Environmental Restoration Program

EG&G MOUND-25-02 -01 -04 - -9503130001

SOUTH PROPERTY
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
OPERABLE UNIT 5
SAMPLING AND ANALYSIS PLAN

- Quality Assurance Project Plan
- Field Sampling Plan

Mound Plant
Miamisburg, Ohio

FINAL
(Revision 0)

PREPARED FOR:
EG&G MOUND APPLIED TECHNOLOGIES
AND
THE U.S. DEPARTMENT OF ENERGY

PREPARED BY:
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
4031 COLONEL GLENN HIGHWAY, SUITE 300
BEAVERCREEK, OHIO 45431-1600

December 1993

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OPERABLE UNIT 5

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QUALITY ASSURANCE PROJECT PLAN

DEPARTMENT OF ENERGY, MOUND PLANT

MIAMISBURG, OHIO

Approved by _____ Date
U.S. EPA Region V Remedial Project Manager

Approved by _____ Date
DOE Dayton Area Office Remedial Project Manager

Approved by _____ Date
DOE AL Installation Coordinator

Approved by _____ Date
ER Program Manager, Mound Plant

Approved by _____ Date
ER Program Quality Assurance Officer, Mound Plant

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ACKNOWLEDGEMENTS

This OU5 Quality Assurance Project Plan (QAPjP) was prepared by Science Applications International Corporation in Dayton, Ohio under prime contract DE-AC04-88DP4395, issued to EG&G Mound Applied Technologies, Inc. by the Department of Energy, and pursuant to Basic Ordering Agreement (BOA) No.52264. The contributors to this document include N. Luedtke, D. Reed, A. Meyer and K. Davidson.

ACRONYMS

AA	Atomic absorption
AL	Albuquerque Operations Office
AOC	Areas of concern
ASTM	American Society for Testing and Materials
CA	Corrective action
CCC	Calibration check compound
CDRL	Contract-required detection limit
CEC	Cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CGI	Combustible gas indicator
CLP	Contract Laboratory Program
CRF	Contractor central records facility
DAO	Dayton Area Office
DOE	U.S. Department of Energy
DQO	Data quality objective
EG&G	EG&G Mound Applied Technology
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FFA	Federal Facilities Agreement
FID	Flame Ionization Detector
FIDLER	Field instrument for the detection of low-energy radiation
FS	Feasibility study
FSP	Field sampling plan
GC	Gas chromatography
HPLC	High-performance liquid chromatography
HSP	Health and Safety Plan
ICP	Inductively coupled plasma
IDL	Instrument detection limit
MS	Mass spectrometry
MSA	Method of standard addition
NCR	Nonconformance report
O&M	Operations and Maintenance
OU	Operable Unit
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PRMDL	Project Required Method Detection Limit
PRQL	Project Required Quantitation Limit
QA	Quality assurance
QAM	Quality assurance manager
QAO	Quality assurance officer
QAPP	Quality Assurance Program Plan
QAPjP	Quality Assurance Project Plan
QC	Quality control
RI	Remedial investigation
ROD	Record of Decision
RPD	Relative percent difference
RPM	Remedial Project Manager
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan

ACRONYMS
continued

SOP	Standard Operating Procedure
SOW	Statement of work
SPCC	System performance check compounds
SW846	"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (U.S. Environmental Protection Agency)
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total dissolved solids
TIC	Tentatively identified compound
TOC	Total organic carbon
TSS	Total suspended solids
VOC	Volatile organic compounds

1. INTRODUCTION

1.1. OVERVIEW

Section 1.1. of the Operable Unit 9 (OU9) Site-Wide Quality Assurance Project Plan (QAPjP) (DOE 1993) does not apply to this Operable Unit 5 (OU5) QAPjP. This QAPjP applies to OU5 Remedial Investigation/Feasibility Study (RI/FS) activities at the U.S. Department of Energy (DOE) Mound Plant in Miamisburg, Ohio. This OU5 QAPjP describes the quality assurance (QA) and quality control (QC) procedures that will be applied to all RI/FS activities in OU5 to ensure that valid and reliable data of consistent quality is obtained to meet the objectives of the RI and FS for OU5 and adequately support the site-wide baseline risk assessment. The specific QAPjP Preparation Guidelines used to prepare the OU5 QAPjP were the following: (1) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA 1988); (2) Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1980); and, (3) USEPA Region V Model Quality Assurance Project Plans specific to Superfund Projects (EPA 1991).

This OU5 QAPjP is structured to interface with the Mound Plant OU9 Site-Wide QAPjP (DOE 1993) and is therefore supplemented where appropriate by reference to that document. Where the OU9 Site-Wide QAPjP (DOE 1993) differs from this OU5 QAPjP, the specific information and/or procedures applicable to OU5 RI/FS activities have been incorporated herein. Consequently, the OU5 QAPjP and the OU9 QAPjP (DOE 1993) complement one another and must be used jointly to achieve the desired QA/QC objectives for the Mound Plant Environmental Restoration Program and to avoid unnecessary duplication of effort.

If changes/revisions are made to the OU9 Site-Wide QAPjP (DOE 1993), the impact on this OU5 QAPjP and other OU5 documentation (i.e., the Work Plan, Field Sampling Plan(s), and Health and Safety Plan) will be assessed. When these changes/revisions affect OU5 RI/FS activities, an addendum to this OU5 QAPjP may be required.

This OU5 QAPjP describes the QA/QC organization and their responsibilities (Section 2); the QC standards of performance and acceptance criteria (Section 3); the procedures that will be used during field

sampling activities (sampling procedures in Section 4 and sample custody requirements in Section 5); the procedures for field screening, field measurements and laboratory analysis (Section 6); the QC procedures for calibration of field and laboratory instrumentation (Section 7); specific QC checks to be performed (Section 8); data reduction, validation and reporting procedures (Section 9); quality assurance audits and surveillance activities (Section 10); preventive maintenance procedures for equipment and instrumentation (Section 11); evaluation of field and laboratory QC data (Section 12); non-conformance and corrective action procedures (Section 13); and QA reports to management (Section 14). To accomplish these activities and ensure the QA/QC goals for OU5 are met, this OU5 QAPjP relies upon the structure and organization of the project as described in DOE quality assurance program directives, EG&G Mound Applied Technologies QA manuals and procedures, the OU9 Site-Wide QAPjP (DOE 1993), and on the effectiveness of the individuals responsible for conducting the RI/FS tasks as described in the OU5 Work Plan.

1.2. ENVIRONMENTAL RESTORATION PROGRAM DESCRIPTION

Section 1.2. of the OU9 Site-Wide QAPjP (DOE 1993) applies to this OU5 QAPjP.

1.3. MOUND ER PROGRAM

Section 1.3. of the OU9 Site-Wide QAPjP (DOE 1993) applies to this OU5 QAPjP.

1.4. PROJECT DESCRIPTION

Section 1.4. of the OU9 Site-Wide QAPjP (DOE 1993) does not apply to this OU5 QAPjP.

OU5 consists of the geographic area of the Mound Plant that lies outside the boundaries of OU1 and OU2 (Figure 1.1.). This operable unit includes the Special Metallurgical/Plutonium Processing (SM/PP) Hill, the New Property and the valley between the SM/PP Hill and the Main Hill.

Although originally designated as the radioactively contaminated soils operable unit, OU5 RI/FS responsibilities also include any chemical contamination (both organic and inorganic constituents) that may be present in the soils, sediments, surface water and ground water within and around disposal sites, release sites, spill sites and other areas of concern (AOC) that lie within the geographic area of OU5.

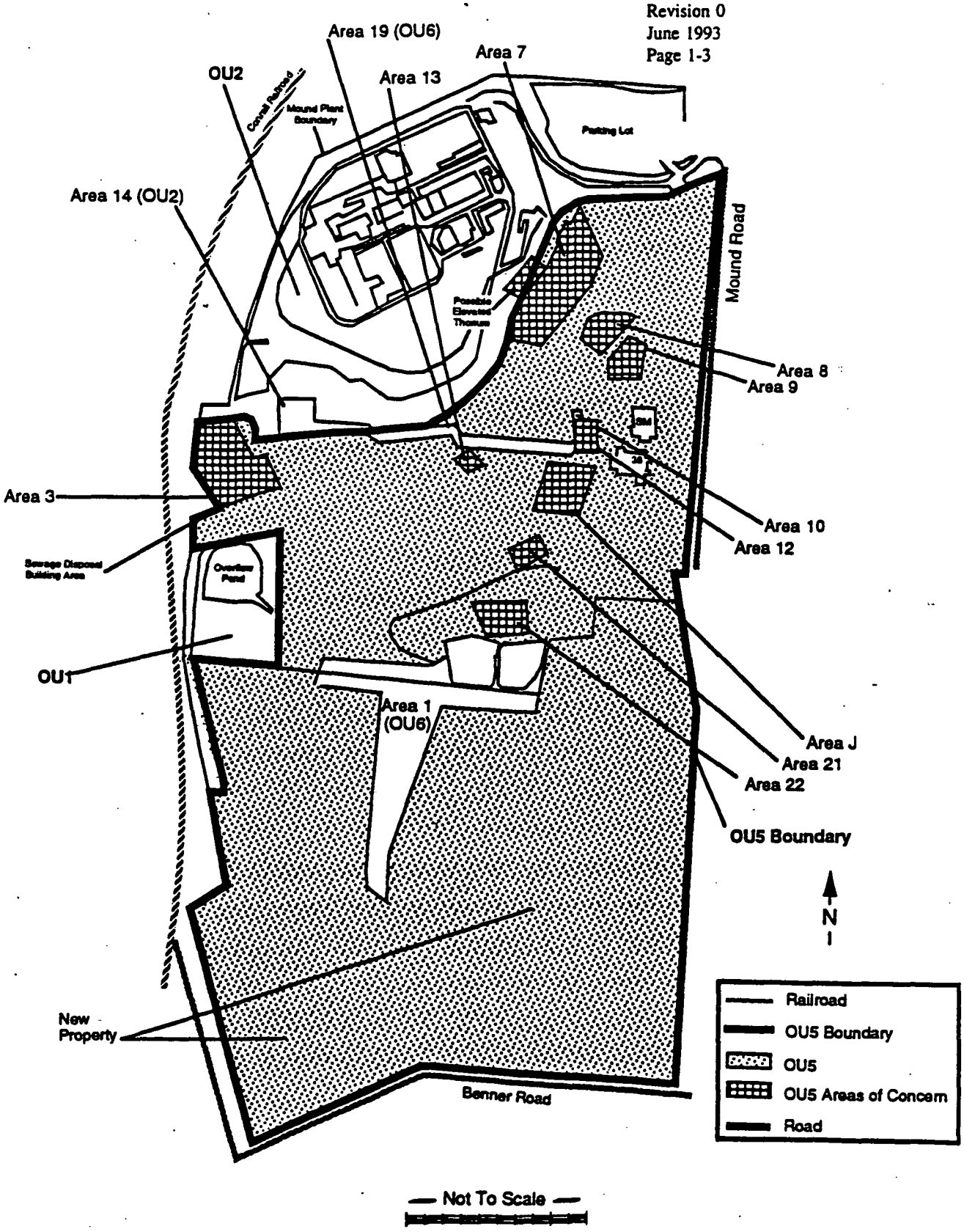

Figure 1.1. Mound Plant Proposed Operable Unit Boundaries.

1.4.1. Current Sites

There are currently 15 sites or AOCs within OU5 that are known to be contaminated with radioactive materials (principally plutonium and/or thorium). Some of these sites may also contain organic solvents, heavy metals, petroleum products and other hazardous materials, such as asbestos. A list of these 15 sites is shown in Table I.1. An additional number of sites, possibly as many as 100 or more, have recently been identified within OU5 (OU3 Limited Field Investigation Report (DOE 1992)). Some of these sites are likely to require further investigation under the scope of this work plan. These sites will be added to the scope of the OU5 RI/FS through addendums to the OU5 Work Plan and this OU5 QAPjP if a review of environmental data, as it becomes available, determines that further investigation is needed to adequately characterize these additional sites.

1.4.2. List of Known or Suspected Contaminants

The 15 known AOCs in OU5 were determined from the results of earlier investigations that identified the presence of radioactive materials (Pu^{238}, Th^{232}, Co^{60}, Cs^{137}, and Ac^{227}) and non-radioactive chemical contaminants (waste oils, paints, paint thinners, organic solvents and various metals (DOE 1992)). The known contaminants found in each of the 15 AOCs are presented in Table I.2. Other radioactive and non-radioactive chemical contaminants that may be found in some of these AOCs are presented in Table I.3.

