for the air pathway.

When deriving levels of concern for the OU B RI from U.S. EPA intake algorithms, certain assumptions apply to all media. These general assumptions include a

1.0×10^{-4} risk level for carcinogens in soils, an adult body weight of 70 kilograms (kg), a life span of 70 years, an exposure frequency of 365 days/year, and an average exposure duration of 9 years (U.S. EPA-recommended average residence time). The assumption of 1.0×10^{-4} risk level for carcinogens is based on the discussion of cumulative carcinogenic site risk in a U.S. EPA Memorandum dated 22 April 1991 (OSWER Directive 9355.030). Another assumption is that the fraction ingested from contaminated media (versus not contaminated media), which corresponds to the "FI" factor in the algorithms, is assumed to be 100 percent. An exception to this last assumption is for soil (incidental ingestion and skin contact) where contact with soil at a depth of 20 feet or greater is assumed to be no greater than 10 percent (i.e., FI = 0.1). Because of this reduced potential for contact, deep soils have Levels of Concern (HRA) that are 10 times greater than those for shallow soils. Media-pathway-specific assumptions are described in the following sections.

B2.0 SOIL LEVELS OF CONCERN (HRA)

Levels of concern (HRA) for soils analyzed in the Operable Unit B Remedial Investigation (OU B RI) were derived for incidental ingestion, dermal absorption, and the combined pathways. The derivation of these limits is described in the following sections.

B2.1 Incidental Soil Ingestion

For the incidental soil ingestion pathway, the following algorithm from the Superfund risk assessment guidance was used to derive detection limits:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CS = Soil Concentration (mg chemical/kg soil);
IR = Ingestion Rate (mg soil/day);
CF = Conversion Factor (1.0×10^{-6} kg soil/mg soil);
FI = Fraction Ingested from Contaminated Source;
EF = Exposure Frequency (days/year);
ED = Exposure Duration (years);
BW = Body Weight (kg); and
AT = Averaging Time (period in days over which exposure is average).

The Superfund risk assessment guidance recommends values for the various parameters in this equation as described in Section B1.0. In addition, an IR of 100 mg/day is recommended for adults. Although not specifically recommended in the guidance, an FI value of 1.0 (the most conservative value) is used for the surface soil layer. A less conservative FI value of 0.1 is assumed for soils at a depth greater than one foot, since at this depth, surface soil would have to be removed before direct contact could occur. The AT of 9 years is multiplied by 365 days/year for noncarcinogens and of 70 years is multiplied by 365 days/year for carcinogens. Thus, for noncarcinogens the algorithm becomes:

Intake (mg/kg-day) =

$$\frac{CS \times 100 \text{ mg/day} \times 1.0 \times 10^{-6} \text{ kg/mg} \times 1.0 \times 365 \text{ days/year} \times 9 \text{ years}}{70 \text{ kg} \times 9 \text{ years} \times 365 \text{ days/yr}}$$

This reduces to:

$$\text{Intake (mg/kg-day)} = CS \times (1.43 \times 10^{-6} \text{ kg soil/kg-day})$$

If intake is set at the reference dose (RfD) (i.e., acceptable daily intake) for a particular noncarcinogen and the equation is solved for CS, then:

$$CS \text{ (mg chemical/kg soil)} = RfD \div (1.43 \times 10^{-6} \text{ kg soil/kg-day})$$

Thus, the Level of Concern (HRA) may be derived by dividing the RfD by the simplified factor calculated from the dose algorithm.

For carcinogens, the AT is 70 years multiplied by 365 days/year, instead of 9 years multiplied by 365 days/year. Thus:

$$\text{Intake (mg/kg-day)} = CS \times (1.84 \times 10^{-7} \text{ kg soil/kg-day})$$

which, when intake is set at the risk-specific dose (RSD) and solved for CS, converts to:

$$CS \text{ (mg chem/kg soil)} = RSD \div (1.84 \times 10^{-7} \text{ kg soil/kg-day})$$

where RSD is a dose corresponding to a particular probability of contracting cancer if exposed to that dose every day for a 70-year lifetime.

B2.2 Dermal Absorption

The same approach may be taken for the dermal absorption pathway (i.e., absorption of contaminants from soil via the skin). The algorithm from the Superfund risk assessment guidance is:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times FI \times EF \times ED}{BW \times AT}$$

where:

CS = Soil Concentration (mg chemical/kg soil);
CF = Conversion Factor (1.0 x 10^{-6} kg soil/mg soil);
SA = Skin Surface Area Available for Contact (square centimeters [cm^2]/event);
AF = Soil to Skin Adherence Factor (mg/cm^2);
ABS = Absorption Factor;
FI = Fraction Contacted from Contaminated Source;
EF = Exposure Frequency (days/year);
ED = Exposure Duration (years);
BW = Body Weight (kg); and
AT = Averaging Time (period in days over which exposure is averaged).

As for the incidental ingestion pathway, the Superfund risk assessment guidance recommends values for several of the equation parameters in this equation. Assuming hand and arm (no leg) exposure, the SA is 3,120 cm^2 for an adult male. A conservative estimate for AF is 2.77 mg soil/cm^2 skin. For the ABS, a default value of 0.03 (3 percent) is assumed. This is judged to be health-protective for most compounds which would not be expected to partition from soil to skin at this high a level. An FI value of 1.0 is used for surface soils. An FI of 0.1 is assumed for soils at a depth greater than one foot since the surface soil layer would have to be removed before direct contact could occur. The recommended values for EF, ED, BW, and AT are the same as those recommended for the incidental ingestion pathway. Thus, for noncarcinogens, the algorithm becomes:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times 1.0 \times 10^{-6} \times 3{,}120 \times 2.77 \times 0.03 \times 1.0 \times 365 \text{ days/year} \times 9 \text{ years}}{70 \text{ kg} \times 9 \text{ years} \times 365 \text{ days/year}}$$

This reduces to:

$$\text{Absorbed Dose (mg/kg-day)} = \text{CS} \times (3.70 \times 10^{-6} \text{ kg soil/kg-day})$$

If the absorbed dose is set at the RfD (i.e., acceptable daily intake) for a particular noncarcinogen and the equation is solved for CS, then:

$$\text{CS (mg chem/kg soil)} = \text{RfD} \div (3.70 \times 10^{-6} \text{ kg soil/kg-day})$$

Therefore, the Level of Concern (HRA) may be derived by dividing the RfD by the simplified factor calculated from the skin absorption dose algorithm.

For carcinogens, the AT is 70 years multiplied by 365 days/year, instead of 9 years multiplied by 365 days/year. Thus:

$$\text{Absorbed Dose (mg/kg-day)} = \text{CS} \times (4.76 \times 10^{-7} \text{ kg soil/kg-day})$$

which, when dose is set at the RSD and solved for CS, converts to:

$$\text{CS (mg chem/kg soil)} = \text{RSD} \div (4.76 \times 10^{-7} \text{ kg soil/kg-day})$$

where RSD is a dose corresponding to a particular probability of contracting cancer if exposed to that dose every day for a 70-year lifetime.

B2.3 Combined Direct Contact Pathways

The two pathways of incidental soil ingestion and dermal absorption may be combined to derive a Level of Concern (HRA) for noncarcinogenic effects, which accounts for both pathways. The combined equations become:

$$\text{Total Dose (mg/kg-day)} = \text{RFD for incidental ingestion} + \text{RFD for dermal}$$

$$= (\text{CS} \times 1.43 \times 10^{-6}) + (\text{CS} \times 3.70 \times 10^{-6})$$

$$= \text{CS} \times (1.43 \times 10^{-6} + 3.70 \times 10^{-6})$$

$$= \text{CS} \times (5.13 \times 10^{-6} \text{ kg soil/kg-day})$$

Setting dose at the RfD and solving for the corresponding soil concentration:

$$\text{RfD} = \text{CS} \times (5.13 \times 10^{-6} \text{ kg soil/kg-day})$$

$$\text{CS} = \text{RfD}/5.13 \times 10^{-6} \text{ kg soil/kg-day}$$

$$\text{CS} = \text{RfD} \times (1.95 \times 10^{5} \text{ kg-day/kg soil})$$

A similar procedure is followed for carcinogens, except that the RSD (corresponding to a 1 in 10,000 risk level) is used instead of an RfD.

$$\text{Total Dose (mg/kg-day)} = \text{RSD for incidental ingestion} + \text{RSD for dermal absorption}$$

$$= \text{CS} \times (1.84 \times 10^{-7}) + \text{CS} \times (4.76 \times 10^{-7})$$

$$= \text{CS} \times (1.84 \times 10^{-7} + 4.76 \times 10^{-7})$$

$$= \text{CS} \times (6.60 \times 10^{-7} \text{ kg soil/kg-day})$$

Setting dose at the RSD and solving for the corresponding soil concentration:

$$\text{RSD} = \text{CS} \times (6.60 \times 10^{-7} \text{ kg soil/kg-day})$$

$$\text{CS} = \text{RSD}/6.60 \times 10^{-7} \text{ kg soil/kg-day}$$

$$\text{CS} = \text{RSD} \times (1.52 \times 10^{6} \text{ kg-day/kg soil})$$

B3.0 DRINKING WATER LEVELS OF CONCERN (HRA)

The following algorithm from the Superfund risk assessment guidance is used to derive Levels of Concern (HRA) required for drinking water.

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times FI \times EF \times ED}{BW \times AT}$$

where:

CW = Chemical Concentration in Water (mg/liter [L]);
IR = Ingestion Rate (L/day);
FI = Fraction Ingested from Contaminated Source;
EF = Exposure Frequency (days/year);
ED = Exposure Duration (years);
BW = Body Weight (kg); and
AT = Averaging Time.

The Superfund *risk assessment guidance recommends* using a drinking water IR of 2 L/day. All water is assumed to be drunk from a contaminated source (FI = 1.0); EF is assumed to be 365 days/year; ED is assumed to be 9 years, which is the average residence time recommended in the guidance; body weight is 70 kg, which is the average adult body weight; and AT varies for noncarcinogens versus carcinogens (365 days/year multiplied by 70 years).

Thus, for non-carcinogens, the algorithm becomes:

$$\text{Intake (mg/kg-day)} = \frac{CW \times 2\ \text{L/day} \times 1.0 \times 365\ \text{days/year} \times 9\ \text{year}}{70\ \text{kg} \times 365\ \text{days/year} \times 9\ \text{year}}$$

This reduces to:

$$\text{Intake (mg/kg-day)} = CW \times (2.86 \times 10^{-2}\ \text{L/kg-day})$$

If intake is set at the reference dose (RfD) (i.e., acceptable daily intake) for a particular noncarcinogen and the equation is solved for CW, then:

$$CW\ (mg/L) = RfD/(2.86 \times 10^{-2}\ L/kg\text{-}day)$$

This is equivalent to the RfD multiplied by the reciprocal of this factor, or:

$$CW\ (mg/L) = RfD \times (35\ kg\text{-}day/L)$$

Thus, the Level of Concern (HRA) required to evaluate risk under conservative exposure conditions for a noncarcinogen may be derived by multiplying the RfD by the simplified factor calculated from the dose algorithm.

For carcinogens, since the AT is 365 days/year multiplied by 70 years instead of 365 days/year multiplied by 9 years, the algorithm becomes:

$$Intake\ (mg/kg\text{-}day) = \frac{CW \times 2\ L/day \times 1.0 \times 365\ days/year \times 9\ year}{70\ kg \times 365\ days/year \times 70\ year}$$

This reduces to:

$$Intake\ (mg/kg\text{-}day) = CW\ (mg/L) \times (3.67 \times 10^{-3}\ L/kg\text{-}day)$$

If intake is set at the risk-specific dose (RSD) (corresponding to a 1 in 10,000 risk level) for a particular carcinogen and the equation is solved for CW, then:

$$CW\ (mg/L) = RSD/(3.67 \times 10^{-3}\ L/kg\text{-}day)$$

This is equivalent to the RSD multiplied by the reciprocal of this factor, or:

$$CW\ (mg/L) = RSD \times 272\ kg\text{-}day/L$$

B4.0 AIR INHALATION LEVELS OF CONCERN (HRA)

Minimum air inhalation Levels of Concern (HRA) required for risk assessment purposes have been calculated for airborne chemicals. For the air pathway, the following algorithm from the Superfund risk assessment guidance was used:

$$\text{Intake (mg/kg-day)} = \frac{\text{CA} \times \text{IR} \times \text{ET} \times \text{FI} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where:

CA = Air Concentration (mg/cubic meter [m^3]);
IR = Inhalation Rate (m^3/hr);
ET = Exposure Time (hr/day);
FI = Fraction Inhaled from Contaminated Source;
EF = Exposure Frequency (days/year);
ED = Exposure Duration (years);
BW = Body Weight (kg); and
AT = Averaging Time (period in days over which exposure is averaged).

The Superfund risk assessment guidance recommends values for the various parameters in this equation. For example, an IR of 20 m^3/day (0.833 m^3/hr) is recommended for adults. Although not specifically recommended in the guidance, an FI value of 1.0 (the most conservative value possible) is used for the fraction inhaled from the contaminated source. EF is also conservatively assumed to be 365 days per year; ED is 9 years (the average residence time recommended in the guidance); BW is 70 kg; and AT is 9 years multiplied by 365 days/year for noncarcinogens and 70 years multiplied by 365 days/year for carcinogens. Thus, for noncarcinogens:

$$\text{Intake (mg/kg-day)} = \frac{\text{CA} \times 0.833\ \text{m}^3/\text{hr} \times 24\ \text{hr/day} \times 1.0 \times 365\ \text{days/year} \times 9\ \text{year}}{70\ \text{kg} \times 365\ \text{days/year} \times 9\ \text{year}}$$

This reduces to:

$$\text{Intake (mg/kg-day)} = (\text{CA mg/m}^3) \times (2.86 \times 10^{-1}\ \text{m}^3/\text{kg-day})$$

If intake is set at the reference dose (RfD) (i.e., acceptable daily intake) for a particular noncarcinogen and the equation is solved for CA, then:

$$\text{CA (mg/m}^3\text{)} = \text{RfD}/(2.86 \times 10^{-1} \text{ m}^3\text{/kg-day})$$

This is equivalent to the RfD multiplied by the reciprocal of this factor, or:

$$\text{CA (mg/m}^3\text{)} = \text{RfD} \times (3.5 \text{ kg-day/m}^3)$$

Thus, the Level of Concern (HRA) required to evaluate risk under conservative exposure conditions for a noncarcinogen may be derived by multiplying the RfD by the simplified factor calculated from the dose algorithm.

For carcinogens, since the AT is 365 days/year multiplied by 70 years instead of 365 days/year multiplied by 9 years, the algorithm becomes:

$$\text{Intake (mg/kg-day)} = \frac{\text{CA} \times 0.833 \text{ m}^3\text{/hr} \times 24 \text{ hour/day} \times 1.0 \times 365 \text{ days/year} \times 9 \text{ year}}{70 \text{ kg} \times 365 \text{ days/year} \times 70 \text{ year}}$$

This reduces to:

$$\text{Intake (mg/kg-day)} = \text{CA} \times (3.67 \times 10^{-2} \text{ m}^3\text{/kg-day})$$

If intake is set at the risk-specific dose (RSD) (corresponding to a 1 in 10,000 risk level) for a particular carcinogen and the equation is solved for CA, then:

$$\text{CA (mg/m}^3\text{)} = \text{RSD}/(3.67 \times 10^{-2} \text{ m}^3\text{/kg-day})$$

This is equivalent to the risk-specific dose (RfD) multiplied by the reciprocal of this factor, or:

$$\text{CA (mg/m}^3\text{)} = \text{RSD} \times (27.2 \text{ kg-day/m}^3)$$

Table B-1 shows health-based soil and water Levels of Concern (HRA) derived from the incidental ingestion, dermal absorption, and drinking water pathways

TABLE B-1. LEVELS OF CONCERN FOR HEALTH RISK ASSESSMENT

Chemical	RfD*	RSD*	Levels of Concern Shallow Soils (mg/kg)	Deep Soils (mg/kg)	Groundwater (μg/L)[m]	Air ($\mu g/m^3$)
Acenaphthene	6.0×10^{-2} [a]	--	1170	11,700	2100	210
Acenaphthylene	4.0×10^{-4} [a]	--	7.8	78	14	1.4
Acetone	1.0×10^{-1}	--	1950	19,500	3500	350
Acetophenone	1.0×10^{-1}	--	1950	19,500	3500	350
Aniline	2.9×10^{-4}	1.8×10^{-2}	2667	26,667	10	1
Anthracene	4.0×10^{-4}	--	7.8	78	14	1.4
Arsenic	1.0×10^{-3}	2.0×10^{-6}	19.5	19	35	0.054
Benzenamine, 4-chloro-	4.0×10^{-3}	--	78	780	140	14
Benzene	--	3.4×10^{-3}	524	5,241	939	94
Benzo[a]anthracene	4.0×10^{-2}	6.0×10^{-5}	9.1	91	16.3	1.6
Benzo[a]pyrene	4.0×10^{-2}	8.7×10^{-6}	1.3	13	2.4	0.24
Benzo[b]fluoranthene	4.0×10^{-2}	6.2×10^{-5}	9.44	94	17	1.7
Benzo[g,h,i]perylene	4.0×10^{-2}	--	780	7800	1400	140
Benzo[k]fluoranthene	4.0×10^{-2}	--	780	7800	1400	140
Butyl benzyl phthalate	2.0×10^{-1}	--	3900	39,000	7,000	700
Cadmium	5.0×10^{-4}	1.6×10^{-5}	9.75	97.5	17.5	0.4
4-Chloro-3-methylphenol	5.0×10^{-3} [c]	--	97.5	975	175	17.5
Chlorobenzene	5.0×10^{-3}	--	97.5	975	175	17.5
2-Chloroethyl vinyl ether	--	9.1×10^{-5}	13.8	138	24.7	2.5
Chloroform	1.0×10^{-2}	1.2×10^{-3}	187.6	1,876	336	33.6

Continued

TABLE B-1. Continued

Chemical	RfD*	RSD*	Levels of Concern Shallow Soils (mg/kg)	Deep Soils (mg/kg)	Groundwater ($\mu g/L$)[m]	Air ($\mu g/m^3$)
Chromium	--	--	--	--	--	0.07
Chromium VI	5.7×10^{-7}	2.4×10^{-6}	0.011	0.11	0.02	0.002
Chrysene	4.0×10^{-2}	2.0×10^{-3}	300	3004	538	54
Cyanides (soluble salts)	2.0×10^{-2}	--	390	3900	700	70
4,4'-DDT	5.0×10^{-4}	2.9×10^{-4}	45	447	17.5	1.7
Di-n-butyl phthalate	1.0×10^{-1}	--	1950	19,500	3500	350
Di-n-octyl phthalate	2.0×10^{-2} [e]	--	390	3900	700	70
Dibenzo[a,h]anthracene	4.0×10^{-2}	7.8×10^{-6}	1.2	12	2.1	0.21
Dibenzofurans	1.0×10^{-4} [f]	--	1.95	19.5	3.5	0.35
1,2-Dichlorobenzene	4.0×10^{-2}	--	780	7800	1400	140
1,3-Dichlorobenzene	4.0×10^{-2} [g]	--	780	7800	1400	140
1,4-Dichlorobenzene	2.0×10^{-1}	4.2×10^{-3}	3900	39,000	1134	113.4
1,1-Dichloroethane	1.0×10^{-1}	--	1950	19,500	3500	350
1,1-Dichloroethene	9.0×10^{-3}	8.3×10^{-5}	12.67	126.7	22.7	2.3
1,2-trans-Dichloroethene	2.0×10^{-2}	--	390	3900	700	70
Dichloromethane	6.0×10^{-2}	1.3×10^{-2}	1170	11,700	2100	210
Diethyl phthalate	8.0×10^{-1}	--	15,600	156,000	28,000	2800
2,4-Dimethylphenol	2.0×10^{-2} [h]	--	390	3900	700	70
2,6-Dinitrotoluene	--	1.5×10^{-4}	22.4	224	40	4.0
Ethylbenzene	1.0×10^{-1}	--	1950	19,500	3500	350
bis(2-Ethylhexyl)phthalate	2.0×10^{-2}	7.1×10^{-3}	390	3900	700	70
Fluoranthene	4.0×10^{-2}	--	780	7800	1400	140

Continued

TABLE B-1. Continued

Chemical	RfD*	RSD*	Levels of Concern Shallow Soils (mg/kg)	Deep Soils (mg/kg)	Groundwater ($\mu g/L$)[m]	Air ($\mu g/m^3$)
Fluorene	4.0 x 10^{-2}	--	780	7800	1400	140
Heptachlor epoxide	5.0 x 10^{-4}	1.1 x 10^{-5}	1.67	16.7	3.0	0.3
Hexachlorobutadiene	2.0 x 10^{-3}	1.3 x 10^{-3}	39	390	70	7.0
2-Hexanone	6.0 x 10^{-3} [j]	--	117	1170	210	21
Indeno[1,2,3-cd]pyrene	4.0 x 10^{-2}	3.7 x 10^{-5}	5.7	57	10	1.0
Isophorone	2.0 x 10^{-1}	2.4 x 10^{-4}	37.1	371	66.4	6.64
Lead	4.3 x 10^{-4}	--	8.38	83.8	15	1.5
Mercury	8.5 x 10^{-5}	--	1.66	16.6	2.97	0.3
Methyl ethyl ketone	5.0 x 10^{-2}	--	975	9750	1750	175
Methyl isobutyl ketone	2.0 x 10^{-2}	--	390	3900	700	70
2-Methylnaphthalene	4.0 x 10^{-4} [a]	--	7.8	78	14	1.4
Naphthalene	4.0 x 10^{-3}	--	78	780	140	14
Nickel	2.0 x 10^{-2}	1.2 x 10^{-4}	390	3900	700	3.2
2-Nitroaniline	5.0 x 10^{-4} [k]	--	9.75	97.5	17.5	1.7
Nitrobenzene	5.0 x 10^{-4}	--	9.75	97.5	17.5	1.7
N-Nitrosodi-n-propylamine	--	1.4 x 10^{-5}	2.2	22	3.9	0.39
N-Nitrosodiphenylamine	--	2.0 x 10^{-3}	3,102	31,020	5556	556
PCB-1254	--	1.3 x 10^{-5}	2.0	20	3.5	0.35
PCB-1260	--	1.3 x 10^{-5}	2.0	20	3.5	0.35
Pentachlorophenol	3.0 x 10^{-2}	8.3 x 10^{-4}	126.7	1267	227	22.7
Phenanthrene	4.0 x 10^{-2}	--	780	7800	1400	140
Phenol	6.0 x 10^{-1}	--	11,700	117,000	21,000	2100

Continued

TABLE B-1. Continued

Chemical	RfD*	RSD*	Levels of Concern Shallow Soils (mg/kg)	Deep Soils (mg/kg)	Groundwater (μg/L)^m	Air ($\mu g/m^3$)
Pyrene	4.0×10^{-2}	--	780	7800	1400	140
Selenium	3.0×10^{-3}	--	58.5	585	105	10.5
Styrene	2.0×10^{-1}	3.3×10^{-3}	506.7	5067	907	90.7
1,1,2,2-Tetrachloroethane	4.0×10^{-3}	5.0×10^{-4}	78	780	136	13.6
TCDD, 2,3,7,8-	--	6.5×10^{-10}	9.9×10^{-5}	9.9×10^{-4}	1.8×10^{-4}	1.8×10^{-5}
Tetrachloroethene	1.0×10^{-2}	2.0×10^{-3}	195	1950	350	35
Toluene	2.0×10^{-1}	--	3900	39,000	7	0.7
1,2,4-Trichlorobenzene	1.3×10^{-3}	--	25.54	255.4	45.8	4.6
1,1,1-Trichloroethane	9.0×10^{-2}	--	1755	17,550	477	315
1,1,2-Trichloroethane	4.0×10^{-3}	1.8×10^{-3}	78	780	140	14
Trichloroethene	--	5.9×10^{-3}	894.1	8941	1601	160.1
Trichlorofluoromethane	2.0×10^{-1}	--	3900	39,000	7	0.7
2,4,5-Trichlorophenol	1.0×10^{-1}	--	1950	19,500	3500	350
Vinyl chloride	--	3.4×10^{-4}	51.7	517	92.6	9.26
Xylene (mixed)	8.5×10^{-2}	--	1657.5	16,575	2975	297.5

RfD = Reference dose
RSD = Risk-specific dose
-- Not applicable
[a] Based on naphthalene RfD divided by 10
[b] Considered carcinogenic by inhalation only
[c] Based on 2-chlorophenol RfD
[d] Based on bis(2-chloroethyl)ether cancer potency slope
[e] Based on butyl benzyl phthalate RfD

TABLE B-1. Footnotes Continued

[f] Based on furan RfD divided by 10

[g] Based on 1,2-dichlorobenzene RfD

[h] Based on 2,6-dimethylphenol

[i] Based on heptachlor cancer potency slope

[j] Based on n-hexane RfD divided by 10

[k] Based on nitrobenzene RfD

[l] Based on 1,1,2-trichloroethane RfD

[m] µg/L = mg/L divided by 1000

[*] In order to simplify the calculations, the lowest value was chosen between the oral and inhalation RfDs and the highest potency slope. These values were obtained from HEAST and IRIS tables.

for chemicals, which may be associated with the McClellan Air Force Base (AFB) site. For carcinogens, an RSD corresponding to a 1 in 10,000 chance was used to derive required soil and water detection limits. For those chemicals with both an RfD and an RSD, the lowest detection was used.

RADIAN
CORPORATION

APPENDIX C

Operable Unit B Remedial Investigation
Health and Safety Plan

269-007-04-32

MCCLELLAN AIR FORCE BASE
OPERABLE UNIT B
REMEDIAL INVESTIGATION
HEALTH AND SAFETY PLAN

July 1991

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1.0 INTRODUCTION

The Department of Defense is currently involved in a program to clean up uncontrolled hazardous waste sites on military installations. McClellan Air Force Base (AFB) near Sacramento, California, is the site of an ongoing Installation Restoration Program (IRP) Remedial Investigation/ Feasibility Study (RI/FS). At McClellan AFB, the RI/FS has concentrated on groundwater contaminated by hazardous chemicals. Currently, the groundwater on base is being sampled for a variety of contaminants as part of a long-term groundwater monitoring program.

To integrate the IRP with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), McClellan AFB adopted the CERCLA Remedial Response Process, which consists of three main phases: Identification, Investigation, and Cleanup. Operable Unit B (OU B) (Figure 1-1) is the first OU to advance through the CERCLA process, and will be followed by OU A. The Identification phase of the CERCLA process has been completed for OU B. A comprehensive RI/FS will provide the basis for selection of appropriate and feasible remedies for sites and groundwater requiring cleanup in OU B. The data required to complete the RI/FS field investigation prior to remedy selection will be compiled in the Remedial Investigation and Treatability Investigations for OU B. To determine the nature and extent of contamination, and to select remedies, a comprehensive Sampling and Analysis Plan (SAP) has been developed. The purpose of the OU B RI SAP is to describe the field procedures, sample collection points, analytical methods, data handling and analysis, and decision making criteria in the Site Characterization and Treatability Investigation elements of the RI. This Health and Safety Plan describes the health and safety practices and procedures to be followed during the Site Characterization phase of the OU B RI. All Radian field crews will follow this Health and Safety Plan unless situations encountered in the field mandate Plan modifications. Any variances to this Health and Safety Plan must be approved by the Project Director and the Project Safety Officer. It should be recognized that this Health and Safety Plan is a dynamic document and will be subject to revisions which will improve the efficiency of field procedures and promote, increase, and maintain the highest degree of Health and Safety awareness.

The groundwater and soils encountered during OU B sampling activities at McClellan AFB may contain contaminants potentially hazardous to Radian field personnel. The key elements in prevention of worker exposure are the use of safe work practices and proper personal protection equipment, the maintenance of personal hygiene, and a working knowledge of the potential contaminants.

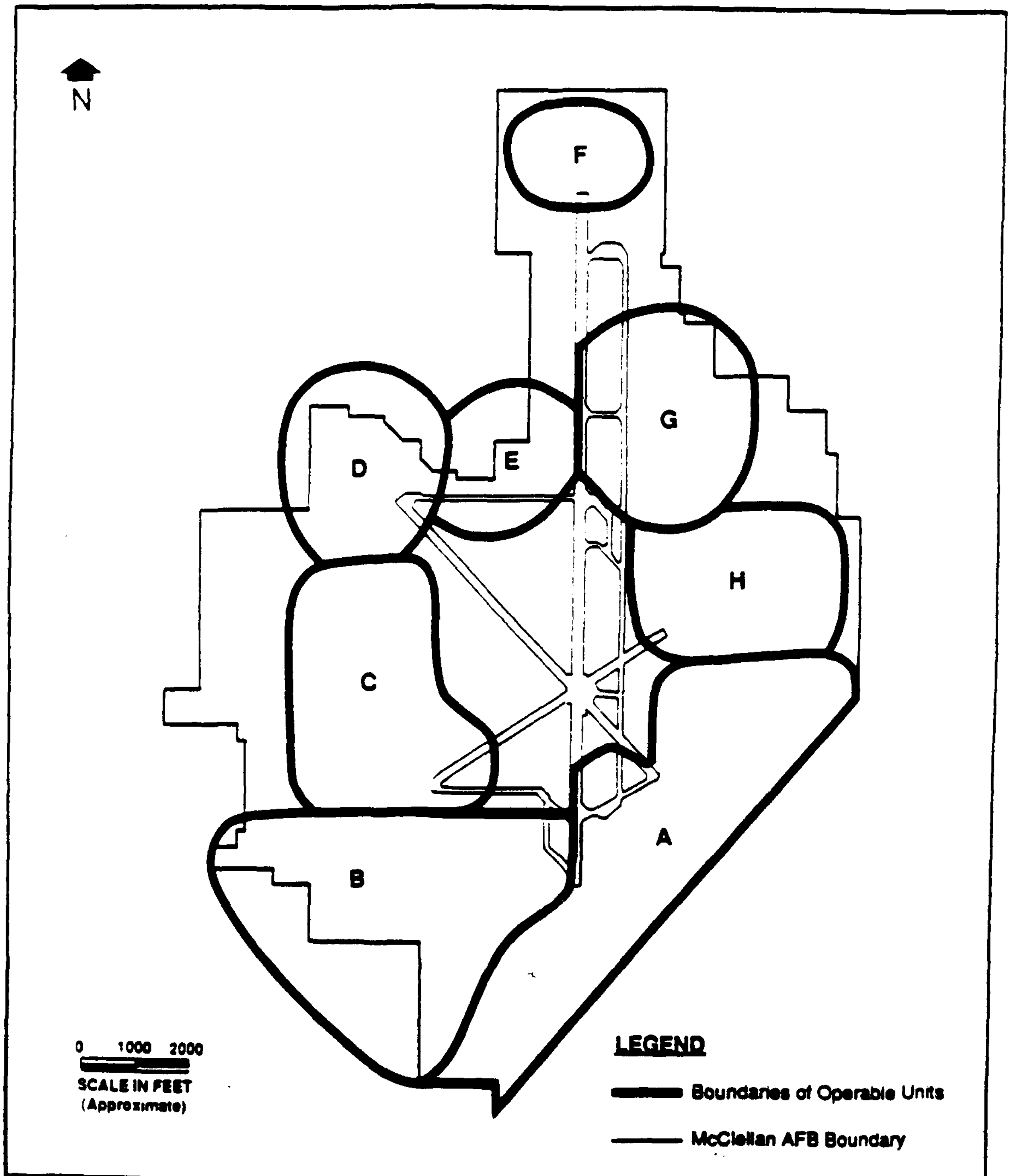

Figure 1-1. Approximate Boundaries of Operable Units at McClellan AFB

1290-075-3

2.0 FIELD ACTIVITIES AND KEY PERSONNEL

This Health and Safety Plan addresses field activities associated with the Site Characterization of OU B.

The anticipated field activities include:

- Sample Preparation, Preservation, Packaging, and Transport;
- Field Blank Preparation;
- Soil Gas Sampling
- Soil Boring
- Groundwater Sampling;
- Surface Water Sampling;
- Surface Soils and Sediment Sampling:
- Monitor Well Drilling, Installation, and Development;
- Aquifer Testing; and
- Surface Geophysical Surveys.

Radian personnel primarily responsible for overseeing the safe operation of this project are:

- Project Manager - Jack Gouge'
- Project Director - Dick Van Dyke
- Project Health and Safety Officer - Rick Moore

All Radian field team members will be ultimately responsible for executing daily work activities in a safe manner and in accordance with basic safety and health protocols outlined in this Health and Safety Plan.

Specific responsibilities of the field team members include:

- Reading and understanding this plan;
- Performing work safely;
- Reporting any unsafe conditions to their immediate supervisor; and
- Being aware of and alert for signs and symptoms of exposure to site contaminants and symptoms of potential over-exposure to the elements while working outdoors.

3.0 HAZARD ANALYSIS

This section of the Health and Safety Plan addresses specific on-site hazards which may be encountered during the OU B Remedial Investigation study at McClellan Air Force Base. Based on the limited historical and technical data available, this plan covers anticipated activities and hazards and allows provision for modification or amendment as health-related data are developed throughout the project.

The general types of hazards associated with this project are:

- Chemical Hazards: Possible exposure to chemical contaminants which may be airborne and/or in the soil or groundwater at the site(s).
- Physical Hazards: Mechanical, electrical, thermal, fire, etc.

3.1 Chemical Hazards

The chemical hazards associated with the anticipated site characterization activities result from chemicals historically deposited or released on site, and those detected in site specific soil and water samples. Analytical results from environmental soil and water samples collected in OU B reveal a diversity of compounds, with a wide range of concentrations. Volatile organic compounds (VOCs) and semi-volatile organic compounds potentially present at the site(s) which may present a chemical exposure hazard are identified in Table 3-1 (Selected Chemical Concentrations).

Based on historical information and a review of the soil and water contaminants detected, it was determined that VOCs and semi-VOCs represent the greatest risk of potential employee exposures. Heavy metals and radioactive particles may also be encountered in select areas. Heavy metals found in the soil, radioactive dust, and semi-VOCs, (which adhere to particulate matter) can present a respiratory hazard under dusty conditions. High winds and other soil disturbing activities can result in airborne particulate matter. Therefore, dust suppression techniques will be initiated during visible dust exposure periods. Significantly contaminated soil particules may produce elevated airborne concentrations and elevated point source concentrations. If it is not possible to suppress particulate emissions and the study site is uncharacterized, or known to contain heavy metals, radioactive soils, or semi-volatile compounds, a respirator with a HEPA filter will be required.

TABLE 3-1. SELECTED CHEMICAL CONCENTRATIONS

Volatile Organic Compounds	[1]PEL (ppmv)	[2]Maximum Concentration* (ppmw)
Benzene	1 (suspect carcinogen)	100
2-Butanone (Methyl Ethyl Ketone-MEK)	200	.7
Carbon tetrachloride	2 (suspect carcinogen)	500
Chlorobenzene	75	.2
Chloroform	2 (suspect carcinogen)	1
Ethyl benzene	100	.1
Hexachlorobutadiene	.02	.20
2-Hexanone (MBK)	5	190
Hexone (Methyl isobutyl ketone-MIBK)	50	50
Nitrobenzene	1	5
1,1,2,2 Tetrachloroethane	1	10
Tetrachloroethylene	25 (suspect carcinogen)	500
Toluene	100	20
1,2-Dichloroethane	100	50
1,2-Dichloroethene	200	20
Trichloroethene	50 (suspect carcinogen)	5000
Vinyl chloride	1 (known carcinogen)	.005
Xylenes (o,m,p,isomers)	100	500

TABLE 3-1. (Continued)

Semi-Volatile Organic Compounds	PEL (ppm)	Maximum Concentration (ppm)
Cyanide salts	2.0	.01
DDT	.07	.01
Diethylphthalate	N/A	.1
2-Methylnapthalene	(Carcinogen)	10
Napthalene	10	15
Pentachlorophenol	.05	10
Phenol	5	.2
Polychlorinated biphenyles (PCBs)	.04	1
Coal Tar Pitch Volatiles (CTPV)	0.2 mg/m^3	
Polynuclear Aromatic Hydrocarbons (PAHs)	(selected carcinogens)	40

-- acenaphthene
-- acenaphthylene
-- anthracene
-- benzo(a)anthracene
-- phenarthrene
-- benzo(b,d)fluoranthene
-- benzo(a)pyrene
-- benzo(g,h,i)perylene
-- chrysene
-- pyrene
-- dibenz(a,h)anthracene
-- flouranthene
-- flourene
-- ideno(1,2,3-cd)pyrene

[1] PEL = The Permissible exposure limit (in parts per millioin by volume [ppmv] in air) for 8 hours/day, 40 hours/week, for a working lifetime.

[2] Maximum Concentration of contaminants detected (in data reviewed to date) in parts per million by weight in soil or water samples.

*** These concentrations may be modified in future revisions of this Health and Safety Plan as continued data review and analytical testing provide additional quantitative information.**

The semi-VOCs present a low airborne exposure potential due to their low volatility. The primary source of exposure to semi-VOCs is through direct skin contact with contaminated material and ingestion of contaminated substances. Exposure to VOCs may occur through inhalation, skin contact, and ingestion. Contaminated soils, groundwater, and equipment are the most likely sources of personnel exposure to VOCs and semi-VOCs in the work area. Table 3-2 lists the volatile and semi-volatile chemical contaminants which pose the greatest health hazard as a result of their toxicity, relative concentration in environmental samples, and the probability of exposure during sampling activities.

Because the concentrations found in environmental samples are relatively low, it is unlikely that personnel will encounter airborne concentrations of semi-VOCs near occupational health criteria. The potential for exposure to VOCs is more likely; however, real-time air monitoring instruments will be used routinely and will indicate the presence of VOCs before an acute or chronic inhalation hazard exists (see Section 5.0). The most probable route of exposure to VOCs and semi-VOCs will be skin contact with contaminated material and surfaces. Correct use of personal protective equipment (PPE) and safe work practices shall prevent skin contact with contaminated material and provide respiratory protection for Radian personnel.

The following safety precautions will be implemented to ensure the protection of Radian employees from potential chemical hazards:

- An air monitoring program as outlined in Section 5.0 will be implemented when Radian personnel are on site to measure airborne concentrations of volatile organic compounds potentially encountered during on-site work.
- Protective clothing will be required during the various work activities, as outlined by the Radian Personnel Hydrocarbon Response Criteria (Table 5-1) and Personal Protective Equipment Requirements (Section 6.1).

3.2 Physical Hazards

Several types of physical hazards may be associated with field operations during the OU B Remedial Investigation activities. Radian personnel must be aware of these hazards as well as the chemical hazards directly related to sampling tasks. Physical hazards present include:

TABLE 3-2. CHEMICAL HAZARDS AND RESULTING EFFECTS

Chemical Compound	PEL	Symptoms and Effects
Volatile		
Carbon tetrachloride	2 ppm	These compounds produce similar health effects due to similarities in structure and composition. All are Central Nervous System (CNS) depressants. Exposures may result in headache, nausea, and an increase in reaction time; acute exposures may result in dizziness, narcotic-like effects, nausea, vomiting. Dermal exposures can cause dermatitis.
Chloroform	2 ppm	
Tetrachloroethene	25 ppm	
Trichloroethene	50 ppm	
Xylenes	100 ppm	
Vinyl chloride	1 ppm	
2-Hexanone (MEK)	5 ppm	
Benzene	1 ppm	Benzene is a suspect human carcinogen. Acute benzene exposure targets the CNS and is a proven *hemotoxin. Studies have associated leukemia with chronic benzene exposure.*
Semi-Volatile		
Coal Tar Pitch Volatiles (CTPVs) Polynuclear Aromatic Hydrocarbons (PAHs) -- Benzo(a)pyrene	.2 mg/m^3	These compounds are suspected human carcinogens. Acute exposures can cause liver damage. Chronic exposures may result in an increased chance of lung cancer, skin carcinomas, and anemia.
-- 2-Methylnapthalene	NE	This compound is a known human carcinogen. Acute and chronic exposures are similar to these identified with CTPVs. There is no PEL established for this compound.

NE: None Established

[1] PEL = The permissable exposure limit (in parts per million by volume [ppmv] in air) for 8 hours/day, 40 hours/week, for a working lifetime.

Mechanical Hazards:

- Cuts, contusions, punctures from gas sampling syringes;
- Being struck by swinging or falling objects;
- Muscular injury potentially caused by overexertion or improper movement;
- Back injury due to improper lifting or awkward positioning;
- Becoming entwined in rotating tools;
- Heavy or moving equipment and machinery;
- Increased braking distance for vehicles pulling trailers; and
- Excessive noise from drilling equipment and/or aircraft operations.

Electrical and Fire Hazards:

- Lightening hazards during electrical storms;
- Equipment contact with overhead power lines;
- Equipment fires and grass fires; and
- Contact and grounding of personnel with electrical equipment and generators.

Fire and Explosion Hazards:

- Possible puncture of buried cables, underground power lines, and underground gas lines during insertion of the soil gas probes, or hollow stem auger and auger operations, or mud-rotary/air-rotary casing drive drilling;

- Ignition during refueling operations of motor vehicles and generators; and

- Ignition of gas or damage to pressurized gas cylinders (See Section 4.1.2).

If excavated materials encountered in borings indicate the possible presence of underground drums or cylinders, operations shall be stopped immediately, and the sampling task leader will contact the field task leader and the Project Director or Health and Safety Officer as soon as possible.

Thermal Hazards:

- Potential for heat stress conditions will exist for workers performing strenuous activities during the summer months. Heat stress prevention procedures will be implemented when ambient temperatures exceed 90°F (Sections 5.5 and 7.2).

- Burn hazard from pressurized hot water and steam cleaning equipment; and

- Burn hazard when working on or near generators and motors.

Slip, trip, and fall hazards:

- Open trenches, pits, and holes;
- Muddy or uneven surfaces; and
- Equipment on the ground.

4.0 SAFE WORK PRACTICES AND PERSONNEL PROTECTION METHODS

Work activities associated with the OU B Remedial Investigation sampling program will involve some potential physical and/or chemical risks to field personnel. Personal Protective Equipment (PPE) will be required to safely perform the various work activities. All Radian field personnel will be required to have the following PPE available at all times:

- Steel-toe leather and rubber boots;
- Chemical resistant gloves (Silvershield® inner glove and Neoprene or Nitrile outer glove);
- Half-face or full-face air purifying respirator;
- Organic vapor/HEPA cartridges;
- Safety glasses with side shields;
- Real-time organic vapor monitor;
- High Voltage Gloves;
- Hard hat;
- Tyvek® coveralls or apron; and
- Additional safety equipment to be carried in the sampling vehicle at all times include: a first aid kit, fire extinguisher, portable emergency eye wash station, orange pylons, and an audit checklist.

4.1 Field Preparation

Several work activities are performed in advance of field activities. The following sections present safe work practices for these activities.

4.1.1 Sample Container Preparation

Acids and bases used to preserve the groundwater samples for laboratory analyses include: hydrochloric acid, nitric acid, and sodium hydroxide. Small amounts of these acids and bases are added to the appropriate sample containers prior to initiating field activities. Liquid and vapor phases of these chemicals may cause severe burns; therefore, extreme care will be used when handling these chemicals.

Personnel handling acids and/or bases are required to wear long pants, long-sleeved shirts, and closed-toe shoes (preferably leather). In addition, the following personal protective equipment must be worn: acid-resistant vinyl or nitrile butyl rubber (NBR) gloves and chemical goggles or a protective face shield. All transfers will take place in a properly-operational fume hood or well-ventilated area. In the event of a small spill, the spill area will be thoroughly flushed with water. Small spills of concentrated acid will be neutralized with soda ash or sodium bicarbonate prior to flushing the area with water. Large spills of concentrated acid can be neutralized with soda ash or lime.

4.1.2 Compressed Gases

Occasionally, compressed gases may be required to calibrate or operate field or laboratory and field instruments. The following procedures are designed to protect against employee injuries due to the improper use of compressed gases. A complete description of procedures to be followed during the receipt and use of compressed gas cylinders, can be found in the McClellan AFB RI/FS Program Health and Safety Plan. The field team should be thoroughly familiar with the following topics:

- Cylinder receipt and content identification;
- Securing of Cylinders -- All cylinders must be secured to a wall, I-beam, or other immovable object by a safety chain or strap;
- General Precautions for Handling and Storing:
    - Cylinders should never be dropped or permitted to strike each other violently;

  - Cylinders should be protected against extremes of weather, the dampness of the ground, and be shaded against direct sunlight;
  - The valve protection cap should be left on each cylinder until it has been secured;
  - Cylinders will not be dragged, rolled or slid;
  - Oil, grease, lubricants,and Teflon tape must not be used on any compressed gas tubing or piping fitting or thread;

- Regulator Handling and Use--A regulator should be attached to a cylinder without forcing the threads;
- Handling of Empty Cylinders; and
- Leak Detection and Control

4.2 Field Activities

The following sections address the potential risks to be aware of and the current work procedures to be followed which will minimize the potential for Radian personnel to be exposed to a hazardous situation.

In addition to the potential physical and chemical hazards associated with daily field activities, a life threatening and emotionally stressful hazard can be experienced by field personnel who trespass on private property, or enter into secured military areas. When working off base in residential areas or business districts, inform all property owners of your identity and presence, and obtain their permission before entering their property boundaries and starting work.

When working in secured areas on base, or on military secured property off base, be absolutey sure that you have the permission of Environmental Management and clearance from McClellan AFB Security to enter these areas. Never jump fencelines or otherwise trespass, you may find yourself in the undignified position of being face down, spread-eagle, with a loaded weapon pointed at you by a young soldier anxious to do his job!

All field personnel will wear steel-toe, leather or rubber boots when performing field work. Silvershield® with Neoprene or Nitrile gloves will be worn during the sampling process to protect personnel from contaminants and organic solvents, and to ensure sample integrity. Safety glasses with side shields will be worn at all times while conducting field work and sampling activities. Hard hats will be worn when working in areas where overhead hazards exist. All field personnel will be fit-tested with a half-face and a full-face air purifying respirator prior to commencement of field activities. Organic vapor chemical cartridges will be used with the air purifying respirators. Respirators will be available for use if air monitoring results indicate the need (see Table 5-1).

Work practices which promote safe and healthful use of air purifying respirators include:

- Respirators which are not in use shall be kept in clean plastic bags and carried in a rigid container (to prevent face-piece disfiguration) in the sampling vehicle at all times;

- Respirators shall be cleaned with a sanitizing solution recommended by the respirator manufacturer, and rinsed with clean water at the end of each work day in which it was used; and

- Respirators equipped with organic vapor cartridges (OVCs) will follow a regular OVC replacement schedule. Each OVC shall have the respirator installation date clearly marked on the cartridge. An appropriate OVC replacement schedule would be:

    - Once each week with little to no use of the respirator;

    - Once every other day with consistent (daily) use of respirator in organic vapor concentrations of 1 - 100 ppmv;

    - Once each 8 hours of use in organic vapor concentrations greater than 100 ppmv (>100 ppmv);

    - Once each hour in atmospheres with detectable vinyl chloride*.

- **The National Institute of Occupational Safety and Health (NIOSH) recommends the use of full face-piece supplied air (SA) or self-contained breathing apparatus (SCBA) for any airborne exposure to vinyl chloride (VC). The Occupational Safety and Health Administration (OSHA) approves the use of full-face air purifying respirators with organic vapor cartridges (OVC's) for concentrations of VC $\leq$ 10 ppmv for one hour (CFR 29, Part 1910.1017, pg.138, 1989). If full-face air purifying respirators are used in atmospheres known to contain detectable concentrations of VC, a rigorous assessment of VC concentrations will be conducted. Draeger tubes for VC will be collected in the workers' breathing zone once every 20 minutes to confirm concentrations are $\leq$ 10 ppmv. In addition, due to the permissible exposure limit (PEL)[1] of VC (1 ppmv), OVC's exposed to VC will be replaced every hour and disposed of at the close of sampling activities. If, at any time, a variance from these procedures should be observed or reported, or airborne concentrations of VC exceed 10 ppmv, SA or SCBA will be mandatory for all sampling activities associated with detectable airborne concentrations of VC.**

[1] PEL = Permissible exposure limit for 8 hours/day, 40 hours/week, for a working lifetime.

The following sub-sections present safe work practices for the various field activities associated with sample collection and the decontamination of sampling equipment with organic solvents.

4.2.1 Sampling Activities

As a precautionary measure, a respirator with organic vapor/HEPA cartridges shall be used during sampling activities under the following circumstances:

- A site is not characterized, but there is reason to suspect the soil is contaminated with semi-VOCs, heavy metals, or radioactive compounds (section 3.0, page 3.3);
- The site is characterized and known to contain soils with hazardous VOCs and semi-VOCs (i.e., PCBs);
- Air monitoring instrumentation indicates the need for respiratory protection because of VOC concentrations exceeding limits listed in Table 5-1; and

- During groundwater sampling activities when removing the well pipe cap and when sampling wells with a known history of organic vapor emissions or sampling wells that have not been characterized for their organic vapor emissions.

Real-time air monitoring will be conducted in the worker's breathing zone (BZ) with an organic vapor photoionization detector (PID). The method of collecting measurements in the BZ will be standardized by providing a suitable support for the instrument so that the instruments air inlet can be positioned 12 to 18 inches above the sampling point (in the workers BZ). This can be accomplished by using a stabilized inverted bucket or having a second field team member hold the air monitoring instrument. All PID measurements will be adjusted with respect to background measurements. For instance, if background PID measurements indicate 2 ppmv organic vapor concentration (OVC), and BZ measurements indicate 7 ppmv OVC, assume 5 ppmv OVC in the BZ resulting from VOC emissions. The following sub-sections present safe work practices for specific field activities associated with sample collection.

4.2.1.1 Borehole Drilling and Sampling

Borehole drilling will be performed using a hand auger or a mobile drill rig equipped with a hollow-stem auger. Cover material, waste material, and underlying soil will be sampled through the hollow-stem auger. Hand augering or a core sampler will be used to collect shallow soil samples. The sampling technique requires manual augering to the desired depth, where the soil to be recovered is then contained in the auger bit, the bit (bucket) is then brought to the surface and the soil is recovered into a stainless steel bowl. The soil is then evenly mixed and placed in a sample container and sealed. Split spoon sampling will be used with the hollow-stem auger. For the split spoon sampling technique, drilling will be conducted to the desired sampling depth. The inner bit is then removed from inside the auger. The split-spoon sampler is lowered inside the auger to the bottom of the borehole. The sampler is either driven or pushed into the undisturbed soil beneath the auger to collect the sample.

Hand auger and hollow-stem auger drilling and sampling will potentially expose field personnel to the following hazards:

- Chemical hazards from potentially contaminated materials (e.g., drill cuttings, ground water, and fugitive vapors), and

- Physical hazards:
  - -- Overhead power lines,
  - -- Buried hazards,
  - -- Snapping cables,
  - -- Becoming entwined in rotating tools, and
  - -- Being hit by equipment or falling objects.

The chemical hazards associated with hand auger or hollow-stem auger drilling and sampling will be mitigated by implementing the following safe work practices:

- A comprehensive air monitoring program will be in effect during all drilling and auger sampling (Section 5.0).

- Appropriate personal protective equipment as identified by the air monitoring program will be required during all drilling and auger sampling activities (Section 6.0).

- Drilling activities must be performed so there is clearance of more than 10 feet from overhead lines. This distance shall be in addition to a possible striking radius should any cables snap during drilling.

- Prior to drilling, the field supervisor shall consult with base personnel about the location of any underground utility lines or other buried hazards. These hazards will be clearly marked prior to beginning work. **(All contact with utility and base representatives shall be documented.)**

- If cuttings indicate possible presence of underground drums or cylinders (i.e., scraps of shredded metal), drilling will be stopped immediately, and the field task leader and project director will be contacted.

- During borehole drilling and split-spoon sampling, a "real-time" organic vapor monitor will be used to detect increases in airborne VOCs emanating from the borehole and the exposed soil samples.

- Field personnel will contain for proper disposal any contaminated material produced during drilling and sampling activities.

4.2.1.2 Groundwater Sampling

Groundwater may be collected from newly established boreholes. The hazards associated with groundwater sampling are related to worker exposure to contaminated air and groundwater. Safe work practices to be instituted during groundwater sample collection activities include:

- Screening the wellhead with the "real-time" organic vapor monitor before sampling to identify airborne organic vapor concentrations as detailed in Table 5-1;

- Using appropriate personal protective equipment as discussed in Section 6.0.; and

- Collecting and containing potentially contaminated groundwater purged from the borehole for proper disposal.

4.2.1.3 Soil Gas Sampling

Soil gas sampling techniques require the use of soil gas probes. Soil gas probes will be driven into the ground using the following techniques:

- Hand-driven slide hammer; and
- Mechanically-driven soil probes.

All probe locations shall be clearly marked for underground utility hazards. In addition, each location will be screened with an underground cable and pipe detector to insure the location is clear of all utilities before the probe is driven into the soil. After the probe is driven into the ground, it will be screened with a voltage detector to confirm it is not energized. During sample collection, workers shall use caution to avoid needle pricks when inserting the syringe needle into the septum and when attaching the septum used during transportation of the syringe. All probes which are removed from the soil shall be treated as contaminated equipment. Safe work practices include the use of the following:

- Appropriate PPE (Section 6.1) shall be used whenever personnel must handle potentially contaminated equipment or substances.

- If voltage is detected, do not touch the sampling probe or hammer. Only personnel wearing high voltage gloves shall be allowed to disconnect electrical lines and air supply lines. The Radian Field Supervisor will be informed immediately. The Radian Field Supervisor will contact the appropriate McClellan authority and/or the Sacramento Metropolitan Utility District (SMUD) to handle the energized probe.

Glass syringes will be required to transport the soil gas samples from the sample collection location (in the field) to the GC operator. Syringes will be protected from breakage and sunlight and with a pliable foam wrap. The stainless steel needles for the syringe shall be inserted into a Teflon septum during transport to and from the field, and immediately after sample collection to reduce the likelihood of the syringe needle causing injury to personnel or property. Glass syringes, stainless steel needles, and sampling ports will be decontaminated by baking them in an oven. Care shall be exercised to prevent burns or breakage when removing hot glassware and needles from the oven.

4.2.2 Hazard Analysis -- Equipment Operation

Field team use of numerous pieces of equipment creates some potential inherent physical hazards, as follows:

- Trailers -- A trailer adds considerable weight and length to a vehicle, making the turning radius greater and stopping distance longer. Drivers will be aware of these conditions and exercise added caution when towing the trailer. When backing a trailer, care will be taken to avoid jack-knifing the trailer. Special care will be exercised when hitching and unhitching the trailer. When backing the vehicle up to the trailer, a team member will stand off to the side to direct the driver. Field team members should never stand between the trailer and the moving vehicle. The vehicle's transmission will be placed in "PARK", and the parking brake set before hitching or unhitching the trailer.

- Transporting Fuel -- Spill-proof fuel containers will be used when transporting fuel in Radian vehicles for any McClellan project.

- Refueling Equipment -- Refueling equipment (generators and compressors) will be necessary. Engines will be allowed to cool 3 - 5 minutes before adding fuel. Care will be taken not to overfill gas tanks. If a spill should occur, the excess fuel will be wiped up before restarting the engine. Chemical-resistant gloves will be used when handling fuel. **To minimize the potential for sample contamination, all vehicles and equipment will be refueled after the close of daily sampling activities whenever possible.**

- Generators -- Electric generators will be operated with caution, as they pose a hazard for potential electric shock. The generator will never be operated during wet conditions and worker's hands will be dry when using this piece of equipment. In case of an equipment related emergency, high voltage gloves will be used to operate or shut down the equipment.

- Steam Cleaner Operation -- During steam cleaner operation, extra caution will be exercised to avoid serious burns. Safety glasses and protective gloves will be worn by all personnel involved with steam cleaner operations. Control of the steam jet will always be maintained, and workers will avoid contact with the back-spray. Workers also will avoid contact with the propane burner exhaust. The metal surfaces around the exhaust get extremely hot and can cause severe burns.

- Drilling Operations -- Mud Rotary / Air Rotary Casing Drive and Hollow Stem Auger operations are hazardous operations which require a high degree of vigilance from all personnel in the area. Hard hats, steel-toe boots, and safety glasses will be worn at all times. Various operations will be occurring in a short period of time involving large, heavy, moving and rotating equipment (several tons). Caution should be used when handling equipment and assisting other task members. Never attempt to handle any rotating equipment or moving cables. Never position any part of your body beneath a piece of suspended equipment. All personnel should actively and constantly perform a visual inspection of supporting cables, connections, ropes, lines, etc., looking for weak links, kinks, frayed or damaged areas, and require replacement before proceeding with the work as planned.

4.2.3 Sample Handling and Collection

Skin contact with contaminated water, soils, debris, or equipment shall be avoided at all times. Extra caution will be exercised when filling bottles containing acid or base preservatives. Following sample collection, sample container lids will be tightened to prevent any leaks, and the containers rinsed with clean water to ensure that it is free of contaminated substances. Sample containers will be protected to prevent breakage during ransport. Employee procedures and work practices to be followed during sampling include:

- Field personnel shall position themselves upwind (if possible) of chemicalexpoure sources when conducting sampling activities, sample collection, and equipment decontamination procedures.

- Silvershield® or 4H® inner gloves with Neoprene or Nitrile outer gloves and safety glasses with side shields shall be worn when filling sample containers and when handling equipment or sample containers that have come in contact with contaminated substances.

- All electrical connections will be inspected regularly to ensure there are no exposed wires, and that they are grounded and waterproof.

- During removal of the sampling line (pipe) from the well, all pipe breaks will be kept at waist height to reduce the splash hazard of water in the line and facilitate handling of pipe.

- When collecting soil, sediment, and water samples, team members will exercise sufficient caution to avoid or minimize any contact with sample media. Scientists will wear at least one layer of Nitrile disposable glove protection if it is necessary to touch samples while describing soil lithology. New gloves will be used daily and gloves will be replaced every 4 hours after exposure to contaminated soil.

4.2.4 Personal Hygiene

Personal hygiene is the most effective way to control potential chemical exposure from skin absorption or accidental ingestion of hazardous compounds. See Section 6.3 for a complete description of effective personal hygiene practices which will minimize the possibility of chemical exposure.

4.2.5 Adverse Weather

Sudden inclement weather can encroach on unprepared samplers in the field. Field crew members shall carry the appropriate clothing for changeable weather. In severe weather conditions (i.e., high wind or electrical storms) the sample crews will leave the area and find shelter until the weather abates and permits continued sampling or a decision is made to halt the sampling activities.

5.0 PERSONAL MONITORING PROGRAM

The goals of the monitoring program are to provide data on potential short-term Radian employee exposures while working on site. Based upon a combination of moderate to low toxicity, low exposure potential (e.g., low volatility), or moderate to low concentration in environmental samples, some compounds detected during the site characterization study were not included in this air monitoring program. The types of monitoring to be performed include real-time airborne organic vapor measurements using:

- Direct-reading instruments (PID); and
- Colorimetric Draeger® detector tubes for:
  - Vinyl chloride
  - Benzene
  - 1,2-Dichloroethane (Ethylene dichloride)
  - Trichloroethene

5.1 Photoionization Detector (PID)

Real-time airborne organic vapor levels will be measured by a photoionization detector (PID) when Radian personnel are participating in soil and groundwater investigation activities. Direct-reading real-time monitoring shall be performed to monitor Radian personnel exposure to potential airborne hazards. The PID shall be used to evaluate the concentration of contaminants present in the air within 3 inches of the following locations and/or operations to provide information on the potential for VOC emissions.

- The soil surface within 5 feet radius of the sampling location;
- All freshly exposed soil samples; and
- Fresh drill cuttings;

The PID shall also be used to monitor the general work area and the Radian Workers Breathing Zone (RWBZ). Personal protective equipment shall be required as specified in Table 5-1. When conducting real-time air monitoring in the (RWBZ) with the PID, the method of collecting measurements in the RWBZ will be standardized. This will

TABLE 5-1. HYDROCARBON RESPONSE CRITERIA

Organic vapor concentrations (OVC) Readings at Sampling Site (SS) by Photoionization Detector (PID)	Sampling Frequency	Action Taken (Log all Results)
OVC from 0 to 1 ppmv > 2 minutes	Immediately before and after disturbing the soil; *and* every 15 minutes or 1 foot depth by hand auger (HA) or 5 foot depth by mechanical boring (MB) *and* after collecting the sample.	• Modified Level C protection. • Proceed with sampling procedures. • Log results and dates on permanent record for future reference.
OVC from 2 to 10 ppmv > 2 minutes *and* Detector tube measurements at SS for: Benzene and vinyl chloride * reveal no detectable concentrations (NDC)	Immediately before and after disturbing the soil *and* every 15 minutes or 1 foot depth by HA or 5 foot depth by MB *and* after collecting the sample.	• Modified Level C protection. • Proceed with sampling procedures. • Log results and dates on permanent record for future reference. • Collect detector tubes at SS for: -- Vinyl chloride.* -- Benzene
OVC from 10 to 100 ppmv > 2 minutes *and* Detector tube measurements at SS for: Vinyl chloride * reveal NDC and Benzene < 10 ppmv with a half-face respirator or < 50 ppmv with a full-face respirator.	Immediately before and after disturbing the soil *and* every 15 minutes or 1 foot depth by HA or 5 foot depth by MB *and* after collecting the sample.	• Level C protection upgrade: -- Half facepiece or full facepiece respirator with organic vapor cartridges and HEPA filters. -- Tyvek coveralls (or splash apron), nitrile and neoprene gloves, neoprene boots. • Work crew positions themselves upwind from site for 15 minutes. • Collect detector tubes at SS for: -- Vinyl chloride* -- Benzene • Proceed with sampling procedures on upwind side of SS. • Log results and dates on permanent record for future reference.

(Continued)

TABLE 5-1. (Continued)

OVC Readings at SS by PID	Sampling Frequency	Action Taken (Log all Results)
OVC from 100 to 500 ppmv *and* Detector tube measurements at SS for: Vinyl chloride * reveal NDC *and* Benzene ≤ 50 ppmv *and* 1,2-Dichloroethene < 100 ppmv *and* Trichloroethene < 500 ppmv	Immediately before and after disturbing the soil *and* every 20 minutes or 1 foot depth by HA or 5 foot depth by MB *and* after collecting the sample.	• Continue Level C protection: -- Use full-face respirators. • Work crew positions themselves upwind from SS for 15 minutes. • Collect detector tubes at SS for: -- Trichloroethene -- Benzene -- Vinyl chloride* -- 1,2-Dichloroethene • Contact field coordinator and inform project Health and Safety Officer. • Proceed with sampling procedures upwind of SS. • Log results and dates on permanent record for future reference.
OVC from 500 to 1,000 ppmv *or* Detector tube measurements at SS for: Vinyl Chloride * reveal detectable concentrations at SS, but not BZ *or* Benzene > 50 ppmv at SS, but <50 BZ *or* 1,2-Dichloroethane > 100 ppmv at SS, but <100 BZ *or* Trichloroethene > 500 ppmv at SS, but <____ BZ	Immediately before and after disturbing the soil *and* every 20 minutes or 1 foot depth by HA or 5 foot depth by MB *and* after collecting the sample.	• Continue Level C protection: -- Use full-face respirators. • Collect detector tubes in the Radian workers breathing zone (RWBZ) for Benzene and Vinyl Chloride*, Trichloroethene, 1,2-Dichloroethane. • Work crew positions themselves upwind from SS. • If concentrations remain >500 ppmv for 2 hours or longer contact field coordinator and inform Health and Safety Officer. • Re-evaluate -- Wait 15 minutes -- OVC < 500 ppmv, resume sampling -- OVC > 500 ppmv, wait 15 minutes.

(Continued)

TABLE 5-1. (Continued)

OVC Readings at SS by PID	Sampling Frequency	Action Taken (Log all Results)
OVC > 1000 ppmv *or* RWBZ concentrations for: Vinyl chloride * > 10 ppmv *or* Benzene > 50 ppmv *or* 1,2-Dichoroethane > 100 ppmv	Immediately before and after disturbing the soil *and* every 20 minutes or 1 foot depth by HA or 5 foot depth by MB *and* after collecting the sample.	• Work crew dons Level B (SA or SCBA) respiratory protection. *or* • Stop Work • Work crew positions themselves upwind from cuttings or borehole.
*** Detectable concentrations of vinyl chloride in the workers breathing zone require immediate response. See bold print footnote following this table.**	Continuously to every 20 minutes.	• Work crew dons full-face respirators with organic vapor cartridges (OVC's). Respirators will have exposed OVC's replaced every hour while working in an atmosphere containing 1-10 ppmv vinyl chloride.* *or* • Work crews don supplied air (SA) or self-contained breathing apparatus (SCBA). *or* • Work stops. • Work crew positions themselves upwind from cuttings and borehole. • Re-evaluate -- Wait 15 minutes -- Sample vinyl chloride with an unused detector tube in the WBZ - Vinyl chloride not detected in WBZ, resume well sampling procedures - Vinyl chloride detected in WBZ, wait 15 minutes, resample for vinyl chloride, re-evaluate. • Inform project Health and Safety Officer.

*** The National Institute of Occupational Safety and Health (NIOSH) recommends the use of full facepiece supplied air (SA) or self-contained breathing apparatus (SCBA) for any airborne exposure to vinyl chloride. The Occupational Safety and Health Administration (OSHA) approves the use of full-face air purifying respirators with organic vapor cartridges (OVC's) for concentrations of vinyl chloride $\leq$ 10**

ppmv for one hour (CFR 29, Part 1910.1017, pg.138, 1989). If full-face air purifying respirators are used in atmospheres known to contain detectable concentrations of vinyl chloride $\leq$ 10 ppmv, a rigorous assessment of vinyl chloride concentrations will be conducted. Drager tubes for vinyl chloride will be collected in the workers' breathing zone once every 20 minutes to confirm concentrations are $\leq$ 10 ppmv. In addition, due to the permissible exposure limit (PEL)[1] of vinyl chloride (1 ppmv), OVC's exposed to vinyl chloride will be replaced every hour and disposed of at the close of sampling activities. If, at any time, a variance from these procedures should be observed or reported, or airborne concentrations of vinyl chloride exceed 10 ppmv, SA or SCBA will be mandatory for all sampling activities associated with wells or borings known to contain detectable airborne concentrations of vinyl chloride.

** Modified Level C protection allows the use of a disposable Tyvek® apron versus Tyvek® coveralls only when splash hazards are limited to the frontal body area.

TLVs® = Threshold Limit Values recommended by the American Conference of Governmental Industrial Hygienists for 1989-90.

1,1,1-Trichloroethane = 350 ppmv
Trichloroethene = 50 ppmv
1,1-Dichloroethene[a] = 5 ppmv
1,2-Dichloroethane[b] = 1 ppmv
Vinyl chloride[c] = 1 ppmv
Cyclohexane[d] = 300 ppmv
Methanol[d] = 200 ppmv
Benzene = 1 ppmv

[a] Vinyl chloride detector tubes will be used for detection of 1,1-dichloroethene. Vinyl chloride tubes respond at two times the sensitivity for 1,1,-dichloroethene, i.e., 1 ppm in air will indicate 2 ppm on the detector tube.

[b] Methyl bromide detector tubes will be used for detection of 1,2-dichloroethane. These tubes have a lower limit of detection of 100 ppm, and therefore, will be used as a criteria for response only when concentrations of this substance exceed 100 ppm.

[c] Occupational Safety and Health Administration Permissible Exposure Limit 29 CFR 1910.1017.

[d] Cyclohexane and methanol are routinely used during procedures for decontamination of sampling equipment.

[1] PEL = Permissible exposure limit for 8 hours/day, 40 hours/week, for a working lifetime.

be done by providing a suitable support for the instrument so that the air inlet can be positioned approximately 12"-18" above the sampling location near or in the RWBZ. This can be accomplished by using a stable inverted bucket for the instruments support. Real-time volatile organic compound (VOC) measurement will provide a basis for triggering corrective actions of further monitoring requirements and to monitor compliance with concentration levels listed in Table 5-1 (Hydrocarbon Response Criteria) on a real-time basis.

All PID measurements will be adjusted with respect to background measurements. For instance, if background PID measurements indicate 2 ppmv organic vapor concentration (OVC), and RWBZ measurements indicate 7 ppmv OVC, assume 5 ppmv OVC in the BZ resulting from environmental contaminants. Detectable concentrations of organic vapors will require the field crew to follow the appropriate response designated by Table 5-1. Organic vapor concentrations will be recorded on a field data log.

5.2 Direct-Reading Detector Tubes

A Draeger® detector tube kit shall be available for use to determine airborne concentrations of specific/key contaminants during work activities where the PID is being used to screen for volatile hydrocarbons. During soil boring activities, the on-site Radian Safety Officer shall take periodic readings for vinyl chloride and benzene with detector tubes as directed by the Hydrocarbon Response Criteria (Table 5-1).

The readings are taken by drawing a known volume of air through a detector tube and observing a colorimetric indication or airborne concentration. Measurements will be taken in the Radian worker breathing zone (RWBZ). A log of the detector tube observation results will be made part of the permanent McClellan AFB field project file. The time, date, location, type of detector tube, any observed color change, and the name of the individual taking the measurement will be recorded on the field data sheet and kept in the field project file.

An estimate of contaminant concentration can be assumed by observing the portion of the detector tube that shows any detectable color change and comparing the color to the concentration values marked on the side of the detector tube. Care should be exercised to use the correct number of compressions of the Draeger® pump for the detector tube being used. Directions for the proper number of compressions can be found in the instructions contained in each package of detector tubes.

Field team members should be aware that actual air contaminant concentrations can vary by 50% from the values displayed by the detector tubes. Detector tubes may also indicate false positive readings because more than one chemical compound present in the air may cause a reaction similar to the compound specified on the Draeger® tube. The field team has to assume that a compound indicated as a false positive is actually present in the air, and respond according to the Hydrocarbon Response Criteria (Table 5-1.)

When using the hand pump, care should be exercised to:

- Completely compress the bellows;
- Allow sufficient time for the bellows to completely expand; and
- Use the correct number of compressions (as dictated in the instructions for the detector tubes).

5.3 Integrated Sampling

Personal integrated air sampling will be required due to the absence of information on contaminant speciation and concentration which can be expected during the many tasks which will take place over the course of the OU B Remedial Investigation study. Tables 5-2 and 5-3 provide contaminant concentrations detected at selected sites and locations at McClellan AFB. These contaminant concentrations are provided as a reference only, and are not to be used as an indicator of contaminant species and concentrations expected to be encountered at sites other than those listed during the OUB RI. Integrated personal samples will be collected for volatile and semi-volatile organic compounds which cannot be speciated with the real time instruments. The compounds of primary concern are benzene and vinyl chloride, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs). Air samples may be collected for additional compounds based on the exposure hazards as determined by the concentrations of contaminants collected in environmental samples. These compounds have been detected in soil and water samples collected from various sites at McClellan AFB. Personal air monitoring will be conducted in areas known or suspected to contain levels of VOC or semi-VOC compounds which require the use of respirators for extended periods (>1 hour).

TABLE 5-2. VOLATILE ORGANIC CHEMICAL COMPOUNDS IN SOIL GAS

Compound	Locations	PEL[a] (ppmv)	Concentration Detected Relative to PEL
Benzene	SA16P04	1	100 x
	T8P03, L5P134, 24D0103, 24D0104		1 x
Chloroform	SA7P08, SA16P0201	2	1 x
Cyclohexane	SA16P04	300	1 x
1,2-Dichlorobenzene	L6P30	50	1 x
Freon® 113	L6P30, SA7P08	1,000	1 x
Heptane	SA16P04	400	1 x
Hexane	SA16P04	50	10 x
Nonane	SA16P04	200	1 x
Tetrachloroethene	L6P01, L6P02, 36P15	25	1 x
Toluene	L6P30, SA16P05, SA7P08	100	10 x
Trichloroethene	L5P86, L5P145, L5P09, L6P01	50	1 x
Vinyl chloride	L6P30, 48P01	1	1,000 x
Xylenes	SA16P04, 24P03, 24P08, 24D0103	100	1 x
Total hydrocarbons	L5P30, T8P03, SA16P04	300[b]	10 x
	L6P30		100 x

[a] PEL (ppmv) = The Permissible Exposure Limit established by the Occupational Safety and Health Administration (OSHA) to the concentration of a chemical compound in parts per million by volume in air.

[b] A PEL of 300 ppmv for total hydrocarbons is assumed, based on the PEL of 300 ppmv for gasoline.

TABLE 5-3. SELECTED OPERABLE UNIT B SOIL CONTAMINANTS

Compounds	Sites Detected	Maximum Concentration (ppmv)	PEL		Notes
			(ppmv)	(mg/m^3)	
<u>Volatile Organic Compounds</u>					
Benzene	CS 47 Site 38 Site B-5 Site S-26 Site S-27 Site S-7 Site T-16 Site T-17 Site T-20 Site T-47 Site T-57 Site T-59	<5	1	3	Suspect carcinogen
Chloroform	CS 23 CS 47 CS 48 PRL 30 PRL 36 Site 24 Site 38 Site S-24 Site S-7 Site T-20	<1	2	9.78	Suspect carcinogen
Gasline range petroleum hydrocarbons^3	Site T-12 Site T-21 Site S-21	>700 >700 420	300	890	
Nitrobenzene	Site S-24	5	1	5	
2-Hexanone (MBK)	Site 38 Site S-7	200	5	20	
Hexachlorobutadiene	Site 38 Site S-7	0.2	0.02	0.2	
Hexone (MIBK)	Site 38 Site S-7	50	50	205	
1,1,2,2-Tetrachloroethane	Site 38 Site S-7 PRL 30	5	1	7	

(Continued)

TABLE 5-3. (Continued)

Compounds	Sites Detected	Maximum Concentration (ppmv)	PEL (ppmv)	PEL (mg/m^3)	Notes
Volatile Organic Compounds (Continued)					
Xylenes (o,m,p-isomers)	Site S-7	500	100	434	
	Site 38	500			
	Site T-61	75			
	Site T-16	50			
	Site T-20	20			
	SA 91	2			
	Site T-12	2			
	Site T-21	2			
Semivolatile Organic Compounds		**Maximum Concentration (ppmw)**			
2-Methylnaphthalene	CS 23	<10	NE	NE	Confirmed carcinogen
	SA 45				
	Site 38				
	Site S-24				
	Site S-7				
	Site T-20				
Naphthalene	SA 107	<10	10	52	Suspect carcinogen
	SA 12				
	SA 45				
	SA 91				
	Site S-24				
	Site T-20				
PAHs[4]	CS 23	40	NE	0.2	Confirmed carcinogen
	SA 107	40			
	SA 12	10			
	SA 32	10			
	SA 45	10			
	SA 24	10			
	SA 40	10			
	Site S-24	10			
	Site T-20	10			
	Site 34	1			
	Site 38	1			
	Site B-5	1			
	Site P-6	1			
	Site S-7	1			
	PRL B-1	1			
	SA 3	1			

(Continued)

TABLE 5-3. (Continued)

Compounds	Sites Detected	Maximum Concentration (ppmw)	PEL		Notes
			(ppmv)	(mg/m^3)	
Semivolatile Organic Compounds (Continued)					
Pentachlorophenol	CS 23	10	0.05	0.5	
	Site 24	10			
	SA 12	1			
	Site S-24	1			
PCBs[1]	SA 12	1	0.04	0.5	
	SA 67				
	Site S-21				
Cyanides (salts)	PRL 36	0.01	~2.0	5	

[1] Represents total of all polychlorinated biphenyl (PCB) species (1254, 1260).

[2] Sites listed are those with total xylene exceeding 1 ppm.

[3] Sites listed are those with total gasoline range petroleum products exceeding 100 ppm.

[4] Represents total of all polycyclic aromatic hydrocarbon (PAH) species (acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(b,k)fluroanthene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluroanthene, fluroene, indeno(1,2,3-cd)pyrene, phenarthrene, and pyrene).

PEL = Permissible Exposure Limit established by OSHA
ppmv = Parts per million by volume
ppmw = Parts per million by weight
mg/m^3 = Milligrams per cubic meter of air
NE = None established

5.3.1 Passive Monitoring-Organic Vapor Badges

Personnel exposure to volatile organic compounds (VOCs) will be periodically monitored during remedial investigation operations using 3M® Brand #3250 Organic Vapor Badges. Only personnel working closest to the exposed soil and contaminated equipment will be monitored. The procedures to be followed when using these monitors are:

- Open the badge container;
- Mark the date and sampling start time on the badge;
- Place the badge on an individual with the greatest potential of being exposed to organic vapors;
- Complete personal monitoring form;
- The badge should be placed on the outside of the individual's clothing, near the breathing zone (the lapel on the collar will be sufficient);
- The badge will collect organic vapors automatically; and
- At the end of the sampling period (usually eight hours), remove white plastic permeable membrane, place the plastic cap on the badge, mark the end of the sampling time, and forward the badge to the Project Safety Officer. The organic vapor badges should be refrigerated after collection, and sent immediately for laboratory analysis. Observations noted in the field will mandate the selection of badges to be analyzed. The results will be made part of the permanent program file. Excessive exposures will be reported immediately to the affected individual and his/her supervisor.

5.3.2 Active Monitoring-Air Sampling Pumps

Industrial hygiene air sampling pumps will be used to collect integrated personal samples from Radian field samplers (determined by the Project H&S Officer) working closest to the sample collection point or the potential exposure source. Samples will be collected in the workers breathing zone (BZ) to collect a representative sample of airborne concentrations that are inhaled by the worker. Results of personal monitoring will be compared to occupational exposure limits presented in Table 3-1. Personal integrated air samples provide valuable information about air contaminant concentration the worker is exposed to during the sampling period. The on-site H&S Officer will maintain detailed notes based on observations of worker practices throughout the workday. In addition to integrated sampling, real-time monitoring for volatile organic compounds (VOCs) will be conducted throughout the remedial investigation activities.

The collection frequency for integrated air samples will be determined based on the following parameters:

- Historical information on the site;
- Sample collection technique;
- Employee job requirements;
- Level of effort required to collect the sample;
- Amount of time spent at the sampling location; and
- Meteorological conditions (past 24 hours and current)

5.4 Radiation Dosimetry

Selected areas of OU B soils may contain detectable quantities of radioactive substances. These soils may be present on the surface, however, the probability is greater that they will be encountered in the subsurface. Periodically, soil cuttings will be screened with a radioactive spectrum detector to determine the presence and relative concentration of radioactive particles. If it is determined that a potential hazard exists, all Radian field team members who are working at the site will be required to wear approved film badges which are capable of monitoring an individual's exposure to x-ray, beta, and gamma emissions.

A potential radiation hazard will be determined to exist when exposures to Beta, Gamma, and X-ray emissions to the whole body, head and trunk, active blood forming organs, eyes or gonads exceed 0.2 millirems (mrems)/hr. This value is 4% of the minimum recommended exposure (5 mrems/hr) by the National Committee on Radiation Protection, and 10% of the minimum recommended exposure (2 mrems/hr) as specified in California Code of Regulations, Title 17, Section 30268.

5.5 Heat Stress

During the summer, the field activities at McClellan AFB involve working in warm to hot temperatures, often over 100°F. An appropriate work/rest regimen should be initiated under hot conditions or when personnel complain of heat distress. An example would be a 20 to 30 minute work period followed by a 10 minute rest period in a shaded location. The body's reaction to heat stress can be determined by monitoring the person's heart rate (HR). If the HR is higher than 110 beats per minute, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the HR is 110 beats per minute at the beginning of the next rest period, the following work cycle should also be shortened by 33 percent. Resting HR should be determined prior to the start of on-site activities. For a healthy individual, the resting HR is usually 60 to 72 beats per minute. If symptoms of heat stroke are observed, workers will seek medical attention immediately and contact the Project Safety Officer.

When field teams are working in these high temperatures, precautions will be taken to avoid heat stress illnesses. These precautions include:

- A shaded work area;
- Provide adequate quantities of liquids, such as water or Gatorade™; and
- A clean towel which can be moistened and used to cool heat-stressed personnel.

Heat-related disorders can range from dizziness, nausea, and profuse sweating in the early stages, to unconsciousness, brain damage, or even death in the late stages. Heat stress can be prevented by establishing work-rest regimens and avoiding overexertion. Liquids should be replenished frequently throughout the day. Workers also should rest in the shade, away from surfaces that radiate heat (metal or concrete) as often as possible so they may more efficiently cool down during rest periods.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal protective equipment shall be used by Radian personnel to reduce Radian employee exposure hazards, and to provide an additional measure of safety beyond that provided by engineering or other controls. Protective equipment selection is based on the results of the preliminary site inspections and historical data of contaminants known to exist at the site. Protective equipment assignments may be modified based upon the results of the air monitoring program described in Section 5.0.