1.5. QAPjP SCOPE

The scope of the QA/QC activities to be performed in support of the RI/FS for OU5 includes all field sampling, sample handling and shipment, laboratory analyses, data reduction and data validation efforts associated with the collection and reporting of RI quality information (i.e., environmental data documenting the types and concentrations of radioactive and chemical contaminants in soils, sediments, surface water and ground water obtained through field sampling, analysis, data validation and reporting procedures in accordance with CERCLA) necessary to meet RI/FS objectives and support risk assessment requirements. These QA/QC activities also include the appropriate use of field and laboratory QC samples, approved field and laboratory calibration procedures, QA audits and surveillances, non-conformance reporting and corrective actions, and appropriate QA/QC follow-up efforts.

Table I.1 Current List of OU5 Areas of Concern

Grouping	Designation Name/Number	Description
Waste Water Treatment	Sewage Disposal Building Area	—
Drum Storage Areas	- Area 3	Storage and redrumming area
	- Area 9	Former thorium storage and redrumming area
Ground Disposal Areas - Soil	- Area 8	Contaminated soils from Areas 9 and 1
	- Area 12	Contaminated soil from Area 1 and SM Building operations
	- Area 21	Old bunker
	- Area 22	Orphan soil
Ground Disposal Areas - Construction Spoils	- Area 7	Soil from SW cave, contaminated ventilation exhaust system, and crushed empty thorium drums
	- Area 10	Concrete from Unit 4 Dayton operations
	- Area 13	Polonium - contaminated wood
	- Area J	Dredged material disposal and hillside catch basin

Table I.2 Known Contaminants in Operable Unit 5

Release Site		Known Contaminants
Area 3, storage and redrumming area		Plutonium-238, thorium, 1, 2 transdichloroetherene
Area 7,	soil from SW cave, contaminated ventilation exhaust system, and crushed empty thorium drums	Plutonium-238, thorium, cesium-137, actinium-227, tritium, and xylene
Area 8,	contaminated soils from Areas 9 and 1	Plutonium-238, thorium, and tritium
Area 9,	former thorium storage and redrumming area	Plutonium-238 and thorium
Area 10,	concrete from Unit 4 Dayton Operations	Plutonium-238
Area 12,	contaminated soil from Area 1 and SM Building operations	Plutonium-238, thorium, and cobalt-60
Area 13,	polonium-contaminated wood	Plutonium-238[a]
Area 21,	old bunker	Plutonium-238, cesium-137, and tritium
Area 22,	orphan soil	Plutonium-238, cobalt-60, radium-226, cesium-137
Area J, dredged material disposal and hillside		Paint and thinners, plutonium-238, thorium, tritium, cobalt-60
Sewage disposal building area		Plutonium-238 and thorium-232

[a]Although polonium-210 decays to stable lead, lead is not listed as a suspected contaminant. The relatively high specific activity of polonium-210, and the limited amount of polonium-210 that was present at Mound Plant, would yield extremely small quantities of stable lead (Pb^{206}). Low concentrations of Plutonium-238 were found in this area, possibly from run-on cross contamination.

(Developed by Roy F. Weston, Inc.)

Table L3 List of Possible Chemicals, Radionuclides, and Metals of Concern
page 1 of 2

Chemicals

Acetic acid
Acetone
Acetonitrile
Acrylonitrile
n-Alkylidimethylbenzyl
Aluminum chloride
Ammonium bicarbonate
Ammonium hydroxide
Ammonium iodide
Ammonium sulfate
Ammonium thiocyanate
Anco Algaecide No. 1
Ancocide 4020
Ancool 3310
Ancosperse 3830
Anion exchange resin (e.g. Dowex-50)
Aqueous glutaraldehyde
Arsenic
Asbestos fiber
Benzene
Benzidine
2-Benzyl-4-chlorophenol
Bismuth phosphate
Blankrola
Boric acid
Brucine
2-Butanone
Calcium carbonate
Calcium chloride
Calcium hypochlorite
Calcium nitrate
Calcium phosphate
Carbamoyl phosphonate
Carbon dioxide
Carbon disulfide
Carbon monoxide
Carbon tetrachloride
Caustic sode
Chlorine
Chlorobenzene
Chloroethene
5-Chloro-2,methyl-4,-isothiazoline-3-one
Chromic acid
Citric acid
Copper cyanide
Copper sulfate
Cresols
Cyanide
Cyclohexane
Diacetone alcohol
Dially phthalate (DAP)
Dibutyl N, N diethyl
Dichlorodifluoromethane
Dichloromethane
Diethyl ether
Dimethylamine
Dimethylformamide
Dimethylsulfoxide
p-Dioxane
Epoxy resins
Ethyl acetate
Ethyl alcohol
Ethylene glycol
Ethylene glycol monobutyl ether
Ferric chloride
Ferric sulfate
Ferrous hydroxide
Ferrous sulfide
Ferrous sulfomate
Fluoroboric acid
Fluorotrichloromethane
Formaldehyde
Formic acid
Freon-TE
Freon-TF
Glutaraldehyde
Herbicide
Hexane
Hexanitrostilbene
High explosives
- PETN
- PBX
- RDX
- HMX
Hydriodic acid
Hydrochloric acid
Hydrofluoric acid
Hydrogen peroxide
Hydrogen sulfide
Hydroxylamine nitrate
Iodomethane
Isobutyl alcohol
Isocyanate
Isopropal
Isopropanol
Kerosene
Lactic acid
Lead acetate
Lithium chloride
Lithium hydride
Maleic anhydride
Methanol
Methyl alcohol
Methyl ethyl ketone
Methyl isobutyl ketone
2-Methyl-4-isothiazolin-3-one
4'4'Methylene Bix(2-chloroanoline)
Methylene blue
Methylene chloride
Microbicide 77
Nalco 2532
Nalco 2575
Nalco 2590
1-Naphthylamine
2-Naphthylamine
Nickel acetate
Nickel chloride
Nickel sulfamate
Nickel sulfate
Nitrate
Nitric acid
Nitric oxide
Nitrogen dioxide
Nitrous oxide
Oakite
Organophosphate
Oxalic acid
PCB oils
Pentaether

Perchlorate
Perchlorethylene
Phenol
Phosphonate
Phosphoric acid
Polyacrylate
Polyalkylene glycol
Potassium bromide
Potassium carbonate
Potassium hydroxide
Potassium permanganate
Potassium pyrosulfite
Potassium sulfate
Propanol
Propylene glycol
Resorcinol
Silicon
Siltex
Sodium bisulfate
Sodium chromate
Sodium cyanide
Sodium dichromate
Sodium hexametaphosphate
Sodium hydrogen sulfate
Sodium hydroxide
Sodium molybdate
Sodium nitrate
Sodium nitrite
Sodium polyacrylate
Sodium sulfite
Sodium tartrate
Sulfuric acid
Tetrachloroethane
Tetrahydrofuran
Thenoyltrifluoroacetone
Thermite
Toluene
Toluene diisocyanate
Tolytriazole
Triazole
Bis(tributylin) oxide
Tribromomethane
Tributyl phosphate
Trichloroethane
Trichlorofluoromethane
Trichloromethane
Tritium
Xylene
Zinc chromate
Zirconium oxide

Radionuclides

Actinium-227
Americium-241
Cesium-137
Cobalt-60
Neptunium-237
Neptunium-239
Plutonium-238
Plutonium-239
Plutonium-240
Plutonium-241
Plutonium-242
Polonium-208
Polonium-209
Polonium-210
Protactinium-231
Radium-226
Radon-222[b]
Strontium-90
Thorium-228
Uranium-233
Uranium-234
Uranium-235
Uranium-238
Thorium-229
Thorium-230
Thorium-232

Metals (includes unspecified radionuclides)

Aluminum
Antimony
Barium
Beryllium
Bismuth
Cadmium[a]
Chromium
Cobalt[a]
Copper
Curium
Gallium
Gold
Iron[a]
Lead
Lithium
Magnesium
Manganese
Mercury
Nickel[a]
Niobium
Ruthenium
Selenium[a]
Silver[a]
Tellurium[a]
Tin[a]
Vanadium
Zinc
Zirconium

[a] These were identified as contaminants in either the bismuth or the aluminum cans that were irradiated to produce polonium. The specified radionuclides that may have been produced have not been thoroughly evaluated.
[b] Radon-222 is a daughter product of radiuim, actinium, and thorium.
HMX - octahydro-1,3,5,7-tetranitro-1,3,5,6-tetrazocine cyclo-tetramethylenetetranitramine
PBX - plastic bonded explosive
PCB - polychlorinated biphenyl
PETN - pentaerythritol tetranitrate (explosive)
RDX - hexahydro-1,3,5-trinitro-s-triazine-cyclotetramethylene-tetranitramine

(developed by Roy F. Weston, Inc.)

1.6. DATA QUALITY NEEDS AND OBJECTIVES

The data needs and data quality objectives (DQOs) applicable to OU5 RI/FS activities are described in Section 4 of the OU5 Work Plan and can be summarized as follows to:

- Obtain environmental data (types and concentrations of radioactive contaminants present in soils, sediments, surface water and ground water) of sufficient and consistent quality from within and around the various AOCs in OU5 to adequately characterize the nature and extent of radioactive contamination;
- Obtain environmental data (types and concentrations of non-radioactive/chemical contaminants present in soils, sediments, surface water and ground water) of sufficient and consistent quality from within and around the various AOCs in OU5 to adequately characterize the nature and extent of non-radioactive/chemical contamination;
- Obtain RI quality data to support an OU5-specific risk assessment and the site-wide risk assessment for the Mound Plant;
- Obtain environmental data (types and concentrations of radioactive and non-radioactive contaminants present in soils, sediments, surface water and ground water) of sufficient and consistent quality to support the screening of remedial action technologies; and,
- Obtain environmental data of sufficient quality and quantity to support a record of decision (ROD) addressing the need for removal actions, interim remedial actions, remedial actions or no further action required determinations in accordance with CERCLA and the terms and conditions of the Mound Plant Federal Facility Agreement (FFA).

In addition, the various areas within OU5 will require individual development of specific objectives. In order to appropriately address the sampling and analytical quality needs of each site, specific direction will be presented in area-specific Field Sampling Plans (FSPs). Data Quality Levels, such as EPA I - V, may be utilized to assist in defining the degree of analytical documentation required. As discussed in the OU9 Site-Wide QAPjP (DOE 1993) these levels range from field screening and indicator measurements to comprehensive analytical methods with complete documentation package deliverables. Depending on the intended use of the data, appropriate data quality will be determined.

2. PROJECT ORGANIZATION AND RESPONSIBILITY

Section 2 of the OU9 Site-Wide QAPjP (DOE 1993) does not apply to this OU5 QAPjP.

Project organization and responsibility are divided among the DOE Environmental Remediation (ER) Program Group, which includes the following: the DOE Albuquerque Field Office (DOE/AL); the DOE Dayton Area Office (DOE/DAO) and its operating contractor (EG&G Mound Applied Technologies, Inc.); and the ER Program subcontractors. The current identified EG&G subcontractor for OU5 is Science Applications International Corporation (SAIC).

DOE/DAO has primary responsibility for the execution of the ER Program and Mound Plant, with technical support/oversight provided by DOE/AL. SAIC will conduct the OU5 RI/FS at Mound Plant, under the direction of EG&G, and will be responsible for the quality of the environmental data.

Figure 2.1 illustrates the specific lines of authority and communication for OU5. The U.S. EPA Region V is responsible for review and approval of this OU5 QAPjP. The U.S. EPA Region V Central Regional Laboratory and/or Central District Office Regional Laboratory are responsible for performing external audits of the OU5 field activities. The Central Regional Laboratory is also responsible for performing external audits of all laboratories. Additional review and approval of these activities is provided by the Ohio EPA Southwest District Office.

2.1. OPERATIONAL RESPONSIBILITIES

Section 2.1 of the OU9 Site-Wide QAPjP (DOE 1993) does not apply to this OU5 QAPjP.

The DOE is organized into divisions that have tiered elements at DOE Headquarters, DOE/AL and DOE/DAO. One of these divisions is the Environmental, Safety and Health Division, which includes the Environment and Health Group. The DOE/AL has an ER Program Group that is responsible for ER Program implementation at all seven DOE installations under their purview.