6.1 Selection of Protective Equipment

The scope of this task is strictly limited to the OU B Remedial Investigation at MClellan AFB. The major hazards that personnel will be exposed to during this study are:

- Inhalation of airborne contaminants either in the form of dust or fugitive vapors emanating from contaminated soils or liquids; and
- Dermal contact with, or ingestion of, contaminated soils or liquids.

Work shall be conducted in modified EPA Level C or Level B PPE. Use of modified Level C respiratory protection shall be justified by results of the real-time air monitoring data described in Table 5-1.

The PPE ensemble required for Radian personnel during the OU B RI sampling activities include:

*Modified Level C

- Hard hat;
- Safety glasses with side shields;
- Chemically-resistant clothing (when splash hazard exists)
    - Disposable Tyvek® coveralls;

- Steel-toe and shank work boots
  - -- Leather; and
  - -- Chemical resistant if liquid contaminants are expected;

- Gloves
  - -- Leather work gloves;
  - -- Leather gloves with Silvershield® or 4H® inner gloves when working with equipment or contaminated soils that are unsaturated;
  - -- Double layer chemical resistant gloves* (Silvershield® or 4H® inner gloves and Neoprene or Nitrile outer gloves) when working with contaminated liquids and saturated soils;
  - -- High voltage rubber gloves when operating electrical equipment (1 pair per sampling team);

- Hearing protection; and

- Half-face or full-face respirator with organic vapor/HEPA cartridges.

* Modified Level B or C refers to the requirements for respiratory protection. Modified Level B (includes all PPE required for Modified Level C), plus respiratory protection upgrade consisting of Self Contained Breathing Apparatus (SCBA) or Supplied Air (SA). Respirator use will be based on the hydrocarbon response dictated by Table 5-1. Chemical resistant gloves will be required for all phases of the OU B Remedial Investigation which require personnel to handle contaminated equipment, soils, or water (i.e., removing contaminated soil probes and hand augers from the ground, breaking auger flights, removing split spoon soil samples, etc.).

The following safety equipment is also required to be carried in the sampling vehicle at all times: A first aid kit; fluorescent orange pylons; portable eye wash, fire extinguisher; and audit checklist.

6.2 Temperature Limitations

Chemical-resistant protective clothing and respirator use can cause employees to fatigue rapidly and will inhibit body cooling. Radian personnel shall be instructed to pace themselves to ensure adequate rest periods and be aware of the signs and symptoms of heat stress as described in Section 7.2.

6.3 Personal Hygiene

Personal hygiene and safe work practices are the most effective way to control potential chemical exposure from skin absorption or accidental ingestion.

Safe work practices to follow when working in the field include:

- Wear a clean change of clothes each day and change work clothes at the end of each workday;
- Eating and smoking are not permitted during sampling activities;
- Wash your hands and forearms with soap and water before eating, drinking, or smoking;
- Immediately wash exposed areas of the body which contact contaminated liquid or equipment;
- Immediately change clothing saturated with contaminated liquids;
- Store food and personal gear separately from contaminated equipment and sample containers;
- Wash your hands before and after using the toilet;
- Take a thorough shower at the end of the day;

- Respirators which are not in use shall be kept in clean plastic bags and carried in a rigid container (to prevent face-piece disfiguration) in the sampling vehicle at all times;

- Respirators shall be cleaned with a sanitizing solution recommended by the respirator manufacturer, and rinsed with clean water at the end of each work day in which it was used; and

- Respirators equipped with organic vapor cartridges (OVCs) will follow a regular OVC replacement schedule. Each OVC shall have the respirator installation date clearly marked on the cartridge. An appropriate OVC replacement schedule would be:

  -- Once each week with little to no use of the respirator;

  -- Once every other day with consistent (daily) use of respirator in organic vapor concentrations of 1 - 100 ppmv;

  -- Once each 8 hours of use in organic vapor concentrations greater than 100 ppmv; and

  -- Once each hour in atmospheres with detectable vinyl chloride*.

* **The National Institute of Occupational Safety and Health (NIOSH) recommends the use of full face-piece supplied air (SA) or self-contained breathing apparatus (SCBA) for any airborne exposure to vinyl chloride (VC). The Occupational Safety and Health Administration (OSHA) approves the use of full-face air purifying respirators with organic vapor cartridges (OVC's) for concentrations of VC $\leq$ 10 ppmv for one hour (CFR 29, Part 1910.1017, pg.138, 1989). If full-face air purifying respirators are used in atmospheres known to contain detectable concentrations of VC, a rigorous assessment of VC concentrations will be conducted. Draeger tubes for VC will be collected in the workers' breathing zone once every 20 minutes to confirm concentrations are $\leq$ 10 ppmv. In addition, due to the permissible exposure limit (PEL)[1] of VC (1 ppmv), OVC's exposed to VC will be replaced every hour and disposed of at the close of sampling activities. If, at any time, a variance from these procedures should be observed or reported, or airborne concentrations of VC exceed 10 ppmv, SA or SCBA will be mandatory for all sampling activities associated with detectable airborne concentrations of VC.**

7.0 EMERGENCY RESPONSE PLAN AND PHONE LIST

Emergency procedures listed in this plan are designed to give the field team instruction in handling medical emergencies.

7.1 Injuries

Medical problems that may occur on-site need to be handled competently and quickly. Each field team member will be aware of the instructions and information given below. Each field team member must also know the location and contents of the first aid kit supplied to them.

- Become familiar with the emergency telephone numbers in Section 7.3 of this Addendum of the Air Force Base, community ambulances, and medical facilities provided in the Emergency Phone List;

- Seek professional medical attention for personnel who are not breathing, bleeding severely, experiencing intense pain, or are unconscious. Each member of the site team will know how to call for an ambulance (on and off base);

- If you get chemicals or dust in your eyes, flush them with water for 15 minutes;

- Do not remove objects that are stuck in the eye. Always seek medical attention for eye injuries;

- All burns (chemical or thermal) will be treated by running cold water over the affected area;

- Report all injuries to the Project Safety Officer and/or your supervisor; and

- In case of any emergency, McClellan AFB Environmental Management will be notified.

7.2 Heat Stress

All project personnel should be familiar with the signs and symptoms of heat stress, as follows:

- Heat Exhaustion - dizziness, fatigue, copious perspiration, cool skin that is sometimes pale and clammy, and nausea; and
- Heat Stroke - hot, dry, flushed skin; delirium, and coma (in some cases).

Heat stress can be prevented by resting frequently in a shaded area and consuming large quantities of fresh, potable water. If symptoms of heat exhaustion are observed, the person will be required to rest in a shaded area and consume liquids. If symptoms are widespread or observed frequently, an appropriate work/rest regimen will be initiated. This may involve limiting the work period so that after one minute of rest, a person's heart rate (HR) does not exceed 110 beats per minute. (See Section 5.6 for additional information).

7.3 Emergency Phone List

HOSPITALS

- On-base (if life threatening): 115
- Out-patient Clinic: Building 541
- Off-base: 965-2155
  Mercy-San Juan Hospital - Emergency Room
  6501 Coyle Avenue
  Carmichael, CA

URGENT CARE

- **Immediate Care**
  Elkhorn Plaza
  5339 Elkhorn Plaza
  331-2800

FIRE

- On-base: 117 or 643-6666
- Off-base: 911

AMBULANCE

- On-base: 115
- Off-base: 911

POLICE

- On-base: 112 or 643-2111
- Off-base: 911

RADIAN SAFETY OFFICER - To be contacted in this order:

		Office	Home
1.	Rick Moore	(916) 362-5332	368-1611
2.	Mike Wasserman		677-7189
3.	Kim Worl		452-0573
4.	Kate Hall		753-0156

BASE SAFETY OFFICER

- Ron Gamber: (916) 643-6227

ENVIRONMENTAL MANAGEMENT

- Elaine Anderson: (916) 643-1250
  Mario Ierardi
  Bud Hoda

SURGEON GENERAL BRANCH

- Beeper: (916) 328-2042

APPENDIX A

Site Safety Audit Checklist

HEALTH AND SAFETY PLAN AUDIT CHECKLIST

Project:
Key Personnel (Names and Companies):
Starting and Ending Dates:

		Yes	No	N/A	Comments
1.	Safety issues addressed in the weekly project meeting held?	[ ]	[ ]	[ ]	
2.	Attended by entire field crew?	[ ]	[ ]	[ ]	
3.	Are respirators available on-site for immediate use?	[ ]	[ ]	[ ]	
4.	Are respirators in proper working order and ready to use?	[ ]	[ ]	[ ]	
5.	Respirators stored in plastic bags in the Support Zone?	[ ]	[ ]	[ ]	
6.	Are respirators marked with installation date?	[ ]	[ ]	[ ]	
7.	Each employee has required personal protective equipment?	[ ]	[ ]	[ ]	
8.	Safety glasses worn?	[ ]	[ ]	[ ]	
9.	Gloves worn?	[ ]	[ ]	[ ]	
10.	Hardhats worn?	[ ]	[ ]	[ ]	
11.	Hearing protection available and used when required?	[ ]	[ ]	[ ]	
12.	Proper type of fire extinguisher available?	[ ]	[ ]	[ ]	
13.	Fire extinguisher inspected?	[ ]	[ ]	[ ]	

HEALTH AND SAFETY PLAN AUDIT CHECKLIST (Continued)

	Yes	No	N/A	Comments
14. Fire extinguisher in an accessible location?	☐	☐	☐	
15. Electrical connections on equipment inspected regularly to insure integrity?	☐	☐	☐	
16. Well pipe protected to prevent abrasion of electrical lines?	☐	☐	☐	
17. Electrical line secured to sampling line?	☐	☐	☐	
18. Pipe breaks conducted at waist level?	☐	☐	☐	
19. First aid kit available and properly stocked?	☐	☐	☐	
20. First aid kit in an accessible location?	☐	☐	☐	
21. Employee trained in first aid located at this site?	☐	☐	☐	
22. Telephone available for emergency phone calls?	☐	☐	☐	
23. Procedures established for maintaining contact with field teams working in isolated locations?	☐	☐	☐	
24. Emergency phone numbers posted by the telephone or in an accessible location?	☐	☐	☐	
25. Exclusion zone established around work site?	☐	☐	☐	
26. Unauthorized personnel prevented from entering the Exclusion Zone?	☐	☐	☐	
27. Support Zone been established?	☐	☐	☐	

HEALTH AND SAFETY PLAN AUDIT CHECKLIST (Continued)

	Yes	No	N/A	Comments
28. Washing stations established in the Exclusion Zone for decontaminating safety equipment, and for hand washing?	☐	☐	☐	
29. Trash containers available for disposal of gloves, paper towels, etc.?	☐	☐	☐	
30. Barrels available for containerizing spent decontamination fluids?	☐	☐	☐	
31. Safety equipment being decontaminated?	☐	☐	☐	
32. Employees wash hands before leaving Exclusion Zone?	☐	☐	☐	
33. Employees eat, drink, or smoke only in the Support Zone?	☐	☐	☐	
34. Sufficient supply of drinking water located in the Support Zone:	☐	☐	☐	
35. Support Zone located upwind and in an uncontaminated area?	☐	☐	☐	
36. Bathroom facilities available?	☐	☐	☐	
37. Shaded area available for taking breaks while working in hot environments?	☐	☐	☐	
38. Appropriate direct-reading analyzer available for use?	☐	☐	☐	
39. Field calibration checks of direct-reading analyzer being performed and documented?	☐	☐	☐	

HEALTH AND SAFETY PLAN AUDIT CHECKLIST (Continued)

	Yes	No	N/A	Comments
40. Direct-reading analyzer measurements are documented on the proper form?	☐	☐	☐	
41. Appropriate types of detector tubes available for use?	☐	☐	☐	
42. Detector tube bellows pump calibrated and leak tested?	☐	☐	☐	
43. Detector tube measurements are documented?	☐	☐	☐	
44. Appropriate personal monitoring devices being used?	☐	☐	☐	
45. Personal monitoring samples being documented?	☐	☐	☐	
46. On-site safety coordinator maintains a health and safety log?	☐	☐	☐	
47. Health and Safety Plan available?	☐	☐	☐	
48. Deviations from the health and safety plan are documented?	☐	☐	☐	
49. High voltage gloves and voltage sensor available?	☐	☐	☐	
50. Heat resistant gloves available?	☐	☐	☐	
51. Eyewash available?	☐	☐	☐	
52. Eyewash water changed and dated quarterly?	☐	☐	☐	

Recommended corrective measures for any items checked "No":

Auditor: ____________________ Date: __________
On-Site Safety Officer Signature: ____________________ Date: __________
Field Task Leaders Signature: ____________________ Date: __________
Project Safety Officer's Signature: ____________________ Date: __________
Distribution:

APPENDIX D

Responses to Regulatory Agency Comments on the Draft Operable Unit B Sampling and Analysis Plan

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SACRAMENTO AIR LOGISTICS CENTER (AFLC)
McCLELLAN AIR FORCE BASE, CALIFORNIA 95652-5990

27 SEP 1991

REPLY TO ATTN OF: EMR

SUBJECT: Operable Unit B (OUB) Remedial Investigation (RI) Draft Final Sampling and Analysis Plan (SAP)

TO: Distribution

1. Attached are the responses to your comments on the subject document. Also enclosed are further revisions to the SAP. Please substitute the enclosed pages for the ones currently in your copy of the Draft Final SAP.

2. If you have any questions, please feel free to contact me at (916) 643-0531.

Elaine Sue Anderson

Elaine Sue Anderson
Project Officer

1 Atch
Responses to Comments

Distribution:
EPA (Levis Mitani)
Cal-EPA (Mark Malinowski)
RWCQB (Alex MacDonald)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

JUN 05 1991

RECEIVED
JUN 10 1991
Ans'd.......0212

Mr. Mario Ierardi
Project Manager
SM-ALC/EM
McClellan AFB, CA 95652-5990

Dear Mr. Ierardi:

Enclosed are the comments of the Environmental Protection Agency (EPA) to Operable Unit B Remedial Investigation Sampling and Analysis Plan (OUBSAP) for McClellan Air Force Base (MAFB).

In reviewing the OUBSAP it was difficult to determine how the phases of investigation will be integrated to meet the objectives of the remedial investigation (RI). We believe a performance based Data Quality Objective(s) (DQO) when linked with RI objectives and a conceptual model (site specific and/or OU wide) should guide the overall RI. The achievement of the objective(s) will be a measure of completeness of an RI. The number of phases to achieve the objective(s) will depend on site conditions and investigative approach. Therefore whether or not a site proceeds onto another phase of investigation will depend upon the achievement of performance based RI objective(s).

To determine the achievement of performance objectives, a conceptual model will help determine data gaps, number of samples to be taken, pathways, where samples would be taken and help identify potential remedial technologies. We envision a complete conceptual model will account for multiple objectives of an RI. An example of a performance based objective would be the setting data quality levels by setting completeness, precision and accuracy. This is set in the QAPP and verified by the data validation process.

Another example of a performance based RI objective would be the use of statistically based performance to measure data needs for risk assessment. Minimum criteria for the measurement of performance would be confidence level, power, and minimum detectable difference. For risk assessment it is important to detect differences between the site chemistry and background. Therefore, risk assessment performance data would be at a confidence of 90%, power of 90%, and detectable difference of 20%. The parameters will prescript the number of samples needed to meet these risk assessment performance criteria.

Since background levels are an important RI objective, criteria for background should also be set along statistical performance levels, as well as the vertical and horizontal nature of contamination. Each RI objective with its own performance criteria becomes a layer in constructing a conceptual model and when all criteria are met, the completed picture will help bring the RI to a conclusion.

We understand MAFB is considering using site screening or field screening as part of the RI. When validated and integrated with fixed laboratory analysis, EPA believes this to be a cost effective method for site characterization. Accordingly, an addendum to the QAPP should be prepared and the OUBSAP should explain how field screening data will be utilized, validated and integrated with the RI (e.g. DQO application to performance criteria).

If you have any questions please contact me at (415) 744-2412.

Sincerely,

Lewis C Mitani

Lewis Mitani
Remedial Project Manager

enclosure

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EPA Comments to
Operable Unit B Remedial Investigation Sampling & Analysis Plan
McClellan Air Force Base

GENERAL COMMENTS

Sampling Strategy

G-1. The stated objectives of the sampling program ". . are:

- Identification of sources of contamination of soil, soil gas ground water, and surface water in OU B;
- Determination of the nature and extent of contaminants with a high degree of confidence; and
- Evaluation of alternatives for remediation of sites or contaminated media requiring cleanup." (p. 1-5)

The text of the SAP alludes to the importance of contaminant movement in making decisions on potential sampling depths for different contaminants (p. A4-17; p. A2-3). However, the remedial investigation objectives should also include the following two specific objectives:

- Identification and characterization of migration pathways
- Evaluation of contaminant transport.

These two objectives should also be explicitly incorporated into the decision tree for Phase 1 and Phase 2 activities so that the link from contaminant sources to environmental receptors is clearly established.

In particular, the subsurface materials in the unsaturated and saturated zones should be characterized because of their role in contaminant transport. This characterization should include collection of data on the physical and chemical properties that will affect contaminant migration, including moisture content, organic carbon content, particle-size distribution, gas phase permeability, and soil bulk density. Physical tests to determine these variables are outlined in Table 6-6 and pp. 6-14 to 6-19 of the SAP. However, the SAP does not address what, if any, samples in Phase 1 will be analyzed by these tests. The discussion of samples for physical tests in Phase 2 suggests that only selected samples will be analyzed where "vertical migration of contaminants has occurred" and where these physical factors will affect the selection of remedial alternatives (p. A5-5).

In addition, variables that are not addressed in the SAP include porosity, tortuosity, dispersivity, source vaporization pressure, barometric pressure, hydrologic permeability, and temperature. The mechanism of migration is treated in the SAP as a simple gas diffusion mechanism, ignoring the multiphase interaction of solution-adsorption-gas phases. For example, the contaminant can migrate as a solution and adsorb onto a carbon-rich clay, without any gas diffusion. These variables should be addressed and either characterized in the study or an explanation for their exclusion should be provided.

All major lithologic types should be characterized (e.g., clay, silty clay, silt, sand, and gravel). Sufficient samples should be collected to determine the variability of properties for each soil type. A summary of the physical tests should be added to the analytical methods portion of the data quality objectives tables for applicable site-specific plans in Sections 3.1 to 3.22.

G-2. The sampling decision protocol provides different sampling guidelines for soil-gas targets and non-soil gas targets or suspected source targets. For example, where soil-gas targets are found [i.e., total volatile organic compounds (VOCs) are ≥100 ppbV], the maximum borehole depth proposed for sampling of VOCs in Phase 1 is extended to 95 feet. Where soil-gas targets are not found, the maximum depth proposed for VOC sampling at most of the specific sites in Section 3 is 15 feet.

The distinction between soil-gas and non-soil gas targets goes beyond vertical sampling differences. For example, the lateral spacing criteria for soil-gas targets (p. A4-4) are arbitrary compared with the statistical approach used to define lateral spacing criteria for non-soil gas targets (pp. A4-6 to A4-12). The latter criteria are based on estimates of contaminant patch sizes. In both cases, sources may be undefined or poorly characterized, yet by design, the resulting data may be substantially different in terms of vertical and lateral density of information. A statistically-based sampling scheme should be used for soil-gas investigations and subsequent soil-vapor extraction designs (if needed during remedial action). Such a scheme should account for a minimum source size of concern and a maximum distance for detection to establish a unit-wide grid spacing.

Overall, the soil-gas decision branch places more weight on the reliability of soil-gas measurements than is warranted. Appendix A of the SAP states that a validation study was conducted to demonstrate that soil gas could be used as a remote indicator of VOC contamination (p. A2-9). The available data are not sufficient to support the conclusion that sampling for VOCs is unnecessary at depth when soil-gas readings are less than 100 ppbV (p. A2-23). Because false negative results are possible with soil-gas measurements (discussed further in specific comments), these data should not be used in Phase 1 to eliminate areas from being sampled or to reduce depths at which samples should be collected. A preferred strategy would be to have only two decision paths instead of three: suspected sources and undefined sources. Soil-gas data could then be used to refine decisions within these paths, such as determining the location or spacing of boreholes in addition to those placed by statistical sampling considerations.

The SAP also provides a second definition of non-soil gas targets as "sites at which VOCs are not expected to be contaminants of greatest concern" (p. A4-6). The ambiguity of this definition also occurs in the vertical spacing criteria on p. A4-13, which indicate that "Samples for analysis of mobile contaminants (e.g., VOCs, radionuclides, and phenols) will be collected at depths from surface to a minimum of 15 feet at sites where their presence is suspected." The criteria for suspecting mobile contaminants should be explicitly defined in the SAP.

It is also possible that strongly sorbing chemicals (e.g., PCBs) will not always be restricted to the upper 10-15 feet of the unsaturated zone. Such chemicals can be dissolved in a solvent plume and transported further into the aquifer by gravity flow. It is also possible that there will be no visual or olfactory evidence of plumes that have passed deeper into the aquifer system (i.e., a detectable trail may not be present). This concern could be addressed by analyzing a small percentage of samples (e.g., 5-10 percent) from 15 to 95 feet for a broad spectrum of chemicals. These samples could be chosen in areas for which historical sources of strongly sorbing chemicals have been documented, or at random.

G-3. In Section A4.0, a statistical approach is used to define the probability of missing a 10-foot circular zone of contamination with a random, systematic sampling scheme. These calculations are used to predict a high probability of locating contamination using a rectangular grid system. However, these calculations do not reflect the planned spacing between boreholes, which may be separated by 15 to 100 feet. These calculations are useful but should be performed using the range of actual sampling conditions to show the range of probabilities that are expected. In addition, an alternative calculation should be performed to determine what is the largest zone of contamination that could be undetected using the planned sampling scheme with a probability of at least 0.1 percent.

In addition to the statistical approach to sampling, the decision criteria should include a provision to sample any stained areas, even if the area is not on the regular grid system. The purpose of the Phase 1 investigation is to identify contamination, not just define its probable distribution.

G-4. Potential changes in chemical concentrations and composition over time are not adequately addressed in the site characterization plan. For example, the possibility of chemical degradation is mentioned (p. 3.0-14) but is not integrated into the decision protocol in Appendix A. The range of degradation rates for biodegradable compounds and their major metabolites should be identified. Marker degradation products may be useful in determining sources of contaminants.

In addition, data from various years of sampling will be available for use in the remedial investigation. Decision criteria are needed for identifying what older historical data can be combined with newer data for interpretation so that changes in concentrations over time are properly interpreted.

G-5. Based on the existing data, groundwater contamination is the driving force behind the remedial investigation and is recognized in the decision protocol for Phase 2 (pp. 3.0-07 to 3.0-15). The SAP states that the existing groundwater investigations have only partially determined the extent of ground water contamination and have not identified sources of the contaminants migrating in ground water. However, no groundwater samples are proposed in Phase 1 to complete the characterization of this medium, which is identified to be of concern at Investigation Clusters 1 and 8 and Special Study Area 2. The text indicates that new wells may be constructed during Phase 2 to confirm contaminants in groundwater if existing wells are not located along the principal groundwater flow path downgradient or upgradient from a site (p. 3.0-14). A summary of potential locations based on existing data should be presented in the SAP.

The link between Phase 1 samples in Section 3 and groundwater criteria discussed for Phase 2 in Appendix A (pp. A5-8 to A5-10) should also be discussed. For example, it is unclear how "[p]otential sources identified by tracking an OU B plume to its origin will be considered for evaluation in accordance with Phase 1 and Phase 2 procedures. Return to Phase 1." (p. A5-10). This feedback loop is not recognized in the flow diagram for the sampling decision protocol (e.g., p. 3.0-5).

The issue of groundwater contamination should be heavily stressed because the aquifer is used as a principal water supply for the base, and groundwater resources beneath off-base areas beyond the base supply well are also threatened (e.g., p. 3.1-12). This pathway could become the primary exposure route, more important than exposure to the upper 15 feet of soil. If there is reason to believe the groundwater in certain areas will never be used for human consumption or by wildlife, then that reason should be clearly stated early on. Justification based on known groundwater contamination should also be cited where appropriate for proposed boreholes. For example, the tri- and tetrachloroethene contaminant plume is cited as one general justification for sampling in Investigation Cluster 1, but the relationship of specific boreholes to the plume is not discussed. There is no discussion of the link between documented ground-water contamination and proposed boreholes in either Investigation Cluster 8 or Special Sampling Area 2.

G-6. There is no table summarizing a timeline of historical activities, and prior sampling efforts, or integrating the results of prior water and soil sampling. Such a table should be provided. At a minimum, Tables 2-1 and 2-2 should be combined. It would also be helpful to summarize in an appendix the available data by sample number, sample location, depth, and analyses performed. If the samples are to be set on a grid system from a 0 point, then the X, Y, and Z coordinates should be included.

In general, the SAP does not provide sufficient details of data from previous investigations. Although the SAP does summarize data from other reports, it only provides a listing of positive results, which do not provide a complete picture of the site contamination. The location and depth of uncontaminated samples, and the detection limits of the analytical methods employed, are essential to assess the extent of contamination and the need for further sampling. Either the historical data should be expanded so that all pertinent information is presented, or summaries should be carefully referenced (by document table or figure number).

With respect to ground-water data, the existing aquifer data should be integrated into the description of the Unit B site in Section 2. These data are needed to support the delineation of five hydrostratigraphic zones. The only support currently provided is the slight difference in the piezometric level, which appears to support a single hydrostratigraphic unit hypothesis. There is no indication of vertical or horizontal hydraulic conductivity. In addition, there are no cross-sections showing the depth of the wells, the relative locations, zones of completion, approximate hydrostratigraphic units, or lithology. There are also no tables showing these data.

The only groundwater maps show plumes of total VOCs, without presenting the concentrations of the individual constituents. It is unclear if these data represent only the major contaminants identified in the figures and text (p. 2-25) or the sum of all VOCs. The summary of available groundwater data, as part of the site description or in a separate section, should contain:

- Cross-sections showing the lithology
- Cross-sections showing the placement and depth of the wells and the location of the groundwater
- Maps of the contaminant plumes separated by chemical and by hydrostratigraphic zones.

Although these summaries will be developed in the remedial investigation, they would improve the understanding of the subsurface conditions and aid in, or alter, the placement of the Phase 1 sampling locations.

Risk Assessment

G-7. Appendix B does not identify how the LOCs will be used in the investigation. One likely goal of the analysis is to identify detection limits for each medium that are low enough to detect a concentration associated with a 10-6 risk level. Section 4.3 of the SAP states "LOCs for soil, solid waste, and water were determined based on the analytical requirements of the various data uses, including risk assessment, site characterization, and feasibility studies." However, there is no presentation of the LOCs in comparison of analytical methods selected, and the methods selected do not meet the LOCs. While other intended uses of the LOCs are feasible (i.e., selection of remedial action goals), these comments primarily address the problems identified in Appendix B under the assumption that the LOCs will be used in selection of analytical methods for the

site. In addition, while Appendix B is not identified as a risk assessment, it may represent the approach to be used in a later risk assessment, and thus assumptions used in Appendix B that would not be appropriate for use in a risk assessment are identified in these comments.

G-8. The criteria for selecting chemicals for the LOC analysis in Appendix B should be identified. It is not clear whether the chemicals reviewed are method analytes, all of the chemicals detected at the site, or selected site contaminants of concern, or were derived from some other criteria. Without this information, it is not possible to judge whether all key contaminants have been considered.

G-9. While the analysis presented is largely based on exposure assumptions and algorithms presented in the EPA Risk Assessment Guidance for Superfund (U.S. EPA 1989), several assumptions made in the calculations and some aspects of the applications of the algorithms warrant comment since they all may impact the selection of methods, and many would be inappropriate for risk assessment. Since one of the potential uses of the LOC is identification of detection limits needed to conduct the human health risk assessment, LOC calculations should be based on the most conservative exposure assumptions and toxicity values (reference doses and slope factors) that will be used in the risk assessment. Analytical methods selected based on assumptions that are less conservative than those to be used in the risk assessment may not provide detection limits that are adequate to support the risk assessment.

G-10. A duration of exposure of 9 years in all calculations. This is the average duration of time that individuals live at one residence as identified in U.S. EPA (1989b). Thus, a 9-year exposure duration was used correctly in calculation of the average exposure scenario for carcinogens. In addition, use of a 9-year duration was acceptable in calculations for noncarcinogenic effects where exposures were correctly averaged over the same time period. This exposure duration, however, will not be acceptable in the risk assessment calculation of a reasonable maximum exposure scenario (RME) for carcinogens, which is required by U.S. EPA (1989b). A more appropriate duration of exposure for the RME would be 30 years. Thus, use of a 9-year duration in derivation of levels of concern may lead to selection of methods with detection limits that are not low enough to evaluate risks associated with the RME exposure scenario.

G-11. No reference is provided for the toxicity values used in deriving LOCs. Comparison of reference doses (RfDs) and risk-specific doses (RSDs) [slope factors were converted to RSDs in Appendix B by division by a 1*10-6 risk level] presented in Table B-1 with RfDs and slope factors presented in the Fourth Quarter Health Effects Assessment Summary Tables (U.S. EPA 1990b) indicates some discrepancies, which may reflect changes in the EPA approved toxicity factors since Table B-1 was prepared. In addition, toxicity values based on oral exposures were incorrectly used in calculation of LOCs for air, and dermal toxicity values were derived incorrectly. However, toxicity values are updated frequently by EPA and thus Radian should prepare an updated version of the toxicity values and submit it for approval by EPA Region 9 prior to conducting the risk assessment.

Terms, Document Organization, and Data Presentation

G-12. The classification of organic compounds in the SAP should be according to the migration potential and expected fate of each, which are functions of chemical and physical characteristics. The VOCs detected should, at a minimum, be grouped into chlorinated alkanes and alkenes, aromatic compounds or BTX (benzene, toluene, xylenes), and ketones, rather than grouped as a single class of solvents. Pertinent physical parameters such as vapor pressure, solubility, and density should be presented in a table.

In discussing metal concentrations, total threshold limit concentration (TTLC) values are used as criteria for metals contamination. TTLC values are only designations to classify the material as hazardous waste for the purpose of transportation. TTLCs are not appropriate for determining if a release has occurred. Background samples should be taken to establish background concentrations for metals.

G-13. The definition of specific terms is often unclear, and sometimes a single term is used with at least two different meanings. For example, "source" is used as: 1) the origin of the contaminating material or the area where the contamination first entered the environment, and 2) a sample containing a contaminant (for soil gas). "Site" usually refers to the areas numbered for focused investigations, but sometimes is used for a cluster, or the whole unit, or simply a contaminated area. "Soil" is used for 1) the solid matrix or soil particles, and 2) a unit volume having all three phases (solid, liquid, and gas). Also, the term "decision level" is used for an applied action concentration.

Terms should be clarified and the definitions adhered to. A strict hierarchy of terms, especially for physical dimensions, should be defined, structured, and adhered to. The physical dimensions include: time (rarely a problem), areas (locations), and volumes. Terms such as soil, soil gas, sediment, and other geological terms should also be consistently defined and used. Physical states must also be defined, especially definitions that are used interchangeably, such as vapor and gaseous phase. Processes are also often misused or used inter-changeably, such as volatilization and evaporation. A standard or site-specific glossary could be included in the text and a list of acronyms should be provided.

In addition, the SAP introduces two new sites, Special Study Areas (SSA) 2 and 3. These sites are not discussed in the Operable Unit B Preliminary Assessment Summary Report prepared by Radian (1990a) (PASR). The term SSA should be defined early in the SAP (it is not apparent until the end of Section 3, where the SSAs are first discussed, that these sites will be investigated) and should be included in Tables 2-1 and 2-2 and in the combined table discussed in the following comment.

G-14. There is no table in the SAP summarizing the proposed sampling effort. There should be a table (or separate summary table for each medium sampled) for all investigation clusters indicating the total number of samples to be collected by analyses to be performed. All field quality control samples should be included in this table. This documentation would provide an overall view of the investigation and would make possible an accurate assessment of adequacy of the sampling strategy and quality control. The existing sample matrix tables are good summaries but are not convenient for cross-referencing of samples.

G-15. It would be helpful to construct a grid system for the entire base and overlay all maps with the grid. All samples can then be described by length, width, and depth axes. This grid system will be invaluable when plotting the data. The grid will ease the input of the sample locations into a database and will allow interfacing of the database with mapping programs (e.g., ArcInfo, AutoCad, Intergraph).

G-16. Ecological Assessment. Surface runoff pattern(s) is a likely pathway to a ecological target (e.g. Magpie Creek) and should be determined as part of the RI. Any sampling in Magpie creek should be in the depositional zones of the creek. Analysis of the sediment samples should include particle/grain size and total organic carbon (TOC).

SPECIFIC COMMENTS

Introduction (Section 1)

S-1. 1.0 Introduction (p. 1-1, footnote)

Use of the term "site" as a geographical reference and the term "Site" to imply the confirmed presence of contamination is confusing. It would be better to consistently use the term "area" as a geographical reference and "site" as an area in which contamination has been confirmed.

Site Description (Section 2)

S-2. 2.2 Site Topography (p. 2-9, para. 1)

A topographic map would be helpful.

S-3. 2.2 Soils (pp. 2-9 to 2-10)

The soil types are summarized in the text. To facilitate understanding and comparison, a table should be presented providing the soil classification (and abbreviation), the soil type (material), permeability, water absorption, water capacity, shrink-swell potential, erosion potential, and use.

S-4. 2.5.2 Geology (pp. 2-16 to 2-19)

Cross-sections of the site should be provided, showing and describing the lithologic types.

S-5. 2.5.3 Hydrogeology (p. 2-20)

A cross-section showing the approximate depths of the different hydrogeologic zones should be provided. The only reference to the depths of these zones are the depths of the screened intervals for well BW-18 (discussed in the following Section 2.5.4).

S-6. Figures 2-16 to 2-20 VOC Concentrations. (pp. 2-26 to 2-30)

A plume may be a mixture of two or more chemicals. However, when plumes are plotted, each chemical should be plotted separately because the physical properties of the VOCs (including migration rates) differ. Integrating the chemicals as one plume instead of as overlapping plumes tends to imply that the physical characteristics of the plumes are the same.

Total VOC values are given in the figures, while the plumes are listed as a one-or two-chemical plume. It is unclear whether the concentration isopleths refer to total VOCs or to the concentration of the specific chemicals listed as the plume contributors.

S-7. Tables 2-1 and 2-2 (pp. 2-33 to 2-38)

Tables 2-1 and 2-2 should be combined to facilitate review. The term "SSA" in Table 2-2 is undefined.

A confirmed release is reported for potential release location (PRL) B-1 in the text (p. 2-37). In the PASR, however, PRL B-1 is described as having no reported releases. PRL B-1 is also not listed in Table 2-1 or Table 2-2. A contaminant release at study area (SA) 15 is described in the text (p. 2-37) as documented but in Table 2-2 as potential. Soil contamination at SA 3 is described as confirmed in text (p. 2-37) and in Table 2-3, but only as suspected in Table 2-2. A confirmed leak at PRL L-6 is noted in Table 2-2 and in one part of the text (p. 2-41), but PRL L-6 is not cited in the summary of documented releases (p. 2-37). A historical leak at PRL T-8 is also noted in Table 2-2 but not in text.

Stored materials at PRL S-13 are noted in text (p. 2-41) as including fuels, oils, acids, bases, solvents, and PCBs. In addition, PRL S-13 is listed elsewhere (p. 2-36) as having the only current use of cyanide compounds. However, Table 2-2 only lists heavy metals and PCBs for PRL S-13 and shows current cyanide handling at PRL S-28.

These discrepancies should be resolved, and the tables and text should be carefully reviewed for additional errors.

S-8. 2.6.4 Groundwater Contamination Investigation (p. 2-43).

In the first sentence, "source of" should be deleted.

S-9. 2.6.5 Ground-water Contamination (p. 2-47, para. 3)

The text states that "metal ions have been detected in groundwater samples from both on- and off-base monitoring wells of OU B." Later, the text continues with "The metal ions calcium, sodium, magnesium, silicon, and iron are the dissolved metals occurring most commonly and in the greatest concentration in groundwater." Although the text indicates that metals can result from the dissolution of naturally occurring minerals, it should make clear that the high concentration of these particular ions is typical of ground water in general. The ratios of these metals can indicate the locale and the age of the water. Furthermore, the concentrations and ratios of the solute will help demonstrate the hydraulic continuity or independence of the aquifer under the site.

S-10. 2.6.5 Ground-water Contamination (p. 2-48, para. 1)

The text states that only one metal was found in concentrations exceeding the maximum contaminant levels for drinking water. The text should state which metal was found, at what concentration it was detected, what the maximum contaminant level is, and which maximum contaminant level (state or federal) is quoted.

S-11. 2.6.5 Ground-water Contamination (p. 2-48, para. 2)

The statement "dissolved metals . . . may dissolve in groundwater as a result of atural processes" should read "dissolved metals . . . may have originated from the dissolution of the soil solid phase by natural processes."

S-12. 2.6.6 Soil Gas Results (p. 2-49, para. 3)

The second to the last sentence states "Therefore, soil gas concentrations less than 150 ppbV total VOCs can be used to eliminate areas of a site from soil sampling for VOCs analysis." As discussed in the following review of Appendix A, soil gas data can be used as an indicator of contamination, but should not be used to eliminate sites because there is a strong likelihood of false negative results.

Data Quality Objectives (Section 4)

Most comments on levels of concern and the health risk assessment are provided in the Appendix B section of this review.

S-13. Tables 4-3. Levels of Concern for Soil (p. 4-6)

Method SW 8280 shown for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is a low-resolution technique that can be substituted by high-resolution method SW 8290 to achieve practical quantitation limits (PQLs) of 0.000001 to 0.0002 for 2,3,7,8-TCDD in soils. Highly contaminated samples may require use of SW 8280. However, the lower range of limits in SW 8290 is more appropriate for the risk assessment level of concern for most soil samples. The SAP should also identify how toxicity equivalent concentrations will be determined for other chlorinated dioxins and furans.

S-14. 4.3.2 Practical Quantitation Limits (p. 4-11, para. 2)

Thirteen water contaminants shown in Table 4-4 have levels of concern that are below the PQLs rather than nine as stated in the text. The SAP should discuss whether it is possible to attain the risk-based levels of concern in soil and water using specialized techniques or modifications to standard techniques, such as increasing the sample size. In addition, the SAP should discuss, for these compounds, whether the method detection limits for each standard method (e.g., provided in Tables 6-3 to 6-6) or limits of detection would meet the level of concern. Limits of detection are often 5-10 times lower than the PQLs. For example, routine application of Method SW 8080 is capable of attaining a 0.02 mg/kg detection limit for PCBs in soil, which matches the lowest risk assessment levels of concern for surface soil. Data reported below the PQL and above the limit of detection provide an estimate of whether levels of concern have been exceeded. All data exceeding the limit of detection for each method should be reported.

S-15. 4.4 Data Quality Parameters (pp. 4-11 to 4-14)

Specific sampling objectives for precision and bias have not been set (p. 4-12) in the SAP, although some numerical limits pertaining to the referenced analytical procedures are given in Section 4.0 of the quality assurance project plan (Radian 1990b). Either the numerical objectives in the quality assurance project plan should be applied to all sites (except for samples with unavoidable interferences) or specific objectives should be provided in Section 3 as stated in Appendix A (p.A1-5).

Hand Augering (Section 5)

S-16. 5.3.1 Hand Auger Sampling (p. 5-10)

The use of hand augering to obtain samples to a depth of up to 5 feet may be difficult given the alluvial nature of the subsurface lithology. In addition, it is not clear why hand augering will be necessary to collect "surface soil" samples such as proposed at Cluster IC-1. Surface scraping (defined in the quality assurance project plan as the collection of a thin layer of soil) may be more appropriate in the transformer storage yard at Site 47.

The method described for hand auger sampling (ARTS type) is designed to minimize the contamination of deeper soil samples by materials falling from above. However, this method of tapering the hole, as described in Section 5.3.1 (p. 5-10) of the SAP, does not necessarily eliminate downhole cross-contamination with surface material as stated in the SAP. (This telescoping method is not described in the quality assurance project plan and should be documented there in Section 5.7 as part of the standard operating procedure.)

Hand augered samples will typically be analyzed for PCBs and other semivolatile organic compounds or metals. However, analyses for total volatile petroleum hydrocarbons (Method SW 8015/3550) are proposed for samples collected at SSA 3 (p. 3.22-6), and analyses for VOCs (Method SW 8240) are proposed for samples collected at SA 12 A (p. 3.5-12) and PRL S-13 (p. 3.12-14). Both types of volatile compound analyses are proposed for samples collected at PRL P-9 (p.3.7-32). The quality assurance project plan (Section 5, p. 58) states that the hand augering method "is not appropriate for collecting samples for volatile parameter analyses [because] undisturbed samples are not obtained, and volatile compounds may be lost." An alternative coring method with soil sleeves is recommended for the collection of relatively undisturbed samples (see quality assurance project plan, Section 5, p. 61).