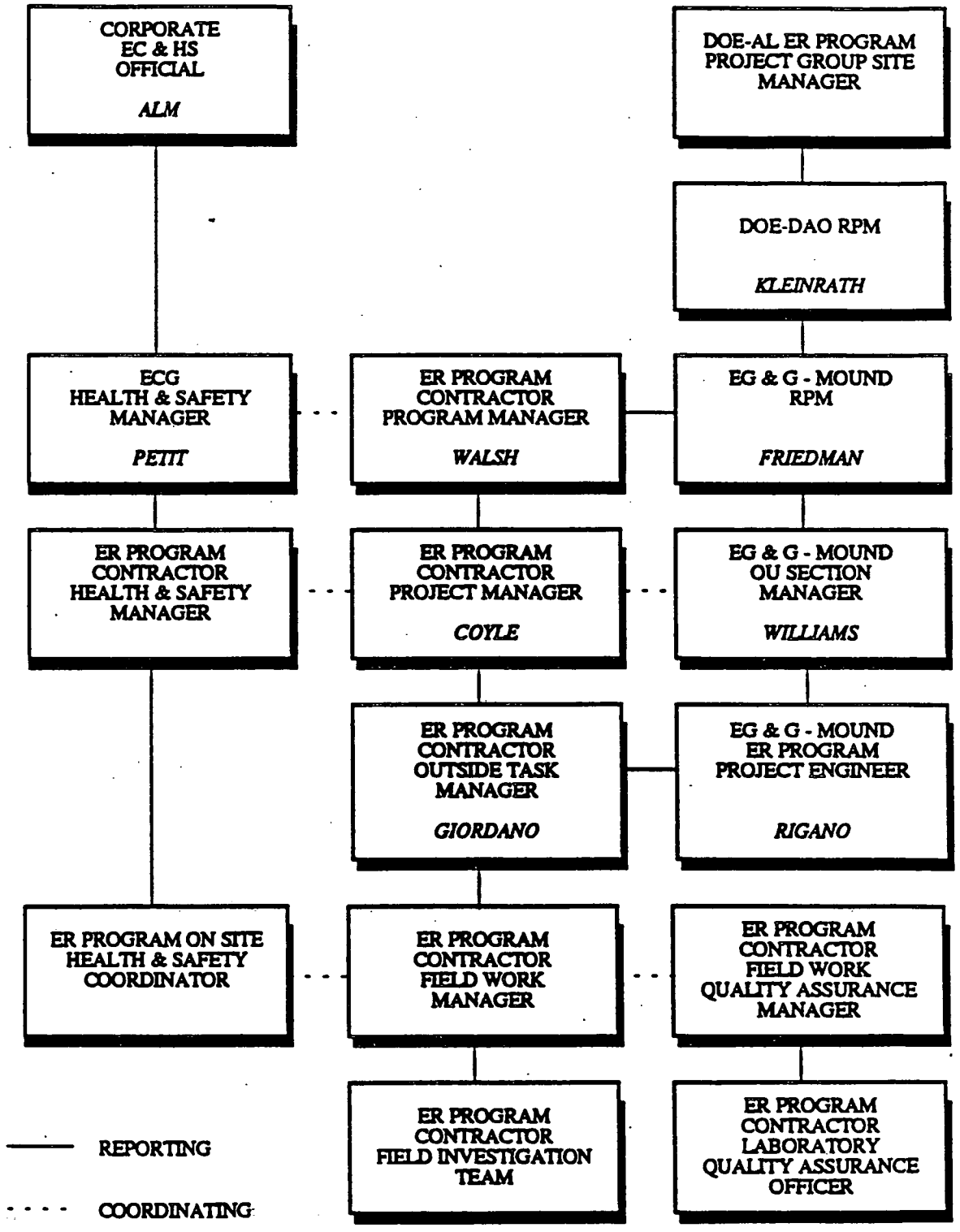

Figure 2.1. Lines of Authority and Communication for OU5.

Descriptions of the operational responsibilities of each entity are as follows:

- DOE Dayton Area Office. The DOE DAO is responsible for implementing the FFA with EPA. The designated Remedial Project Manager (RPM) is Mr. Arthur Kleinrath. The DAO is accountable for all substantive procedural requirements of the agreement, including quality assurance.

- EG&G Mound Applied Technologies, Inc. EG&G is the operations and maintenance (O&M) contractor at Mound Plant and has an environmental compliance structure paralleling that of the DOE. EG&G has a manager responsible for environment, safety and health, Mr. Warren Smith, and a subordinate vice-president responsible for Environmental Restoration/CERCLA, Mr. Charles S. Friedman. The Mound Plant environmental assessment and planning group has functions that include environmental compliance and waste management. Mr. Jim Rigano is responsible for the project management of OU5. Mr. Rigano's subcontractor, SAIC, with local offices in Dayton, Ohio, provides technical support and will perform the RI/FS in OU5.

  - The SAIC program manager, Mr. Maury Walsh, is responsible for implementing contracted ER Program activities. His primary responsibilities are to provide access to the resources within SAIC and to ensure project quality, timeliness and cost-effectiveness of the program. The program manager is also the primary point of contact between EG&G and SAIC.

  - The SAIC project manager, Mr. Steven Coyle, is responsible for the daily management of the project and support staff. In addition to his responsibilities for the work plan, associated plans (including this OU5 QAPjP) and schedules, the project manager coordinates the work and serves as the liaison to the EG&G project manager. The project manager will also ensure that sampling and analysis activities are conducted in full compliance with this OU5 QAPjP. Based upon reports from the Quality Assurance Manager (QAM), the project manager will ensure that appropriate corrective actions are implemented, as necessary, to address nonconformances.

  - SAIC task managers are responsible for the day-to-day implementation of the work plans, including all associated plans such as the health and safety plan (HSP) and this OU5 QAPjP. The task managers are responsible for coordinating daily activities and informing the project manager of technical progress, nonconformances, health and safety problems and other related project matters.

  - The SAIC Quality Assurance Manager (QAM), Mr. Nile Luedtke, is responsible for the development and implementation of this OU5 QAPjP. The QAM also conducts internal performance and system audits of laboratory, field and project activities and ensures corrective action(s) are implemented.

  - The SAIC Quality Assurance Officer (QAO), Ms. Amy Meyer, is responsible for implementing QA procedures and conducts systems and performance audits at field and office locations to verify that published QA procedures are properly followed.

- DOE/AL. DOE/AL has line authority over DAO and is responsible for program management. The designated project manager is Mr. David Flynn.

2.2. FIELD TEAM RESPONSIBILITIES

Section 2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception.

All references to "Operable Unit 9" under this section in the OU9 Site-Wide QAPjP (DOE 1993) are replaced with "Operable Unit 5."

2.3. LABORATORY RESPONSIBILITIES

Section 2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

2.4. QUALITY ASSURANCE RESPONSIBILITIES

Section 2.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

3. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Section 3 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

The objectives for field sampling and analytical measurement are to produce information of known and sufficient quality to support the investigations and resulting decisions. This section defines the project goals for accuracy, precision, completeness, representativeness, and comparability of measured data. Appropriate procedures and quality control checks will be employed to document that known and acceptable levels of accuracy and precision are maintained for each data set. Goals are primarily expressed in terms of acceptance criteria for the quality control checks performed.

- The known and potential COCs for OU5 work sites are listed in Table I.2 and I.3. OU5 investigations will include these contaminants as well as parameters identified on EPA's target compound list (TCL) for organic compounds, target analyte list (TAL) for inorganic constituents, and HPLC method compound list for explosive compounds.

- The field and laboratory quality control checks planned for this investigation are presented in Table III.1. through III.3. and are consistent with those identified in the OU9 Site-Wide QAPjP (DOE 1993).

- In the discussion of Completeness and in Table III.4, "Calculations for Completeness of Measurement Data" of the OU9 QAPjP (DOE 1993), the term "valid" for OU5 analysis will include all "J" (estimated) data which are identified by the validation process to be useable for the project.

3.1. ACCURACY

3.1.1. Definition

Section 3.1.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

Table III.1 Summary of Quality Control Procedures for Field Screening and Field Measurements
(page 1 of 2)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
SOP 2.2	pH	Calibration with two buffer solutions (pH4 and 7 or 7 and 10) (for accuracy)	Before and after a well purge	± 0.1 units of true value
		Calibration check with one buffer solution (for accuracy)	Once per well, after alkalinity analysis	± 0.1 units of true value
SOP 2.2	Electrical conductivity	Calibration (3 standards) (for accuracy)	Before and after sample shift	± 10% of true value
		Calibration check (1 standard) (for accuracy)	One per ten or fewer field samples collected	± 20% of true value
SOP 2.2	Temperature	Duplicate sample (for precision)	One per ten or fewer field samples collected	± 1°C
		Calibration (for accuracy)	NA	± 2°C (manufacturer's specification)
SOP 2.2	Dissolved O_2	Duplicate sample (for precision)	One per ten or fewer field samples collected	≤ 20%RPD
		Calibration (for accuracy)	One per day	± 10% of expected value
SOP 2.2	Oxidation-Reduction Potential	Calibration (for accuracy)	Once per day	± 10% of true value
		Duplicate sample (for precision)	One per ten or fewer field samples collected	≤ 20% RPD
SOP 3.1	Water level	Duplicate measurement (for precision)	Once per well sampled	± 0.02 feet of first reading
SOP 3.3	Water level (transducer)	Depth response (for accuracy)	Once per test	≤ 2-5% difference, measured vs. recorded
SOP 6.1	Combustible gas level	Calibration (1 standard) (for accuracy)	Once per day	± 10% of true value
		Duplicate standard (for precision)	Once per day	± 20% of initial calibration
SOP 6.2	Organic vapor level (PID)	Initial calibration (for accuracy)	Once per day	± 10% of true value
		Duplicate standard (for precision)	Once per day	± 20% of initial calibration

Table III.1 Summary of Quality Control Procedures for Field Screening and Field Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
SOP 6.4	Alpha surface contamination	Source check (for accuracy)	Once per day or after instrument adjustments or repairs	± 10% of expected value
		Background count (10 minutes) (for accuracy)	Once per day	≤ 2 cpm
		Replicate measurement (for precision)	Once every 10 measurements	± 4xSD
SOP 6.7	Low-energy gamma radiation	Source check (for accuracy)	Once per day	± 3xSD
		Background check (for accuracy)	Once per day	± 3xSD
		Voltage plateau (for accuracy)	Once per week	Voltage should be 1100 to 1300V
		Replicate measurement (for precision)	Once every 10 measurements	± 4xSD
SOP 6.15	Gamma-Ray Fields	Source check (for accuracy)	Once per day	± 10% of known value
		Background check (for accuracy)	Once per day	± 10% of previous value

NA - not applicable

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E907.0[a]	Isotopic Uranium	**Field quality control**		
E907.0[a]	Isotopic Plutonium	Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	+4 x SD[b,c] Not Applicable
E907.0[a]	Isotopic Thorium			
E903.1[a] (water)	Radium-226	Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤10 x level in associated samples
E907.0[a] (water)	Americium-241	**Laboratory quality control**		
		Background (1000 minutes)	Once per week	For background subtraction; minimum detectable activity
		Pulse check	Once per day	Peak counts at 5meV ± 3xSD
		Method blank	1 per 20 samples of a given matrix	≤2 x MDA
		Method spike	1 per 20 samples of a similar matrix or whenever a batch of samples is prepared in a day, whichever is more frequent.	±3 x SD[b] normalized deviations
		Matrix spike	1 per 20 samples of a similar matrix	±3 x SD[b] normalized deviations
		Replicate sample	1 per 20 samples of a similar matrix	+4 x SD[b,c] normalized range
E906.0[d]	Tritium	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	+4 x SD[b,c] Not applicable

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E906.0[a] (cont.)	Tritium	Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤10 x level in associated samples
		Laboratory quality control		
		Background	Once per day	+ 3 x SD, limit-gross contamination; background subtracts
		Source check	Once per day	± 3 x SD
		Method blank	1 every 20 or fewer samples of a given matrix or whenever a batch of samples is prepared in a day, whichever is more frequent	≤2 x MDA
		Method spike	1 every 20 or fewer field samples of a smiliar matrix	±3 x SD[b] normalized deviations
		Matrix spike	1 every 20 or fewer field samples of a smilar matrix	±3 x SD[b] normalized deviations
		Replicate sample	1 every 20 or fewer field samples of a similar matrix	+ 4 x SD[b,c] normalized range
E901.1[a]	Gamma radiation	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	+4 X SD[b,c] Not applicable
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤ 10 x level in associated samples
		Laboratory quality control		

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E901.1[d] (cont.)	Gamma radiation	Background (10 minutes)	Once per day	No identifiable peaks; ± 20% error
		Background (1000 minutes)	Once per month	Not Applicable; Stored for background subtraction
		Source check	Once per day	± 3 x SD
		Mixed standard	Initial setup and as necessary	Full range energy, linearity and efficiency calibration ± 5% of known standard
		Replicate sample[e]	1 every 20 or fewer samples of a similar matrix	± 4 x SD[b,c] normalized range
E905.0[d]	Strontium-90	**Field Quality Control**		
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	+4 x SD[b,c] Not Applicable
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤10 x level in associated samples
		Laboratory quality control		
		Method blank	Once per day	≤|2 x MDA
		Background check	Once per week	+3 x SD, limit-gross contamination
		Instrument reliability	Once per day	+3 x SD

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E905.0[d] (cont.)	Strontium-90	Method spike	1 per 20 samples of a similar matrix	±3 x SD Normalized deviations
		Matrix spike	1 per 20 samples of a similar matrix	±3 x SD Normalized deviations
		Replicate sample	1 per 20 samples of a similar matrix	+ 4 x SD Normalized range
		Plateau	Once per year	Not applicable
		Efficiency determination	Once per year	Not applicable
CLP SOW[f]	Organochlorine pesticides/PCBs (TCL)[g]	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤ 10 x level in associated samples
		Laboratory quality control		
		Method blank	1 per 20 samples analyzed of a given matrix or fewer; see CLP SOW	≤ CRQL; surrogate retention times per CLP SOW
		Sulfur cleanup blank	When portion of samples require sulfur clean up	≤ CRQL; surrogate retention times per CLP SOW
		Instrument blank	CLP SOW	CLP SOW

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[f] (cont'd)	Organochlorine pesticides/PCBs (TCL)[g] (cont'd)	Matrix spike	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3; surrogate retention times per CLP SOW
		Matrix spike duplicate	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3; surrogate retention times per CLP SOW
		Surrogate spike	All lab and field samples	See Table III.3
		Calibration (initial and continuing)	CLP SOW	CLP SOW
		GC/MS confirmation	Any samples with a detection from the TCL list for pesticides/PCBs	CLP SOW
		Laboratory Control Sample	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	See Table III.3
		Retention times and Retention time window	CLP SOW	CLP SOW
CLP SOW[f] Modification D	Volatile organic compounds (TCL)[g]	**Field quality control**		
		Trip blank	1 per shipping container to Lab	≤ 10 x level in associated samples
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	≤ 35% RPD Not Applicable

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
(page 6 of 19)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[f] Modification D (cont'd)	Volatile organic compounds (TCL)[g] (cont'd)	Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤ 10 x level in associated samples
		Sample bank blank	1 every 20 or fewer field samples	≤ 10 x level in associated samples
		Ambient blank	1 every 20 or fewer field samples	≤ 10 x level in associated samples
		Laboratory quality control		
		Method blank	Once per 12 hour period	≤ 5 x CRQL of common lab solvents[h] ≤ CRQL others
		Matrix spike	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3
		Matrix spike duplicate	1 per 20 samples of a given matrix in a case or fewer; see CLP SOW	See Table III.3
		Laboratory Control Sample	Once per 12 hour period	See Table III.3
		System monitoring compounds	All lab and field samples	See Table III.3
		Instrument performance check	Daily or each 12-hour period, whichever is more frequent	CLP SOW
		Calibration	CLP SOW	CLP SOW
		Retention time window	CLP SOW	±0.06 relative retention time units (sample and standard)
		Qualitative verification	When a detection occurs in a sample	CLP SOW

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[f] Modification D (cont'd)		Calibration check	With every calibration	CLP SOW
		Internal standard	Every standard and sample	CLP SOW
		Continuing calibration check	Once each 12-hour period	CLP SOW
SW8010[k] SW8020[k] SW8030[k]	Halogenated and aromatic volatile organic compounds Acrylonitrile, Acetonitrile	**Field quality control**		
		Trip blank	1 per shipping container to lab	≤ 10 x level in associated samples[a]
		Duplicate	1 every 10 or fewer field samples (water)	≤ 35% RPD[a]
		Equipment (rinsate) blank[m]	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[a]
		Sample bank blank[o]	1 every 20 or fewer field samples	≤ 10 x level in associated samples[a]
		Ambient blank	1 every 20 or fewer field samples	≤ 10 x level in associated samples[a]
		Laboratory quality control		

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
SW8010[k] SW8020[k] SW8030[k] (continued)	Halogenated and aromatic volatile organic compounds Acrylonitrile, Acetonitrile	Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of sampels is prepared in a day, whichever is more frequent	<PQL
		Calibration	5 points; when calibration check criteria exceeded	≤ 20% RSD for calibration factors
		Calibration check	Once per 10 samples analyzed	± 15% from initial response factor
		Matrix spike	1 per 20 sampels of a given matrix	See Table III.3
		Matrix spike duplicate	1 per 20 samples of a given matrix	See Table III.3
		Surrogate spikes	All field and lab samples	See Table III.3
		Retention time window	When new column installed and as needed	± 3 x SD of three retention times for each analyte as per SW846
		Laboratory control sample (LCS)	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent.	See Table III.3
CLP SOW[f] Modification D	Semivolatile organic compounds (TCL)[g]	**Field quality control**		

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[f] Modification D (cont'd)	Semivolatile organic compounds (TCL)[g] (cont'd)	Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	≤ 55% RPD[e] Not applicable
		Equipment (rinsate) blank[m]	1 every 10 or fewer field samples (water and soil)	≤ 10 x level in associated samples[e]
		Laboratory quality control		
		Method blank	1 per 20 samples analyzed of a given matrix or whenever a batch of samples is prepared in a day, whichever is more frequent; see CLP SOW	≤ 5 x CRQL phthalate esters ≤ CRQL others
		Matrix spike	1 per 20 samples of a given matrix or fewer; see CLP SOW	See Table III.3
		Matrix spike duplicate	1 per 20 samples of a given matrix or fewer; see CLP SOW	See Table III.3
		Laboratory Control Sample	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent, see CLP SOW	See Table III.3
		Surrogate spike	All lab and field samples	See Table III.3
		Instrument performance check	Daily or each 12-hour period, whichever is more frequent	CLP SOW

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[f] Modification D (cont'd)	Semivolatile organic compounds (TCL)[g] (cont'd)	Calibration	CLP SOW	CLP SOW
		Calibration check	With every calibration	CLP SOW
		Internal standard	Every standard and sample	CLP SOW
		Continuing calibration check	Once each 12-hour period	CLP SOW
		Retention time window	CLP SOW	± 0.06 relative retention time units (sample and standard)
		Qualification verification	When a detection occurs in a sample	CLP SOW
CLP SOW[i] Modification A	Metals and Cyanide	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	≤ 25% RPD[a] Not applicable
		Equipment (rinsate) blank[m]	1 every 10 or fewer field samples (water and soil)	≤ 10 x level in associated samples[a]
		Laboratory quality control		
		Initial and continuing calibration blanks (ICB, CCB)	After every ICV and CCV or 10% or every 2 hours, whichever is more frequent	≤ CDRL

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[i] Modification A (cont'd)	Metals and Cyanide (cont'd)	Preparation Blank (PB)	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent; see CLP SOW	≤ CDRL
		Laboratory Control Sample	1 per group of samples in a delivery group or batch, whichever is more frequent	80-120% Recovery
		Initial calibration verification std. (ICV)	CLP SOW	CLP SOW
		Continuing calibration verification std. (CCV)	CLP SOW	CLP SOW
		Linear range check standard (CRI, CRA)	CLP SOW	Not established
		Interference check sample (ICS)(ICP and AA only)	Sample twice per 8-hour shift, or at beginning and end of analysis run, whichever is more frequent	±20% of true value
		ICP Serial dilution (L)(ICP only)	1 per group of samples of a given matrix, concentration, or each delivery group, whichever is more frequent	If result > 50 x IDL: ± 10% difference
		Spike sample (S)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent	75-125% Recovery

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[i] Modification A (cont'd)	Metals and Cyanide (cont'd)	Sample dup. (D) (sample replicate)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent	If result $\geq$ 5 x CRDL: ± 20% RPD If result $\leq$ 5 x CRDL: ± CRDL
		Method std. addition GFAA only (MSA)	CLP SOW	CLP SOW
		Linear range analysis (LRA) for ICP only	CLP SOW	CLP SOW
		Interelement corrections for ICP only	Once per year or when instrument adjusted	CLP SOW
E325.1[j] (water); SW9250 (soil) E325.2[j] (water); SW9251 (soil) E353.2[j]	Chloride, (Cl) Nitrate-Nitrite (NO_3-NO_2)	**Field quality control**		
E375.2[j] or E375.4 E351.3[j] (water) E365.1[j] (water)	Sulfate (SO_4) Total nitrogen (N) Total phosphorous (P)	Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	$\leq$ 25% RPD Not applicable

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E340.2[j]	Fluoride	Equipment (rinsate) blank	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples
E325 1[j] (water); SW9250 (soil)	Chloride, (Cl)	**Laboratory quality control**		
E353.2[j]	Nitrate-Nitrite (NO_3-NO_2)	Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	< PQL
E375.2[j] or E375.4	Sulfate (SO_4)	Calibration (3 points) and Reagent Blank	When instrument conditions change or when calibration check criteria exceeded	Correlation coefficient ≥ 0.995 or plot curve for nonlinear analytes
E351.3[j] (water)	Total nitrogen (N)			
E365.1[j] (water)	Total phosphorous (P)			
E340.2[j]	Fluoride	Calibration check	Prior to sample analysis and one per 20 samples analyzed	± 15% of initial calibration response
		Matrix spike	1 per 20 samples of a given matrix	75-125% Recovery
		Matrix spike duplicate	1 per 20 samples of a given matrix	≤ 20% RPD
		Laboratory Control Sample (chloride, nitrate)	1 for each calibration	Vendor specification

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E160.1[j] E160.2[j]	Total dissolved solids (TDS)	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water)	≤25% RPD[l]
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water)	≤10 x level in associated samples
		Laboratory quality control		
		Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	<PQL
		Replicate sample	1 per 20 samples analyzed	≤20% RPD
		Laboratory control sample (LCS)	1 per 20 samples analyzed	Vendor specification
E415.1[j]/E415.2[j]	Total organic carbon (TOC)	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water & soil)	≤ 35% RPD
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples
		Laboratory quality control		

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
E415.1[j]/E415.2[j] (cont'd)	Total organic carbon (TOC)	Method blank	1 per 20 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	< PQL
		Calibration	When instrument conditions change or when calibration check criteria exceeded	Second reading must be within 25% RSD of initial
		Calibration check	1 per 20 samples analyzed	± 15% of initial calibration response
		Matrix spike (MS)	1 per 20 samples of a given matrix	75-125% Recovery
		Matrix spike duplicate (MSD)	1 per 20 samples of a given matrix	≤ 20% RPD
		Replicate sample	4 analyses for every sample	≤ 20% RPD
SW 8330[k]	Explosives (Method List)	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water) 1 every 10 or fewer field samples (soil)	35% RPD samples Not applicable
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water and soil)	≤ 10 x level in associated samples
		Laboratory quality control		
		Method blank	1 per 20 samples of a given matrix	< PQL

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
SW 8330* (cont'd)	Explosives (Method List) (cont'd)	Calibration	(5 pt.) when calibration check limit criteria exceeded	≤ 15% RSD of average RF
		Matrix spike (MS)	1 per 20 samples of a given matrix	See Table III.3
		Matrix spike duplicate (MSD)	1 per 20 samples of a given matrix	See Table III.3
		Retention time window	With every calibration check	Column and Compound Specific
		Calibration check	Prior to sample analysis and 1 per 10 samples analyzed	± 25% of peak height of initial 10 x TRL calibration standard
SW9081	Cation exchange capacity (CEC)	**Field quality control**		
ASTM D422-63	Particle size Analysis	Duplicate (for soil pH, alkalinity only)	1 every 10 field samples (soil)	Not applicable
ASTM D854-83	Specific gravity			
ASTM D-2434	Hydraulic conductivity	**Laboratory quality control**		
ASTM D-4254	Relative density	Method blank (CEC) analyzed	1 per 20 samples	as per SW846
ASTM D-4254	Maximum density			

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[1] Modification C	Lanthanides	**Field quality control**		
		Duplicate	1 every 10 or fewer field samples (water & soil)	≤ 25% RPD[a], not applicable for soils
		Equipment (rinsate) blank	1 every 10 or fewer field samples (water)	≤ 10 x level in associated samples[a]
		Laboratory quality control		
		Initial and continuing calibration blanks (ICB, CCB)	After every ICV and CCV or 10% or every 2 hours, whichever is more frequent	≤ CRDL
CLP SOW[1] Modification C (cont'd)	Lanthanides (cont'd)	Preparation blank (PB)	1 per 10 samples of a given matrix or 1 whenever a batch of samples is prepared in a day, whichever is more frequent	≤ CRDL
		Laboratory control sample (LCS)	1 per group of samples in a delivery group or batch, whichever is more frequent	80-120% recovery
		Initial calibration verification aid (ICV)	CLP SOW	CLP SOW
		Continuing calibration verification aid (CCV)	CLP SOW	CLP SOW

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements
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Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria
CLP SOW[1] Modification C (cont'd)	Lanthanides (cont'd)	Linear range check standard (CRI, CRA)	CLP SOW	Not established
		Interference check sample (ICS)	Sample twice per 8-hour shift, or at beginning and end of analysis run, whichever is more frequent	± 20% of true value
		ICP Serial dilution (L)	1 per group of samples of a given matrix, concentration, or each sample delivery group, whichever is more frequent	If results > 50 x IDL ± 10% difference
		Spike sample (S)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent	75-125% Recovery
		Sample dup. (D) (sample replicate)	1 per group of samples of a given matrix, concentration, or sample delivery group, whichever is more frequent	If results $\geq$ 5 x CRDL; ± 20% RPD If results $\leq$ 5 x CRDL; ± CRDL
		Method std. addition GFAA only (MSA)	CLP SOW	CLP SOW
		Linear range analysis (LRA) for ICP	CLP SOW	CLP SOW
		Interelement corrections for ICP	Once per year or when instrument adjusted	CLP SOW

Table III.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements (page 19 of 19)

[a] A sample blank monitors for VOC's potentially present in the surrounding environment where samples are commonly handled before shipment. The blank is prepared with organic-free deionized water in sample vials, capped with no bubbles, and placed in the desired location during sample handling.