Geophysical Surveys (Section 5)

S-17. 5.6 Monitoring Well Drilling, Installation, and Development (p. 5-13, para. 2)

Section 5.6 of the SAP and Section 5.1 of the quality assurance project plan (Radian 1990b) provide some discussion of borehole geophysical techniques (resistivity logging, spontaneous potential logging, gamma ray logging, and caliper surveys). It is not clear whether the geophysical logs will be interpreted by a certified geophysicist.

In addition, Section 5.6 pertains to well development but all discussion is referred to Section 5.3 of the quality assurance project plan (Radian 1990b). It would be helpful to summarize in the SAP the well development method and the rationale for the well development method in regard to groundwater sampling for VOCs. There should also be a discussion of how to conduct product sampling should either floating or sinking product be detected in the wells.

S-18. 5.8 Surface Geophysical Surveys

Ground-penetrating radar (GPR) and magnetometer surveys are specifically proposed in Section 3 for locating the following objects:

- Buried tanks and pipes in PRL T-8 (p. 3.2-9) (Tanks 756A, 756B, and 756C; Figure 3.2-1)
- Buried pipes near Building 765 (p. 3.2-19)
- The orientation of a buried tank in PRL T-60 (p. 3.6-4) (Tank T-60; Figure 3.6-1)
- Buried tank at SA 11 (p. 3.7-25) (Tank 699; Figure 3.7-3B)
- Buried tank at SA 8 (p. 3.18-3) (at Building 663; Figure 3.18-1).

McClellan should consider using GPR as a screen for subsurface metal objects at all locations for which detailed utility and tank records are not available. Probing without this knowledge could result in a rupture of an intact container. The SAP discusses the use of GPR and magnetometer surveys to determine the "exact" location and orientation of underground storage tanks and pipes and "precise" borehole locations. These geophysical survey techniques are applicable in some circumstances. However, there is no discussion of surface geophysical surveys in the quality assurance project plan (Radian 1990b). The SAP should discuss the following specifications, rationales, and limitations of GPR and magnetometers:

- Define what specific GPR and magnetometer equipment will be used for the survey and the rationale for equipment selection.
- Identify the site conditions that are conducive for using this type of geophysical survey and identify the site-specific limitations of using these remote sensing techniques.
- Define data quality objectives for the surface geophysical task (including, for example, the expected depth of penetration for GPR given the electrical characteristics of the soil, size of targets, and conductivity of the target relative to surrounding soils).
- Identify contingencies in the event the data quality objectives are not met (e.g., the hyperbolic reflection pattern of a buried tank is distorted by soil conditions).

Health and Safety Plan (Section 7)

S-19. 7.0 Health and Safety Plan

It is not clear from the text when the 1989 health and safety plan will be revised for the sampling effort beginning in 1991. An updated and health and safety plan should be in place prior to beginning site activities.

Schedule (Section 8)

S-20. 8.0 Schedule

A detailed schedule for sampling in specific areas of the operable unit should be presented so that oversight activities can be coordinated.

Purpose and Structure of Sampling Decision Protocol (Appendix A)

S-21. A1.1 Purpose (p. A1-1)

The data quality objectives (as defined in Section 4.4, p. 4-11) referred to in the third bullet should be listed in the appendix or their location for specific sites should be referenced. The discussion of sampling procedures should reference where to find specific standard operating procedures and quality assurance project plan details.

S-22. A1.2 Protocol Structure (p. A1-5, para. 2)

The general data quality objectives of the remedial investigation and the methods of investigation are presented under the heading of Source Identification in Section 4.0. Specific data quality objectives for accuracy in terms of bias and precision are not provided in Section 3.0. The text in this section should be corrected as described in the previous comment on Section 4.4.

Soil Gas Investigation (Appendix A)

S-23. A2.0 Soil Gas Investigation (p. A2-1)

The first paragraph refers to the initial soil-gas investigation that defined the borehole work. The text states that the soil-gas results can be used to make meaningful determinations about the solid soil phase contaminant levels. However, as stated later in the plan, the data correlate poorly, which contradicts the logic of using soil-gas sampling initially to establish where to locate bore-holes.

Some rationale for using soil-gas surveys is provided at the bottom of p. A2-1. The first bulleted statement is correct, except that the vapor phases of the VOCs are the soil gases at that point.

S-24. A2.1. Sampling Strategy (p. A2-2, para. 3)

The text states that sites PRL T-48 and PRL T-60 were not sampled because they are "surrounded by concrete pavement." Volatile compound sources could exist under pavement as the result of leaking pipelines or practices on the surface of the barrier. The concern for potentially high levels of volatile compounds under concrete pavement is recognized later in the SAP (bottom of p. A2-3). Sampling through pavement should be addressed or the absence of any potential sources of contamination in such areas should be documented.

S-25. A2.1.1 Soil Gas Sampling (p. A2-2, para. 5)

The SAP states that 10-20 percent of the pore volume will be VOC residual saturation. For chlorinated hydrocarbons, residual saturation can vary an order of magnitude (and possibly more) with a 2-orders-of-magnitude change in the hydraulic conductivity (K) of the soil (Schwille 1988). It is unlikely that K changes by only 1 order of magnitude as implied by the stated range in residual saturation. Therefore, the range in VOC residual saturation is likely underestimated, which will affect calculations of free product that might be trapped in pore spaces.

Liquid-phase VOCs are also assumed in the SAP to be greater beneath the "source" (assuming "source" refers to the original spill location). This assumption should be clarified. Layering and channeling with a factor of two, or more, changes in permeability over distances much less than a meter are commonplace. These small changes in permeability can lead to large variations in flow paths. The conclusion that vaporization will occur "as long as there is soil gas moving through the pores that contain liquid phase VOCs" is inaccurate because diffusion is not addressed as a transport process at this point. In addition, the text mentions a steady rate of "partitioning into the vapor phase" (i.e., volatilization) with this advective flow. However, volatilization under advective flow conditions will depend on the rate of that advective flow, which is unlikely to be steady.

Comment S-26. A2.1.1 Soil Gas Sampling (p. A2-2, bottom)

The SAP states that soil gases may move ". . . downward by displacing less dense soil gas molecules," which implies that density-driven flow is always possible. However, density-driven flow only occurs with sufficient relative vapor density values of the contaminated gas.

S-27. A2.1.1 Soil Gas Sampling (p. A2-3, top)

The sixth sentence states that "soils gas originating in the soil near a contaminant source may be detected at lateral distances of one to two hundred feet." This proximity to a source needed for detection depends on a variety of factors, including the detection limit of the sampling and analytical methods and the nature of the porous media (e.g., stratigraphy, lithology, pore water distribution, past and present advective forcing on the system, and source strength). The last sentence of the paragraph cites Marrin and Kerfoot (1988) and Silka (1988). However, their work does not definitively prove the connection between groundwater concentrations and "shallow" soil gas concentrations. Therefore, later assumptions that an approximate 70-foot grid is appropriate (i.e., 1 borehole for each 5,000 square feet; p. A4-4) may be invalid. This limitation should be addressed in the sampling strategy (see General Comments).

S-28. A2.1.1 Soil Gas Sampling (p. A2-3, para. 2)

Gas migration properties are cited to Table A2-1, but this table summarizes concentrations of VOCs in soil and soil gas sampling from validation boreholes. These properties are not summarized in any other table of the SAP and should be provided.

S-29. A2.1.1 Soil Gas Sampling (p. A2-3, para. 3)

Gas-phase VOCs will partition into spilled nonvolatile and semivolatile organic compounds (e.g., oils, grease) as well as into "natural organic carbon." It is also important to note that pore water distributions will not remain constant under conditions of infiltration.

The SAP states that the listed physical parameters of the shallow subsurface soils may be considered to be constant within a lateral distance of 100-200 feet. However, the borehole logs presented in the SGI (Radian 1991a) show considerable variability in physical parameters between boreholes (some as close as 50 feet apart).

S-30. A2.1.1 Soil Gas Sampling (p. A2-5, top)

The statement that diesel fuel "does not have VOC constituents that could enter the vapor phase and therefore may not be confirmed by soil gas readings" is not true, considering that diesel fuel has odor.

A more appropriate statement would be: "Diesel fuel is a mixture of heavier hydrocarbons than contained in gasoline or jet fuel, but still contains a small fraction of VOCs. Most of the VOC constituents of diesel fuel are likely to be adsorbed to the soil matrix and not into the gas phase. Therefore, there is less chance of detecting diesel fuel by a soil-gas investigation."

S-31. A2.1.2 Soil Gas Decision Levels (p. A2-5)

It is inaccurate to say that the soil-gas data identify contaminant sources. Soil-gas data suggest where VOC sources may be found, but core samples are needed to verify free or sorbed product.

S-32. A2.1.2 Soil Gas Decision Levels (p. A2-5, equation)

The unsaturated zone is a three-phase system, consisting of the aqueous, sorbed, and gas phases. The equation given here should be rewritten to take into account the mass of pore water that is present. The use of bulk density defines the mass of soil that is present. The aqueous phase mass is ignored. The mass of contaminant that ends up in the solid soil phase is also a function of the water mass present in a unit volume of soil.

The particle density is assumed to be 2.65 g/cm3, rather than 2,650 g/cm3.

S-33. A2.1.2 Soil Gas Decision Levels (p. A2-6, top)

The last sentence of the first paragraph is unclear. The conclusion that migration results in lower concentrations of sorbed VOCs than expected under equilibrium conditions is questionable. Migration in itself does not determine whether soil gas will or will not be at equilibrium with the solid phase. The relative concentrations of gas phase to sorbed-phase VOC (e.g., benzene) cited as examples in the second paragraph are also arbitrary. The extrapolation of a 500 ppbV detection limit for benzene in the gas phase to an assumed adsorbed concentration of 375 ppb on soil grains is only one of a wide range of possible values. There is little point in citing such specific examples because gas-phase and soil-phase concentrations may or may not be at equilibrium.

Overall, the procedure of correlating soil gas to absorbed concentrations relies too heavily on the use of soil-gas results for characterizing subsurface contaminant distributions in liquid or solid phases (see Comment G-2).

S-34. A2.1.2 Soil Gas Decision Levels (p. A2-6, para. 3)

The text states that the "soil gas decision level to be used for locating soil sample locations has been increased for Phase 1 of the RI." This discussion should be referred to Section A4.2.1 (Soil Gas Targets; p. A4-4) where the spacing criteria for boreholes are presented.

Comment S-35. A2.2.2 Soil Gas Sampling (p. A2-12)

Choosing a borehole with the highest known concentrations of contaminants for validation generates best-case results for 50-foot spacings of soil-gas samples. It makes little sense to apply conditions to a validation study that will not be used in practice. If 100-foot spacings are used in practice, then the validation study should use 100-foot spacings. The probe locations south of Building 781 are 50 feet apart, even though they are part of the normal soil-gas screening and should be 100 feet apart according to the SAP. The reasons for the difference should be explained.

S-36. A2.3 Validation Study (p. A2-9)

The phrase "VOC contaminants/contamination in soil" is used interchangeably to mean either VOCs present in any phase or specifically in the immobile solid soil phase. A consistent term should be defined. The usefulness of the validation study is discussed under General Comments.

S-37. A2.3.3 Soil Borehole Sampling (p. A2-20)

Figures A2-4, A2-6, and A2-7 show the soil-gas sampling locations at Site 23; however, the sample locations on these maps do not match.

The results from the validation study clearly show the problem with using soil-gas results (e.g., only finding high concentrations of aromatic compounds in the soil gas about 200 feet from the high concentrations in the soil boreholes, but not in between). This finding supports the statement in the second paragraph, last sentence, that soil-gas results should not be compared with soil results when the samples are more than 6 feet apart (vertically). This finding further repudiates the logic of establishing a 100-foot, or even 50-foot, grid for soil-gas samples. Also, the text implies that horizontal transport is an order of magnitude greater than vertical transport in this system, which is not necessarily true. The grid spacing should be recalculated taking this information into account. The entire SAP should reflect this decision.

S-38. A2.3.4 Validation Results (p. A2-20)

Figure A2-6 is quoted as showing probe locations, but does not (Figure A2-4 does). The text states that soil-gas results were as high as 8,000 ppbV, but no soil gas results in Table A2-1 for Borehole #01 have VOC concentrations totaling over 1,000 ppbV, much less 8,000 ppbV. The third sentence seems to indicate that the field gas chromatography had a Teflon column. Teflon can adsorb compounds and cause memory problems with all the compounds listed. The quality assurance project plan should address the reliability of the equipment and the reliability of the data collected and analyzed.

The last sentence in the first paragraph contradicts the isopleth maps in Figures A2-6 and A2-7, as does the first sentence under Site 23. These contradictions should be checked and eliminated.

S-39. A2.4 Data Interpretation (pp. A2-22 to A2-23)

The third observation, that if soil-gas results are less than 100 ppbV, VOCs will not be detected in soil samples, is unwarranted. Results from many soil-gas samples are needed to narrow down the probable location of VOC sources.

The fourth observation is rather arbitrary. VOC concentrations may also increase 3 orders of magnitude over only 5 linear feet between sampling points, depending on a variety of factors.

The only lithology described was in the borehole logs in the Soil Gas Investigation (SGI), and the percent of clay (vs. silt and sand) and carbon content is not recorded. Because the physical parameters are critical in determining the transport of the soil gas, no correlation between lithology and VOC concentrations would be likely if they are not taken into account.

S-40. A2.4 Data Interpretation (pp. A2-24 to A2-25)

The first interpretation at the top of p. A2-24 that the soil samples for the soil-gas investigation were collected short distances away from more highly contaminated soils is speculation that cannot be supported.

The second interpretation, that much of the mass of VOCs had entered the vapor phase since the time of discharge, is too simplistic because the relative masses of contaminants in the gas aqueous and solid phases are a function of numerous parameters that have not been considered.

The third interpretation assumes that VOC concentrations of the soil gas and the absorbed phases were once related, but are no longer (the initial hypothesis of the SAP was that they in fact can be related at any time). Gas- and sorbed-phase concentrations may be related spatially, but this relationship is no more likely than near-equilibrium existing between the soil-gas and sorbed-phase concentrations. The relative concentrations depend on more factors than just advective flow (a process discussed in the supporting argument on p. A2-25).

The conjecture in the fourth sentence of the last paragraph on this page, that liquids would penetrate downward without spreading over a large horizontal area, is not based on supporting data and contradicts the cone analogy in the sixth and seventh sentences. Both scenarios can occur with the correct conditions; however, in most heterogeneous media, a degree of "fingering" occurs. Only a statistical treatment of the potential flow paths would generate uniform geometric shapes, and there would be a probability distribution for contaminant fingers dependent on stratigraphy, lithology, contaminant properties, presence of co-contaminants, and soil wetting history.

In summary, making conclusions concerning contaminant distributions in other phases from an extrapolation of soil-gas data is speculative without a large data set on system properties and use of sophisticated numerical models.

S-41. A2.4 Conclusions (p. A2-26)

The first conclusion that total VOC concentrations can be used to predict concentrations adsorbed on soils is questionable. There may be false negative results. The validation study presented in the SAP is only adequate to support use of soil-gas surveys to identify positive results where they occur. The second conclusion that the survey can determine the lateral and vertical distribution of subsurface soil gas is correct, but a vapor extraction system should not be designed without a more intensive soil-gas data set near each positive result.

Background Investigation (Appendix A)

S-42. A3.0 Background Investigation (p. A3-1, para. 1)

Determining the origin of the sediments in each strata sampled (i.e., coastal or Sierra Nevada mountains) may be important because the granitic material from the Sierra Nevadas may have

higher concentrations of radionuclides than coastal sediment. In addition to naturally occurring elements and radionuclides, the investigation should determine background concentrations of polycyclic aromatic hydrocarbons. These organic compounds occur naturally.

S-43. A3.0 Background Investigation (p. A3-1, para. 2)

The SAP states that background sampling locations were selected in areas with no historical evidence of industrial activities. Other sources of contaminants of concern such as agricultural use of pesticides containing arsenic, mercury, or persistent organic compounds should also be considered. The site history described in Section 2.6.1 (p. 2-32) indicates that farming is one of the land uses in the area within and adjacent to the base (even though pasture lands may have predominated).

In addition, the SAP appropriately states that background samples will be selected from soils in strata that are "generally similar to those underlying sites to be investigated in OU B." However, data should also be collected on organic carbon content and grain size to assess the comparability of site and background soils. Because organic content or grain size are important predictors of the ability of soils to accumulate metals, organic compounds, or radionuclides, comparison of these factors will help to determine how well background sampling areas represent site areas.

S-44. A3.0 Background Investigation (p. A3-3, para. 3)

The approximate number of samples that will be analyzed from the 10 soil boreholes should be specified. The method of selecting samples for analysis should be clarified. It is not clear if a sample from each layer encountered will be analyzed or if a percentage of the fine and coarser samples will be tested. The text states that there will be continuous borehole sampling until 90 feet, and samples for analyses will be chosen on the basis of lithology. Key lithologies that will be looked for and sampled should be further explained.

Background borehole BACKB01 through BACKB04 are located off the base in the Sacramento Security Park, southwest of Operable Unit B. This park is within the off-base remedial action area shown in Figure 2-23. Municipal drinking water connections have been provided in this area "beneath which groundwater contamination has been detected that may be attributed to sources within

McClellan AFB." (p. 2-50) Although VOC plumes are not shown directly in this area (Figures 2-16 through 2-20), justification should be provided for background boreholes that are located downgradient of potential or known source areas. It is not clear how it will be determined if a borehole drilling location has been affected by contamination. If contamination is detected in a borehole, it should not be used as a background sampling location (see following comment).

S-45. A3.0 Background Investigation (p. A3-3, Table A3-1)

Contaminants of concern at the base include acids, bases, fuels and oils, solvents, heavy metals, PCBs, radionuclides, cyanide compounds, burn residues, pesticides, and herbicides. Background soils should be tested for each of these groups of contaminants or the SAP should identify the specific limits of detection (not PQLs) that will be interpreted as background thresholds for artificial contaminants in lieu of background testing.

Table A3-1 indicates that total volatile petroleum hydrocarbons and total extractable petroleum hydrocarbons will only be "performed on the samples from 0 to 1 foot and the 5 foot sample at each location to determine ambient background from widespread use of fuel hydrocarbons." Sampling for VOCs and other contaminants of concern that may have migrated laterally in ground water is essential, because the proposed boreholes are downgradient of solvent releases and will be sampled to approximately 90 feet. Although the water table beneath McClellan AFB may typically be 90-110 feet (p. 2-19), these boreholes may encounter contaminated soils. As part of the data quality objectives, specific criteria for accepting or rejecting a borehole location for background sampling should be presented, and justification for not selecting boreholes that are upgradient of the site should be detailed.

In addition, a wind rose is not included in the SAP and the predominant wind direction is not stated. However, background boreholes should be placed upwind of the base, if possible, because of the potential for historical and ongoing contribution of airborne contaminants from the base to offsite surface soils. The data quality objectives should include specific criteria for accepting or rejecting background locations on the basis of wind patterns.

S-46. A3.0 Background Investigation (p. A3-4, para. 1)

The criterion for selecting on-base boreholes is that "no Site, Potential Release Locations, or Study Areas have been identified within 300 feet." However, most of the background boreholes are downgradient of contaminated areas and several of the boreholes are located in areas of known ground-water contamination by VOCs. For example, borehole BACKB05 is south of area SA 15 (warehouses) and west of areas PRL T-8 and PRL T-48 (unclassified areas). This borehole location is also over the solvent plumes shown in Figures 2-16, 2-17, 2-18, 2-19, and 2-20. Borehole BACKB06 in Figure A3-1 is south of areas SA12 (open storage area), PRL 29 (unclassified area), and SA13 (open storage area). The borehole appears to be at the edge of the solvent plumes shown in Figures 2-16 and 2-18. Background borehole BACKB08 is in the vicinity of area SA4 (warehouses). This location may lie over the solvent plume shown in Figure 2-16. The acceptance and rejection criteria discussed in the previous comment for background borehole locations apply especially to proposed onsite locations.

S-47. A4.6.3 Compare Data to Background and PQL (p. A4-24)

The PQLs discussed in this section are provided in Tables 4-3 and 4-4 (pp. 4-5 to 4-10). However, the criterion for how background or PQL values will be used to screen site data should be stated. It is also unclear what chemicals will be compared with background values (or some statistical parameter for background value) and what chemicals will be compared with PQLs.

Phase 1: Source Identification (Appendix A)

S-48. A4.0 Source Identification (p. A4-1)

If ground-water contamination is found in a certain well but not in upgradient wells, and no source is found, then additional investigation is warranted.

S-49. A4.0 Source Identification (p. A4-1)

The types of and rationale for the physical analyses of soils should be stated. Various methods of analysis are listed in Section 6.4.2 of the SAP, but their specific use is not described. Physical analyses should be correlated to the chemical analyses to determine if preferential flow paths exist that may affect remedial actions.

S-50. A4.1 Phase 1: Decision Protocol (p. A4-2)

Details of the lateral spacing criteria described in the soil gas investigation criteria are provided in subsections of the following section of Appendix A. However, it would be helpful to provide specific section numbers whenever cross references are made to information in other parts of the document.

Lateral Spacing Criteria (Appendix A)

S-51. A4.2 Lateral Spacing Criteria (pp. A4-2 to A4-4)

Use of the "physical setting of the site" as a criterion is not clearly explained. The criterion for historical uses is also not clearly presented, although historical use is the basis of many of the site decisions. Some examples of how to apply the lateral spacing criteria and appropriate caveats should be presented.

S-52. A4.2.1 Soil Gas Targets (p. A4-4)

Before boreholes are installed, a second or third round of soil-gas sampling should be conducted in areas of contamination with a much tighter grid spacing than described previously. The selection of a 5,000-square-foot unit area for each borehole seems arbitrary based on the data presented in Appendix A. This unit area corresponds to a square grid spacing of just over 70 feet, which is much larger than the 6-foot distance needed for soil gas detection referred to in Section 2.2.

S-53. A4.2.2 Suspected Source Targets (pp. A4-4 to A4-6)

A distance of 25 feet was chosen as the minimum spacing for targets outside of active buildings or mat areas. Some scenarios may benefit by closer spacing and this option should be left by only "recommending a minimum spacing of 25 feet." The rationale behind the 25-foot spacing should be provided. A variable grid spacing may better define the contaminant distribution with the same or fewer boreholes. No indication is provided of how many samples should be taken at what depths or in what directions away from the pipeline. The plan for untested pipelines calls for a large number of boreholes. A more intensive soil-gas survey than described in the SAP may be more cost-effective in tracing sources (based on the decision tree). The same logic applies for underground tanks. Different numbers of samples for different sized tanks is not necessarily warranted. A 100-gallon tank may have leaked its entire contents, while a 10,000-gallon tank may have leaked only 1 gallon. The sample spacing should not be based only on tank size but also on the potential spill sizes, the compound spilled, and soil characteristics. The same applies for removed tanks.

The justifications or rationale for the different sampling densities should be clarified. Site-specific deviations based on a number of constraints (e.g., historical uses, onsite observations, site security) may be acceptable, but justification should be provided in each site-specific plan.

Compositing Rationale (Appendix A)

S-54. A4.2.2 Non-Soil Gas Targets (pp. A4-7 to A4-13)

A compositing scheme is described in Appendix A of the SAP for non-soil gas targets (pp. A4-8 to A4-9). Although there are errors in the calculation in Table A4-2, the proposed maximum composite ratio of 1:12 subsamples is reasonable for an objective of detecting PCB contamination in the composite if only 1 of the 12 subsamples is contaminated at a maximum level of approximately 5 ppm. This analysis assumes a desired detection level of 2 times a PQL of 0.2 ppm. However, PCB contamination of less than 4.8 ppm in only 1 of the 12 sub-samples would not be detected in the composite at the desired level.

The SAP identifies a risk-based level of concern for PCBs in surface soils of 0.02 mg/kg, which is less than the PQL. The SAP should provide justification for why the compositing rationale does not consider these levels of concern in determining an appropriate number of subsamples and why a more sensitive PCB analysis is not used to support the risk-based levels of concern.

Vertical Spacing Criteria (Appendix A)

S-55. A4.3. Vertical Sampling Criteria (p. A4-13)

The text states that sampling frequency should be greater between ground surface and the 15-foot depth. However, additional details should be provided on the sampling frequency. Where historical releases of VOCs have occurred, VOCs may have mixed with "non-mobile" contaminants and transported them below 15 feet. Thus, analyses for non-mobile contaminants should not necessarily be restricted to samples from 15 feet deep or less.

It is recommended that at locations of suspected VOC releases, a certain portion of the boreholes be extended to deeper depths. Ideally all boreholes should be extended to ground water. The data collected to date indicate that the higher concentrations are found at depth. These elevated concentrations could occur as the result of a variety of mechanisms: simple vertical migration away from the surface sources, migration both laterally and vertically away from the source, or vaporization of the contaminants from the ground water (although this latter mechanism is the least likely). Sampling all locations to ground water would help establish a database to characterize the subsurface stratigraphy and lithology. However, since deeper boreholes are more costly, a balance between the collection of data and schedule and expenditure must be made.

A scheme could be followed to extend at least 20 percent of the boreholes to ground water, 20 percent to a depth of 50 feet, 30 percent to 25 feet, and 30 percent to 15 feet. The rationale for fewer boreholes at deeper levels is that there are fewer loss pathways for the contaminants at depth. Unless specific history on spills can be used to demonstrate that the contamination in a given area is recent and the subsurface conditions are likely to limit mobility (and, therefore, the contamination should be restricted to the shallow zone), deeper boreholes should be required.

S-56. A4.3.1 All Target-Type Vertical Sampling Criteria
(p. A4-14)

The text states that "at least one but no more than two samples" will be collected for chemical analysis between specified sampling depths when physical evidence suggests contamination. Samples should be collected from all major horizons of contamination in a heterogenous sampling interval, regardless of the number of horizons. If cost constraints dictate fewer samples, then a rationale should be developed for compositing across adjacent horizons.

S-57. A4.4 Analytical and Depth Matrix (p. A4-17)

The last paragraph states that "Decisions on sampling made with the matrix are based on the soil gas analytical results and observations in the field." The evidence from the soil gas results shows that the sampling density is too sparse to be of use in any interpretations except those involving close proximity to the sample (approx. 5 meters). If the sampling decisions were based on the soil gas results, then the matrix must be revised.

S-58. A4.4 Analytical and Depth Matrix (Figure A4-1)

The text states (p. A4-17, para. 1) that the Figure A4-1 illustrates the depth at which relative concentrations are found as a result of migration under the subsurface conditions that exist beneath the operable unit. The concept of relative concentrations of contaminant groups is not explained. The figure implies a homogeneous medium, which is not the case according to the borehole logs in the SGI. Because the subsurface contains a variety of media both laterally and vertically, the subsurface conditions referred to should be stated or the sentence should be clarified.

S-59. A4.4.6 Metals (p. A4-20)

The mobility of metals is not limited by the least soluble compound of each metal in the percolating water as stated in the text. The availability of reactants are just as critical. For example, if FeS is less soluble than FeCl2, an absence of sulfur in the water will not stop the iron chloride from migrating. The discussion of metals migration should be clarified.

S-60. A4.4.10 Paints (p. A4-21)

Although paints contain heavy metals and semivolatile compounds, many of the these compounds are water-soluble and may migrate in solution. Therefore, these components should not necessarily be assumed to remain in the near-surface soils.

Integrated Data Analysis Criteria (Appendix A)

S-61. A4.6.2 Entry in Database (p. A4-24)

A data management plan should be written prior to entry of data, so that the design of the database can be reviewed and tailored to the data objectives. The data management plan can then be referenced.

S-62. A4.6.4 Data Plotting (p. A4-25)

All data printouts and plots should include all samples analyzed, including samples in which no contaminants were detected and samples that contain contaminants between the detection limit and the PQL. If sample locations are not labeled it is not known whether they were sampled or not. Concentration contours should be plotted by chemical and by depth.

Phase 2: Extent Determination (Appendix A)

S-63. A5.2 Lateral Spacing Criteria (p. A5-3, para. 2)

The text explains that part of the Phase 2 stepout locations strategy is for soil-gas targets to "incorporate all Phase 1 and 2 sample locations at the site into a square or triangular array." The criteria for selecting one or the other array are not clear.

For sediment sampling locations, a 100-foot interval is specified along the upstream course of the influent. The guideline should specify sampling at the nearest accumulation of fine-grained material at approximately 100-foot intervals.

S-64. A5.7.2 Health Risk Criteria (p. A5-10)

The unnamed deeper zone should be addressed in terms of how action will proceed in Phase 3.

Derivation of Levels of Concern (Appendix B)

S-65. B1.0 General Assumptions (p. B1-1, para 1)

While the evaluation of detection limits in terms of human health risk is recommended in U.S. EPA (1989a) and other EPA guidance documents, because of limitations in available analytical technology it may not be possible to meet the LOCs derived in these calculations for all of the contaminants in all exposure media. As a result, however, where contaminants are strongly suspected to be present at the site (based on site history or other factors), but are only infrequently detected, the detection limits should be input as concentration values to calculate risk levels. Such an analysis may not be appropriate for deriving clean up values, but will help to identify uncertainties associated with the final risk estimates.

S-66. B1.0 General Assumptions (p. B1-1, para. 2)

In the calculation of LOCs, RSDs and RfDs are based on exposure to each media and each chemical individually. However, exposure to multiple contaminants in multiple pathways would result in a cumulative cancer risk exceeding the 10-6 level or a dose above the RfD level for noncarcinogenic effects. This must be considered in the baseline risk assessment. Some analysis of the implications of the effects of multiple pathways on the derivation of LOCs should be made. For example, Region 10 recommends the use of a 10-7 risk level in analysis of detection limits to take into account the effects of multiple contaminants of concern.

S-67. B2.1 Incidental Soil Ingestion (p. B2-2)

Because children ingest more soil than adults, it is more conservative to derive LOCs for incidental soil ingestion based on exposures during childhood. The increased ingestion of soil during childhood has little impact in derivation of LOCs for carcinogenic effects, because exposures are averaged over a lifetime. In contrast, LOCs for noncarcinogenic effects are derived over shorter exposure periods, and it is thus most conservative to consider a scenario where children ingest soil for the first 7 years of their lives. If site-specific conditions require that this scenario be considered in the baseline risk assessment, a childhood exposure scenario should be used in derivation of LOCs for noncarcinogenic effects of contaminants in soil.

An error was noted in calculation of LOCs for soils as presented in Table B-1 (p. B4-3). The algorithms derived on p. B2-2 for calculation of LOCs for carcinogenic and noncarcinogenic effects associated with ingestion of shallow soil were based on the assumption that all of the soil ingested comes from the contaminated source (frequency of intake is 1). However, although Appendix B states that the calculations for deep soil were based on a frequency of intake of 0.1, the algorithms for shallow soil were also apparently used to calculate the LOCs for deep soils (more than 1 foot deep) as presented in Table B-1. Therefore, all LOC values for deep soils presented in Table B-1 are 10 times too low. It should also be made clear that the LOCs for this pathway are derived by using oral toxicity values.

S-68. B2.2 Dermal Absorption (B2-3)

While some exposure parameters used in evaluating dermal absorption are quite conservative, others are not. The use of only the 50th percentile of the area of hands and arms (and not legs or feet) to evaluate dermal contact is not conservative for the reasonable maximum exposure case. However, an exposure frequency of 365 days per year is too conservative for an adult. If these calculations are adapted for use in a risk assessment, site-specific weather conditions (e.g., rain or snow days excluded), type of human activities, and age of potentially exposed population should be considered in determining the appropriate exposure frequency (U.S. EPA 1989a).

Unlike the ingestion and inhalation route of exposure, which is generally based on administered doses, dermal contact is evaluated based on the absorbed doses. Radian (1991b) used an assumption of 3 percent dermal absorption for all contaminants of concern. This may not be accurate for many contaminants, such as benzene and VOCs that are absorbed much more extensively. References from the scientific literature suggest that an absorption factor of 0.03 may be too low for VOCs and some semivolatile organic compounds and too high for metals and, therefore, not health-protective in regard to VOCs and some semivolatile organic compounds. Ryan et al. (1987) suggest a range of soil dermal absorption factors for three classes of compounds, as follows:

VOCs	10-25 percent
Semivolatile organic compounds	1-10 percent
Metals	0.1-1 percent

In the calculation of LOCs, either more compound- or class-specific dermal absorption values should be used, or the statement of health-protectiveness should be removed. If these algorithms are adapted for use in risk assessment, correct dermal absorption factors should be agreed upon with appropriate EPA Region 9 personnel.

In addition, there are no EPA-verified toxicity values (slope factors or reference doses) for evaluation of dermal exposures. U.S. EPA (1989a) does, however, describe a method for deriving dermal toxicity values from oral toxicity values, but the method requires that the oral toxicity values be adjusted for oral absorption efficiency where the oral toxicity values were developed based on administered doses. Radian (1991b) did not include this adjustment in their calculation of LOCs for dermal contact. These limitations in the analyses of dermal exposures would tend to produce LOCs that are too high for chemicals that are readily absorbed through the skin and, thus, is not a conservative approach. This correction must be made if these algorithms are adapted for use in risk assessment.

S-69. B2.3 Combined Direct Contact Pathway (pp. B2-4 to B2-5)

As with Section B2.2, oral absorption efficiencies should be factored in dermal exposure equations presented in this section. To calculate the total dose resulting from ingestion of and dermal contact with soil, Radian (1991b) added the administered ingestion dose and absorbed dermal contact dose together. The correct total dose equation for noncarcinogenic effects should be:

Total Dose (mg/kg-d) = (CS x 1.43 x 10-6) +
[(CS x DI x 10-6)/% oral absorption efficiency]

where:

DI = intake corrected for dermal absorption
CS = soil concentration (mg/kg).

Likewise, the correct total dose equation for carcinogenic effects should be:

Total Dose (mg/kg-d) = (CS x 1.84 x 10-7) +
[(CS x DI)/% oral absorption efficiency]

where:

DI = intake corrected for dermal absorption
CS = soil concentration (mg/kg).

The resultant CSs, therefore, should be lower than the values Radian has calculated.

S-70. B3.0 Drinking Water Detection Limits (p. B3-1)

Two additional pathways should be considered in the ground-water exposure scenario: inhalation of VOCs volatilized from ground water during household use (such as showering) and dermal contact with ground water. Estimates of intake through inhalation of VOCs from ground water vary from a fraction of that associated with ingestion of contaminants in ground water to as high as many times greater than exposure via ingestion. McKone (1987) suggests that exposure to VOCs in water via inhalation could be as great as 6 times that via ingestion. EPA Region 9 regularly assumes that the dose from inhalation of VOCs while showering is approximately equivalent to the dose from ingestion of 2 liters/day of the same water (U.S. EPA 1989b). Thus, for VOCs, neglecting this potential route of exposure could lead to an overestimation of the LOCs for ground water. Estimation of exposure via dermal contact has a number of uncertainties, and, therefore, the degree of overestimating the LOCs by not evaluating this route is not known. However, exclusion of the dermal exposure pathway from calculation of LOCs is also likely to overestimate LOCs for ground water. In addition, these pathways may need to be included in future risk assessments for the site, depending on site-specific variables including current and potential future uses of ground water.

S-71. B4.0 Air Detection Limits (p. B4-1)

Oral toxicity values were used in the calculation of LOCs for air for most chemicals, including those that have available inhalation values. This method should not be used in the calculation of LOCs for air or the health risk resulting from inhalation of contaminants. Many contaminants that are toxic following oral exposures produce different effects, produce effects at different concentration levels, or do not produce adverse effects following inhalation exposures. Incorrect use of toxicity factors in the derivation of LOCs for air may lead to selection of inappropriate methods (or modification of methods) for analyses of contaminants in air. In cases where oral toxicity values were used instead of available inhalation toxicity values, the latter should be substituted. Where inhalation toxicity values are not available, it may not be possible to derive LOCs for some of the contaminants in air.

S-72. Table B-1 (p. B4-3)

The sources of toxicity information presented in this table should be footnoted. References to toxicity values derived from sources other than the EPA should also be included. Discrepancies regarding toxicity values presented in this table should be corrected and the associated LOCs should be adjusted. The use of RSD values for nickel inhalation derived from industrial exposure to nickel sulfide particles and the oral RfD of selenious acid for selenium may be too conservative. As discussed earlier, all LOCs for shallow soils and deep soils should be corrected.

The method for evaluating Class C carcinogens in Radian (1991b) is not consistent. While the carcinogenic effects of isophorone and hexachlorobutadiene (Class C) were considered, other Class C compounds were not evaluated using their available carcinogenic toxicity values. These compounds are: 1,4-dichlorobenzene, 1,1-dichloroethene, 1,1,2,2-tetrachloroethane, and 1,1,2-trichloroethane. If the proposed oral unit risk for arsenic, 5E-05 µg/L-1, is used (U.S. EPA 1990b) instead of the RfD, the level of concern for arsenic in water would be 0.155 µg/L instead of 105 µg/L, which was derived through the use of the RfD.

SITE-SPECIFIC SAMPLING PLAN REVIEW

The following comments on site-specific sampling plans are based on the available information in the SAP, quality assurance project plan, and SGI documents. All of the general and specific comments on the areawide investigation (including comments on Appendix A) apply to these investigations and are not repeated. In particular, a comprehensive assessment of each plan was limited by the synthesis and presentation of historical data noted in general comments G-1, G-4, G-5, and G-6.

S-73. 3.0 Site-Specific Sampling Plans (Overall Data Presentation)

This review would be facilitated by an integration of information from existing borehole logs and mapping of initial areas of concern by major classes of chemicals. In addition, all intermediate calculations for determining the number of boreholes by application of the Appendix A guidelines should be summarized in a work table for each area. This work table would not only facilitate agency review, it would provide an indication that quality control checks have been performed by the Air Force's contractor. With few exceptions, however, it appears that the Appendix A sampling guidelines were followed for the lateral spacing of samples.

S-74. 3.0 Site-Specific Sampling Plans (Sampling Decision Protocol)

The first sentence of the rationale sections for nearly all of the areas to be sampled states that the objective of the remedial investigation is to determine the presence of specific contaminants in the area (e.g., Section 3.3.4 for IC 3). This objective should be expanded to include characterization of the nature and extent of any contamination at the area (e.g., similar to the statement of objectives in Section 3.1.5 for IC 1).

None of the proposed site plans address the possibility of encountering dense nonaqueous phase liquids (DNAPLs) near the suspected source areas. The SAP does not mention a contingency plan in the event that DNAPL is encountered. DNAPL constituents could migrate downward via the borehole as drilling proceeds. The plans should contain a contingency plan (or reference a standard operating procedure in the quality assurance project plan) for the following actions when DNAPL is encountered during drilling:

- Collect an undisturbed soil sample containing the DNAPL and submit the sample for analysis of VOCs and semivolatile organic compounds.

- Do not drill beyond the next fine-grained lithologic unit

- Log the finding

- Abandon the borehole by installing bentonite grout, which has been tremied in place.

S-75. 3.0 Site-Specific Sampling Plans (Overall Source Characterization)

Many proposed boreholes have been located at approximately the same coordinates as soil gas samples that were found to have high concentrations of VOCs. Soil gas results should be used to better define source locations. Placing boreholes where soil gas was found to have high concentrations assumes the location of the soil gas sample was optimally positioned before it was collected. A positive soil gas result does not imply the source is at that location. Data for a particular compound from nearby soil gas samplings should be used to optimize placement of boreholes. This optimization process should emphasize pattern recognition by data analysts rather than by computer unless a sufficiently large data set is available for computer analysis.

Investigative Cluster 1 (Sites 36, 47, 48, and PRL L-5D)

S-76. 3.1.5 Sampling Rationale (p. 3.1-14)

Sampling is not planned below 10 feet from surface at Site 36 (boreholes IC01B13 and IC01B14, p. 3.1-24). Because of the reported history of washdowns onto unpaved soil at this site (p. 3.1-14), extractable TPH in this spill area may have been advected deeper than expected and contamination may be missed if sampling is constrained to 10 feet. Justification should be provided for not continuing these two boreholes to the groundwater table.