[b] Isotopic uranium, isotopic plutonium, isotopic thorium, Radium-226, and Americium-241 will be analyzed by approved laboratory developed SOPs. These SOPs will be based on National Academy of Sciences (NAS) literature, U.S. DOE procedures, U.S. EPA procedures, ASTM methods, or other established literature references.

[b] Procedures according to "Environmental Radioactivity Laboratory Intercomparison Studies Program," U.S. EPA, EPA-600/4-81-004.

[c] "Improved Evaluation of Environmental Radiochemical Inorganic Solid Matrix Replicate Precision: Normalized Range Analysis Revisited," J. W. Dillard and R. E. Gladd, 36th Annual Conference on Bioassay, Analytical, and Environmental Radiochemistry, Oak Ridge, TN, 1990.

[d] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.

[e] Counted twice on different detectors.

[f] U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, No. OLM01.8, August 1991.

[g] Target Compound List

[h] For methylene chloride, acetone, toluene, or 2-butanone.

[i] U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, No. ILM01.0, March 1990.

[j] "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA-600/479-020, revised March 1983.

[k] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, U.S. EPA, November 1986 or most recent version.

[l] Soil and Rock; Dimension Stone, Geosynthetics Vol. 4.08, 1991 Annual Book of ASTM Standards Section 4 "Construction."

[m] To be prepared for sampling locations without dedicated sampling equipment.

[n] All field quality control samples associated with a batch of samples will be evaluated as a unit. This criterion is designed for evaluating an isolated quality control sample and does not take into account the interdependencies of quality control results. Corrective actions will be taken at all levels of detection in the blank samples associated with field sampling. The criterion applies only if there is a positive detection of the same compound in associated samples. All data will be evaluated on a case-by-case basis; therefore, this criterion may not be applicable at times (e.g., reported levels near detection limits).

Table III.3 Laboratory Control Limits
for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes
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Analytical Method	Spiking Compounds	Spike Concentration		Advisory Limits			
		Water (µg/L)	Soil (µg/kg)[b]	Percent Recovery[a] Water	Soil	Relative Percent Difference (%) Water	Soil
CLP SOW Pesticides PCBs	**Matrix Spike/LCS**						
	Lindane	[c]	[c]	56-123	46-127	≤15	≤50
	Heptachlor	[c]	[c]	40-131	35-130	≤20	≤31
	Aldrin	[c]	[c]	40-120	34-132	≤22	≤43
	Dieldrin	[c]	[c]	52-126	31-134	≤18	≤38
	Endrin	[c]	[c]	56-121	42-139	≤21	≤45
	4,4'-DDT	[c]	[c]	38-127	23-134	≤27	≤50
	Surrogates						
	Tetrachloro-m-xylene	per CLP SOW	per CLP SOW	60-150	60-150	NA	NA
	Decachlorobiphenyl	per CLP SOW	per CLP SOW	60-150	60-150	NA	NA
CLP SOW Volatile Organic Compounds	**Matrix Spike**						
	1,1-DCE	[c]	[c]	61-145	59-172	≤14	≤22
	Trichloroethene	[c]	[c]	71-120	62-137	≤14	≤24
	Benzene	[c]	[c]	76-127	66-142	≤11	≤21
	Toluene	[c]	[c]	76-125	59-139	≤13	≤21
	Chlorobenzene	[c]	[c]	75-130	60-133	≤13	≤21

Table III.3 Laboratory Control Limits
for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes.
(page 2 of 6)

Analytical Method	Spiking Compounds	Spike Concentration		Advisory Limits			
CLP SOW Volatile Organic Compounds (cont'd)	Surrogates						
	Toluene-d8	per CLP SOW	per CLP SOW	88-110	84-138	NA	NA
	4-Bromo-fluorobenzene	per CLP SOW	PER CLP SOW	86-115	59-113	NA	NA
	1,2-Dichloroethane-d4	per CLP SOW	per CLP SOW	76-114	70-121	NA	NA
SW8010 and SW8020	Matrix Spike'/LCS						
	Bromodichloromethane	*	*	42-172	60-140	≤15	≤30
Halogenated and Aromatic Volatile Organic Compounds	Bromoform	*	*	13-159	60-140	≤15	≤30
	Carbon tetrachloride	*	*	43-143	60-140	≤15	≤30
	Chloroform	*	*	49-133	60-140	≤15	≤30
	Dibromochloromethane	*	*	24-191	60-140	≤15	≤30
	1,4-Dichlorobenzene	*	*	42-143	60-140	≤15	≤30
	1,2-Dichloroethane	*	*	51-147	60-140	≤15	≤30
	1,1-Dichloroethene	*	*	28-167	60-140	≤15	≤30

Table III.3 Laboratory Control Limits
for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes
(page 3 of 6)

Analytical Method	Spiking Compounds	Spike Concentration		Advisory Limits			
SW8010 and SW8020 Halogenated and Aromatic Volatile Organic Compounds(cont'd)	1,1,1-Trichloroethane	[c]	[c]	41-138	60-140	≤15	≤30
	Trichloroethene	[c]	[c]	35-146	60-140	≤15	≤30
	Vinyl chloride	[c]	[c]	28-163	60-140	≤15	≤30
	Benzene	[c]	[c]	39-150	60-140	≤15	≤30
	Surrogates						
	Bromochloromethane	30	30	59-117	70-130	≤15	≤30
	Fluorobenzene	30	30	48-120	70-130	≤15	≤30
	o-Chlorofluorobenzene	30	30	44-124	70-130	≤15	≤30
SW8030	Matrix Spike[a]/LCS						
	Acrylonitrile	[c]	NA	70-135	NA	≤15	NA
CLP SOW Semi-volatile Organic Compounds	Matrix Spike						
	Phenol	[c]	[c]	12-110	26-90	≤42	≤35
	2-Chlorophenol	[c]	[c]	27-123	25-102	≤40	≤50
	1,4-Dichlorobenzene	[c]	[c]	36-97	28-104	≤28	≤27
	N-nitoso-di-n-propylamine	[c]	[c]	41-116	41-126	≤38	≤38
	1,2,4-Trichlorobenzene	[c]	[c]	39-98	38-107	≤28	≤23
	4-Chloro-3-methylphenol	[c]	[c]	23-97	26-103	≤42	≤33

Table III.3 Laboratory Control Limits
for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes
(page 4 of 6)

Analytical Method	Spiking Compounds	Spike Concentration		Advisory Limits			
CLP SOW Semi-volatile Organic Compounds (cont'd)	Acenaphthene	[c]	[c]	46-118	31-137	≤31	≤19
	4-Nitrophenol	[c]	[c]	10-80	11-114	≤50	≤50
	2,4-Dinitrotoluene	[c]	[c]	24-96	28-89	≤38	≤47
	Pentachlorophenol	[c]	[c]	9-103	17-109	≤50	≤47
	Pyrene	[c]	[c]	26-127	35-142	≤31	≤36
	Surrogates						
	Nitrobenzene-d5	per CLP SOW	per CLP SOW	35-114	23-120	NA	NA
	2-Fluorobiphenyl	per CLP SOW	per CLP SOW	43-116	30-115	NA	NA
	p-Terphenyl-d14	per CLP SOW	per CLP SOW	33-141	18-137	NA	NA
	Phenol-d5	Per CLP SOW	per CLP SOW	10-110	24-113	NA	NA
	2-Fluorophenol	per CLP SOW	per CLP SOW	21-110	25-121	NA	NA
	2,4,6-Tribromophenol	per CLP SOW	per CLP SOW	10-123	19-122	NA	NA

Table III.3 Laboratory Control Limits
for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes
(page 5 of 6)

Analytical Method	Spiking Compounds	Spike Concentration		Advisory Limits			
CLP SOW Semi-volatile Organic Compounds (Cont'd)	2-Chlorophenol-d4	per CLP SOW	per CLP SOW	33-110	20-130	NA	NA
	1,2-Dichlorobenzene-d4	per CLP SOW	per CLP SOW	16-110	20-130	NA	NA
SW 8330	Blank Spike[d] (low concentration)						
	RDX	11.6	4.4	62-87	40-160[e]	32[f]	40[e,f]
	1,3,5-TNB	26	2.6	85-100	40-160[e]	19	30
	2,4,6-TNT	5.8	2.6	78-102	40-160[e]	29	40
	2,6-DNT	1.0	2.6	66-102	40-160[e]	45	60
	2,4-DNT	0.8	0.6	74-99	40-160[e]	31	40
	Blank Spike (high concentration)						
	RDX	58	22	49-71	40-160	19	30
	1,3,5-TNB	140	13	85-108	40-160	20	30
	2,4,6-TNT	29	13	83-104	40-160	19	30
	2,6-DNT	5.0	13	74-96	40-160	19	30
	2,4-DNT	4.0	3.0	77-100	40-160	20	30

**Table III.3 Laboratory Control Limits
for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes
(page 6 of 6)**

[a] Percent recovery limits for water are those established in SW846. The control limits for soil matrix spikes and surrogates and for precision are project established advisory limits until enough data points are generated to develop control charts.
[b] Spike amount is for low concentration soils.
[c] Sample will be spiked at a concentration at least 25% above the sample concentration, unless the concentration is less than the detection limit, where the spike concentration will be 2 to 5 the method detection limit.
[d] Control limits for sample matrix spikes have not been determined.
[e] Control limits have not been established for solid matrices. These limits are project-established advisory limits for data evaluation purposes and not for valid and will be used until charts have been developed.
[f] Precision is expressed for this analysis as the difference between the highest percent recovery and lowest percent recovery, as defined in the USATHAMA Quality Assurance Manual (USATHAMA 1990).
[g] Matrix spike recoveries are advisory limits only.

3.1.2. Accuracy Goals for Field Screening and Field Measurements

Section 3.1.2 in the OU9 Site-Wide QAPjP applies to the OU5 QAPjP with the following exception. Table III.1 in the OU9 Site-Wide QAPjP (DOE 1993) is replaced with Table III.1 in this OU5 QAPjP.

3.1.3. Accuracy Goals for Laboratory Measurements

Section 3.1.3 in the OU9 Site-Wide QAPjP applies to the OU5 QAPjP with the following exception. Table III.2 in the OU9 Site-Wide QAPjP (DOE 1993) is replaced with Table III.2 in this OU5 QAPjP.

3.2. PRECISION

3.2.1. Definition

Section 3.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

3.2.2. Precision Goals for Field Measurements

Section 3.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

3.2.3. Precision Goals for Laboratory Measurements

Section 3.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception. Table III.2 in the OU9 Site-Wide QAPjP is replaced with Table III.2 in this OU5 QAPjP.

3.3. COMPLETENESS

Section 3.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception. Tables III.1, III.2, III.3, IV.1 and IV.2 in the OU9 Site-Wide QAPjP (DOE 1993) are replaced with Tables III.1, III.2, III.3, IV.1 and IV.2 in this OU5 QAPjP.

3.4. REPRESENTATIVENESS

Section 3.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

3.5. COMPARABILITY

Section 3.5 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

4. SAMPLING PROCEDURES

Section 4 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

The OU5 RI/FS efforts will follow Mound Plant ER Program SOPs in performing environmental sampling and other field activities. The sampling program for OU5 involves the collection of soil, sediment, groundwater and surface water samples. Surface water and groundwater samples may be collected if they support the objectives of the sampling. Additional activities to be performed include drilling, logging, and health and safety screening. All OU5 sampling activities will be discussed in detail in the OU5 area-specific FSPs and the OU5 Work Plan. However, the procedures for these activities are summarized in this section as part of the QAPjP for the investigations. The SOPs that will be followed were developed for the Mound Plant ER Program and are discussed in Section 4 and Appendix A of the OU9 Site-Wide QAPjP (DOE 1993). Only those SOPs applicable to OU5 activities are referenced in the following paragraphs.

4.1. GENERAL PROCEDURES FOR SAMPLING

Section 4.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exceptions and additions.

Table IV.1 in the OU9 Site-Wide QAPjP (DOE 1993) is replaced with Table IV.1 in this OU5 QAPjP.

Samples will be identified as described in Table IV.2 of this document. Each operable unit will have a unique area identifier or identifiers. This identifier, once assigned, will not be changed.