Table 3.1-2 (p. 3.1-15) lists an area of concern of 24,455 square feet. However, this area only comprises the major soil-gas targets and not the 100 ppbV isopleth (over 100,000 square feet as measured on the map in Figure 3.1-1). Boreholes assigned to discrete soil-gas targets within the 100 ppbV isopleth meet the minimum criteria in Appendix A for the 100 ppbV contour but this total area should be represented on the data quality objective table for ease in tracking contamination for the entire investigative cluster.

(Also note that the borehole descriptors in Table 3.1-7 on p. 3.1-22 should be IC01B rather than IC0B.)

Investigative Cluster 2 (PRLs L-5A, T-8, T-46, T-48, and SA 16)

S-77. 3.2.4 Sampling Rationale (p. 3.2-7)

Table 3.2-2 lists the area of concern for soil-gas sampling as 209,000 square feet. The proposed seven boreholes, which are focused on pipelines, storage tanks, and a trench, apparently leave a large area unsampled. The areas enclosed by the 500 ppbV isopleths for aromatic or halogenated VOCs should be identified to facilitate interpretation of the proposed number of boreholes.

Metals are listed in Table 3.2-4 as contaminants of concern in PRL T-8; however, analyses for metals are not listed in the text (p. 3.2-9) or in summary Table 3.2-12 for boreholes IC02B12-IC02B19. Given the concerns for metals contamination in wastewater from the western portion of the Mat K area, these analyses are justified.

More than two boreholes (IC02B15 and IC02B19 in Table 3.2-4) are needed according to the Appendix A guideline for underground tanks of at least 15,000-gallon capacity. Boreholes between the tanks have not been proposed (perhaps because of their proximity) but are required by the guidelines. Justification should be provided for this deviation.

Investigative Cluster 3 (PRL L-5E, and SAs 3, 10, 17, 19)

S-78. 3.3.4 Sampling Rationale (p. 3.3-6)

Tables 3.3-3 and 3.3-8 list a different set of analytical methods for the same samples listed in Table 3.3-10. The additional analyses indicated for samples from PRL L-5E compared with those in Table 3.3-3 are for arsenic, mercury, and pesticides and herbicides. These analyses are justified for contamination in the underground sump at the Entomology Unit in SA 10. The rationale for including these analyses for samples from PRL L-5E should be provided.

Analyses for total extractable and total volatile petroleum hydrocarbons are justified for the spill area at SA 17 (Table 3.3-8) and should be shown in the summary Table 3.3-10.

The analyses of samples from IC03B01 (Table 3.3-2, p. 3.3-7) should include those methods identified for the sump at SA 10 (Table 3.3-7, p. 3.3-13) because this area has been used to handle pesticides.

The specification of two boreholes in Table 3.3-2 compared with the size of the characterized area (i.e., 24,052 square feet) should be explained with respect to the Appendix A guidelines. It would be most appropriate to list the area enclosed by the isopleth that defines the applicable Appendix A guideline.

Investigative Cluster 4 (Site 30, South PRL L-6, and SA 2)

S-79. 3.4.4 Sampling Rationale (p. 3.4-6)

The data quality objectives for the soil gas target (Table 3.4-1; p. 3.4-8) identify seven analyses to be performed on the samples from borehole IC04B01. However, the summary Table 3.4-6 for IC 4 lists only EPA Method 8240 for this borehole. The more complete analyses in Table 3.4-1 are justified based on the history of storage and disposal of chemicals by the 1155th Technical Squadron (p. 3.4-1). The column currently labelled for IC04B02 through IC04B07 in Table 3.4-2 should be deleted. The analyses listed under IC04B08 in Table 3.4-2 actually apply to IC04B02-IC04B07 (chemical spill). The column for IC04B09-IC04B11 actually applies to IC04B08-IC04B11. The column for IC04B12, IC04B14 actually applies to IC04B12-IC04B16. The last column in the table applies to IC04B17-IC04B18. The footnotes should be corrected accordingly.

Boreholes are proposed at the two discharge points and at each malfunction location for PRL L-6. Justification should be provided for leaving an untested interval of approximately 200 feet along the north side of SA 2. Data are available for historical boreholes along parts of the western side of SA 2 (Figure 3.4-1; p. 3.4-2) but no data are reported for the north side of SA 2.

Investigative Cluster 5 (Site 31, PRLs 29, P-2, and SAs 12, 13)

S-80. 3.5.1 Site Descriptions (p. 3.5-3 to 3.5-7)

Transformers filled with PCB-containing oils are described as nonhazardous (p. 3.5-4). Although definitions of hazardous vary among programs, leaks from these transformers should be considered hazardous.

S-81. 3.5.4 Sampling Rationale (p.3.5-7)

The general assumption of 6-inch penetration by a PCB spill cited in Appendix A (p. A4-9) should be justified for the specific PCB spill areas in this cluster. For sites at which hand augering is proposed, the SAP should acknowledge that deeper samples may be required should the surface soil samples be contaminated.

The assumption for the concentration of PCBs in transformer oil stated on p. 3.5-9 (5 mg/L) should be corrected and stated in the units used in Appendix A (5,000 μg/g).

Site PRL-29 may have been used as a "scrap material burn pit" (p. 3.5-3). Therefore, analyses for chlorinated dioxins and furans should be included in the soil sampling scheme (Tables 3.5-11 and 3.5-13).

There is insufficient analysis of the implications of substituting the nonuniform spill grid for the uniform spill grid in SA 12A (bottom of p. 3.5-9). The patch size and probability of detection should be specified. All calculations should also be provided for the determination of the 374 hand auger samples in SA 12B (p. 3.5-11). For SA 12C, clarification should be provided for the statement that both guidelines in Appendix A and U.S. EPA techniques were used to determine the grid spacing (p. 3.5-11).

Justification should be provided for the assumption that boreholes IC05B10 and IC05B11 are located in the areas that receive runoff from SA 12 (p. 3.5-15; para. 2). The following paragraph calls for collection of noncomposited hand-augered samples for the analysis of VOCs, which is not an acceptable procedure in the quality assurance project plan (Section 5.0, p. 58) (Radian 1990b). An acceptable substitute method should be provided (e.g., the coring method described in the quality assurance project plan). Sampling criteria should also be provided for collecting noncomposited samples.

Chlorinated dioxins and furans should be included as compounds of concern in Table 3.5-8 and in the text at the bottom of p. 3.5-15. These analyses are planned for the burn residue from incinerator operations but should be specified for the refuse storage area as well.

Investigative Cluster 6 (PRL T-60, and SAs 5, 6)

S-82. 3.6.3 Sampling Rationale (p. 3.6-4)

A contingency plan for encountering DNAPLs should be provided for this cluster (p. 3.6-4, para. 2). Bunker C oil can occur as a relatively immobile DNAPL. Contingency actions should also be provided to address the possibility that the GPR, magnetometer, and visual observations may not resolve the location of the underground storage tank because of interferences.

It is not clear how the location of the underground pipe will be determined (p. 3.6-4, para. 4). Also, justification should be provided for the assumption that borehole IC06B10 is correctly located in the suspected point spillage area.

Investigative Cluster 7 (PRLs L-5B, north L-6, P-9, S-5, S-34, S-35, and SAs 7, 11, 14, 18)

S-83. 3.7.4 Sampling Rationale (p. 3.7-14)

The sampling approach should specify contingency actions for drilling into suspected source areas that may contain accumulations of DNAPL (p. 3.7-25, para. 1). Contingency plans are also needed in case interferences prevent location of the tanks using the GPR and magnetometer surveys. Also, an adequate explanation has not been provided for the assumed correlation between the volume of product that was assumed to leak from an underground storage tank and the capacity of the tank (Appendix A). Therefore, the two boreholes assumed for SA 11 should be further justified.

Investigative Cluster 8 (PRLs L-5c, S-29, S-30)

S-84. 3.8.5 Sampling Rationale (p. 3.8-7)

Justification should be provided for not drilling and sampling boreholes in the area immediately south of Building 655 (p. 3.8-11, para. 2). Figure 3.8-1 (p. 3.8-2) does not indicate that this area will be investigated.

Site 23

S-85. 3.9.4 Sampling Rationale (p. 3.9-5)

No additional boreholes from the east side of the spoil pit at Site 23 are proposed. One borehole may be warranted because the halogenated VOC target potentially extends in that direction (Figure 3.9-1, p. 3.9-2).

Proposed boreholes S23B11-S23B14 will be drilled close to previous boreholes that contained contaminants. The results from closely spaced boreholes are noted as being dissimilar (p. 3.9-1). However, historical positive results should not be discounted. Because the objective is to delineate the extent of the contamination, it may be preferable to move the boreholes to provide more extensive coverage of the site. In addition, the soil gas investigation found one location with high levels of halogenated VOCs close to the base boundary. Therefore, a borehole near the fence should be drilled to assist in determining whether off-site migration has occurred.

Potential Release Location L-5F

S-86. 3.10.4 Sampling Rationale (p. 3.10-4)

According to Figure 3.10-1, no soil-gas samples were taken along the approximately 550-foot section of industrial wastewater line (IWL) between boreholes PL05FB18 and PL05FB12. Soil gas samples are recommended. Without soil gas data, additional boreholes should be planned. Considering the age of the IWL, all sections of the IWL should be suspected of leaking, especially at joints.

Potential Release Location L-5G

S-87. 3.11.3 Sampling Rationale (p. 3.11-4)

At least one additional borehole is recommended in the downflow direction from the junction of the pipeline of PRL L-5F with the pipeline of PRL L-5G (location MH-12). Boreholes are recommended at junctions in the pipelines such as MH-12 because of the greater potential for leaks at these locations.

Potential Release Location S-13

S-88. 3.12.4 Sampling Rationale (p. 3.12-3)

Site-specific rationale should be provided for using a 10-foot radius for the assumed size of spill target (p. 3.12-9). In addition, the specific criteria for continuing, in Phase 2, with the collection of deeper samples from the spill area should be identified on p. 3.12-12. Because 1,1,1-trichloroethane was used to clean up the PCB spill, an alternative would be to collect archive soil samples from a deeper depth than the maximum 5 feet proposed and freeze for future possible analysis.

Potential Release Location S-28

No specific comments.

Potential Release Location S-33

S-89. 3.14.3 Sampling Rationale (p. 3.14-1)

The area of characterization listed in Table 3.14-1 is 16,400 square feet. In the text (p. 3.14-1, bottom) the area is listed as 15,400 square feet. This discrepancy should be corrected.

According to the Appendix A guidelines (p. A4-7), approximately 5 sampling locations could be justified for an area of 16,400 square feet. The 10 locations described in the text may be more than is necessary to characterize this area.

Further justification should be provided for using the uniform spill area criteria in Appendix A for this PRL. Because no spill areas are known, the criteria for a nonuniform area of contamination may be more appropriate for designing the sampling survey.

Table 3.14-2 (p. 3.14-5) also indicates that analyses for VOCs by Method SW 8240 will only be conducted to a depth of 5 feet. Because halogenated VOCs were detected in the historical soil gas investigation, VOC analyses should extend to the bottom of the 15-foot borehole.

Potential Release Location T-45

S-90. 3.15.4 Sampling Rationale (p. 3.15-3)

The proposed soil samples should also be analyzed for VOCs. This recommendation is based on the following information provided in the SAP: 1) an adequate number of soil-gas samples could not be collected in this area, but the one soil-gas sample that was collected exhibited moderate concentrations of VOCs; 2) previous sampling by EG&G Idaho (1987) detected one VOC (not specified); 3) it is stated in Section 3.15.2 that "the previous sampling is only indicative of what the oil/water separator contained at the time of sampling and may not be representative of historical wastes collected in the separator" (p. 3.15-1); and 4) the activities at Building 711 are not stated. Therefore, to be conservative, additional samples are needed to demonstrate whether or not VOCs were discharged to the oil/water separator.

Study Area 1

S-91. 3.16.3 Sampling Rationale (p. 3.16-3)

As noted in the text, a minimum of 4 boreholes would normally be assigned to a uniform surface spill area such as at SA 1. The physical limitations of this area are acknowledged, but if possible, two boreholes (to the north and south of the loading dock doorway) are recommended rather than the one borehole proposed.

Study Area 4

No specific comments.

Study Area 8

No specific comments.

Study Area 9

No specific comments.

Study Area 15

No specific comments.

Special Study Area 2

No specific comments.

Special Study Area 3

S-92. 3.22.4 Sampling Rationale (Table 3.22-2; p. 3.22-6)

Analyses for VOCs and semivolatile organic compounds (SW 8240 and SW 8270), identified in Table 3.22-1, should be included in Table 3.22-2.

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RESPONSES TO EPA COMMENTS
OU B RI SAP

I. GENERAL COMMENTS

Comment G-1.

The following has been added to the list of objectives for the OU B Remedial Investigation (RI): "Identification and characterization of contaminant migration pathways and potential receptors" (see page 1-5). This objective will be incorporated into the decision process for Phase 1 and 2 activities (see Appendix A). We do not believe that evaluation of contaminant transport is an objective of the RI. Contaminant transport is evaluated in determining extent and migration pathways of contaminants but it should not be an objective. Physical property tests will be performed during Phase 1 and Phase 2 to characterize the vadose zone beneath OU B.

Physical property testing will be performed for each general type of lithology (e.g., sands, silts, and clays) that is likely to affect contaminant migration in the vadose zone after discharge and prior to and during remediation. Lithologic types that are likely to affect migration are those underlying discharge points and those containing contaminants. Properties, such as organic carbon content, moisture content, soil vapor humidity, grain size distribution, porosity, hydraulic permeability, and bulk density, will be measured in soils because of their identifiable influences on the migration of contaminants and usefulness in practical modeling (Section 2.7.4, Section A4.1, Appendix A). It is not appropriate to specify which Phase 1 or Phase 2 samples will be tested for physical properties. The selection of samples for testing will be directed by the identification of sources and migration pathways from the source.

Comment G-2.

The difference in sampling approaches used for soil gas targets in comparison to non-soil gas targets and suspected source targets in the decision process was based on: prior data for the sites (including soil gas survey data); contaminant mobility (VOCs are mobile in liquid or vapor and have migrated to groundwater); and the dual focus on contaminants near surface and in the deep vadose zone/water table (the 2 zones where remedial actions are most likely to be implemented because of exposure pathways). The proposed use of "statistically-based sampling schemes" and "unit-wide grid spacing" are most appropriate where there are few, if any, prior data to indicate potential discharge points. The approach to soil gas targets, the adjoining areas without soil gas targets, and "anecdotal discharge sites" has been revised with consideration of size or volume of potential "hot spots." However, previous site data will be used in spacing of borings. The proposal to establish "unit-wide grid spacing" is inappropriate for Operable Unit B.

Soil gas surveys were included in the OU B RI to provide screening data for sites at which VOCs are likely to be the contaminants of interest in the soils. Their purpose was to "screen out" portions of sites beneath which no VOC discharge occurred, or discharge was of such limited extent, that boring sampling would not be required. The commentor indicates that screening out portions of a site on the basis of VOC concentrations in soil gas is unacceptable because of the potential for "false negatives." The conditions under which false negatives would occur in soils at McClellan AFB is not explained in the comments. However, in accordance with discussions with U.S. EPA, California EPA, and RWQCB representatives on 20 June 1991, a revised approach to locating reconnaissance borings for sampling with or without soil gas data has been provided (see Appendix A, page A3-2, subsection A3.1 through A3.4).

We question the proposal to sample and analyze 5 to 10 percent of samples taken from depths of 15 to 95 feet for "a broad spectrum of chemicals." The proposal is based on the potential that strongly sorbing compounds could be carried to depth in the soil and possibly to groundwater by a solvent plume. We believe that the commitment of analytical resources for the proposed approach is unwarranted at most sites. We propose instead that in locations where strongly sorbed compound use or generation has been documented, sampling will begin at or near the surface. If, during the investigation of the location, evidence is obtained to indicate the presence of a "solvent plume" moving by gravity flow, samples from several depths will be analyzed for the solvent and strongly sorbed compounds. This surface-to-depth sampling and analysis scheme will be applied at locations where evidence of a solvent plume is identified or suspected.

Comment G-3.

These calculations were performed to determine the grid spacing for PCB sampling of small volume PCB discharges at the surface. Discolored or stained areas that are not a grid sample location will be sampled if observed in the field.

A statistically-based method of sample selection has been added to the location of borings in soil gas target areas (see A3.2.3, page A3-11). Reconnaissance borings are placed in a triangular grid with a spacing of 50 to 60 feet. The spacing within the grid provides a 0.8 to 0.9 probability of locating a contaminant discharge with a radius of 25 feet. Outside of soil gas targets, the lateral spacing is increased to 100 feet. With or without soil gas targets, reconnaissance borings will be placed at the more obvious potential discharge points, such a sumps, underground tanks, and pipeline leaks.

Comment G-4.

Biotic and abiotic degradation of organic compounds was considered in the development of the plan. The analytical methods selected include both precursors and potential metabolites for the major contaminants. Potential ranges of degradation are not included in Appendix A because they may not be applicable to McClellan AFB. The existence of biotic or abiotic conditions suitable for degradation have not been identified for any site within OU B, and those conditions may vary from site to site. Decisions within the OU B RI are based on the presence or absence of contaminants. Identifying degradation products "may be useful" in deciding the source from which a contaminant originated but not essential to that effort.

There has been only one soil sampling event at any site in OU B prior to the OU B RI. The exact locations of previous sampling locations is not known. There is no need to obtain data at the specific locations of previous soil samples for comparison, even if this were possible. Monitoring wells in OU B have been sampled repeatedly since 1986. Previous assessment of the precursor-metabolite relationship in the groundwater indicated no trends could be substantiated.

Comment G-5.

Groundwater is known to be a migration and exposure pathway at McClellan AFB (see Section 2.5 and 2.6). It is identified in that way in the new Section 2.7 Conceptual Model for OU B. The groundwater pathway was the driving force for the OU B Groundwater Remedial Investigation, the OU B EE/CA, and the Preliminary Groundwater Operable Unit Remedial Investigation all of which are cited in the OU B RI SAP. The driving force for the OU B RI is soil contamination throughout OU B, some of which has affected groundwater. Monitoring wells are planned for Phase 2 (Section A4.7.1, Appendix A) to verify linkage between soil and soil gas contaminants and groundwater contaminants.

The emphasis of Phase 1 is source identification. Because there are a number of monitoring wells in OU B, it seems most appropriate to conduct source investigation prior to constructing additional wells. Placement of monitoring wells downgradient (or upgradient) from identified sources is a more cost effective approach. Locations for well construction will be better identified after Phase 1. The feedback loop to Phase 1 (Appendix A, Section A4.7.1) has been eliminated.

There are no discussions of linkage between borings and groundwater contaminant plumes because the borings are intended to identify sources of contaminants and potential migration pathways to groundwater. The linkage between soil and soil gas distribution and groundwater will be a decision made in Phase 2.

Comment G-6.

For most PRLs and SAs in OUB, there has been no sampling other than soil gas sampling in 1990. For the sites and remaining PRLs, there has been one sampling event, the date varying from site to site. The intermittent nature of sampling events throughout OUB does not lend itself to tabular presentation. The available data, both positive and "non-detected" results, have been presented in previous summaries. The initial reports are cited in the text (Sections 2.6.4, 3.1.2, 3.2.2, 3.4.2, etc.). To include all of the prior data by location, depth, and analytical method would add approximately 100 pages to the Sampling and Analysis Plan. (The reviewer should note that no quality assurance/quality control information was provided for most of the older soil data. Therefore, they are considered qualitative.) The pertinent positive data are summarized to assist the reader. The Sampling and Analysis Plan is not intended to provide a "complete picture of site contamination." The decision process in the plan is designed to assess the extent of contamination and define a need for further sampling during the RI. It is impossible to assess the extent and the need before sampling has begun.

Additional groundwater and hydrogeologic information are provided in Section 2.6 and 2.7 of the SAP. Representative cross sections illustrating lithologies and groundwater contaminants concentrations in five monitoring zones are presented in Section 2.7. However, surface sampling locations are not based on the distribution of contaminants in groundwater in Phase 1. The correlation between contaminants in identified sources and contaminants in the groundwater pathway will be addressed in Phase 2.

Risk Assessment

Comment G-7

The Level of Concern discussion in Section 4.3, page 4-4, and Appendix B has been rewritten to clarify their usage in the OUB RI.

Comment G-8

This comment is addressed in Section 4.2.

Comment G-9

The analysis of Levels of Concern in Appendix B is not intended to serve as a risk assessment. These levels are intended to estimate potential remedial action levels because action levels have not yet been determined for McClellan AFB. The Levels of Concern provide bases for comparison with practical quantitation limits for the analytical methods selected for Phase 1. Analytical methods in Phase 1 should have quantitation limits low enough to indicate which sources are likely to require remedial action. Please note that the Levels of Concern and analytical methods will be reassessed at the beginning of Phase 2 (Section A4.1, Appendix A).

Comment G-10

The Levels of Concern stated in the text are for use in Phase 1 to identify sources that are likely to require remedial action; they will be reassessed at the beginning of Phase 2 (Section A4.1, Appendix A). The analysis of Levels of Concern in Appendix B is not intended to serve as a risk assessment (Section B1.0, Appendix B).

Comment G-11

Toxicity factors given in the draft Sampling and Analysis Plan have been updated with the most recent values. The sources of the factors are now referenced. The rationale for the use of oral exposure factors is stated in a footnote to the Table B-1 in Appendix B.

Terms, Document Organization, and Data Presentation

Comment G-12

The migration potential and expected fate of contaminants is contingent on the conditions in the transport pathway as well as the physical and chemical characteristics of the organic compounds. Discussions of transport and fate of contaminants are more appropriate in the RI report in which contaminants detected and physical parameters of the pathway may be discussed together. A listing of physical and chemical parameters for approximately 78 contaminant species, which may be present in OU B, seems inappropriate for the SAP. The exception is the discussion of soil gas validation data for which a table of physical properties is provided in Table A2-1, page A2-5 in Appendix A.

Background concentrations for inorganic species in soils will be developed early in Phase 1 of the OUB RI (Section 3.24).

Comment G-13

Acronyms used in the plan are spelled out where they are initially used. The text has been rewritten to clarify the meaning of terms, such as "source" and "discharge." Where the term "soil" is used, it refers to all phases (solid, liquid, and gas) in the vadose zone in OU B. The terms "soil gas" and "soil particles" are used to specify individual phases that may be sampled and analyzed separately. The Special Study Areas (SSAs) are now explained in Section 2.0, a section preceding their initial introduction in the SAP.

Comment G-14

A summary table listing the analytical methods and number of samples to be collected at each site has been prepared. The Table 3.25-1 is included with these responses and can be inserted in the revised SAP.

Comment G-15.

A northing and easting coordinate system based on California Plane Zone 2 coordinates exists for McClellan AFB. Borings will be located within the coordinate system after they are drilled and sampled.

Comment G-16

Sediment samples will be collected from the center of Magpie Creek. Particle size analyses and total organic carbon analyses will be performed on samples to characterize the sediment if contaminants are detected in Phase 1. See Section 3.0 in individual sites where sediments will be sampled.

II. SPECIFIC COMMENTS

Comment S-1, Section 1.0, page 1-1.

The term "Site" has been used historically in McClellan AFB documents to describe areas in which contaminants have been detected in soils. It would be inappropriate to change this term at this time. As defined in the SAP (Section 1.0, footnote page 1.1), the term "site" (lower case) is the general term used to refer to a geographical area where investigations will be undertaken.

Comment S-2, Section 2.2, page 2-9, paragraph 1.

A topographic map has been included in the final SAP (see Figure 2-7, page 2-10).

Comment S-3, Section 2.2, page 2-9 and 2-10.

Available soil information has been presented in Table 2-1 to facilitate understanding and comparison.

Comment S-4, Section 2.5.2, page 2-16 to 2-19.

Two cross sections have been included in the revised SAP. They are presented in Section 2.7, pages 2-64, 2-65, 2-67, and 2-68. These cross sections are specific to OU B and show lithologies and groundwater monitoring zones.

Comment S-5, Section 2.5.3, page 2-20.

See response to comment S-4.

Comment S-6, Figures 2-16 to 2-20, page 2-26 to 2-30.

Maps illustrating the distribution of contaminants in groundwater have been changed to show all VOCs detected (Figures 2-17, 2-18, 2-19, and 2-20, pages 2-27 through 2-30).

Comment S-7, Tables 2-1 to 2-2, page 2-33 to 2-38.

The tables have two different purposes. Table 2-2 (formerly Table 2-1) lists the types of contaminants used at a location, whereas, Table 2-3 (formerly Table 2-2) lists the rationale for further investigation. The tables and text have been thoroughly reviewed to correct any discrepancies. The SSAs are now defined in the text and listed in Table 2-3.

Comment S-8, Section 2.6.4, page 2-43.

The text of the Groundwater Contamination Investigation, Section 2.6.4, page 2-44 has been revised.

Comment S-9, Section 2.6.5, page 2-47, paragraph 3.

Text has been revised and moved to Section 2.5.5, page 2-31.

Comment S-10, Section 2.6.5, page 2-48, paragraph 1.

Text has been revised to specify the metals detected and is now found in Section 2.5.5, page 2-31.

Comment S-11, Section 2.6.5, page 2-48, paragraph 2.

Text has been revised and moved to Section 2.5.5, page 2-31.

Comment S-12, Section 2.6.6, page 2-49, paragraph 3.

No Sites, PRLs, SAs, or SSAs, will be eliminated from the RI based solely on soil gas results. Text in Section 2.6.6, page 2-51 has been revised.

Comment S-13, Table 4-3, page 4-6.

Method 8280 will be used to analyze samples during Phase 1 to determine higher concentrations of contaminants. Methods of analyses needed during Phases 2 and 3 will be reevaluated in Phase 2 to assure the detection levels needed for health risk assessment are available. No dioxin or furan compounds have been detected in OU B. The toxicity of these compounds is under review by U.S. EPA and may change within the next few months. Toxicity equivalent concentrations will be determined when and if any of the compounds are detected in the OU B RI.

Comment S-14, Section 4.3.2, page 4-11, paragraph 2.

The discussion of Levels of Concern and practical quantitation limits (PQLs) has been revised (Section 4.3). The PQLs listed are preliminary and are a multiple of 5 above the method detection limits. All data at or above the method detection limits will be reported. The methods of analysis will be evaluated in Phase 2 and, if necessary, changed to meet the lower levels needed for health risk assessment and action levels (Section A4.1).

Comment S-15, Section 4.4, page 4-11 to 4-14.

The precision, accuracy, reproducibility, completeness and comparability limits for analyses performed in off-site laboratories on samples from all sites in OU B are stated in the McClellan AFB Quality Assurance Project Plan (Radian, 1991). That plan is referenced in Section 4.4. Including those limits in the SAP would have added unnecessarily to the length of Section 4.

Comment S-16, Section 5.3.1, page 5-10.

Hand augers have been and will be used to collect samples at depths from surface to 5 feet. Surface soil samples will be collected using stainless steel trowels.

This telescoping method for hand auger boring does not eliminate downhole cross contamination with surface materials but it should reduce the possibility of cross contamination. This method has been added to the QAPP.

Core samples will be collected for volatile constituents using a core samplers/slide hammer, as described in the QAPP.

Comment S-17, Section 5.6, page 5-13, paragraph 2.

The geophysical logs will be interpreted by a California Registered Geologist. Well development procedures are fully discussed in the McClellan AFB QAPP. The presence of separate phase liquids will be evident during the initial development of a monitoring well or in results of the Hydropunch® sampling (for floating product). Once identified, the liquids will be sampled with the discrete interval sampling devise described in the September 1991 revision of the QAPP.

Comment S-18, Section 5.8.

All sampling locations are screened and approved by base utility personnel prior to drilling. Applications of surface geophysical surveys are presented in the revised QAPP. Section 5.8 of the revised SAP includes a description of equipment and its use in the OU B RI.

Comment S-19, Section 7.0.

The Health and Safety plan has been revised for the OU B RI field activities. Revisions are included with the revised SAP in Appendix C.

Comment S-20, Section 8.0.

A detailed schedule will be developed after completion of the final SAP. A copy of the schedule will be supplied to agency representatives and will be updated as needed.

Comment S-21, Section A1.1, page A1-1.

The table of contents for the SAP clearly indicates sections describing the development of Data Quality Objectives (DQOs), sampling procedures, and the location of site-specific DQOs. Listing DQOs in the appendix would add unnecessary redundancy.

Comment S-22, Section A1.2, page A1-5, paragraph 2.

Specific data quality objectives for precision, accuracy, etc. are provided in the McClellan AFB QAPP.

Comment S-23, Section A2.0, page A2-1.

Soil gas analyses near surface are used to screen sites and to focus soil sampling in areas of potential discharge of VOCs.

The bullet in question has been revised as follows: "The vapor phase of VOCs from VOC-containing liquid phases in the soil will enter and migrate in soil gas."

Comment S-24, Section A2.1, page A2-2, paragraph 3.

The criteria: "the sites are surrounded by concrete" will be deleted from the paragraph. Potential Release Location T-48 was investigated as part of SA 16 during the OU B Soil Gas investigation. Potential Release Location T-60 was not investigated during the OU B Soil Gas Investigation because the tank contained Bunker fuel, which is a fuel that has few volatiles. Soil sampling is scheduled at each of these locations (Section 3.2.3).

Comment S-25, Section A2.1.1, page A2-2, paragraph 5.

The discussion of vapor phase VOC behavior in soil gas has been revised (Section A2.1.1).

Comment S-26, Section A2.1.1, page A2-2.

The discussion of vapor phase VOC behavior in soil gas has been revised (Section A2.1.1)

Comment S-27, Section A2.1.1, page A2-3.

The discussion of vapor phase VOC behavior in soil gas has been revised (Section A2.1.1).

Comment S-28, Section A2.1.1, page A2-3, paragraph 2.

A corrected Table A2.1 had been added to summarize gas migration properties (page A2-5).

Comment S-29, Section A2.1.1, page A2-3, paragraph 3.

The discussion of vapor phase VOC behavior in soil gas has been revised (Section A2.1.1).

Comment S-30, Section A2.1.1, page A2-5.

The discussion of vapor phase VOC behavior in soil gas has been revised (Section A2.1.1).

Comment S-31, Section A2.1.2, page A2-5.

The statement does not claim that soil gas data identifies contaminant sources; it states that the data are used. The statement does not preclude the use of other data.

Comment S-32, Section A2.1.2, page A2-5, equation.

The equation used is admittedly a simplified representation of the soil gas concentration to soil concentration relationship in the vadose zone. The mass of water on the soil and in the soil gas is ignored because they decrease VOC sorption on soil particles (see Smith et al., 1990, ES and T, page 676), and increase VOC concentration in soil gas. The equation is presented to approximate the relatively low concentrations of VOC in soils that could yield soil gas VOC concentrations at or above the "decision levels." The addition of water to the "system" would tend to increase the soil gas concentration with respect to soil concentration.

Comment S-33, Section A2.1.2, page A2-6.

The sentence is intended to convey that VOC concentrations detected in soil gas at a sample probe may exceed the concentrations of the VOC on soil particles at the same location because the VOCs in the soil gas may have migrated away from the location at which they entered the vapor phase. This phenomenon seems to have been demonstrated in the soil gas sample locations in the validation study areas.

Comment S-34, Section A2.1.2, page A2-6, paragraph 3.

Section A4.2.1 will be referenced.

Comment S-35, Section A2.2.2, page A2-12.

Samples were collected at 50-foot intervals to help determine if the 100-foot soil gas sampling interval was adequate or if the sampling interval needed to be revised based on OU B specific conditions.

Comment S-36, Section A2.3, page A2-9.

The Validation Study, Section A2.3, has been revised.

Comment S-37, Section A2.3.3, page A2-20.

The figures have been revised to show the correct sampling locations.

The method of locating soil sampling locations in areas with VOC concentration in soil gas has been revised throughout the SAP.

Comment S-38, Section A2.3.4, page A2-20.

Figure A2-6 shows soil gas probe locations at Site 23. The sum of VOC concentrations detected in the soil gas sample collected at 6 feet at Boring 6 (Table A2-2) is 7,561 ppbv. Text states the concentration at Boring 1 was 320 ppbv. The column was not made of Teflon®.

Soil Boring 2 at Site 23 was drilled adjacent to a probe sample which has less than 20 ppbv total halogenated VOC (Table A2-2). The aromatic VOC data for the probe were excluded from the table and Figure 2-6. Boring 1 was located adjacent to a probe sample which had 320 ppbv total halogenated VOCs. Boring 6 was drilled adjacent to a soil gas sampling location which had 7,500 ppbv total halogenated VOCs at 4 feet. The data are given in the text and in Table A2-2.

Comment S-39, Section A2-4, page A2-22 to A2-23.

The third bullet under Data Interpretation, Section A2.4, has been revised to "Concentrations of VOCs were low or nondetectable in soil gas samples collected at depths beneath shallow soil gas samples containing total VOC concentrations less than 100 ppbv." The fourth observation is a valid observation. Concentration increases of 10^3 over 5 feet were not observed in the data.

Comment S-40, Section A2.4, page A2-24 to A2-25.

The Data Interpretation, Section A2-4, has been revised (see page A2-25 through A2-27).

Comment S-41, Section A2.4, page A2-26.

The Data Interpretation section has been revised (see page A2-25 through A2-27).

Comment S-42, Section A3.0, page A3-1, paragraph 1.

Note the Background Investigation has been moved to Section 3.24.

Sediments at McClellan AFB originated from the Sierra Nevada Range. Granitic, metamorphic, and volcanoclastic grains may be observed in the sediments. The lithologic log will include a list of minerals and rock fragments that comprise individual layers. These descriptions can be used to determine the source material and the potential for naturally occurring elements such as radionuclides.

Comment S-43, Section A3.0, page A3-1, paragraph 2.

This is now Section 3.24.

Background locations were selected in areas where there is no historical evidence of industrial activities. Agricultural activities occurred throughout the area of OU B prior to the opening of McClellan AFB. Low levels of pesticides may occur throughout the area because of the agricultural history. Former residential areas where pesticides may have been stored or spilled prior to application were avoided. The background samples will only be analyzed for inorganic species and radionuclides. Grain size and visible carbon content will be considered in sample selection (see Section 3.24).

Comment S-44, Section A3.0, page A3-3, paragraph 3.

A detailed description of the sampling strategy is included in Section 3.24.

Samples will only be analyzed for inorganics during the Background Investigation. Therefore, groundwater contamination consisting of VOC will not effect the results. Groundwater sampling and analysis results compiled since 1985 indicate inorganic species are not a potential contaminant from McClellan AFB (see Groundwater Quality Beneath OU B, Section 2.5).

Comment S-45, Section A3.0, page A3-3, Table A3-1.

This is now Section 3.24.

Background soils will only be analyzed for inorganic species (metals and radionuclides). As discussed in previous meetings with the regulatory agencies, the background levels for organic compounds are the detection limits. Prevailing winds at McClellan AFB are southwesterly. Therefore, off-base background sampling locations are upwind of OU B.

Comment S-46, Section A3.0, page A3-4, paragraph 1.

This is now Section 3.24.

Samples will only be analyzed for inorganics during the Background Investigation. Therefore, groundwater contaminants consisting of VOC will not effect the results. Background sampling locations were chosen on base with the following criteria: no Site, PRL, SA, or SSA is within 300 feet and no evidence of contaminant releases or industrial activities.

Comment S-47, Section A4.6.3, page A4-24.

This is now Section 3.24. Only inorganic species or radionuclides will have "Background Concentrations." All organic compounds will be compared to PQLs developed for each analyte.

Comment S-48, Section A4.0, page A4-1.

This is Section A3.0 in the revised SAP.

If contamination is detected but no source is found, further investigation will be conducted in the RI to locate the source of contamination.

Comment S-49, Section A4.0, page A4-1.

This is Section A3.0 in the revised SAP.

Additional information has been added to explain the rationale of physical analyses and specific uses for each physical test (Sections 2.7.4 and 6.4). The physical analytical results will be used to help determine contaminant migration pathways and to evaluate remediation alternatives.

Comment S-50, Section A4.1, page A4-2.

This is Section A3.1 in the revised SAP.

Specific section numbers have been referenced when cross references are made.

Comment S-51, Section A4.2, page A4-2 to A4-4.

This is Section A3.2 in the revised SAP.

Historical uses are discussed generally in Section 2.1 and specifically in Sections 3.1 to 3.23. There is no single "historical use" criterion. Physical settings at each site (e.g., underground tank, buried pipeline, surface discharge, streambed) are used in Sections A3.2.1 to A3.2.3. There is no single physical setting criterion. Both historical and physical information are used to establish a sampling rationale.

Comment S-52, Section A4.2.1, page A4-4.

This is Section A3.2.1 in the revised SAP.

No additional surface soil gas samples will be collected in areas where soil gas samples were collected during the OU B Soil Gas Investigation. Reconnaissance soil borings will be in a triangular grid in and adjacent to soil gas targets. As a result of doubts raised regarding the use of VOC concentrations in soil gas to locate source areas, soil boring sampling appears to be the only acceptable method of verifying contaminants in soil particles.

Comment S-53, Section A4.2.2, page A4-4 to A4-6.

This is Section A3.2.2 in the revised SAP.

A minimum 25-foot spacing along the pipeline is considered adequate for the Phase 1 borings. Previous leak testing data or soil gas data from all segments in OU B allowed spacings to be reduced to 25 feet along some segments of the pipeline. (Borings at 50-foot spacing along untested sections have been deleted.) The purpose of Phase 1 borings is to detect contaminants; contaminant distribution will be defined in Phase 2. Because the pipeline lies within soils that were disturbed during its installation, preferential linear pathways for contaminant migration are likely to exist. Therefore, mobile contaminants in wastewaters have potential to move along the line. Furthermore, if contaminants are detected along a 50-foot or longer segment that is known to contain cracks or offset points, remedial actions are likely to be implemented along the entire segment.

The number of borings placed around tanks is determined by the area of the tank not the volume of the potential discharge. The areal distribution of Phase 1 borings was established to increase the potential of locating a contaminant source. Because the volume of potential discharges and the soil types beneath each tank are not known, a systematic approach based on tank area was adopted.

Comment S-54, Section A4.2.2, page A4-7 to A4-13.

This is Section A3.2.2 in the revised SAP.

Compositing of samples at a ratio of 12:1 will not be conducted for PCB analysis during the RI. Compositing at a ratio of 4:1 for field PCB screening may be necessary.

Comment S-55, Section A4.3, page A4-13.

This is Section A3.3 in the revised SAP.

Non-mobile contaminants such as metals will only be sampled for in the upper 20 feet of boreholes. Samples for non-mobile contaminants will be collected at depth during Phase 2 and 3 if non-mobile contaminants are detected during Phase 1 and there is potential for migration to greater depth. Phase 1 borings will be predominantly drilled to 20 feet BGS to identify contaminants in the near-surface soils. The vertical and horizontal extent of contamination will be determined during Phases 2 and 3.

Comment S-56, Section A4.3.1, page A4-14.

This is Section A3.3.1 in the revised SAP.

There will be no predetermined sampling depths. Soil sampling depths will be chosen using physical evidence (e.g., PID results, discoloration, odor, waste, debris, and lithology). The procedures for to sample selection are be included in the revised SAP.

Comment S-57, Section A4.4, page A4-17.

This is Section A3.4 in the revised SAP.

Decisions on sampling will be made with any available near-surface soil gas data, downhole soil gas data, and physical observations. In any valid sampling program, all data are used in the decision.

Comment S-58, Section A4.4, Figure A4-1.

This is Section A3.4 in the revised SAP.

The explanation of Figure A3-1 has been revised (Section A3.4 on page A3-15) to explain that the depth intervals for selection of analytical methods is generalized for Phase 1. It is a guide for Phase 1 sampling that will be evaluated with site-specific data obtained in Phase 1.

Comment S-59, Section A4.4.6, page A4-20.

This is Section A3.4.6 in the revised SAP.

The explanation of metal mobility has been revised on page A3-20.

Comment S-60, Section A4.4.10, page A4-21.

This is Section A3.4.10 in the revised SAP.

Individual components of paints (e.g., VOCs and metals) will be investigated separately. Therefore, samples may only be collected for metals near the surface, whereas samples will be collected for VOC analysis near the surface (>1 foot) and at greater depths. Non-mobile contaminants, such as metals will initially be sampled in the upper 20 feet of boreholes. Samples for non-mobile contaminant analysis will be collected at depth during Phases 2 and 3 if non-mobile contaminants are detected during Phase 1 and the potential exists for additional vertical migration.

Comment S-61, Section A4.6.2, page A4-24.

This is Section A3.6.2 in the revised SAP.

A data management plan is provided in Section 9 of the McClellan AFB QAPP.

Comment S-62, Section A4.6.4, page A4-25.

This is Section 3.6.4 in the revised SAP.