Table IV.3 in the OU9 Site-Wide QAPjP (DOE 1993) is adopted for OU5 in a modified form as identified in Table IV.3 in this OU5 QAPjP. A table summarizing the planned samples and estimated quality assurance/quality control samples will be developed as part of each AOC's attachment to the FSP.

Table IV.1
Mound Plant ER Program SOPs Applicable to Operable Unit 5
Page 1 of 5

Section		Effective Date	Revision Number	Purpose
Section 1-General				
1.1	General Instructions for Field Personnel	March 1992	2	To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.
1.3	Sample Control and Documentation	March 1992	1	To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.
1.4	Sample Containers and Preservation	March 1992	2	To provide guidance in the selection and preservation of suitable containers for samples, container cleaning, required sample volumes, sample collection, times, and the recommended holding preservation techniques for water, wastes, sediments, sludges, and soil samples.
1.5	Guide to the Handling, Packaging, and Shipping of Samples	May 1991	1	To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.
1.6	General Equipment Decontamination	March 1992	2	To describe methods for the decontamination of field equipment potentially contaminated during sample collection.
1.8	Personnel Decontamination - Level D Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.
1.9	Personnel Decontamination - Level C Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.

Table IV.1
Mound Plant ER Program SOPs Applicable to Operable Unit 5
Page 2 of 5

Section		Effective Date	Revision Number	Purpose
1.15	Guide to Waste Management	February 1993	2	To provide a general guide for the management of investigation-derived material at the Mound Plant.
Section 2-Water Sampling				
2.1	Presample Purging of Wells	March 1992	1	To identify well-purging procedures for evacuation of stagnant water from the will bore and its replacement by groundwater in sufficient quantities so that a water sample representative of the formation of completion can be collected.
2.2	Field Measurements on Ground and Surface Water Samples	March 1992	2	To obtain reliable and accurate measurements of the field chemistry of water quality samples.
2.3	Sampling Monitoring Wells with a Bladder Pump	March 1992	3	To use a bladder pump to obtain representative groundwater samples at shallow depths that are beyond the capabilities of a peristaltic pump.
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer	June 1991	1	To obtain a representative groundwater sample at depths beyond the range (or capability) of suction lift pumps when bailer volatile air stripping is of concern, well-casing diameters are too narrow to accept submersible pumps, or other difficult conditions are present.
2.5	Sampling Monitoring Wells with a Submersible Pump	January 1991	0	To obtain a representative sample of the groundwater at depths beyond the capabilities of peristaltic pumps when bailing and bladder pumps are ineffective.
2.6	Sampling Monitoring Wells with a Peristaltic Pump	June 1991	1	To obtain a representative groundwater sample from a shallow well (less than 26 ft deep).

Table IV.1
Mound Plant ER Program SOPs Applicable to Operable Unit 5
Page 3 of 5

Section		Effective Date	Revision Number	Purpose
2.8	Sampling for Volatile Organics	January 1991	0	To outline procedures for collecting a representative groundwater sample and transporting it from its original environment to the laboratory for analysis of trace volatile organics.
2.9	Surface Water Sampling	June 1991	1	To define guidelines followed by field personnel in sampling surface water bodies and documenting all aspects of surface water sample collection.
2.10	Stream Flow Measurements Using Flumes, Velocity-Cross Sectional Area, and Direct Volume	March 1992	0	To define guidelines that will be followed by field personnel for measuring surface water flow rates in ditches, creeks, and springs using flumes, velocity cross sectional area method, and the bucket and stopwatch method.
Section 3-Hydraulic Testing				
3.1	Water Level Measurement	March 1992	1	To determine the depth-to-water in an open borehole, cased borehole, monitoring well, or potentiometer.
3.3	Operational Check of Pressure, Transducers Used in Measuring Water Levels in Wells	September 1992	1	To describe procedures for conducting office and field checks of pressure transducers.
Section 4-Drilling and Logging				
4.1	Soil Boring	March 1992	2	To ensure acceptable, consistent soil-boring procedures for all pertinent aspects of hazardous waste investigations.
4.1.1	Methods to Control Communications of Subsurface Contaminants with Groundwater	December 1992	2	To insure that acceptable, consistent soil-boring procedures are used to prevent communication of subsurface contaminants in vadose zone soils or landfill materials with underlying groundwater.
4.2	Rock Boring	March 1992	1	To ensure acceptable, consistent rock boring procedures for all pertinent aspects of hazardous waste investigations.

Table IV.1
Mound Plant ER Program SOPs Applicable to Operable Unit 5
Page 4 of 5

Section		Effective Date	Revision Number	Purpose
4.3	Monitoring Well Installation	March 1992	1	To ensure acceptable, consistent monitoring well installation.
4.4	Monitoring Well Development	March 1992	1	To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the monitoring well.
Section 5-Soil Sampling				
5.1	Soil and Rock Borehole Logging and Sampling	March 1992	1	To describe the physical nature of consolidated or unconsolidated subsurface earthen materials encountered during auger, rotary, or other drilling or trenching activities and collect samples of the earthen materials for further evaluation.
5.2	Soil Sampling with a Spade and Scoop	March 1992	3	To describe a method for collecting a soil sample less than 4 ft below the land surface.
5.3	Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler	March 1992	2	To define a method of collecting subsurface solid samples with a hand auger and thin-wall tube sampler.
5.4	General Soil Gas Sampling and Field Chemical Analysis	January 1991	0	To define a method that ensures acceptable, consistent soil gas sampling and on-plant analysis with a gas chromatograph for volatile organic contaminants.
5.8	Soil Sampling with a Stainless Steel Surface Soil Sampler	October 1991	1	To define procedures for collecting surface soil samples to determine the chemical and physical soil properties.

Table IV.1
Mound Plant ER Program SOPs Applicable to Operable Unit 5
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Section	Effective Date	Revision Number	Purpose
Section 6-Health and Safety			
6.1 Health and Safety Monitoring of Combustible Gas Levels	March 1992	1	To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.
6.2 Health and Safety Monitoring of Organic Vapors with a Photoionization Detector	March 1992	1	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).
6.3 Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector	March 1993	1	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable Flame Ionization Detector (FID)
6.4 Total Alpha Surface Contamination Measurements	June 1992	0	To provide guidance for determining levels of total surface alpha contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated with alpha-emitting radionuclides.
6.7 Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER	May 1992	0	To describe the procedure in which a field instrument for the detection of low-energy radiation (FIDLER) is used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emissions.
6.11 Beta-Gamma Radiation Measurements	September 1992	1	To provide guidance for determining levels of total surface beta contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated.
6.15 Measurements of Gamma-Ray Fields Using a Sodium Iodide (NAI) Detector	January 1991	0	To describe the procedure for making count-rate measurements of a gamma-ray field with a sodium iodide (NAI) detector.

Table IV.2 Operable Unit 5 Sample Identification Plan
Page 1 of 1

Sample Identifier:

MNDXX-YYYY-ZZZZ

Where:

MND	=	Mound Plant
XX	=	Sample Area Identifier as assigned by EG&G Mound. None have been assigned to date
YYY	=	Sample Location Number
ZZZZ	=	Sample Type and Sample Round or Depth

- The first "Z" is the sample type (investigative or quality control) as indicated below

0ZZZ	=	Field Sample
1ZZZ	=	Sample Duplicate
2ZZZ	=	Trip Blank
3ZZZ	=	Sample Bank Blank/Ambient Blank
4ZZZ	=	Equipment Blank
6ZZZ	=	Bottle Lot Blank

Field QC samples will be assigned a sample location number and sample round of the last sample of the associated sampling group.

- The second "Z" identifies the sample matrix as indicated below:

Z0ZZ	=	soil
Z1ZZ	=	sediment
Z2ZZ	=	water

- The last two "Z" locations are utilized to identify sampling round or sampling depth.

Table IV.3 Sample Containers, Volumes, Preservation, and Holding Times: Groundwater/Surface Water Samples (page 1 of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume[d]	Preservation	Holding Time[b]
Volatile Organic Compounds	CLP SOW Modification D	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	HCL to pH <2 Cool 4°C	14 days
Purgeable Halocarbons	SW5030/SW8010	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	Cool 4°C	14 days
Purgeable Aromatic Compounds	SW5030/SW8020	Glass vial with Teflon-Lined septum (No headspace)	Two 40 mL vials	HCL to pH <2 Cool 4°C	14 days
Acrylonitrile, Acetonitrile	SW5030/SW8030	Glass vial with Teflon-Lined septum (No headspace)	Two 40 mL vials	Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW Modification D	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Metals or Lanthanides	CLP SOW Modification A or C	Polyethylene bottle	1000 mL	HNO_3 to pH <2, Cool 4°C	6 months, 28 days (Mercury)
Cyanide	CLP SOW	Polyethylene bottle	500 mL	NaOH to pH >12 Cool 4°C	14 days
Nitrate-Nitrite	E53.2	Polyethylene bottle	500 mL	H_2SO_4 to pH <2 Cool 4°C	28 days
Fluoride	E340.2	Polyethylene bottle	500 mL	Cool 4°C	28 days
Sulfate Chloride	E375.2 or E375.4 E325.1	Polyethylene bottle	500 mL	Cool 4°C	28 days
Total Nitrogen Total Phosphorus	E351.3 E365.1	Polyethylene bottle	100 mL	H_2SO_4 to pH <2, Cool 4°C	28 days

Table IV.3 Sample Containers, Volumes, Preservation, and Holding Times: Groundwater/Surface Water Samples (page 2 of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume[a]	Preservation	Holding Time[b]
Total Organic Carbon	E415.1/E415.2	Amber glass bottle with Teflon-lined lid	250mL	H_2SO_4 or HCL to pH <2, Cool 4°C	28 days
Total Dissolved Solids	E160.1	Polyethylene bottle	1000 mL	Cool 4°C	7 days
Total Suspended Solids	E160.2	Polyethylene bottle	1000 mL	Cool 4°C	7 days
Explosives	SW 8330	Amber glass bottle with Teflon-lined lid	1 liter	Cool 4°C	7 days extraction/ 30 days analysis[c]
Radionuclides *Gamma Spectrometry* Plutonium Isotopes Thorium Isotopes Radium-226 Americium-241 Uranium Isotopes Strontium-90	 E901.1 E907.0 E907.0 E903.1 E907.0 E907.0 E905.0	Plastic cubetainer	2x4 liter	HNO_3 to pH <2 (15 mL 1 N HNO_3 *per liter*)	Not applicable
Tritium	E906.0	Glass bottle	250 mL	Cool 4°C	6 months

NOTE: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1, 1988. The laboratory must perform all analyses and any required re-analysis within the required holding times.

[a] Sample containers will be certified cleaned by the manufacturer according to EPA standards.

[b] From date of collection.

[c] From data of extraction.

[d] For samples identified for "MS/MSD" pair of "MS", fill one additional set at containers except for VOC analysis, fill 2 additional sets of containers. Add "MS/MSD" or "MS", depending upon the analysis, on the end of the sample ID for the additional containers.

Table IV.4, as developed for the OU9 Site-Wide QAPjP (DOE 1993), is applicable to OU5 in a modified form as identified in Table IV.4 in this OU5 QAPjP for soil/sediment matrices.

Figure IV.1 in the OU9 Site-Wide QAP (DOE 1993) illustrates the general flow of a sampling event for OU5 field activities.

4.1.1. Instructions to Field Personnel

Section 4.1.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

4.1.2. Sample Control and Documentation

Section 4.1.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception.

Reference to "Operable Unit 9" in the OU9 Site-Wide QAPjP (DOE 1993) is replaced with "OU5" and Table IV.2 is replaced with Table IV.2 in this OU5 QAPjP .

4.1.3. Sample Containers, Preservation, and Holding Times

Section 4.1.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

4.1.4. Sample Shipment

Section 4.1.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

4.1.5. Equipment Decontamination

Section 4.1.6 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

4.2. WATER SAMPLING

Section 4.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

4.3. SOIL/SEDIMENT SAMPLING

Section 4.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

Table IV.4 Sample Containers, Volumes, Preservation, and Holding Times: Soil/Sediment Samples
(page 1 of 2)

Parameters[d]	Analytical Method	Container[a]	Minimum[a] Volume/Weight	Preservation	Holding Time[b]
Volatile Organic Compounds	CLP SOW Modification D	Glass vial with Teflon-lined septum (no headspace)	120 mL (no headspace)	Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW Modification D	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[c]
Metals or Lanthanides	CLP SOW Modification A or C	Wide-mouth polyethylene bottle	1000 mL	HNO_3 to pH <2, Cool 4°C	6 months, 28 days (Mercury)
Cyanide	CLP SOW	Wide-mouth polyethylene bottle	100 grams	Cool 4°C	14 days
Fluoride	E340.2	Wide-mouth polyethylene bottle	50 grams	Cool 4°C	28 days
Nitrate-Nitrite, Chloride Sulfate	E353.2 SW9250 E375.2 or E375.4	Wide-mouth polyethylene bottle	100 grams	Cool 4°C	28 days
Cation Exchange Capacity	SW9081	Wide-mouth polyethylene bottle	100 grams	Cool 4°C	Not Applicable
Grain Size Distribution Specific Gravity Hydraulic Conductivity Relative Density Maximum Density Moisture Content	ASTM D422-63 ASTM D854-83 ASTM D2434-68 ASTM D4254-83 ASTM D4253-83 ASTM D2974-87	1-gallon wide-mouth plastic jar	5 lbs.	None	Not Applicable

Table IV.4 Sample Containers, Volumes, Preservation, and Holding Times: Soil/Sediment Samples (page 2 of 2)

Parameters[d]	Analytical Method	Container[a]	Minimum[e] Volume/Weight	Preservation	Holding Time[b]
Organic Content	ASTM D-2974-87	Wide-mouth ethylene bottle	500 grams	Airtight Cool 4°C	7 days
Explosives	SW8330	125-mL wide-mouth amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	7 days extraction/30 days analysis[c]
Radionuclides Gamma Spectrometry Plutonium Isotopes Thorium Isotopes Uranium Isotopes Strontium-90	 E901.1 E907.0 E907.0 E907.0 E905.0	Wide-mouth nalgene bottle	750 grams	None	Not Applicable
Tritium	E906.0	Glass bottle	750 grams	Cool 4°C	6 months

NOTE: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1, 1988. The laboratory must perform all analyses and any required re-analyses within the required holding times.

[a]Sample containers will be certified cleaned by the manufacturer according to EPA standards.

[b]From date of collection.

[c]From data of extraction

[d]A 40 mL glass vial will be filled with soil for each sample requiring chemical analyses. This vial will be labelled "% moisture" and will be used to determine % moisture for reporting purposes.

[e]For samples identified for MS/MSD pair or an MS, fill one additional set of containers and add "MS/MSD" or "MS" on the end of the sample ID for the additional containers.

4.4. OTHER FIELD ACTIVITIES

Section 4.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exceptions.

An exception is taken to this section of the OU9 Site-Wide QAPjP (DOE 1993), regarding activities for OU5 concerning groundwater measurements and monitoring wells that are not part of the OU5 scope. If activities are added to the OU5 work scope, these activities will be fully addressed in area-specific FSPs. If changes include information required in a QAPjP, a QAPjP addendum will be written for the activity or will be included in an OU5 QAPjP revision, subject to regulatory review. Procedures which may be required that have not been previously reviewed will become part of the QAPjP, QAPjP addendum or appendices.

4.5. SUMMARY OF SAMPLING ACTIVITIES

Section 4.5 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Summary tables will be prepared for specific areas within OU5 as part of the planning and will be located in the respective FSP. These will identify sample matrix, analytical parameters, investigative samples, and field QA samples to be collected and measured. Target analytes identified by each area FSP will be governed by the approach taken in this OU5 QAPjP and the OU9 Site-Wide QAPjP. It will not be necessary for each OU5 area FSP to include all analytes identified in Section 6 of this OU5 QAPjP. It will, however, be necessary for all sampling and analysis to follow the quality assurance requirements defined here and as required to compute the area specific data quality objective.

4.6. FIELD VARIANCE SYSTEM

Section 4.6 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

Procedures cannot fully encompass all conditions encountered during a field investigation. Variances from operating procedures, the Work Plan, the Sampling and Analysis Plan (SAP), and/or the Health and Safety

Plan (HSP) will, therefore, likely occur and must be documented on a field change order form or a nonconformance report (NCR) and be noted in the appropriate logbooks. If a variance is anticipated (e.g., due to a change in field instrumentation), the applicable procedure should be modified and the change noted in the field logbooks.

The Field Team Leader or his designee will initiate and chronologically maintain a field change order log and an NCR log. Field changes fall into two categories, minor and major, as described below. As appropriate, EG&G, DOE and regulatory agencies will be notified of any variances that significantly affect project scope or objectives, and approval from the agencies will be obtained as necessary. Any variances from the HSP must be approved by the H&S Officer. Copies of the field change order form will be maintained by the sampling teams until the field work is complete and will then be forwarded to the Contractor Project Manager for inclusion in the project file and the Contractor Central Records Facility (CRF).

4.6.1. Minor Field Change

Section 4.6.1 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

A minor field change is one that does not affect the objectives of the FSP and may be approved by the Contractor Field Team Leader by noting it in the field logbook. A slight change in the sampling location due to a physical obstruction is an example of a minor change.

4.6.2. Major Field Change

Section 4.6.2 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

A major field change is one that affects the field sampling objectives and/or schedule and may require EPA, DOE, and/or state approval. The major field change must be approved by the site Contractor Project Manager. These changes may require a change in the program. An example of a major field change is

the decision to significantly change the sampling locations or the deletion or non-performance of a requirement of the Work Plan.

5. SAMPLE CUSTODY

Section 5 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exceptions.

All References to "Operable Unit 9" under this section and all associated subsections in the OU9 Site-Wide QAPjP (DOE 1993) are replaced with "Operable Unit 5" for this section of the OU5 QAPjP. All references to "Weston" personnel and organization are replaced with "SAIC" for the OU5 QAPjP. Figure 5.1 of the OU9 QAPjP will be replaced with Figure 5.1 of this document. This provides the same intent for maintaining chain of custody but is specific to SAIC as the OU5 Contractor.

5.1. CHAIN OF CUSTODY

5.1.1. Field Custody Procedures

Section 5.1.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.1.2. Laboratory Custody Procedures

Section 5.1.2 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

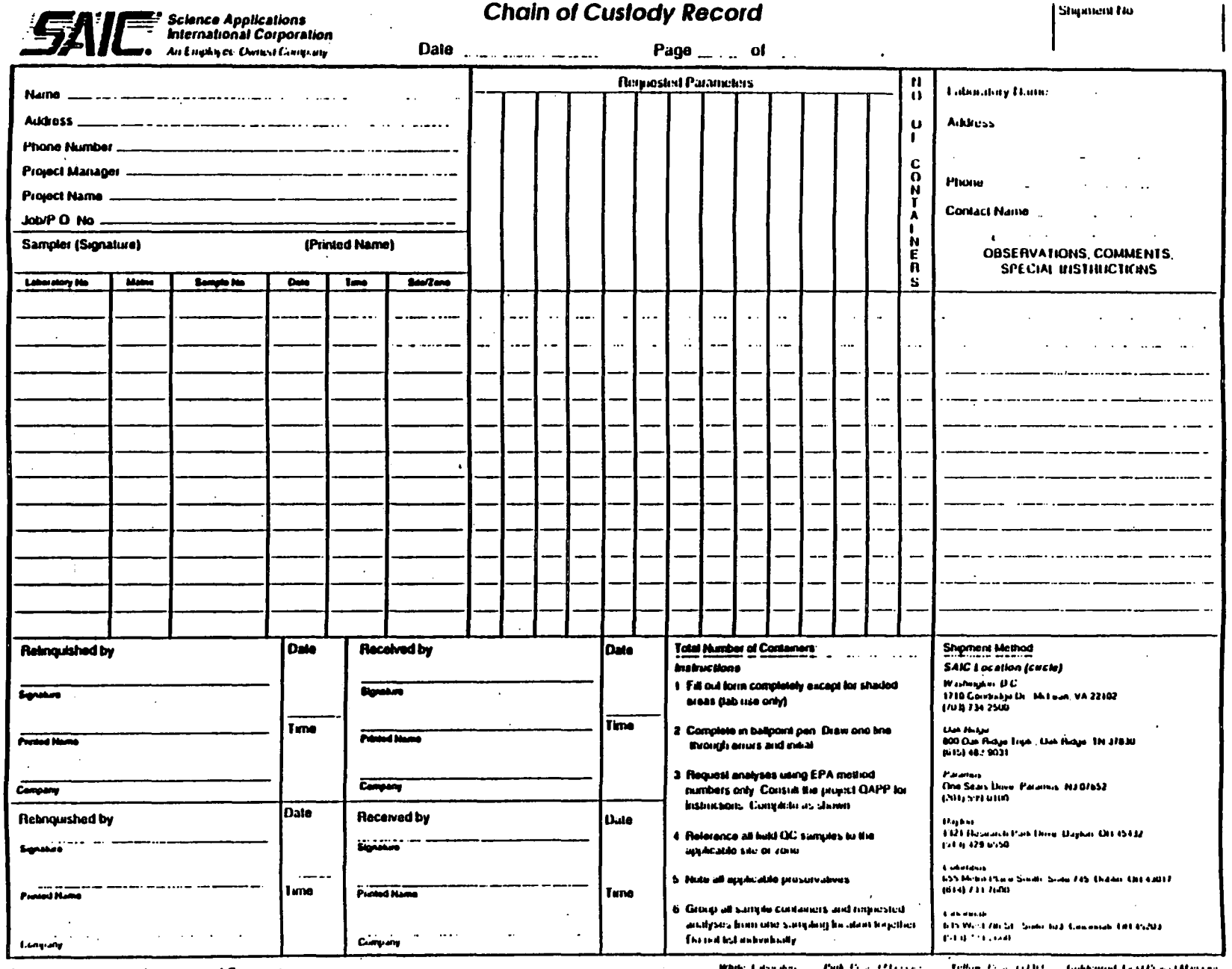
Sample custody procedures in the laboratory include the procedures for general security, sample receipt, storage, preparation, and analysis. Once laboratories have been chosen for area-specific sampling events, laboratory specification attachments will describe these procedures unique for the given laboratory. The following subsections in the OU9 Site-Wide QAPjP (DOE 1993) describe the minimum general requirements for the laboratory.

5.1.2.1. Sample Receipt

Section 5.1.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.1.2.2. Sample Storage

Section 5.1.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.



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An Employee Owned Company

Chain of Custody Record

Date _____ Page ___ of ___

Shipment No

Name _____
Address _____
Phone Number _____
Project Manager _____
Project Name _____
Job/P O No _____
Sampler (Signature) (Printed Name)

Requested Parameters

NO OF CONTAINERS

Laboratory Name:
Address
Phone
Contact Name

OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS

Laboratory No	Matrix	Sample No	Date	Time	Site/Zone

Relinquished by
Signature
Printed Name
Company
Date
Time

Received by
Signature
Printed Name
Company
Date
Time

Relinquished by
Signature
Printed Name
Company
Date
Time

Received by
Signature
Printed Name
Company
Date
Time

Total Number of Containers

Instructions

1 Fill out form completely except for shaded areas (lab use only)

2 Complete in ballpoint pen Draw one line through errors and initial

3 Request analyses using EPA method numbers only Consult the project QAPP for instructions Complete as shown

4 Reference all field QC samples to the applicable site or zone

5 Note all applicable preservatives

6 Group all sample containers and requested analyses from one sampling location together (listed individually

Shipment Method

SAIC Location (circle)

Washington DC
1710 Goodridge Dr McLean VA 22102
(703) 734 2500

Oak Ridge
800 Oak Ridge Turn Oak Ridge TN 37830
(615) 481 9031

Princeton
One Sears Drive Paramus NJ 07652
(201) 587 0100

Dayton
4031 Research Park Drive Dayton OH 45432
(513) 429 6450

Cincinnati
655 Metro Place South Suite 745 Dublin OH 43017
(614) 761 7080

Cincinnati
615 W 131st St Suite 310 Cincinnati OH 45203
(513) 771 1440

Science Applications International Corporation

White Laboratory Pink Originator Yellow Project Manager Goldenrod Receiving Laboratory

Figure 5.1. Chain of Custody Record.

5.1.2.3. Sample Tracking

Section 5.1.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.1.2.4. Record Keeping

Section 5.1.2.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.2. DOCUMENTATION

5.2.1. Field Logs

Section 5.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.2.2. Data Collection Forms

Section 5.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.2.3. Corrections to Documentation

Section 5.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.2.4. Sampling Tracking

Section 5.2.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.3. SAMPLING HANDLING, PACKAGING AND SHIPPING

Section 5.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.4. FINAL EVIDENCE FILE DOCUMENTATION

Section 5.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

5.5. FINAL EVIDENCE FILE CONTROL

Section 5.5 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

Section 5.5 "Final Evidence File Control" is added to the OU5 QAPjP as an overview of the records control efforts that will be established for this work. This project will require the administration of a central project file. The data and records management protocols will provide adequate controls and retention of all materials related to the project. Record control will include receipt from external sources, transmittal, transfer to storage and indication of record status. Record retention will include receipt at storage areas, indexing, filing, storage, maintenance, and retrieval.