Comment is noted. No change required.

Comment S-63, Section A5.2, page A5-3, paragraph 2.

This is Section 4.2 in the revised SAP.

A triangular array will be used for incorporation of borings in Phase 2 sampling. A triangular array results in the least number of sampling points to assess an area with a specified spacing. Sediment and soil sampling for Undefined Discharge Targets are now guided by the same stepout criteria in Phase 2: "select sample locations at approximately half the distance between a location with detected contaminants and the nearest sample without detected contaminants." Only fine-grained sediments are sampled, if they are present.

Comment S-64, Section A5.7.2, page A5-10.

This is Section 4.7.2 in the revised SAP.

The depth zone (20 to 95 feet BGS) and the comparison of data to Levels of Concern for Health Risk Assessment have been added to text, page A4-10.

Comment S-65, Section B1.0, page B1-1, paragraph 1.

The text of Appendix B has been revised. The purpose of the health risk calculations is not to fix detection limits. Levels of Concern for Health Risk Assessment are calculated as "potential" action levels. Potential action levels will be used in Phase 1 to focus and prioritize Phase 2 and Phase 3 efforts on source areas that are most likely to require remedial action. Action levels to determine where remedial actions are needed will be determined by baseline risk assessment. See Section B1.0.

Comment S-66, Section B1.0, page B1-1, paragraph 2.

Appendix B is not intended to be a baseline risk assessment. Therefore, the cumulative affects of contaminant concentrations are not considered prior to the collection of data. See revised Section B1.0.

Comment S-67, Section B2.1, page B2-2.

Appendix B is not intended to be a baseline risk assessment. The comment will be considered at the time that assessment is prepared. All values in Table B-1 have been recalculated.

Comment S-68, Section B2.2, page B2-3.

Appendix B is not intended to be a baseline risk assessment. Dermal absorption factors will be agreed upon before the assessment is prepared.

Comment S-69, Section B2.3, page B2-4 to B2-5.

Oral adsorption efficiency corrections will be used in the algorithms for baseline risk assessment.

Comment S-70, Section B3.0, page B3-1.

Inhalation and dermal exposure pathways will be included for groundwater in baseline risk assessment.

Comment S-71, Section B4.0, page B4-1.

To simplify the calculations, the lowest value available for oral or inhalation RfDs and potency slope factors were used in deriving values in Table B-1. The table has been footnoted to reflect this use.

Comment S-72, Table B-1, page B4-3.

More recent RfD and RSD values are used in calculating concentrations in Table B-1. The source of the values are IRIS and HEAST tables. All values will be updated prior to baseline risk assessment.

Comment S-73, Section 3.0.

The validity of soil contaminant data from previous investigations has not been verified because quality assurance/quality control information was not provided. Previous soil sampling location survey data were not obtained or were not provided. Because this information for previous sampling is not provided, previous analytical results must be considered qualitative. Approximate locations of previous samples are indicated on site-specific maps, and data are summarized in text. Because of the qualitative nature of previous data, Phase 1 sampling locations are placed in the approximate locations of previous borings to verify analyses.

Additional data for the selection of sampling locations are provided in DQO tables for each site. Soil gas sampling locations and concentration data are presented for all locations at which they were obtained (Sections 3.1 to 3.22).

Comment S-74, Section 3.0.

The objective of the Phase 1 Remedial Investigation has been expanded to include the characterization of all contaminants. The use of the sonication method, with the core barrel or the outer drill casing sealing off deposits during drilling, diminishes the potential for downward migration in the event that dense nonaqueous phase liquids (DNAPLs) are encountered. Borings encountering DNAPLs will be terminated at the depth they are detected, and the boring will be abandoned. All Phase 1 borings will be abandoned by filling with bentonite grout (see Section 5.2.4, page 5-12).

Comment S-75, Section 3.0.

Soil borings will be placed throughout a soil gas target area, not just at the location of the highest soil gas concentration detected during the OU B Soil Gas

Investigation. Soil gas targets and adjacent areas will be sampled with borings located in a triangular grid.

Comments S-76 through S-92 Inclusive.

Individual responses to these comments are not provided because all site-specific plans were re-evaluated on the basis of comments received. Boring locations in all areas with soil gas data have been redone. Additional soil gas sampling will be performed along sections of the Industrial Wastewater Line to assist in narrowing the focus of the soil sampling along the line. Sampling depth and analyses have been reassessed on all plans. Reconnaissance borings included in the revised site-specific plans will be sampled to 20 feet below surface, or to the depth below any physical indications of contaminants. See sample selection criteria in the footnote to the Sampling and Analysis Matrix for each site or investigation cluster. Deeper borings will be drilled in selected locations (to a maximum depth of 95 feet) to obtain sample information at specific locations. The locations of borings to determine the vertical penetration of contaminants will be selected in Phase 2 after near-surface contaminant sources are identified

Discrepancies between analyses cited in text and methods specified in tables for each site have been corrected for all sites.

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY

PETE WILSON, Governor

DEPARTMENT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL PROGRAM
REGION 1
10151 CROYDON WAY, SUITE 3
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June 7, 1991

Colonel Keith Findley, USAF
Director, Environmental Management
SM-ALC/EM
McClellan Air Force Base, CA 95652-5000

Dear Colonel Findley;

DHS COMMENTS ON OPERABLE UNIT B, DRAFT REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN (RI PLAN) - McCLELLAN AIR FORCE BASE

Enclosed are the Department of Health Services' (Department) comments on the draft RI Plan dated March, 1991. The draft RI Plan was submitted to the Department for review on March 6, 1991.

The Department has enclosed a proposed technical sampling approach that differs from the sampling approach proposed in the RI Plan. The Department believes that the RI sampling approach better define the inter-relationship of lithology and contamination. With a better understanding of the lithology-contamination inter-relationship, future sampling programs can be better focused. As a result, a net reduction in the number of samples, sample analysis, and field work is feasible while improving the quality of the site evaluation information.

Please address all regulatory comments on a point-by-point basis and add the responses as an appendix to the next draft of the RI Plan.

Also enclosed is the Department's response to the soil cuttings replacement proposal.

If you have questions regarding any issues identified in this letter, please contact Mr. Mark Malinowski at (916) 855-7872.

Sincerely,

Anthony J. Landis

Anthony J. Landis, P.E.
Chief, Site Mitigation Branch

Enclosures

cc: See next page.

JUN 10 RECD

Mr. Lewis Mitani (H-7-3)
U.S. EPA, Region IX
75 Hawthorne Street
San Francisco, CA 94105

Mr. Alex MacDonald
Regional Water Quality Control Board
3443 Routier Road
Sacramento, CA 95827-3098

State of California

Department of Health Services

Memorandum

To : Anthony J. Landis, P.E.
Chief, Site Mitigation Branch

Date: June 7, 1991

Via: David Wang, P.E. DHd (FOR)
Chief, Federal Facilities Unit

From : Toxic Substance Control Program
10151 Croydon Way
(916) 855-7872

Subject : McClellan AFB Operable Unit B Remedial Investigation Sampling and Analysis Plan

This memorandum presents the Department of Health Services (Department) comments on the McClellan AFB (McAFB), Operable Unit B (OU-B), Remedial Investigation Sampling and Analysis Plan (SAP) dated March 1991. The format of this review initially presents general comments followed by specific comments on the SAP. The final section presents secondary comments.

I. GENERAL COMMENTS:

As discussed with McAFB personnel, the technical approach presented in the SAP does not address the lithology-contaminant inter-relationship. Attached is a copy of the Department's recommended technical sampling approach.

Further discussion of monitor well placement criteria should be presented in this SAP. This is to establish the link between the Phase 1 investigation and establishing monitor well locations.

An air monitoring and sampling program is not included in this SAP. Since air sampling will be required for a complete risk assessment, the Department recommends that an air sampling program be added as an addendum to this SAP.

Conceptual site models should have been developed and presented for each Investigative Cluster (IC), each site that not incorporated into an IC unit and for the Operable Unit overall. Conceptual models should include the extent of geologic and contaminant knowledge gained from previous investigations.

The Data Quality Objective (DQO) Tables for each site should provide the maximum depth of sampling for each boring location e.g.; IC01B13: 5'N, 145'W 10'.

The DQO Tables for Industrial Waste Line (IWL) sites should reference the EG&G (1988) report number for each appropriate boring/section of IWL.

Since the IWL has been in operation since the 1940's, it should be considered a continuous release source and major contaminant driving/loading source. Appendix A should provide the general sampling criteria/rational for sampling along the IWL. The depth of the IWL should be determined prior to establishing sampling depths. Samples collected at 5 feet Below Ground Surface (BGS) may actually be above the IWL and sampling depths to 15 feet will be inadequate to determine the vertical extent of contamination.

IWL sections that run east of MH-15 should be included for investigation. See specific comments for details.

Soil gas sampling should be performed along the IWL sections that were not tested by EG&G prior to collection of soil samples. All IWL pump stations with sumps should also be investigated using soil gas prior to soil sampling. Other semi-quantitative field screening methods should be considered to limit the number of soil samples required along the IWL.

Clarify whether the field gas chromatograph (FGC footnote identified in the sampling and analysis matrix tables) will be used to determine if further sampling is necessary during the Phase 1 investigation.

Surface soil samples 0-6 inches BGS should not be collected for volatile analysis unless the sample is investigating a recent spill or the sampling location is immediately beneath capping material (asphalt, concrete, etc.). For areas where the natural ground surface is exposed, volatile sampling depths can begin at 6 inches BGS.

The OU-B SAP cannot be approved until the OU-B addendum to the Health and Safety Plan has been reviewed and approved by the Department.

As previously discussed with McAFB personnel, Appendix B, Derivation of Levels of Concern for Health Risk Assessment must be re-written. As currently presented, Appendix B would appear to propose new detection limits.

If the deepest (proposed) sample location indicates visible or physical signs of contamination, the next deeper sampling point should be collected for lab analysis.

Explain why chemical data from nearby monitor wells is rarely cited or included to help in developing sampling approaches for the ICs or sites.

II. SITE SPECIFIC COMMENTS

Pg	Sec	Pgph	Comment
2-5	2.1		Describe the type of instrument calibration activities in Building 677 and duration of the activities. Were the activities similar to the type carried out in Building 252 where extensive mercury contamination was found?
2-54	2.6.7		Bullet 2. Remove reference to disposal of groundwater to the sanitary sewer.
3.1-1	3.1	1	Proposed sampling locations for all sites should be presented using enlarged Figures (e.g. 3.1-3) for correlation purposes.
3.1-14	3.1.4	1	High soil gas (UVOC) readings occur near the Building 655 sump area. Further investigation of the sump area is required and should be explained in the text. The text should identify the highest levels of soil gas found and propose explanations.
3.1-17	3.1.5	2	Confirm if surface soil staining is evident. Are the proposed borings placed on field observation or random sampling? Is a foundation present?
		3	Is there a slope to the pad that would have directed run-off in a particular direction?

3.1-21		2	There is a forced main section of the IWL from south of Building 655 to MH-12V that was not tested by EG&G. The Department recommends that a soil gas survey be performed around that section of IWL. IWL report #34 identifies leaking section of pipe at 54 and 380 feet North of MH-12V. Borings should be located appropriately and identified in Table 3.1-8.
3.2-1	3.2	1	Figure 2-6 identifies Mat K as PRL S-41. PRL S-41 is not included in this IC description. Correct the discrepancy or explain in the text why PRL S-41 is not included.
3.2-1	3.2.1	-	The fuel spill that occurred at Mat K in December, 1990 should be described in the site description. Is the soil contamination from the December, 1990 spill going to be addressed during the RI?
3.2-4	3.2.1	3	Last Line. Describe who investigated the oil/water separator in 1986 and the extent of the investigation. Were soil samples taken or were only the contents sampled? Describe if the drain lines were capped or sealed.
3.2-7	3.2.3	-	The soil gas results shown in Figure 3.2-1 do not reflect the soil gas isopleths identified in the OU-B soil gas report (Figures 69 &70). Explain the discrepancy.
3.2-14	3.2.4	4	Borings at the following locations should be proposed: From MH-10A to MH-10C, and MH-7 to MH-8 (IWL integrity not determined); From MH-6 to MH-7 (Leaking joints were identified).
3.3-1	3.3.1	1	The Department recommends that the IWL branch extending to Building 692 be included in the OU-B investigation.
3.4-6	3.4.2	1	The Preliminary Assessment for OU-A recommended sampling for Building 628. The Department has not seen or reviewed the EMC data. If no further sampling is recommended based on the EMC data, the data (including depth of

			sampling) and QA/QC information must be presented. Describe the type of risk assessment criteria used to determine that "the soil below or adjacent to Building 628 does not present a significant impact to public health or the environment."
3.4-7	3.4.4	3	The EG&G reports # 31 & 32 indicate extensive etching of the IWL from MH-12M to MH-12J. The Department recommends placing borings at each elbow of the IWL and one between MH-12L and MH-12K. Boring IC04B17 should be placed close to the lift station. Samples should be checked for metals and pH.
3.5-1	3.5	-	Semi-quantitative field screening methods should be used for initial investigation of the possible PCB spill areas.
3.5-2	3.5.1	1	Were the other two possible PRL 29 locations (NE corner of Dean Street & Patrol Road and the area north of the CE yard) reviewed/inspected for use as a scrap burn pit, generator burial yard or transformer storage area?
3.5-5	3.5.2	-	Previous soil borings for all of the IC 5 sites should be identified in Figure 3.5-2.
		2	Reference the report where the sampling information can be found. Clarify if the PCB contaminated soil was removed or left in place.
		3	Describe why the soils were analyzed for pH and sulfides. What contaminants were suspected?
3.5-7	3.5.2	1	Aerial photos should be reviewed to look for staining and possible soil sampling locations.
	3.5.4	2	The Department recommends placement of more soil gas probes to better delineate the soil gas isopleth prior to installation of the boring?

3.5-9	3.5.4	1	Prior to collection of any samples, a site visit should be conducted to look for visible staining. Removal of the Perforated-Steel-Planking should be evaluated to aid in identifying visibly stained soil. Again, semi-quantitative field screening methods should be employed.
3.5-11		2	Confirm if visible staining was present in aerial photos at SA 12C.
3.5-15	3.5.4	2	As identified in the <u>General Comments</u>, the Department recommends that soil samples for volatile analysis be collected at 6-12 inches BGS and not the 0-6 inches BGS as proposed.
3.6-3	3.6.1	1	Were associated vent pipes found for the tanks? Soil gas sampling should be performed adjacent to the vent pipe areas if the areas exist.
3.7-1	3.7.1	1	EG&G report #46 identifies a washdown drain that extends from south of Building 654 toward the IWL between MH-12C and MH-12D. Does the washdown area and drain exist? Additional borings in the area are recommended. Identify the IWL lift stations on the appropriate figures.
3.7-10	3.7.1	1	Identify the locations of pump stations and the washrack in the appropriate figures. More soil gas samples should be performed along the untested portions of the IWL. Use of field screening samples for some of the IWL sampling locations should be considered. Shallow (1 foot BGS) surface soil samples are recommended.
3.7-11	3.7.1	2	PRL S-34. Show the trench locations on the appropriate Figure(s).
3.7-12	3.7.1	1	S-35. A IWL Master Plan Map indicates that abandoned lift station B is located near Building 674. Identify the lift station on the appropriate figures. An additional boring at the lift station may be necessary.

		2	SA 7. Is there any indication of when the berms were installed? The high soil gas readings may be indicative of soil contamination that was caused prior to the installation of the berms. The statement "Therefore, contamination of the surface surrounding the washrack is not suspected." is not valid and shallow surface sampling (1 foot BGS) is recommended. Define the depth of the drain lines.
3.7-12	3.7.1	3	Do the Closure Plans indicate if the tanks were removed? When were the tanks closed? Are there associated vent pipes or other piping that requires further investigation?
3.7-12	3.7.1	4	Have any spills ever been reported or documented at the Building 659 hazardous staging area?
		5	SA 11. Describe the results of the tank sampling. Were only gasoline products found? Was the tank abandoned in place or excavated? Present the results of previous soil sampling (for closure).
3.8-1	3.8.1	1	The location of PRL L-5C does not correspond with the IWL location given in the EG&G report. Soil gas and soil sampling locations for the IWL runs identified in the 1988 EG&G report should be proposed. The IWL location discrepancy should be explained and/or corrected.
3.8-7	3.8.5	5	The Department recommends that surface soil samples be collected from around the washrack.
3.8-11	3.8.5	1	Provide justification for not placing, at a minimum, soil gas sampling points around the perimeter of PRL S-29. Soil gas readings provided in Figures 3.1-1,and 3.8-1 indicate Building 655 may be the source of surface contamination. Several soil borings placed around Building 655 would be appropriate for

			field screening. Further work and investigation into locating drains that connect to the IWL is also recommended.
3.9-1	3.9.1	1	Have berms been in place since Building 781 was constructed? Describe the general types (Acids, Bases, Pesticides, etc.) of chemicals stored in 781 since 1971.
3.9-1	3.9.2	-	Present and discuss the analytical results from the three adjacent monitor wells (MW-3, 48S and 116). Are the same contaminants (if any) found in previous monitor well sampling analysis being looked for at Site 23?
3.10-1	3.10.1	1	Are there lift stations along this portion of the IWL? Discuss the Building 613 washrack activities. Identify the washrack location on Figure 3.10-1.
3.10-3	3.10.4	3	EG&G report #17 identifies several IWL leak locations that are not being addressed by the proposed boring placement. The Department recommends more soil gas sampling along the untested portions of the IWL and along the sections where leakage is expected.
3.11-1	3.11.1	1	The Department recommends that the PRL L-5G investigation extend further east to the OU-B boundary (MH-19). The 1988 EG&G reports indicate leaking joints in the IWL between MH-15 and MH-19.
3.11-4	3.11.3	1	Borings do not have to be placed so close together where adjacent leaking joints exist. DHS recommends deleting borings at GB02, 05, 06, 08, and 14. Depth to the bottom of the IWL should be identified in the text. The rational for beginning soil sampling at 5 feet BGS should be given. The proposed vertical sampling should extend to 35 feet during Phase 1. Vertical sampling should continue if contamination is observed, or identified using field sampling.

3.12-1	3.12.2	1	Further discussion of the PCB spill investigation and cleanup should be presented. Estimate volumes of PCB oil spilled. Were any soil samples taken? Was the spill confined to the paved portion or did spillage occur to nearby soils.
3.12-5	3.12.4	1	Discuss the depths (estimated if necessary) of the sumps and the French drain system. Sampling depths at sumps should extend to at least 35 feet.
3.12-9	3.12.4	2	Prior to the installation of 24 soil samples, the Department recommends more extensive soil gas sampling and/or soil sampling using field screening methods. Use of the screening methods will help to reduce the number of samples needing laboratory analysis while maintaining quality objectives.
		3	Refer to comments on previous PCB investigations. Since 1,1,1-Trichloroethane was used to aid in the PCB cleanup, soil gas testing would be appropriate prior to soil sampling.
3.13-1	3.13.2	1	More soil gas probes should be provided at this site.
3.14-1	3.14.1	1	Describe the general type of chemicals stored at this facility. Do storm drains exist near the loading dock areas?
3.15-1	3.15.1	1	Has the o/w separator been removed and have the inlet and outlet pipes been plugged? Is this the tank that spilled in December 1990? If this is the tank that overflowed in 1990, surface sampling is recommended.
3.16-1	3.16.1	1	Are storm sewers present in the immediate vicinity?
3.17-1	3.17.1	1	Describe the activities at Building 671.

3.17-3	3.17.3	-	The Department recommends a soil boring at the soil gas location where 1220ppbv of AVOCs were detected.
3.17-3	3.17.3	3	Soil samples for borings SA04B03-06 should also be taken immediately beneath the pavement.
3.18-1	3.18		The Department recommends that the tank be tested prior to sampling. If the tank passes the tank test, shallow sampling to determine if the lines to Building 663 should be conducted. Does the tank have a vent pipe? The depth of the tank should be presented. Sampling at 5 feet BGS may be inappropriate when the depth of the tank is determined.
3.22-4	3.22.4	-	Is an objective of the sampling to determine the impact of contaminants on the creek ecologies (environmental sampling) as well as potential human pathways? Discuss how the sampling program will be used to perform an environmental assessment on the creeks.
5-1	5.1	-	The Sampling and Analysis Matrix Tables indicate that soil gas will be collected at each depth sample that would be collected for laboratory analysis. If the sample probe is driven 2 feet deep, when are the "undisturbed" soil samples taken for laboratory analysis. Since soil gas results will vary depending on lithology and contaminant concentrations, how can soil gas results be evaluated since the lithology at the soil gas sampling point is unknown?
5-8	5.2.2	-	Based on the proposed sampling methods, predetermined sampling points are selected independent of lithology. The Department does not agree with the proposed sampling method. Attached is a copy of the Department's recommendation for a technical sampling approach.
5-8	5.2.2	2	The percent recovery from the split spoon sampler should be indicated on each borehole log.

5-9	5.2.3	1	Provide a more detailed explanation of borehole decommissioning procedures. For example; The amount of bentonite added to the cement will be weighed using a scale and provisions will be made to meter the volume of water used. Weights and volumes will be recorded on the borehole decommissioning logs. Calculated and actual volumes of grout used to fill the boreholes will also be included on the individual borehole logs. The grout will be tremied into the borehole.
5-12	5.4	1	The date of the most recent rainfall event and rainfall amount should also be recorded.
5-12	5.5	1	Monitor wells are not proposed in the RI SAP. The analytical methods to be used for monitor well samples should be submitted to the regulatory agencies for evaluation prior to collection of the samples.
5-12	5.5	2	Holes left by the Hydropunch must be filled using cement or bentonite grout.
7-1	7.0	1	The revised Health and Safety Plan must be reviewed and approved by the Department prior to initiation of field work.
Appendix A			The regulatory agencies and McAFB will be meeting to discuss major elements of the proposed Sampling Decision Protocol. The Department's comments will be provided at those meetings.
Appendix B			The Department's comments were discussed with McAFB personnel in April 1991. Further clarification of the General Assumptions used for the Derivation of Levels of Concern for Health Risk Assessment and use of the RfDs was requested.

FIGURES General Comments

Since washracks and IWL lift stations are major potential sources of contamination, they should be identified on all appropriate figures.

Trench drains and sump locations within buildings should be shown on the appropriate figures.

Previous (contractor and McAFB EM) sampling locations should be provided on figures that identify proposed sampling locations.

SPECIFIC COMMENTS

Figures 2-8,9 & 10 give a good understanding of the basewide soils classification, surface drainage, and 100-year flood plain conditions. Present more detailed maps for the OU-B areas (separate OU-B out and enlarge to 8 1\2" X 11").

Figure 2-12. Remove CW-150 or annotate that it has been properly decommissioned.

Figure 3.1-1. Show the Building 655 sump location identified in the IWL Report #50. Also include the sump in the figure for IC-6. The IWL report indicated a broken pipe 166 feet from MH-12Q. Borings are needed in both the sump and broken pipe areas. Label the concentration for the inner HVOC contour.

Figure 3.4-1. Present AVOC contours.

Figure 3.4-2. Are the soil borings completed by EMC (west side of Building 628) close enough to the IWL to make the conclusion that the IWL is not a source of contamination at this site?

Figure 3.6-1. Edit. IC06B14 should be IC06B04.

Figure 3.7-2B. Missing arrow for identifying location of PRL L-5B.

Figure 3.7-3B. Boring locations identified in Figure 3.6-1 (SA-18) are not shown or identified in Figure 3.7-3B. Explain or correct the discrepancy.

Figure 3.10-1. Identify lift station locations.

TABLES

Table 3.1-1. Include IWTP #4 in this Table. IWTP #4 was only a pretreatment facility and discharge to the IWL.

Table 3.1-8. Boring IC01B36 Location should be corrected to be 563 feet not 463 feet N of MH-12Q.

Table 3.2-9. The Department recommends a single boring placed at 265' W of MH-10A to take the place of IC02B35 and IC02B36. Borings IC02B46, 48 and 50 can also be deleted. Treat the IWL section from 164' N of MH-9 to 200' N of MH-9 as a single source.

Table 3.4-4. Boring IC04B16 should placed to consider the off-set joint at 29'N of MH-12N identified in EG&G report #27.

Table 3.6-5. Boring ID numbers are incorrect. Analytical methods for IC06B03 should be identified for the 95 foot sample.

Table 3.12-8 Continued. Further describe the notes identified under the Depth column. What is meant by "distance to bottom"?

Table 3.13-3. A soil sample should be collected at 1 foot for SW8240 analysis.

Table 3.16-2. See General Comment on shallow soil sampling for VOCs.

III. Secondary Comments

Pg	Sec	Pgph	Comment
2-48	2.6.5		Line 2. Specify which metal exceeded the MCL.
3.0-7	3.0	3	Last Line. Include horizontal extent in the Phase 2 evaluation.
3.2-6	3.2.2	1	Identify if Tank 756A is still in operation.
		2	Line 7. EG&G did not test the section between MH-10A and MH-10C.
3.5-9	3.5.4	2	Line 3. Correct discrepancy of "5 mg/L" in text and "5000 mg/kg" in the DQO Tables-Assumption 5.
3.1-12	3.1.2	1	Line 1. Edit. **Tank 7** should be **Tank 1** and the referenced diagram should be Figure **3.1-5**.
3.1-14	3.1.5	2	Indicate that boring locations are also placed based on previous data.
3.19-1	3.19.1	1	How long has the area been paved?
	3.19.2	1	Previous sampling locations and contaminants should be provided in a figure. What VOCs were found in the soil samples?
3.21-1	3.21.2	1	Monitor Well locations should be identified on Figure 3.21-1.
4-1	4.1	1	Line 3. Edit. (U.S. EPA, **1896b**) should be **1986b**.

Sincerely,

(FOR)
Mark Malinowski
Hazardous Materials Specialist

RADIAN
CORPORATION

RESPONSES TO DHS COMMENTS
OU B RI SAP

I. GENERAL COMMENTS

Comment 1, paragraph 1.

The technical approach regarding sample collection and addressing lithology-contaminant inter-relationships is included in the draft final OU B RI SAP. Field observations of contamination (e.g., PID readings or discoloration) and lithology will be used to help determine depths at which samples will be collected. In the absence of PID readings or discoloration, samples will be collected from fine-grained sediments.

Comment 1, paragraph 2.

Additional text in Section 3.0 and Section A4.7.1 has been added to elaborate on the criteria used in selecting monitoring well locations and how the Phase 1 investigation results will be used to select monitoring well locations.

Comment 1, paragraph 3.

A limited air sampling program has been added to the SAP. The Phase 1 investigation will include monitoring badges worn by field personnel, PID readings from open boreholes, and PID readings from the breathing zone. Sampling in Phases 2 and 3 will include the same measurements made in Phase 1 sampling plus surface flux measurements at selected locations where near surface VOC contamination could enter the atmosphere from soils.

Comment 1, paragraph 4.

A conceptual site model has been developed for OU B. Because there are limited or no data for most sites or ICs, a generalized migration model has been developed (see Section 2.7). Conceptual models for each site/IC will be developed following Phase 1.

Comment 1, paragraph 5.

Approximate maximum boring depths are now provided on DQO tables. However, boring depths are contingent upon field observations (see Section 5.2.3).

Comment 1, paragraph 6.

The DQO tables for the Industrial Waste Line (IWL) sites have been changed to include references to EG&G report numbers.

Comment 1, paragraph 7.

Appendix A has been modified to provide several sampling criteria/rationales for sampling along the IWL. Vertical spacing criteria for the Phase 1 investigation are discussed in Section A3.3. Specific sample depths will be determined in the field. Sample selection criteria are 1) below potential discharge depths, 2) in depth interval where contaminants were previously detected, 3) in observed waste or contamination, 4) at high FGC (≥ 50 ppm) readings, 5) where discoloration or odor is present, and 6) in clay, silt, or fine sand layers between potential discharge depths and the total depth of boring.

Comment 1, paragraph 8.

The section of the IWL east of MH-15 will be investigated in the OU B RI (See Section 3.11).

Comment 1, paragraph 9.

Soil gas sampling is being conducted, while these comment responses are being prepared, along IWL sections that were not investigated by EG&G prior to selection of boring locations for soil samples (see Sections 3.10 and 3.11).

Comment 1, paragraph 10.

The field gas chromatograph will be used to help determine if more soil gas samples are needed but not to determine whether more subsurface soil samples are needed.

Comment 1, paragraph 11.

Surface soil samples will not be analyzed for volatile compounds between 0 to 6 inch depths.

Comment 1, paragraph 12.

The revised Health and Safety plan for the OU B Remedial Investigation has been transmitted for review. Revisions to the plan have been made in response to comments received.

Comment 1, paragraph 13.

Sampling approaches were developed based on known or suspected contaminant sources instead of tracing groundwater back to sources. The phased approach begins with investigating the sources of contamination and locating hot spots in soils. In Phases 2 and 3, data from these hot spots will be compared to groundwater data to define the source(s) of contamination and to evaluate remedial alternatives for groundwater and soil. Additional monitoring wells will be constructed for groundwater sampling if contaminants in soils at identified sources do not account for the contaminant distribution in groundwater (Section A4.7.1, Appendix A).

II. SITE SPECIFIC COMMENTS

Page 2-5, Section 2.1

Manometers and flow meters have been calibrated in Building 677 since the early 1960s. The activities are similar to those that were performed in Building 252. Building 677 (SA 29) and adjacent soils will be investigated (see Section 3.21) during the OU B RI.

Page 2-54, Section 2.6.7

The text has been revised to eliminate the reference to the sanitary sewer (see page 2-55).

Page 3.1-1, Section 3.1, paragraph 1.

Enlarged figures were prepared for some location maps to aid in correlation (see Figures 2-9, 2-10, and 2-11). Investigation clusters were selected to illustrate the relationship between borings at adjacent sites.

Page 3.1-14, Section 3.1.4, paragraph 1.

The sump at Building 655 will be investigated as part of IC 8. The investigation of the sump located at the northeast corner of Building 655 will be investigated by reconnaissance borings that will also investigate PRL L-5C, and PRL S-30. These investigations have been explained in the IC 8 discussion in Section 3.8. The highest concentration of soil gas found has been included in the discussion of soil gas results in Section 3.8.2.

Page 3.1-17, Section 3.1.5, paragraph 2.

No soil staining can be attributed to the storage of transformers or PCB spills. Boring placement was selected at one point that would have received potential runoff of discharge liquids. There is a concrete pad that may have been used for storage of transformers at the location.

Page 3.1-17, Section 3.1.5, paragraph 3.

There is no predominant slope to the pad that would direct all of the runoff in one direction.

Page 3.1-21, Section 3.1.5, paragraph 2.

Soil gas sampling is being conducted, while these comment responses are being prepared, along the section of IWL south of Manhole 12V. Soil borings are located within 25 feet of identified leaks.

Page 3.2-1, Section 3.2, paragraph 1.

Potential Release Location (PRL) S-41 is Mat K. This area (the paved area between the hangars) is not considered a source of contamination because any contaminant discharges are most likely to have occurred from subsurface pipelines, or tanks around the periphery or surface runoff. Runoff flows into the hangars that surround it and then into sumps at the back of the hangars. This is explained in the text on pages 3.2-5 and 3.2-6.

Page 3.2-1, Section 3.2.1.

All available information regarding the 1990 spill are included in the site description (page 3.2-3). The only soil that may have been contaminated by the spill at IC 2 is located in a small ditch that lays north and parallel to Dean Street. Soil samples will be collected in the ditch (pages 3.2-6, paragraph 1, and 3.2-17, paragraph 2).

Page 3.2-4, Section 3.2.1, paragraph 3.

EG&G Idaho Inc. investigated the oil/water separator in 1986. Only the contents of the oil/water separator were sampled. The oil/water separator was emptied in 1987 and removed in the fall of 1990. Soil samples were collected from beneath the former tank. All pipelines were capped or sealed.

Page 3.2-7, Section 3.2.3.

The figures use the same soil gas data but have different concentration intervals for isopleths.

Page 3.2-14, Section 3.2.4, paragraph 4.

Soil gas sampling is being conducted, while these comment responses are being prepared, along the IWL that was not investigated during the OU B Soil Gas Investigation. Reconnaissance soil borings were proposed along the IWL between MH-10A to MH-10C. Soil gas probes were proposed along the IWL between MH-8 and the northern boundary of OUB. Locations of soil borings along the IWL will be determined after results from the soil gas investigation have been reviewed by the Air Force and the regulatory agencies.

Page 3.3-1, Section 3.3.1, paragraph 1.

The IWL branch extending to Building 692 has been included in the Remedial Investigation of OU B for IC 3.

Page 3.4-6, Section 3.4.2, paragraph 1.

The full text of the McClellan AFB report on the investigation of Building 628 is not yet available. The report is currently being reviewed by the Nuclear Regulatory Commission (NRC). It will be provided when the NRC review has been completed. Boring locations selected in IC 4 address the locations of potential soil contamination on the periphery of Building 628.

Page 3.4-7, Section 3.4.4, paragraph 3.

Etching of a pipe surface does not necessarily result in leakage. Soil samples will be collected from locations at three points between the IWL between MH-12M and MH-12J (see Figure 3.4-1). Samples taken along the IWL will be analyzed for metals and pH. Reconnaissance boring B9 is placed next to the lift station.

Page 3.5-1, Section 3.5.

Field PCB screening will be used to determine which samples should be sent for off-site analysis.

Page 3.5-2, Section 3.5.1, paragraph 1.

All three areas were reviewed to determine which was the correct location of PRL 29.

Page 3.5-5, Section 3.5.2.

The approximate locations of previous borings are shown on Figure 3.5-2.

Page 3.5-5, Section 3.5.2, paragraph 2.

Approximately 10 inches of topsoil was removed from a 45 by 45 foot area (approximately 63 cubic yards of soil). Post-clean-up samples indicate that the remaining soil is still contaminated with PCBs, VOCs, and semivolatile organic compounds. The data were obtained from McClellan AFB EM files.

Page 3.5-5, Section 3.5.2, paragraph 3.

The soils were analyzed for only pH to detect the presence of acids and bases. Sulfides were analyzed to detect the presence of pesticides. Pesticides were not considered contaminants of concern for this location but were sampled as an added precaution.

Page 3.5-7, Section 3.5.2, paragraph 1.

Aerial photographs were reviewed to identify areas of discoloration or activities associated with chemical handling, storage, or disposal. No stains were observed during the aerial photograph review.

Page 3.5-7, Section 3.5.4, paragraph 2.

The halogenated VOC isopleth is fairly well defined. The high aromatic VOC concentration was probably a result of contamination introduced during sampling; it has been deleted from the site map.

Page 3.5-9, Section 3.5.4, paragraph 1.

The perforated-steel-planking (PSP) cannot be removed. Field personnel will look for visible evidence of contamination (e.g., staining or disturbed soil) through the openings in the PSP. If visible evidence of contamination is observed, soil samples will be collected from the affected locations.

Page 3.5-11, Section 3.5.4, paragraph 2.

No soil staining was observed on the aerial photographs of SA 12.

Page 3.5-15, Section 3.5.4, paragraph 2.

Soil samples for VOC analysis will be collected from 1 to 5 feet below ground surface (BGS). Soil samples for immobile components (e.g., PCBs) will be collected from 0 to 3 inches BGS.

Page 3.6-3, Section 3.6.1, paragraph 1.

A square metal cover and a vent pipe were found at the location. Soil gas samples were not collected at the location because Bunker Fuel No. 5, a fuel oil with few volatile components that could be identified by the gas chromatograph was stored in the tank.

Page 3.7-1, Section 3.7.1, paragraph 1.

The washdown drain is in use south of Building 654. Soil gas samples were collected next to the drain during the OU B Soil Gas Investigation. Additional soil borings will be placed near the drain. Manholes and lift stations have been identified on the appropriate figures (Figures 3.7-3A and 3.7-3B).

Page 3.7-10, Section 3.7.1, paragraph 1.

The location of the washrack and lift stations have been identified on the appropriate figures. A revised approach to locating soil borings in soil gas targets has been adopted; a statistically based approach is used for sampling inside and around the perimeter of soil gas targets. No additional surface soil gas sampling is planned along this portion of the IWL.

Page 3.7-11, Section 3.7.1, paragraph 2.

The locations of the trench drains in Building 652 (PRL S-34) have been identified in the appropriate figures (Figures 3.7-4B, page 3.7-8).

Page 3.7-12, Section 3.7.1, paragraph 1.

The location of abandoned Lift Station B has been included in the appropriate figures (Figures 3.7-2B and 3.7-3B). Boring B46 will be placed next to the approximate location of the abandoned lift station.

Page 3.7-12, Section 3.7.1, paragraph 2.

The available evidence indicates that the berms were installed when the washrack was constructed in 1951. The depth of the drain lines is not known but will be determined during the Remedial investigation, if appropriate. Reconnaissance borings will be sampled from 1 foot to total depth.

Page 3.7-12, Section 3.7.1, paragraph 3.

The closure plans only state that the tanks were emptied in 1987, and it was recommended that the tanks be removed; however, there is no verification that they were removed. The tanks have not been used since 1981. No vent or fill pipes were identified during the site visit.

Page 3.7-12, Section 3.7.1, paragraph 4.

No information was found indicating that there have been any spills at the hazardous waste staging area.

Page 3.7-12, Section 3.7.1, paragraph 5.

The tank was sampled in 1986. The tank was only used to store gasoline. The tank was recommended for removal; however, it is unknown if the tank was removed. Results from a June 1991 surface geophysical survey that was conducted to locate underground objects were inconclusive. Oil and grease (1,200 ppm), benzene (18,200 ppm), ethyl benzene (6,700 ppm), toluene (28,100 ppm), xylenes (20,900 ppm), naphthalene (3897 ppm), 2-methylnaphthalene (1,544 ppb), fluorene (7 ppb), phenanthrene (15 ppb), and anthracene (8 ppb) were detected in the tank.

Page 3.8-1, Section 3.8.1, paragraph 1.

The EG&G report mislocated some sections of the IWL. Based on field observations (e.g., surface traces of trenches and manholes), utility maps, and the Water Pollution and Verification of Industrial Waste Drain Report, locations of IWL sections have been more accurately located and confirmed through Radian investigations.

Page 3.8-7, Section 3.8.5, paragraph 5.

Soil borings will be sampled around the perimeter of the washrack.

Page 3.8-11, Section 3.8.5, paragraph 1.

Soil gas samples were collected along the perimeter of PRL S-29 as part of investigations for PRL L-5D, PRL L-5C, and PRL S-29. The soil gas probe locations adjacent to PRL S-29 are identified in IC 6, IC 1, and IC 8. A revised approach to locating soil borings in soil gas targets has been adopted; a statistically based approach is used for sampling inside and around the perimeter of soil gas targets. Drains to the IWL exit Building 655 on the east side.

Page 3.9-1, Section 3.9.1, paragraph 1.

The berm (curb) was most likely constructed at the same time Building 781 and the asphalt lot surrounding Building 781 were constructed. The general types of chemicals stored in Building 781 include: acids, bases, fuels and oils, heavy metals, paints, and solvents.

Page 3.9-1, Section 3.9.2.

Volatile organic compounds had been detected in two, MW-3 and MW-116, of the three monitoring wells. Two, MW-3 and MW-48S, have been abandoned, and the third MW-116, is now dry. No other analytes, other than metals less than MCLs, were detected. The soil analyses at Site 23 will include volatile organic compounds.

Page 3.10-1, Section 3.10.1, paragraph 1.

There is one lift station in this section of the IWL located adjacent to MH-58. Building 613, the washrack is shown on the appropriate figures. The washrack at Building 613 was constructed in 1968 and has been used to steam clean communications equipment and automobiles.

Page 3.10-3, Section 3.10.4, paragraph 3.

Additional soil gas sampling is being conducted, while these comment responses are being prepared, along untested portions of the IWL to define soil gas targets. A revised approach to locating soil borings in soil gas targets has been adopted; a statistically based approach is used for sampling inside and around the perimeter of soil gas targets.

Page 3.11-1, Section 3.11.1, paragraph 1.

The investigation of PRL L-5G will extend eastward to the OU B/OU A boundary. This section of the IWL had been designated part of PRL L-3.

Page 3.11-4, Section 3.11.3, paragraph 1.

Surface soil gas sampling is being conducted, while the comment responses are being prepared, along PRL L-5G to help determine appropriate soil boring locations. A revised approach to locating soil borings in soil gas targets has been adopted; a statistically based approach is used for sampling inside and around the perimeter of soil gas targets. Soil sampling depths will be selected below the depth of the potential discharge. Therefore, if the IWL is 5 feet BGS, sampling would begin at 5 feet BGS and continue to a minimum of 20 feet BGS. Soil borings will be drilled to greater depths, if necessary, during Phases 2 and 3 to define the extent of contamination.

Page 3.12-1, Section 3.12.2, paragraph 1.

The PCB spill was confined to the paved area of PRL S-13. See the Preliminary Assessment for PRL S-13 for more information pertaining to the PCB spill and clean-up.

Page 3.12-5, Section 3.12.4, paragraph 1.

The sumps and french drain are approximately four to six feet deep. All proposed soil sampling depths will be at or below the depth of the potential contaminant discharge (i.e., the bottom of the sumps and trench drains).

Page 3.12-9, Section 3.12.4, paragraph 2.

Field screening for PCBs and VOCs will be used to reduce the number of samples sent for off-site analysis.

Page 3.12-9, Section 3.12.4, paragraph 3.

Field screening for PCBs and VOCs will be used to reduce the number of samples sent for off-site analysis. Three soil gas samples were collected near the PCB spill area.

Page 3.13-1, Section 3.13.2, paragraph 1.

Soil borings will be drilled and sampled at the location. In addition, down-hole soil gas samples will be collected and analyzed to determine the extent of soil gas contamination.

Page 3.14-1, Section 3.14.1, paragraph 1.

The following types of chemicals were stored at PRL S-33: acids, bases, fuels and oils, paints, and solvents. A drainage ditch is located approximately 50 feet west of the loading docks.

Page 3.15-1, Section 3.15.1, paragraph 1.

The oil/water separator has not been removed. It is unknown if the inlet and outlet pipes have been plugged. This is not the tank that spilled in 1990, the spill occurred at PRL T-8.

Page 3.16-1, Section 3.16.1, paragraph 1.

There are no storm drains near the location; however, a small ditch runs along the western set of railroad tracks and flows into a storm drain approximately 200 feet north of SA 1.

Page 3.17-1, Section 3.17.1, paragraph 1.

Building 671 is a latrine for personnel working in the storage yard.

Page 3.17-3, Section 3.17.3.

A soil boring will be placed next to the soil gas sampling location (SA4P20) where aromatic VOCs were detected at 1220 ppbv.

Page 3.17-3, Section 3.17.3, paragraph 3.

Three hand auger soil samples will be collected in the interval from 6 inches to 5 feet BGS. The exact sample depth will be chosen in the field using physical evidence (e.g., discoloration, PID readings, lithology).

Page 3.18-1, Section 3.18.1.

Because the tank is small and it is adjacent to Building 663, only soil borings are proposed to determine if contamination is present. All tank testing is preformed under a separate McClellan AFB program monitored by the Regional Water Quality Control Board. Two soil borings will be placed adjacent to the tank (to evaluate potential discharge from the pipelines connecting to Building 663). Soil sampling depths will be selected on the basis of potential discharge depths.

Page 3.22-4, Section 3.22.4.

Phase 1 sampling will be conducted to locate areas of contamination. Phase 2 and 3 sampling will include data collection for a health risk assessment (HRA) and ecological assessment (see Conceptual Model for OU B, Section 7.7).

Page 5-1, Section 5.1.

Soil gas samples will be collected at preselected depths after a soil sample is collected. Therefore, soil gas samples will be collected independently of the soil sample. The soil gas results will be used principally to determine the extent of soil gas contamination.

Page 5-8, Section 5.2.2.

Soil sampling depths will be determined in the field using the following: depth of potential discharge, PID readings, discoloration, odor, lithology, and previous sampling information. The sampling protocol has been revised to indicate that there are no predetermined sampling depths (see Section 5.2.3).

Page 5-8, Section 5.2.2, paragraph 2.

The percentage of recovered core from each split spoon sampler will be recorded on the field drilling log form filled out by the rig geologist.

Page 5-9, Section 5.2.3, paragraph 1.

Additional specifications for borehole decommissioning are given in Section 5.2.4 of the revised SAP.

Page 5-12, Section 5.4, paragraph 1.

The date of the last rainfall event and the amount of rain that fell will also be recorded for each surface water sample. This addition will be made to the McClellan AFB QAPP.

Page 5-12, Section 5.5, paragraph 1.

Monitoring wells are included in Phase 2 of the OU B RI. Analysis of samples will include VOCs (Method 8010 and 8020) and other mobile analytes detected in soils at upgradient locations.

Page 5-12, Section 5.5, paragraph 2.

Holes made by the Hydropunch® will be filled using a bentonite-cement grout.

Page 7-1, Section 7.0, paragraph 1.

The revised Health and Safety plan for the OU B Remedial Investigation has been transmitted for review. Revisions to the plan have been made in response to comments received.

Appendix A.

The Sampling Decision Protocol, redesignated the Remedial Investigation Decision Process, has been revised to reflect discussions that involved DHS, EPA, RWQCB, and McClellan AFB during meetings on 20 June, 24 June, and 11 July.

Appendix B.

Appendix B has been revised to better address Levels of Concern for Health Risk Assessment. The values for RfD and RSD used in the calculations are clarified and referenced.

III. FIGURES - GENERAL COMMENTS

Paragraph 1.

Washracks and lift stations have been added to appropriate figures.

Paragraph 2.

Trench drains and sumps have been added to appropriate figures.

Paragraph 3.

Approximate locations of previous contractor and McClellan AFB EM borings have been added to appropriate figures. Locations are approximate because no survey data were available from the previous borings.

IV. SPECIFIC COMMENTS ON FIGURES

Figure 2-8, 9, and 10.

Figures 2-8, 2-9, and 2-10 have been revised to show more detail within OU B.

Figure 2-12.

Figure 2-12 has been revised to indicate that CW-150 has been properly decommissioned.

Figure 3.1-1.

The sump at Building 655 is north of IC 1 and northeast of IC 6, it is at the northeast corner of Building 655. The sump has been omitted from the Figure 3.8-1; it is coincident with the UVOC target. Figure 3.8-1 (IC 8) will be revised to show the location of the sump. Innermost concentration isopleths will be labeled if space allows. Interior isopleths have 10 times greater concentration than the next closest outer isopleth.

Figure 3.4-1.

Aromatic VOC concentrations are below 500 ppbv for all probe locations at IC 4. Therefore no aromatic VOC isopleths are shown.

Figure 3.4-2.

The borings are within 15 feet of the IWL. Data from these borings have been incorporated into the RI and used to reach conclusions about contamination associated with the IWL, west of Building 628.

Figure 3.6-1.

Boring locations and labels have been revised.

Figure 3.7-2B.

An arrow will be added to show the location of PRL L-5B.

Figure 3.7-3B.

Boring locations on Figures 3.7-1, 3.7-2A, 3.7-2B, 3.7-3A, 3.7-3B, 3.7-4A, and 3.7-4B have been corrected.

Figure 3.10-1.

No lift stations have been identified along the IWL segment in Figure 3.10-1.

V. COMMENTS ON TABLES

Table 3.1-1.

The IWTP No. 4 has been added to the table.

Table 3.1-8.

Boring locations and labels have been revised.

Table 3.2-9.

Soil gas sampling is being conducted, while these comment responses are being prepared, along Sections of the IWL that were not investigated during the OU B Soil Gas Investigation. Additional soil borings will be placed along the IWL after results of the soil gas investigation have been reviewed.

Table 3.4-4.

The location of boring IC04B16 will be moved to 27.5 feet north of MH-12N. This will place the boring at the mid-point between line failures (1.5 feet away from each).

Table 3.6-5.

All sampling matrix tables have been revised.

Table 3.12-8.

Table footnotes have been revised.

Table 3.13-3.

The table has been revised. Soil samples will be collected for field volatile organic compounds (FVOC) and possibly for SW8240 analysis in an off-site laboratory based on an evaluation of FVOC results from the interval between 1 foot and 5 feet BGS. The exact sample depth will be determined using field evidence.

Table 3.16-2.

Soil samples for VOC analysis will be collected from 1 to 5 feet below ground surface.

VI. SECONDARY COMMENTS

Page 2-48, Section 2.6.5.

The text has been revised (see page 2-48, paragraph 1).

Page 3.0-7, Section 3.0, paragraph 3.

The purpose of Phase 2 is explained on page 3.0-17 in the revised SAP.

Page 3.2-6, Section 3.2.2, paragraph 1.

Tank 756A is still in operation.

Page 3.2-7, Section 3.2.2, paragraph 2.

The last line has been revised as follows: "Sampling locations and analytical methods presented here are based on the results of the EG&G investigation."

Page 3.5-9, Section 3.5.4, paragraph 2.

Tables have been revised.

Page 3.1-12, Section 3.1.2, paragraph 1.

Line one is revised as follows: "The section of pipe from Tank 1 to the IWL at Site 48, through which effluent was transported (Figure 3.1-5) and several sections of PRL L-5, reportedly contained cracked joints and areas of breakage."

Page 3.1-14, Section 3.1.5, paragraph 2.

Section 3.1.5 has been deleted and has been replaced by the revised Section 3.13.

Page 3.1-19, Section 3.19.1, paragraph 1.

The location has been paved since the early to mid-1970s.

Page 3.19-1, Section 3.19.2, paragraph 1.

Previous soil sample locations are not documented. All that is known about the sampling locations is that the samples were collected from the soil area east of Building 684. The following compounds were detected in soil samples: trichlorofluoromethane (97 ppb), toluene (10 ppb), and xylenes (1 ppb).

Page 3.21-1, Section 3.21.2, paragraph 1.

No monitoring wells are located within the boundaries of Figure 3.21-1. The nearest monitoring wells are 500 feet to the south, 750 feet to the southwest, and 1,000 feet to the south.

Page 4-1, Section 4.1, paragraph 1.

The reference has been revised as follows: "...(U.S. EPA, 1989b)..."

STATE OF CALIFORNIA PETE WILSON, Governor

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3 April 1991

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OPERABLE UNIT B REMEDIAL INVESTIGATION SAMPLING PLAN, MC CLELLAN AIR FORCE BASE

Thank you for the opportunity to review the subject report. Enclosed is a copy of a memorandum concerning Regional Board staff's review. These comments should be used when developing the final version of the report.

If you have any questions regarding this matter, please call me at (916) 361-5626.

Alexander MacDonald

ALEXANDER MACDONALD
Project Engineer

AMM

cc: Mr. Lewis Mitani, Environmental Protection Agency, San Francisco
Ms. Tracy Billington, Dept. of Health Services, Sacramento

MEMORANDUM

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD - CENTRAL VALLEY REGION

3443 Routier Road, Suite A
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Phone: (916) 361-5600
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TO: McClellan AFB Files

FROM: Alexander MacDonald
Project Engineer

DATE: 3 April 1991

SIGNATURE: Alexander MacDonald

SUBJECT: ***OPERABLE UNIT B REMEDIAL INVESTIGATION SAMPLING ANALYSIS PLAN***

We received the subject report on 5 March 1991. Regional Board staff has reviewed the report and presents the following comments:

1. Page 3.2-6, paragraph 2. It is stated that Tanks 756B and 756C were tested, found to be leaking, and repaired. Were the tanks retested? If so, what were the results?
2. Page 3.3-6, paragraph 3. In this paragraph it is proposed to place borings and collect samples at 50-foot intervals along the untested section of the industrial wastewater line (IWL) at IC3. The remainder of the IWL in IC3 has been tested and has had soil gas samples collected along it at regular intervals. Staff recommends that soil gas samples be placed along the untested section of the IWL to better place soil borings.
3. Page 3.3-10, paragraph 3. Four borings around a sump 6-feet in diameter, with samples collected to 95-feet seems excessive.
4. Page 3.3-17, Table 3.3-10. The borings IC03B30 through IC03B33 are proposed to extend to 95-feet in depth. Why should the samples be collected at such depths when the site at which these borings are located is a surface spill?
5. Page 3.5-5, paragraphs 1-2. The discussion in these paragraphs deals with previous investigations at Site 30 and refers the reader to Figure 3.5-2. This figure should have the borings labeled so that the reader can determine where the samples with contaminants delineated in the discussion are located. This would also help in formaulating a determination of the adequacy of the proposed investigation.
6. Page 3.5-7, paragraph 1. The borings at PRL 29 by previous contractors should be delineated on Figure 3.5-2.
7. Page 3.5-9. This page discusses the sampling rationale for investigation of possible PCB spills at SA 12A. This investigation could require up to 3000 borings on the 365,000 ft^2 site. From a water quality perspective, this amount of sampling just to determine the extent of relatively minor concentrations of PCBs, is not justified. The concentrations found in previous investigations and locations of contaminants plotted on a figurewould be useful.
8. Page 3.6-6, Table 3.6-2. This table lists the analyses to be performed on samples from PRL T-60. Since this is an underground storage tank that contained fuels, staff recommends sampling for benzene, toluene, xylene, and ethyl benzene (SW8020) instead of for semi-volatiles (SW8270).

9. Page 3.7-16, paragraph 2. This paragraph states that borings will be placed at 50-foot intervals along the untested portion of the IWL at PRL L-5B. Soil gas sampling performed along that section of line did not indicate the presence of leakage. The reason for the soil gas investigation was to help delineate potential sites and help better locate additional investigative efforts. Is the proposed sampling necessary?

10. Page 3.7-19, paragraph 1. It is proposed to collect sediment samples along the ditches at PRL P-9 and SA 14 and perform soil borings adjacent to the ditch at the location of the sediment samples. The hand auger borings in the ditch to 5-feet in depth should be sufficient for an initial assessment. In most cases the soil gas sampling performed at these sites did not indicate the presence of volatile contaminants. At soil gas hot spot locations the additional borings should be considered.

11. Page 3.7-27, Table 3.7-11. See comment 8, above.

12. Page 3.10-9, Table 3.10-5. This table lists the analyses to be performed on samples collected from 35-feet in borings PL05FB02-PL05FB13 as SW8270. Staff recommends that the analysis be by SW8240.

13. Page 3.11-2, Figure 3.11-1. This figure delineates proposed soil boring locations at PRL L-5G. It appears that many of the borings labeled PL05GB01-PL05GB11 are very close to each other. Is it possible to combine some of the borings to eliminate potential duplicatio? Also, soil gas sampling along the IWL at this site is advisable prior to placing soil borings.

14. Page 3.14-1. The proposal calls for the placement of ten borings along the perimeter of Building 786A. The soil gas survey performed along the perimeter did not indicate contamination by volatile organics, the main potential contaminant of concern at PRL S-33. What is the justification for the additional borings?

15. Page 3.17-6, Table 3.17-3. The analyses listed for samples from borings SA04B01-02 show SW6010, SW8080, SW8140, SW8150, SW8240, SW8270, and HML 338. Table 3-17.1, listing data quality objectives for the same borings shows only SW8240 analysis to be performed. Which is correct?

16. Page 3.18-4, Table 3.18-1. Staff recommends analysis by SW8020 for BTXE constituents since this site is an underground storage tank containing fuel.

17. Page 3-19.3. Sampling outside of soil gas target does not appear to be justified. Why are metals and semi-volatiles being analyzed for in addition to volatile organics?

18. Page 4-4, Levels of Concern. The Level of Concern is defined as the concentration above which some action may be needed. For surface water and ground water, federal and/or California Maximum Contaminant Levels have been specified as levels of concern. Levels of concern for soil presented in the text have been derived based on a Health Risk Assessment. Surface waters need to take aquatic species protection into the equation. Protection of surface waters for aquatic habitat may be more stringent for some parameters than drinking water standards. Ground water concentrations should initially be compared to background to determine if action may be warranted. The non-degradation of ground waters should be a primary

focus of the clean-up action. Levels of concern for soils should also take into account protection of ground and surface waters and not just health risk calculations.

19. Pages 4-5,6,7, Table 4-3. This table lists the levels of concern of soils and solid waste. These values have been developed based on a health risk assessment and not on protection of ground water. Many of the concentrations presented in the table do not appear to be protective of ground or surface waters. Some levels of concern appear to be too conservative (i.e. for lead).

20. Pages 4-8,9,10, Table 4-4. Levels of concern for water are listed in this table. The concentrations are reported to be in units of mg/l. Staff believes the units should be listed as µg/l. If not, the values are unrealistically high. If the values have actually been expressed in µg/l, there are several values which are not acceptable. Some of the listed values that exceed Primary Drinking Water Standards or MCLs are for arsenic, selenium, mercury, cadmium, benzene, 1,1-DCE, 1,1-DCA, PCE, TCE, xylenes, and T1,2-DCE. Many of the semi-volatile contaminants easily exceed established criteria and MCLs.

Quite a few of the practical quantitation limits presented in the table also need to be reevaluated. The levels of concern also do not take into account the possibility of a combination of contaminants that would pose a greater threat than when analyzed individually.

21. Page 5-8, paragraph 3. It is stated that split spoon samples will be collected at 5-foot intervals and that samples will be collected at all depths at which a lithologic change is evident. How will that be possible given the great number of lithologic changes over short distances that can be found at McClellan AFB? In addition, it will not be known that a lithologic change has occurred at other than the standard sampling depths until the drill bit is past the depth at which the lithologic change occurred. Also, staff recommends continuous sampling in the upper 15- feet at known source areas.

22. Page 5-12, paragraph 4. It is stated that the Hydropunch sampler will be used to determine if soil contamination beneath identified sites is impacting ground water. Soil borings will be deepened to the water table where soil contamination to 95-feet is identified. At what concentrations at 95-feet warrant additional investigation and using the hydropunch? What rationale will be used in locating additional borings at which the Hydropunch sampler will be used?

23. Page A3-4, paragraph 2. How many samples will be analyzed for from each of the background borings? What is the rationale for selection of samples for analysis?

24. Page A4-12, paragraph 2. Here it is stated the lateral spacing criteria for sampling of ditches, creeks, and intermittent streams. Surface water runoff is proposed to be collected from flowing water within one week of a rain event. It will likely not be possible to collect surface water samples from normally dry drainage courses one week after a rainfall event. In most cases, given the limited watershed and high runoff coefficient of most areas at the Base, runoff in drainage ditches will cease soon after rainfall ceases. To gather samples that have some relevancy, the samples should be collected during the storm event, and preferably within the first several hours of the commencement of runoff.

Staff cannot find a location in the report where specific surface water sample collection is proposed. Are surface water samples to be collected during the next phase of the investigation?

25. Page A4-13, paragraph 1. The Magpie Creek Drainage is slated for sediment sampling. The City and/or County of Sacramento collected sediment samples downstream of McClellan for an EIR regarding flood control along Magpie Creek. The results of this sampling should be incorporated into the RI if feasible.

26. Page A5-2, Bullet 6. Lateral spacing criteria for surface water samples are proposed, but no specific surface water sampling has been specified in the text. An appropriate sampling procedure may be to sample each drainage course outfall to surface waters during a significant storm water runoff period.

27. Page A5-3, Bullet 1. It is stated that if analyses of Phase 2 stepout samples indicate presence of contaminants exceeding background or PQL values, subsequent sampling would be repeated until the contaminants are below background or PQL values in samples or specified distance limits are reached. Is it necessary to define the contamination until background or PQL values are reached? If the concentrations of contaminants fall below levels of concern or levels requiring remediation, then staff believes additional sampling is not warranted.

28. Page A5-4, Bullet 1. The vertical spacing criteria presented for non-soil gas targets does not address the possibility of Phase 1/2 investigation results having found contaminants deeper than 15-feet. If contaminants were detected below 15-feet, subsequent sampling should also look at soils below 15-feet for sample collection and analysis.

29. Page A5-4, Bullet 2. The vertical spacing criteria presented for surface water targets calls for sampling to 95-feet at areas where the greatest concentrations of contaminants were found in the samples to 3-feet. It seems somewhat excessive to sample to 95-feet in all cases at the highest concentrations of contaminants. What if the concentrations are below levels of concern? What if the contaminants are relatively immobile contaminants? More flexibility needs to be built into the criteria.

30. Page A5-5, Bullet 1. Soil gas sampling at each sampling point prescribed by the Phase 2 Vertical Spacing Criteria, at any site where VOCs were detected is too restrictive. Sampling should also be related to concentrations detected in soils in the initial phase(s) of the investigation.

31. Page A5-11, Surface Water/Stream Sediment Criteria. It is proposed to identify any surface water stream sediment samples in which contaminant concentrations exceed Federal or California Maximum Contaminant Levels for drinking water. First, sediment samples will be analyzed for contaminants and concentrations will be reported in mg/kg. Drinking water standards are in mg/l. Comparison between drinking water standards and sediment concentrations is not valid. Second, in addition to the concern for drinking water, the effect of contaminants on aquatic life is also a major concern and may drive some portions of the cleanup.

    The second bullet in this section has three sub-items. These three sub-items provide criteria as to when further investigation is warranted when contaminants are detected in surface water samples or stream sediment samples. Criteria for remediation is based on drinking water standards and proposed health risk-based concentrations in sediments. These criteria do not take into account aquatic habitat effects and should do so.

32. Pages B4-3 through B4-6. The required detection limits for water listed in Table B-1 are not acceptable. Several of the detection limits are above established water quality criteria for drinking water and/or protection of aquatic life. This table should be revised. See comments 20-23, above.

AMM

RESPONSES TO RWQCB COMMENTS
OU B RI SAP

Comment 1, page 3.2-6, paragraph 2.

It is standard procedure at McClellan AFB to retest USTs after they have been repaired; however, there is no available documentation indicating re-test results for these tanks.

Comment 2, page 3.3-6, paragraph 3.

Additional soil gas sampling is planned along the untested portion of the IWL to help locate soil gas targets and soil boring locations (see page 3.3-8, paragraph 4).

Comment 3, page 3.3-10, paragraph 3.

Boring locations and the depth of borings have been revised in the SAP. More emphasis will be placed on sampling in the upper 20 feet of soil. Phase 2 and 3 borings will be used to determine the vertical and horizontal extent of contamination (see pages 3.3-8, paragraph 5, and page 3.3-11).

Comment 4, page 3.3-17, Table 3.3-10.

Boring locations and the depth of borings have been revised in the SAP. More emphasis will be placed on sampling in the upper 20 feet of soil. Deep borings (95 feet) are proposed to confirm the presence of contamination and to characterize subsurface lithologic conditions that would affect contaminant migration. Phase 2 and 3 borings will be used to determine the vertical and horizontal extent of contamination (see pages 3.3-8, paragraph 2, 3.3-12, paragraph 3, and page 3.3-22).

Comment 5, page 3.5-5, paragraph 1-2.

Figure 3.5-2 has been revised to show boring designations.

Comment 6, page 3.5-7, paragraph 1.

Figure 3.5-2 has been revised to show approximate boring locations of previous contractors (see page 3.5-6).

Comment 7, page 3.5-9.

The number of borings placed in SA 12A was determined by the need to identify relatively small PCB discharges to surface soil with a probability of 90% or more (a risk of missing a discharge of 10% or less). The potential impact on groundwater is considered minimal; however, the potential health risks of PCBs in surface soils are much greater. The exact locations of all previous soil samples are not clearly identified. Approximate sampling locations are plotted on Figure 3.5-2 (see page 3.5-6).

Comment 8, page 3.6-6, Table 3.6-2.

Benzene, toluene, xylenes, and ethyl benzene would be detected by Modified method SW8015/5030 analysis.

Comment 9, page 3.7-16, paragraph 2.

The section of the IWL east of MH-12F and south of MH-12E was not investigated during the OU B soil gas investigation. Therefore, soil borings will be drilled and sampled along that section. A revised approach to locating soil borings in soil gas targets has been adopted; a statistically based approach is used for sampling inside and around soil gas targets (see page 3.7-18).

Comment 10, page 3.7-19, paragraph 1.

Sediment samples will be collected in the ditch to a depth of 4 to 6 feet. Reconnaissance soil borings will be drilled to a depth of 20 feet below the bottom of the ditch if contaminants are detected in the samples from 4 to 6 feet. The data collected from the sediment samples will be used to evaluate the surface water pathway and the data collected from the soil boring samples will be used to evaluate the potential for contaminant migration to groundwater. The location of reconnaissance borings has been revised to evaluate locations where VOCs were detected in soil gas or sediments (see page 3.7-22).

Comment 11, page 3.7-27, Table 3.7-11.

Benzene, toluene, xylenes, and ethyl benzene would be detected by a Modified method SW8015/5030 analysis.

Comment 12, page 3.10-9, Table 3.10-5.

Table 3.10-6 has been revised using the recommended analyses (see page 3.10-11).

Comment 13, page 3.11-2, Figure 3.11-1.

No soil borings will be drilled along PRL L-5G until a soil gas investigation has been conducted. Soil gas samples will be collected along PRL L-5G to help determine appropriate soil boring locations. A revised approach to locating soil borings in soil gas targets has been adopted; a statistically based approach is used for sampling inside and around soil gas targets (see page 3.11-4, paragraph 3).

Comment 14, page 3.14-1.

Hand auger borings have been placed around the perimeter of Building 786A and in a drainage ditch to the west of Building 786A in addition to soil gas samples for two reasons: 1) not all contaminants of concern are VOCs, and 2) to confirm soil gas results (see page 3.14-3).

Comment 15, page 3.17-6, Table 3.17-3.

Tables 3.17-1 and 3.17-2 have been revised and made consistent (see pages 3.17-4 through 3.17-6).

Comment 16, page 3.18-4, Table 3.18-1.

Benzene, toluene, xylenes, and ethyl benzene would be detected by a Modified method SW8015/5030 analysis.

Comment 17, page 3.19-3.

Soil samples collected at SA 9 indicate that low levels of contamination are present outside of the soil gas target area. Therefore, to characterize the location, hand auger borings have been placed throughout the exposed soil area (where contamination was previously detected). Samples will be analyzed for metals and semivolatile organic compounds because all of the potential contaminants have not been determined (see page 3.19-3).

Comment 18, page 4-4.

The discussion of Levels of Concern has been revised in the SAP taking into account the protection of aquatic species for stream sediment and surface waters. Background concentrations for metals in water have not been determined.

Comment 19, page 4-5,6,7, Table 4-3.

The discussion of Levels of Concern for soil and solid waste has been revised in the SAP.

Comment 20, page 4-8,9,10, Table 4-4.

The discussion of Levels of Concern and practical quantitation limits for water have been revised in the SAP. The concentrations are now correctly reported in μg/L.

Comment 21, page 5-8, paragraph 3.

Continuous core samples will be collected from all borings. Soil sampling locations will be determined using field evidence (e.g., PID readings, discoloration, odor, and lithology) and previous data collected from nearby borings (see pages 5-8 through 5-12).

Comment 22, page 5-12, paragraph 4.

Previous soil or groundwater analytical data from borings within the area of interest will be used to determine where Hydropunch® samples will be collected. PID concentrations of 50 ppmv or greater total VOCs in soil gas or visual contamination at 95 feet are also criteria for collecting groundwater samples (see page 5-24).

Comment 23, page A3-4, paragraph 2.

Approximately 10 samples will be analyzed for SW 6010, SW7471, and SW3005/SW7421 in each of the 10 background borings. Approximately 7 samples will be analyzed for SW7740 in each of the 10 background borings. Approximately 6 samples will be analyzed for SW9310, SW7060, and E901.1 in each of the 10 background borings. Additional QA/QC samples will be collected. Samples will not be analyzed for pH. Soil samples will be chosen from different horizons to characterize lithologic units in the vadose zone for inorganics and radionuclides. A detailed description of the sampling strategy has been included in the draft final SAP (see pages 3.24-1 through 3.24-4).

Comment 24, page A4-12, paragraph 2.

Surface water samples will be collected as soon as feasible after a rainfall event. Surface water samples will be collected during the latter part of Phase 1 or during the beginning of Phase 2 of the investigation.

Comment 25, page A4-13, paragraph 1.

Data from the City and/or County investigations for an EIR regarding flood control along Magpie Creek will be incorporated into the remedial investigation.

Comment 26, page A5-2, bullet 6.

Surface water samples will be collected in the drainage ditches in 500-foot intervals. The exact sampling locations will be placed near storm sewer discharge points and in surface water collection areas (low spots) within the ditches.

Comment 27, page A5-3, bullet 1.

In 1990, EPA and DHS representatives requested that the extent of organic compound contamination be defined to the level of detection by standard methods. Inorganic compound contamination must be defined to "background" concentrations.

Determining the extent of contamination to levels of concern or levels requiring remediation would be more cost effective.

Comment 28, page A5-4, bullet 1.8

If contamination is detected at or below 20 feet BGS during Phase 1, subsequent sampling during phase 2 will be performed at depths equal to and greater than the depth at which contamination was detected to determine the vertical extent of contamination.

Comment 29, page A5-4, bullet 2.

A maximum of three locations per drainage ditch will have additional borings drilled to a minimum depth of 20 feet BGS. The maximum depth of the boring will be determined by the contaminants potential for vertical migration. Mobile contaminants such as VOCs will require deeper sampling (see page A4-4, bullet 2).

Comment 30, page A5-5, bullet 1.

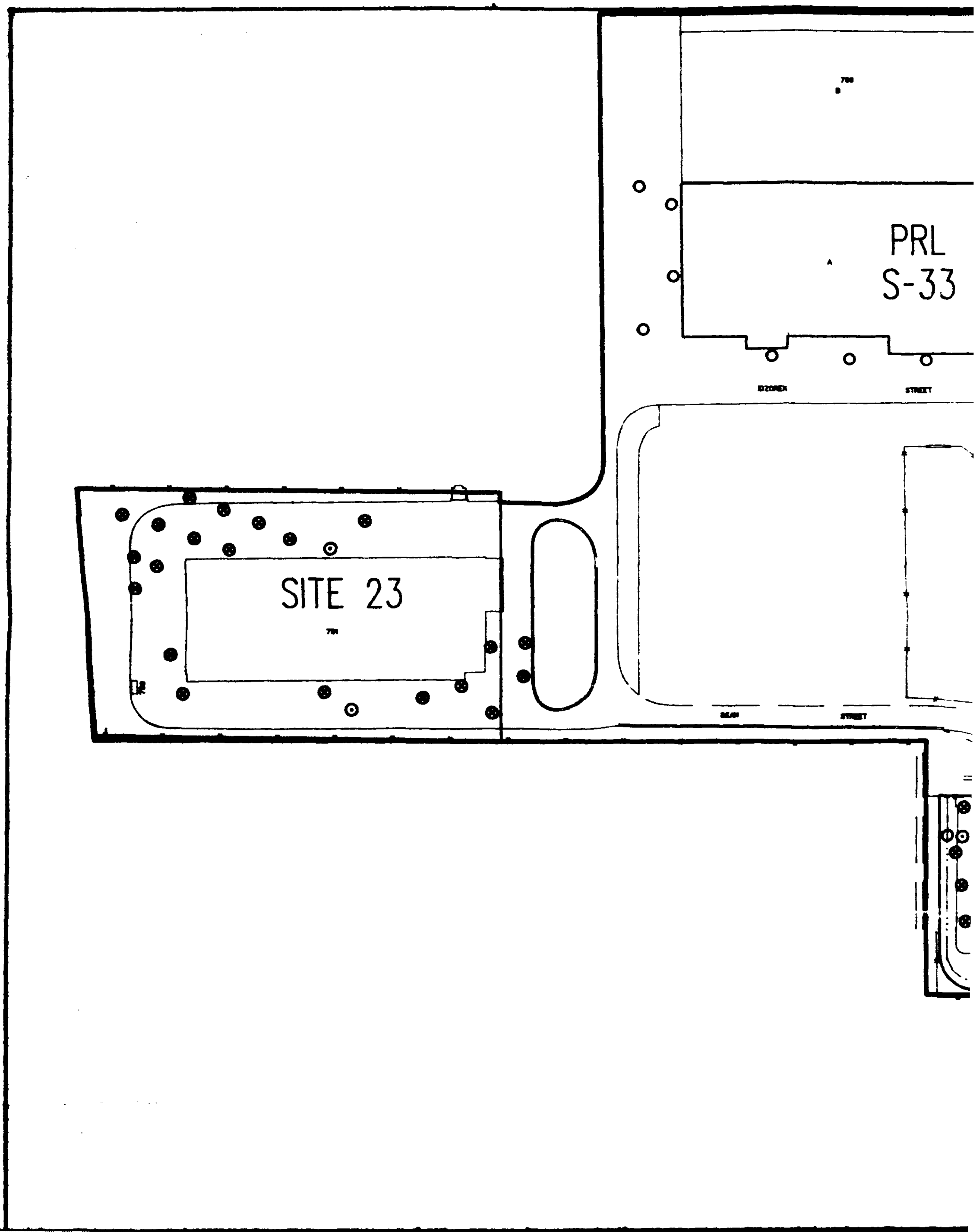
Text has been revised to indicate Phase 2 soil gas sampling points will be based on the detection of VOCs in soil gas during Phase 1 and on physical evidence.

Comment 31, page A5-11, Surface Water/Stream Sediment Criteria.

The Surface Water/Stream Sediment Criteria has been revised to accommodate the protection of aquatic life as a major concern and resolve the comparability problem between data collected from sediment samples and drinking standards.

Comment 32, page B4-3 through B4-6.

Table B-1 has been revised taking into account established water quality criteria for drinking water and/or protection of aquatic life in the SAP.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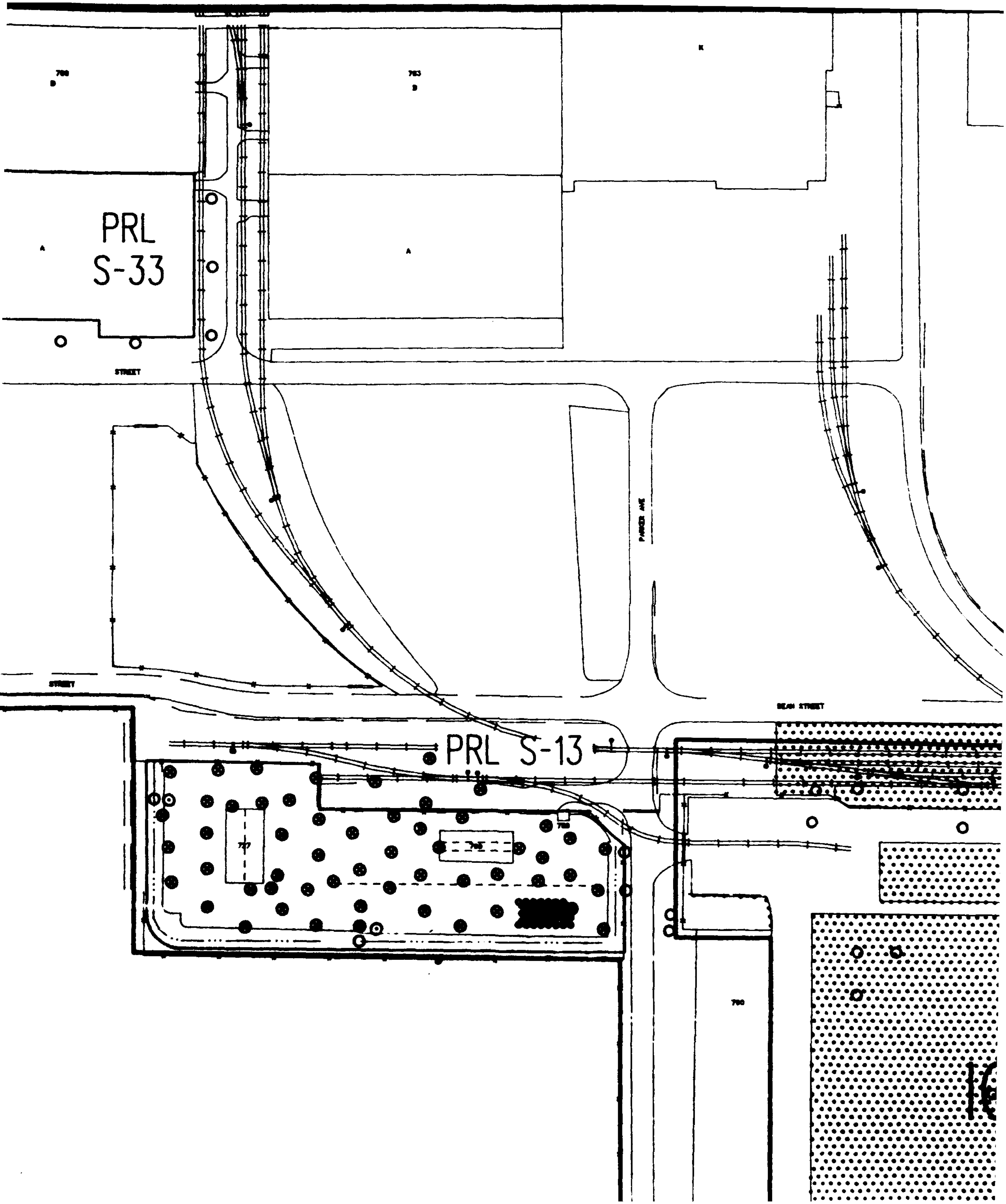
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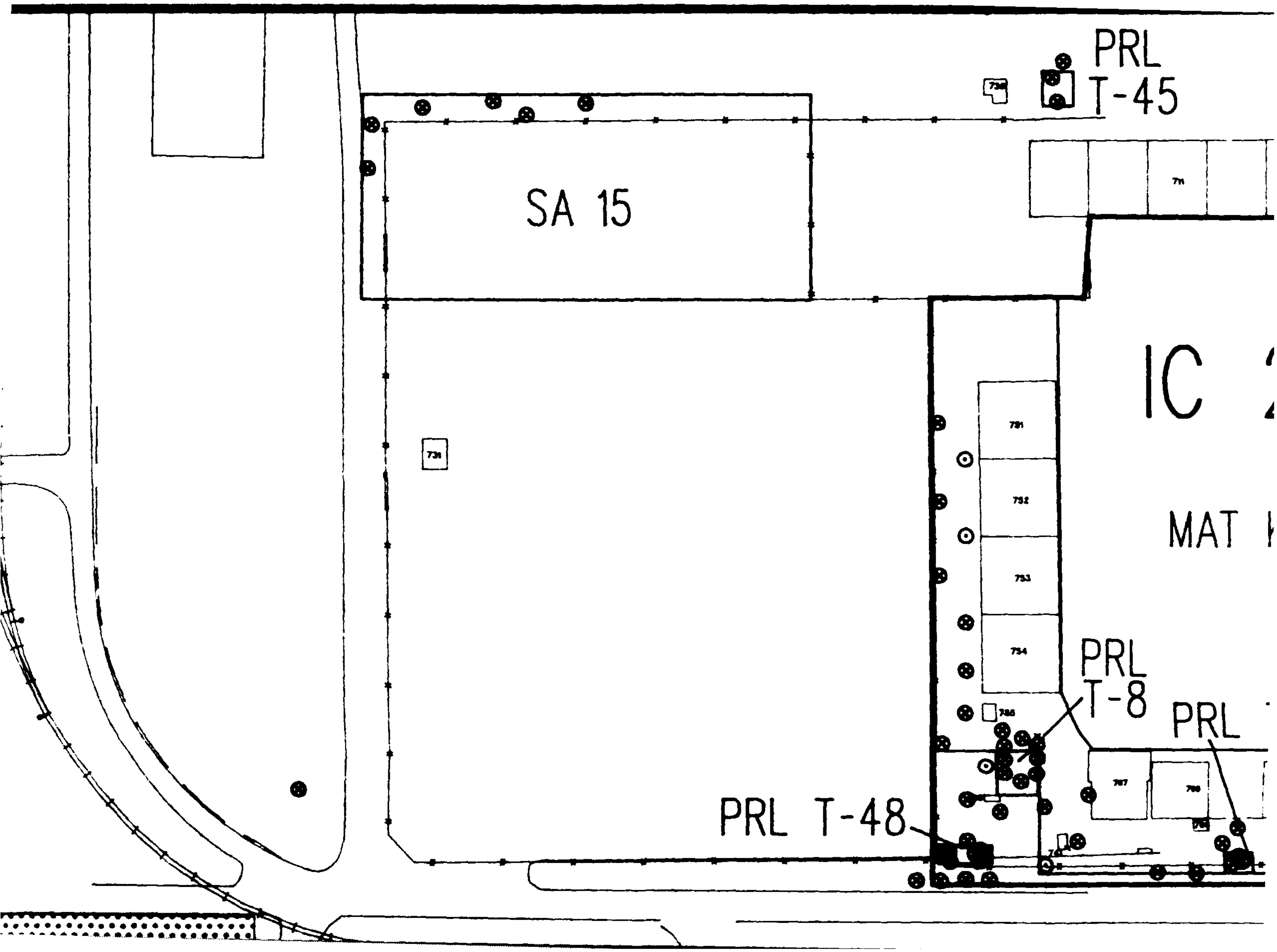
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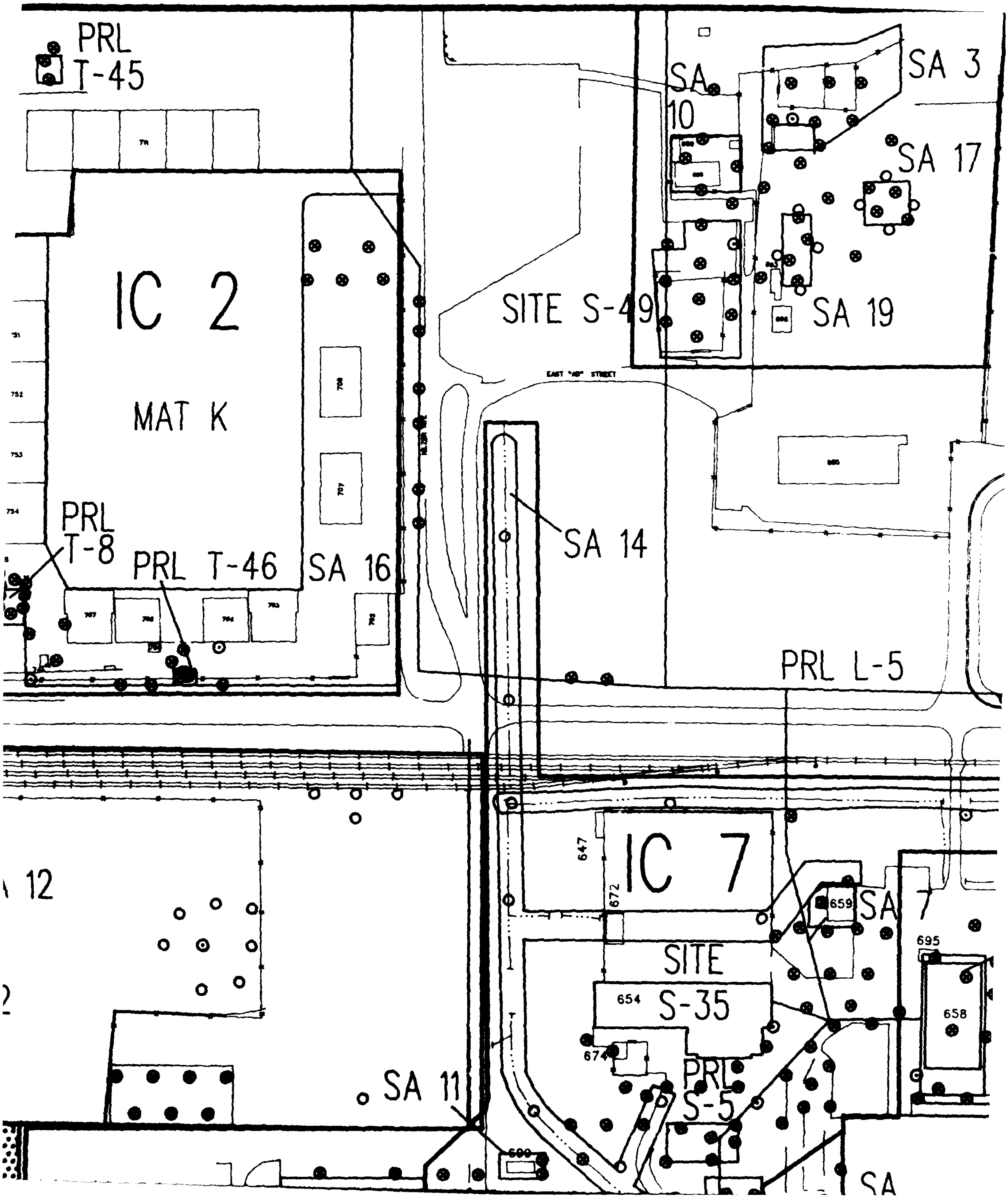
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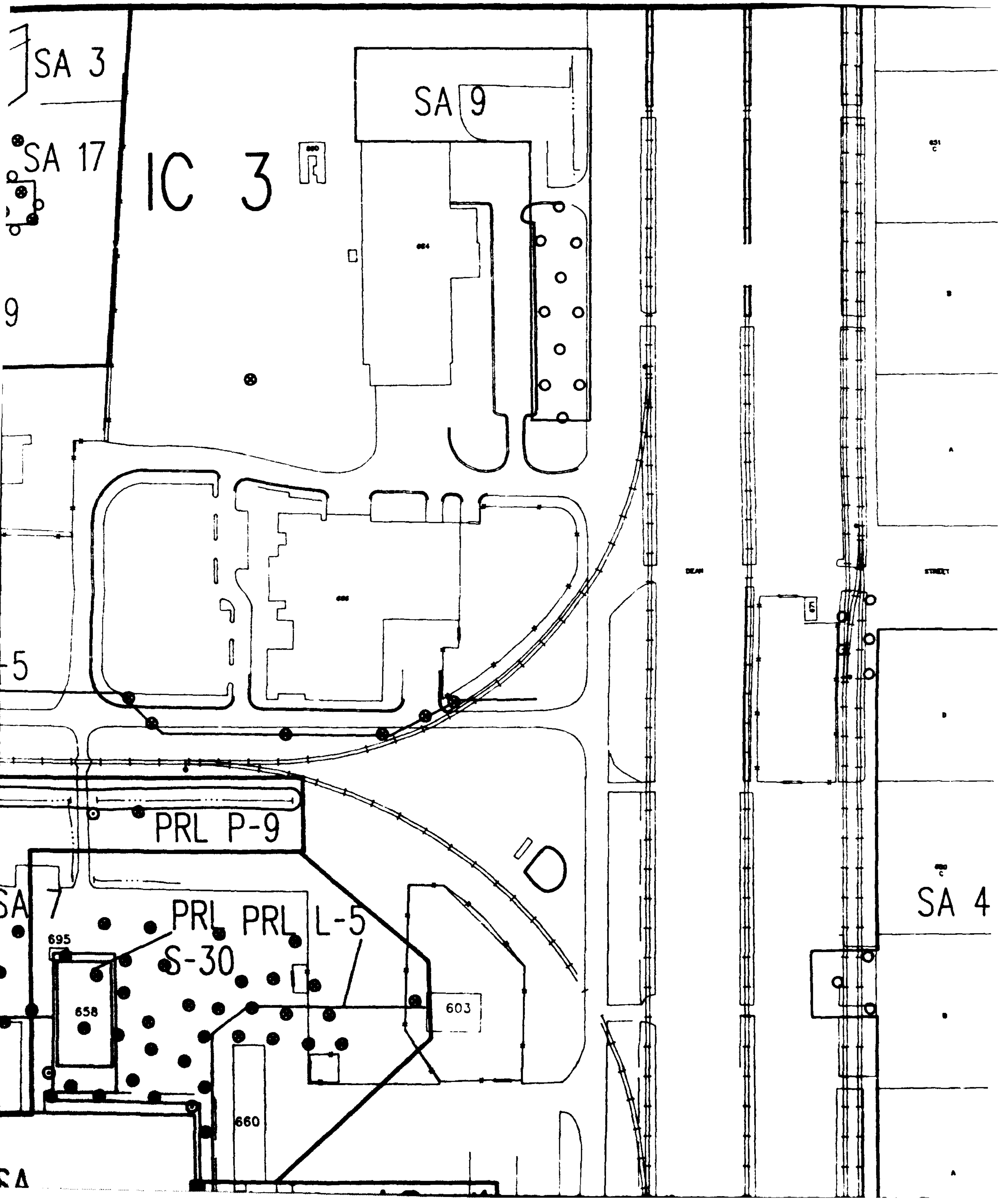
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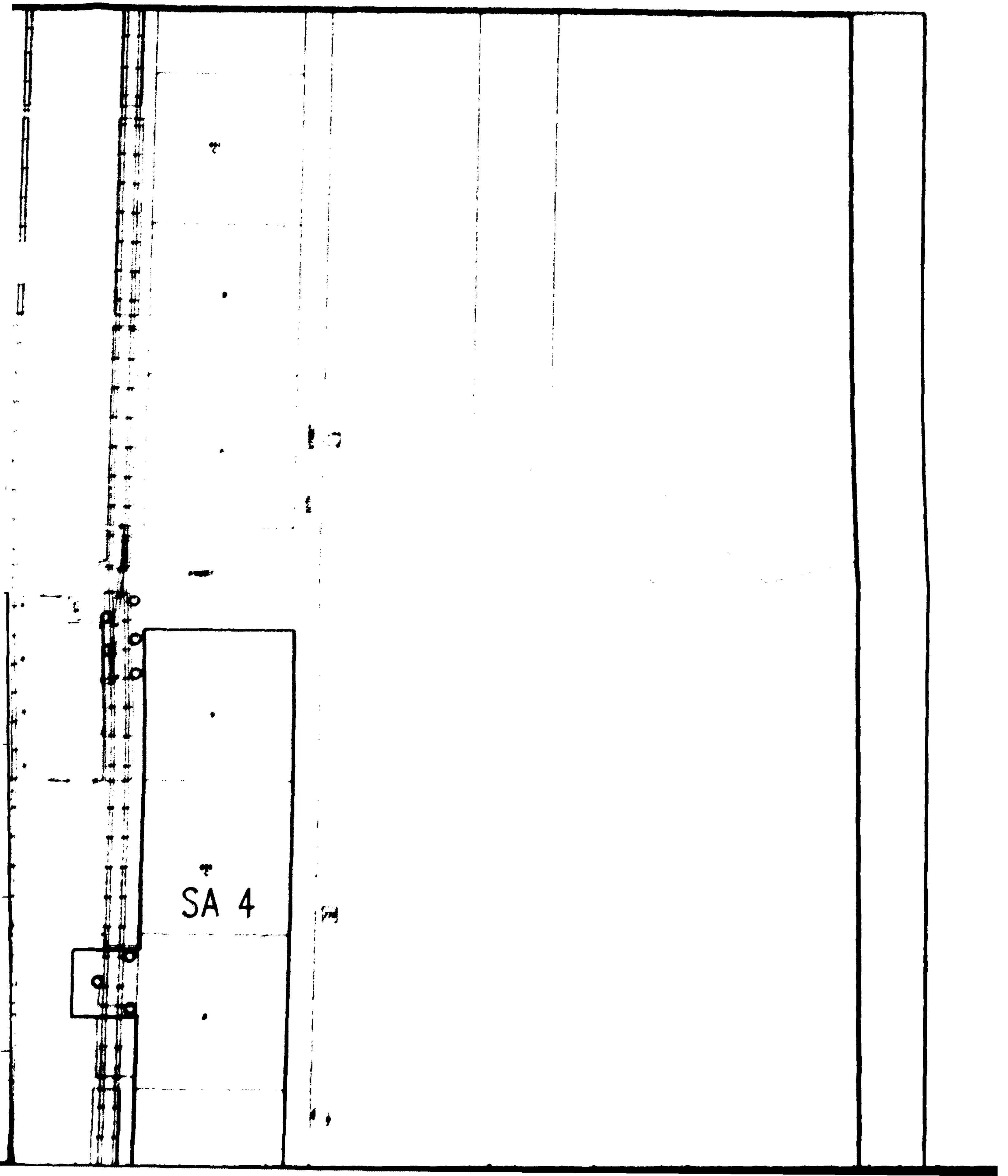
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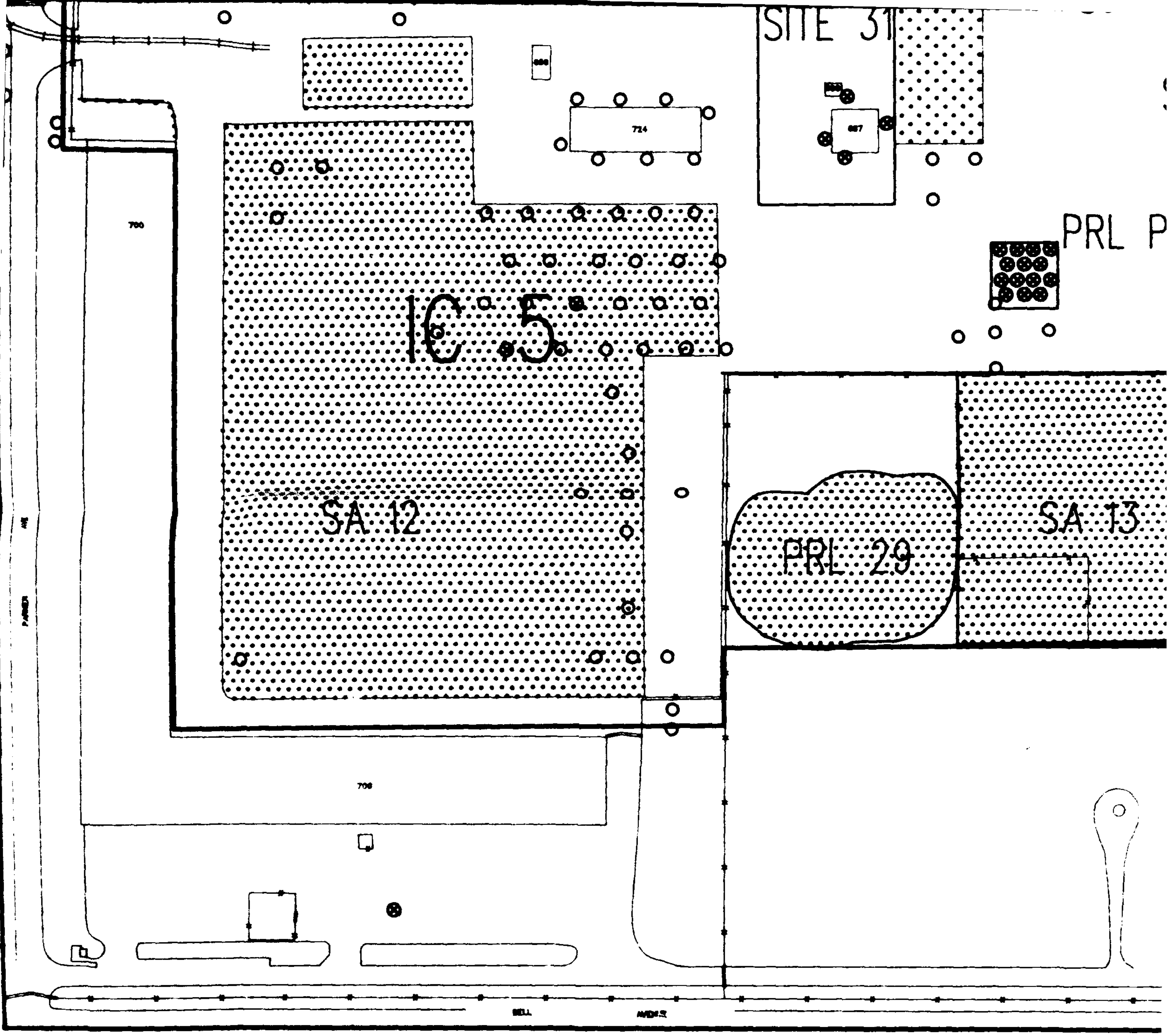
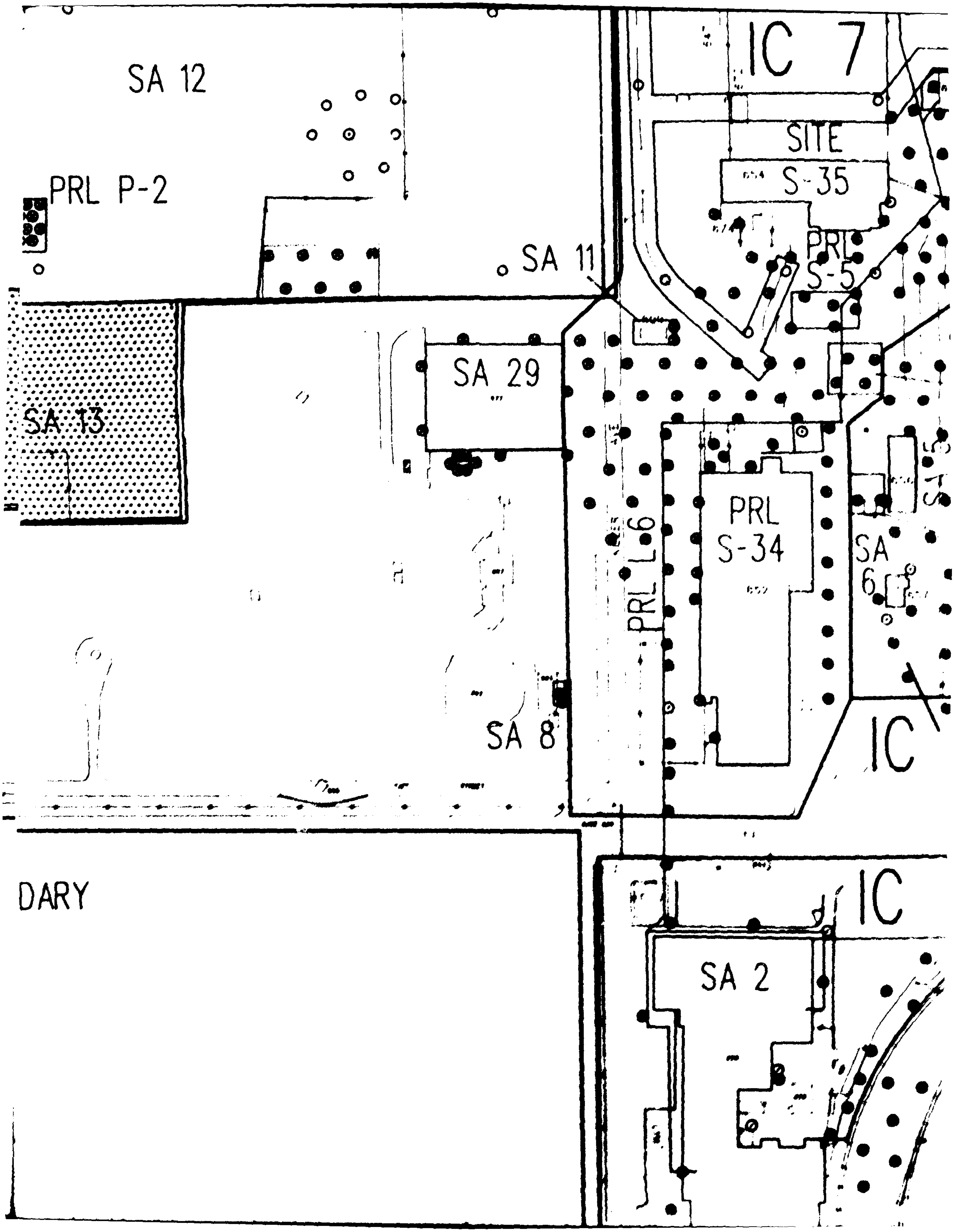


OPERABLE UNIT B BOUNDARY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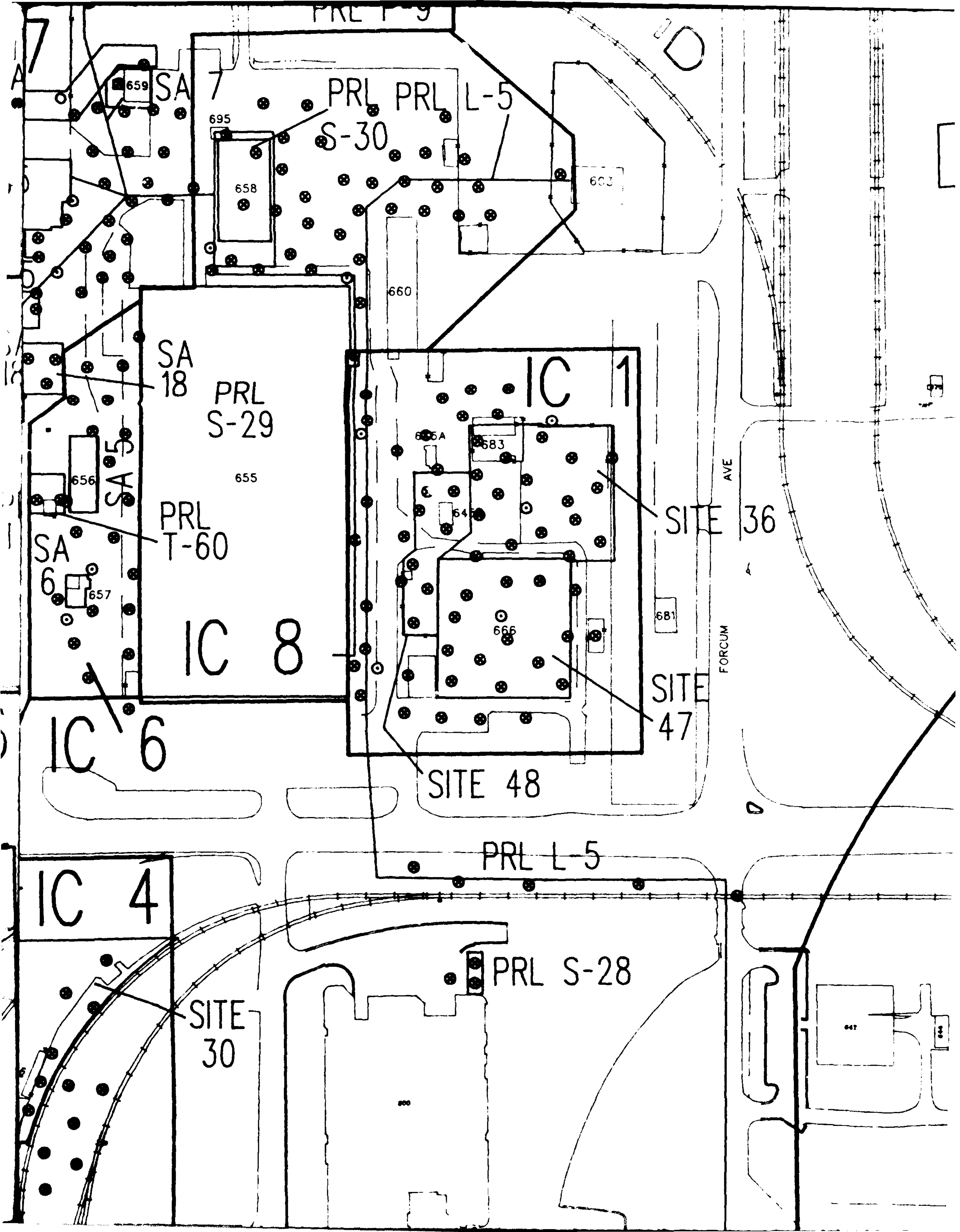
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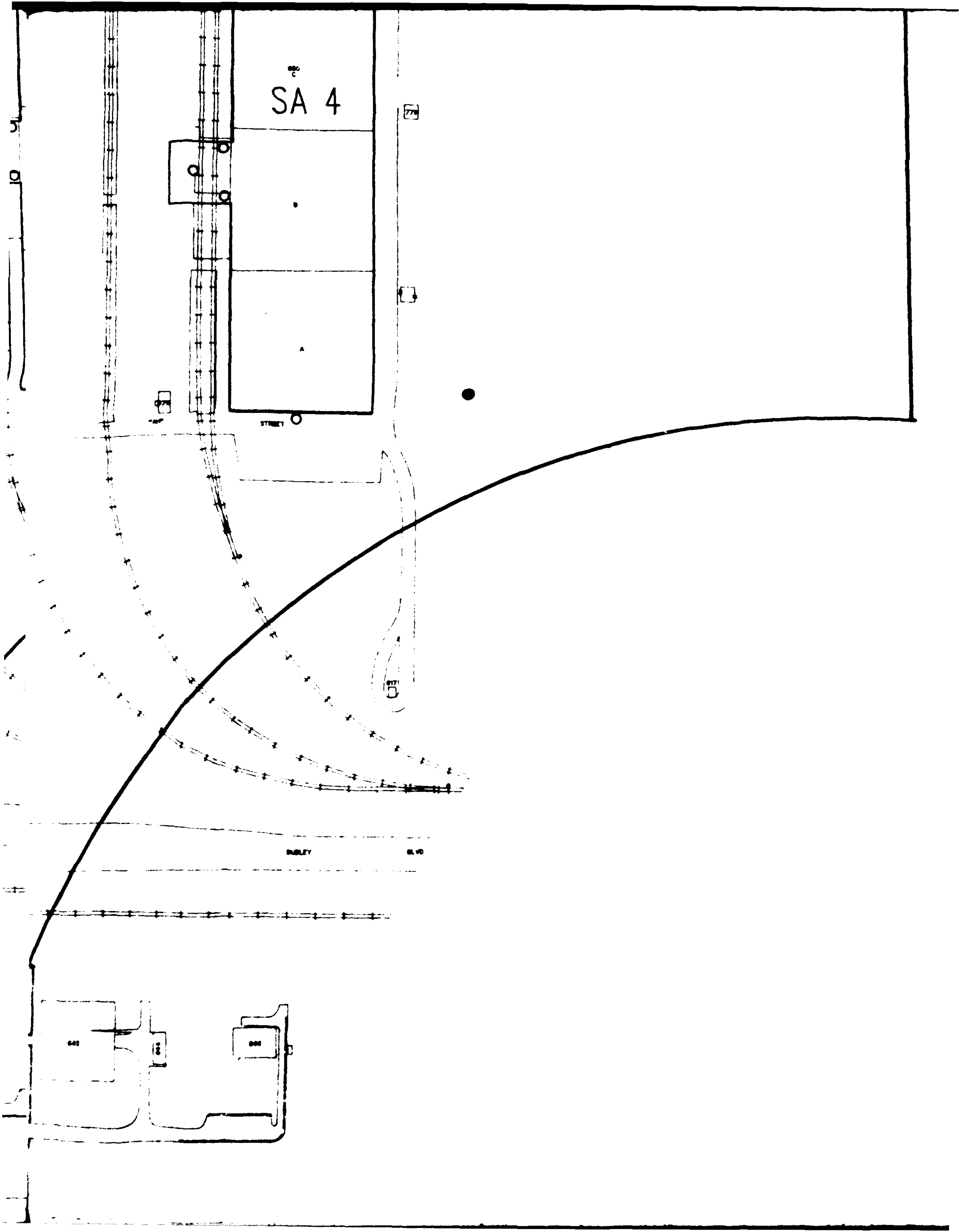
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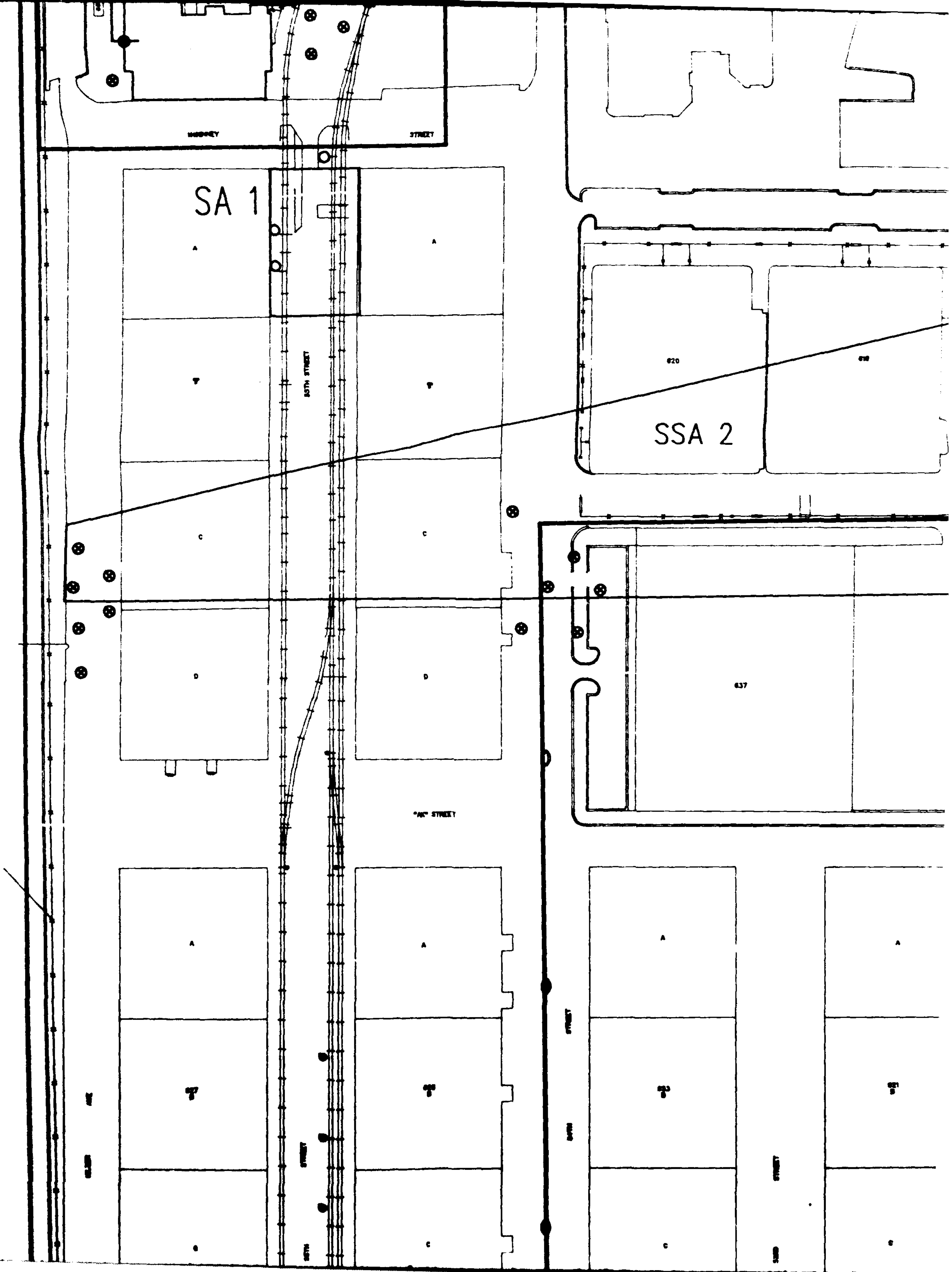
NOTES:

1. BORING LOCATIONS ARE SHOWN ONLY FOR OU B PHASE I, INSIDE OU B BOUNDARIES. SAMPLING POINTS OUTSIDE OU B BOUNDARIES ARE SHOWN ON INDIVIDUAL SITE FIGURES.
2. BORING LOCATIONS SHOWN ARE APPROXIMATE AND MAY BE MODIFIED IN THE FIELD TO ACCOMMODATE LOGISTICAL FACTORS IN THE FIELD SUCH AS ACCESS AND/OR UTILITIES.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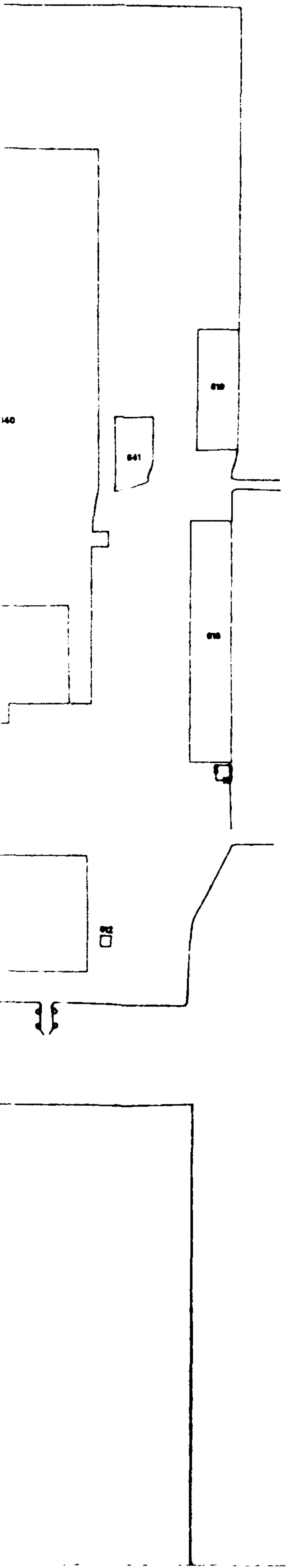


LEGEND:

- ▬ OPERABLE UNIT B BOUNDARY
- ▬ IC BOUNDARY
- — SITE BOUNDARY
- —· · ·— STREAMS/DRAINAGE (DOTTED WHERE COVERED)
- ⊗ PROPOSED RECONNAISSANCE BORING
- ⊙ PROPOSED DEEP BORING
- ○ PROPOSED HAND AUGER BORING
- • SURFACE SCRAPE

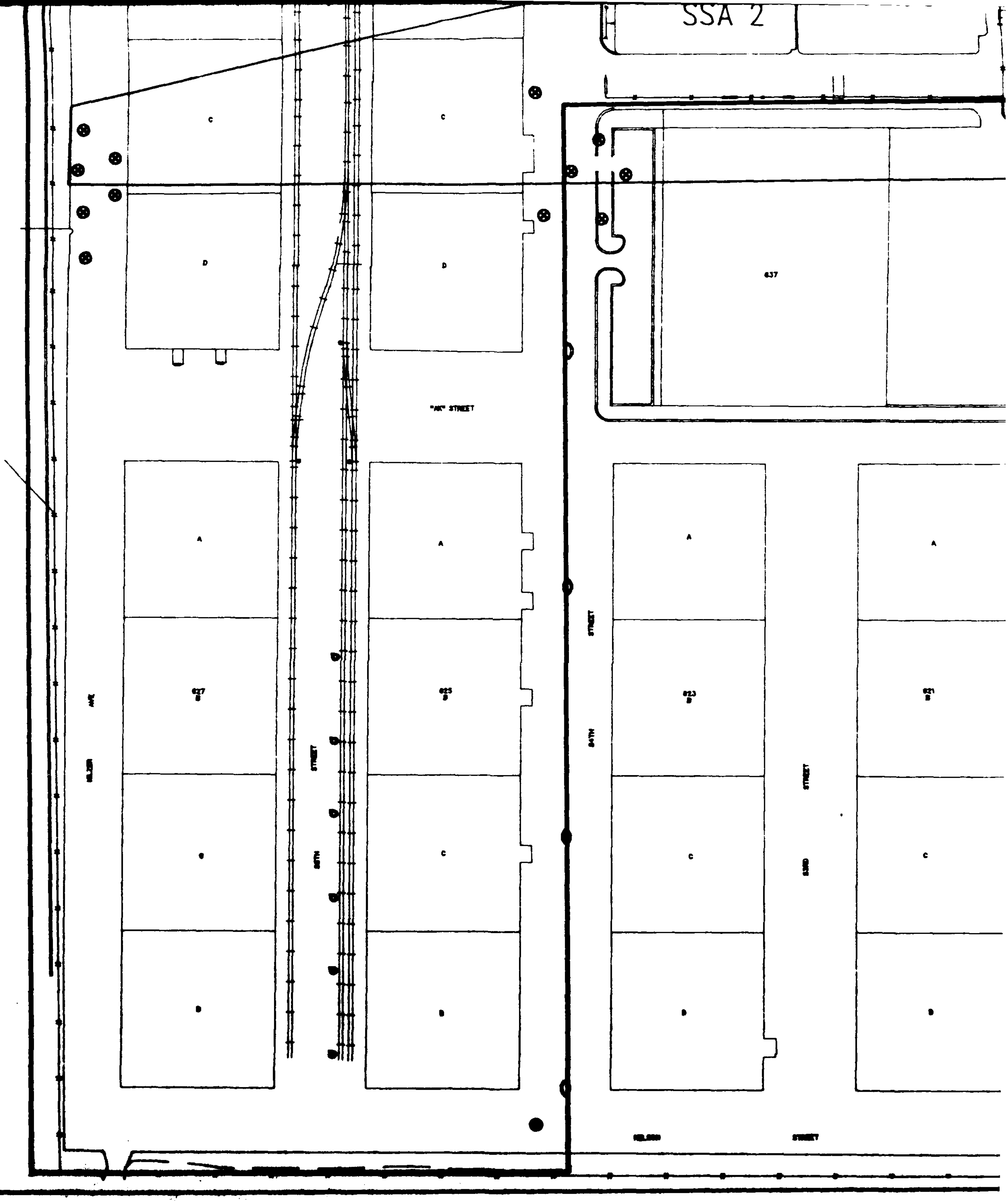
N

0 150
SCALE IN FEET

PLATE 1.

SOIL BORING LOCATIONS PROPOSED FOR PHASE I OF OU B RI

McCLELLAN AFB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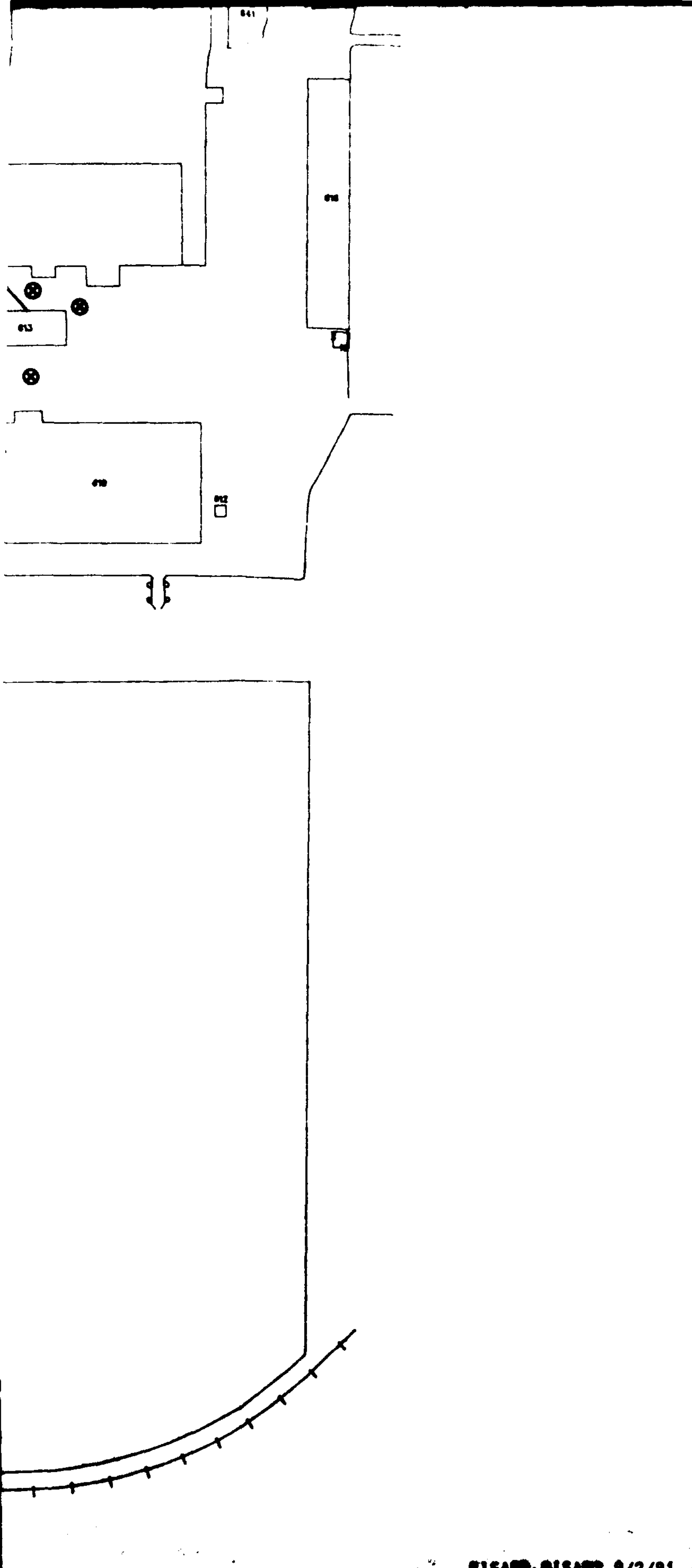

RISAPB-RISAPB 9/2/91

LEGEND:

━━	OPERABLE UNIT B BOUNDARY
━━	IC BOUNDARY
──	SITE BOUNDARY
—·-·—	STREAMS/DRAINAGE (DOTTED WHERE COVERED)
⊗	PROPOSED RECONNAISSANCE BORING
⊙	PROPOSED DEEP BORING
○	PROPOSED HAND AUGER BORING
•	SURFACE SCRAPE

N

0 150
SCALE IN FEET

PLATE 1.

SOIL BORING LOCATIONS PROPOSED FOR PHASE I OF OU B RI

McCLELLAN AFB

SEPTEMBER 2, 1991

GENERATED BY: DATE: 9-3/91
PEER REVIEW: Thomas F. Cudzilo DATE: 9/3/91
PROJECT REVIEW: DATE: 9/3/91

RADIAN CORPORATION