5.5.1. Record Control

Section 5.5 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

All incoming materials related to the project including sketches, correspondence, authorizations, and logs shall be forwarded to the Contractor Project Manager or designated assistant. These documents will be placed in the project file as soon as practical. If correspondence is needed for reference by project personnel, a copy will be made rather than retaining the original. All records shall be legible and easily identifiable. Examples of the types of records that will be maintained in the project file are:

- field documents;
- correspondence;
- photographs;
- laboratory data;
- reports; and,
- procurement agreements.

Outgoing project correspondence and reports must be reviewed and signed by the Project Manager prior to mailing. The office copy of all outgoing documents shall bear distribution information.

5.5.2. Record Status

Section 5.5.2 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

To prevent the inadvertent use of obsolete or superseded project-related procedures, all personnel of the laboratory and project staffs will be responsible for reporting changes in protocol to the Project Manager and/or the Laboratory Manager. The Project Manager and/or Laboratory Manager will then inform the project and laboratory staffs and the Project Quality Assurance Officer of these changes.

Revisions to procedures will be subject to the same level of review and approval as the original document. The revised document will be distributed to all holders of the original document and discussed with project personnel. Outdated procedures will be marked "void". The voided document may be destroyed at the request of the Project Manager. However, one copy of the voided document will be maintained in the project file. The reasons why and the date the document was voided should be recorded.

5.5.3. Record Storage

Section 5.5.3 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

All project related information will be maintained by the Contractor. Designated personnel will assure that incoming records are legible and are in suitable condition for storage. A records index will be initiated at the beginning of the overall project. Each document that is placed into the project file will be logged. The logging of the records will be the responsibility of the Project Manager or his designee. Record storage will be performed in two stages:

- storage during and immediately following the project; and,
- permanent storage of records directly related to the project.

Both phases will use storage facilities that provide a suitable environment to minimize deterioration or damage and prevent loss. The facilities will have controlled access and will provide protection from excess moisture and temperature extremes. Records will be secured in steel file cabinets labeled with the appropriate project identification. The removal of records from all files during both stages will be controlled by the use of withdrawal cards.

At the completion of the project, the Project Manager or his appointed document custodian will be responsible for inventorying the project file. The records contained in the project file will be compared against the records listed on the file index sheets. Discrepancies must be resolved prior to transferring the file to a permanent storage facility. All project records will be provided to EG&G Mound in hard copy and electronic format, when appropriate, on completion of the RI/FS for each prioritized study area. Copies of these records will be kept for a period of three years by the Subcontractor following the close of this project.

5.5.4. On-Site Control

Section 5.5.3 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

A secure file, similar to the project central file, will be established and maintained by field personnel under the direction of the Field Team Leader. Upon completion of the field program, the on-site file will be transferred to and integrated with the office project files.

6. ANALYTICAL PROCEDURES

Table VI.1 of OU9 Site-Wide QAPjP, as modified for OU5, is presented in this document as Table VI.1. Residential well samples or drinking water samples will not be analyzed as part of the OU5 scope.

6.1. FIELD MEASUREMENTS AND SCREENING

Section 6.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.1. Specific Conductance

Section 6.1.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.2. pH

Section 6.1.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.3. Dissolved Oxygen

Section 6.1.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.4. Temperature

Section 6.1.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.5. Combustible Gas

Section 6.1.5 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.6. Organic Vapor

Section 6.1.6 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.7. Radionuclide Screening

Section 6.1.7 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 1 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Volatile Organic Compounds (VOCs)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
Chloromethane			10	10
Bromomethane			10	10
Vinyl Chloride			10	10
Chloroethane			10	10
Methylene chloride			5	5
Acetone			10	10
Carbon disulfide			5	5
1,1-Dichloroethene			5	5
1,1-Dichloroethane			5	5
1,2-Dichloroethene (total)			5	5
Chloroform			5	5
1,2-Dichloroethane			5	5
2-Butanone			10	10
1,1,1-Trichloroethane			5	5
Carbon Tetrachloride			5	5
Vinyl Acetate			10	10
Bromodichloromethane			5	5
1,2-Dichloropropane			5	5
cis-1,3-dichloropropene			5	5
Trichloroethene			5	5
Dibromochloromethane			5	5
1,1,2-Trichloroethane			5	5
Benzene			5	5
trans-1,3-dichloropropene			5	5
Tribromomethane			5	5
4-Methyl-2-pentanone			10	10

Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 2 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Volatile Organic Compounds (VOCs) (cont.)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
2-Hexanone			10	10
Tetrachloroethene			5	5
Toluene			5	5
1,1,2,2-Tetrachloroethane			5	5
Chlorobenzene			5	5
Ethylbenzene			5	5
Styrene			5	5
Xylenes (total)			5	5
Additional compounds:				
Acrylonitrile			100	100
Acetronitrile			100	100
Diethylbenzene			5	20
Trichlorotrifluoroethane			5	10
Hexane			10	10
Iodomethane			NA	10
Semivolatile Organic Compounds (SVOC)	**CLP SOW[b] Modification D**	**CLP SOW[b] Modification D**		**Low Soil/Sediment[c]**
Phenol			10	330
bis(2-chloroethyl) ether			10	330
2-Chlorophenol			10	330
1,3-Dichlorobenzene			10	330
1,4-Dichlorobenzene			10	330
Benzyl alcohol			10	330
1,2-Dichlorobenzene			10	330
2-Methylphenol			10	330
bis(2-chloroisopropyl) ether			10	330

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 3 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Semivolatile Organic Compounds (SVOC) (cont'd)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
4-Methylphenol			10	330
N-nitroso-di-n-dipropylamine			10	330
Hexachlorethane			10	330
Nitrobenzene			10	330
Isophorone			10	330
2-Nitrophenol			10	330
2,4-Dimethylphenol			10	330
Benzoic Acid			50	1600
bis(2-chloroethoxy) methane			10	330
2,4-Dichlorophenol			10	330
1,2,4-Trichlorobenzene			10	330
Naphthalene			10	330
4-Chloroaniline			10	330
Hexachlorobutadiene			10	330
4-chloro-3-methylphenol			10	330
(para-chloro-meta-cresol)				
2-Methylnaphthalene			10	330
Hexachlorocyclopentadiene			10	330
2,4,6-Trichlorophenol			10	330
2,4,5-Trichlorophenol			50	1600
2-Chloronaphthalene			10	330
2-Nitroaniline			50	1600
Dimethylphthalate			10	330
Acenaphthylene			10	330
2,6-Dinitrotoluene			10	330
3-Nitroaniline			50	1600

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 4 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Semivolatile Organic Compounds (SVOC) (cont'd)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
Acenaphthene			10	330
2,4-Dinitrophenol			50	1600
4-Nitrophenol			50	1600
Dibenzofuran			10	330
2,4-Dinitrotoluene			10	330
Diethylphthalate			10	330
4-Chlorophenyl-phenyl ether			10	330
Fluorene			10	330
4-Nitroaniline			50	1600
4,6-Dinitro-2-methylphenol			50	1600
N-nitrosodiphenylamine			10	330
4-bromophenyl-phenylether			10	330
Hexachlorobenzene			10	330
Pentachlorophenol			50	1600
Phenanthrene			10	330
Anthracene			10	330
Di-n-butylphthalate			10	330
Fluoranthene			10	330
Pyrene			10	330
Butylbenzylphthalate			10	330
3,3'-Dichlorobenzidine			20	660
Benzo(a)anthracene			10	330
Chrysene			10	330
bis(2-Ethylhexyl)phthalate			10	330
Di-n-octylphthalate			10	330
Benzo(b)fluoranthene			10	330

Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 5 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Semivolatile Organic Compounds (SVOC) (cont'd)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
Benzo(k)fluoranthene			10	330
Benzo(a)pyrene			10	330
Indeno(1,2,3-cd)pyrene			10	330
Dibenzo(a,h)anthracene			10	330
Benzo(g,h,i)perylene			10	330
Additional Compounds				
2-benzyl-4-chlorophenol			10	330
Volatile Organic Compounds (VOCs), Groundwater				
Purgeable Halocarbons	SW5030/ SW8010[d]	NA		
Vinyl chloride			1.0	NA
Trichlorofluoromethane			2.0	NA
1,1-dichloroethene			1.3	NA
Methylene chloride			5.0	NA
1,1-dichloroethane			0.7	NA
Trichloromethane			0.5	NA
1,1,1-trichloroethane			0.3	NA
Carbon tetrachloride			1.2	NA
1,2-dichloroethane			0.3	NA
Trans-1,2-dichloroethene			1.0	NA
Cis-1,2-dichloroethene			1.0	NA
Trichloroethene			1.2	NA
1,2-dichloropropane			0.4	NA
Bromodichloromethane			1.0	NA
Dibromomethane			2.0	NA
2-chloroethyl vinyl ether			1.3	NA
Cis-1,3-dichloropropene			3.4	NA

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 6 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Purgeable Halocarbons (cont'd)	SW5030/ SW8010[g]	NA		
Trans-1,3-dichloropropene			3.4	NA
1,1,2-trichloroethane			0.2	NA
Tetrachloroethene			0.3	NA
Dibromochloromethane			0.9	NA
1-chlorohexane			1.0	NA
Chlorobenzene			2.5	NA
1,1,1,2-tetrachloroethane			1.0	NA
Bromoform			2.0	NA
1,1,2,2-tetrachloroethane			0.3	NA
1,2,3-trichloropropane			1.0	NA
Phenyl bromide			2.0	NA
Chlorotoluene			1.0	NA
1,3-dichlorobenzene			3.2	NA
1,4-dichlorobenzene			2.4	NA
1,2-dichlorobenzene			1.5	NA
Bis(2-chloroisoproply) ether			20	NA
Additional Compounds:				
Trichlorotrifluoroethane			2	NA
Purgeable Aromatic Compounds, Groundwater	SW5030/ SW8020[g]	NA		
Benzene			2.0	NA
Chlorobenzene			2.0	NA
1,2-Dichlorobenzene			4.0	NA
1,3-Dichlorobenzene			4.0	NA
1,4-Dichlorobenzene			3.0	NA
Ethylbenzene			2.0	NA
Toluene			2.0	NA

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 7 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Purgeable Aromatic Compounds, Groundwater (cont'd)	SW5030/ SW8020[g]	NA		
Xylenes			2.0	NA
Additional Compounds:				
Diethylbenzene			1	NA
Vinyl acetate			3	NA
Carbon disulfide			5	NA
Acetone			20	NA
Methylethyl ketone (2-butanone)			10	NA
Methylisobutyl ketone (4-methyl-2-pentanone)			5	NA
Additional Compounds:				
Acrylonitrile	SW5030/ SW8030[g]	NA	10	100
Acetonitrile	SW5030/ SW8030[g]	NA	10	100
Pesticides and PCBs	CLP SOW[b]	CLP SOW[b]		
alpha-BHC			0.05	1.7
beta-BHC			0.05	1.7
delta-BHC			0.05	1.7
gamma-BHC (Lindane)			0.05	1.7
Heptachlor			0.05	1.7
Aldrin			0.05	1.7
Heptachlor epoxide			0.05	1.7
Endosulfan I			0.05	1.7
Dieldrin			0.10	3.3
4,4'-DDE			0.10	3.3
Endrin			0.10	3.3
Endosulfan II			0.10	3.3

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 8 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Pesticides and PCBs (cont'd)	CLP SOW[b]	CLP SOW[b]		
4,4'-DDD			0.10	3.3
Endosulfan sulfate			0.10	3.3
4,4'-DDT			0.10	3.3
Methoxychlor			0.5	17.0
Endrin ketone			0.10	3.3
Endrin aldehyde			0.10	3.3
alpha-Chlordane			0.05	1.7
gamma-Chlordane			0.05	1.7
Toxaphene			5.0	170.0
Aroclor-1016			0.5	33.0
Aroclor-1221			0.5	67.0
Aroclor-1232			0.5	33.0
Aroclor-1242			0.5	33.0
Aroclor-1248			0.5	33.0
Aroclor-1254			0.5	33.0
Aroclor-1260			0.5	33.0
Metals (Target Analyte List)	CLP SOW[d] Modification A	CLP SOW[d] Modification A		(mg/kg)
Aluminum			20	4
Antimony			10	2
Arsenic			10	2
Barium			200	40
Berylium			1	0.2
Cadium			5	1
Calcium			5000	1000
Chromium			10	2
Cobalt			50	10
Copper			25	5

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 9 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Metals (Target Analyte List) (cont'd)	CLP SOW[d] Modification A	CLP SOW[d] Modification A		(mg/kg)
Iron			100	20
Lead			3	0.6
Magnesium			5000	1000
Manganese			15	3
Mercury			0.2	0.04
Nickel			40	8
Potassium			5000	1000
Selenium			5	1
Silver			10	2
Sodium			5000	1000
Thallium			10	2
Vanadium			10	2
Zinc			20	4
Additional Elements:				
Molybednum			20	2
Tin			50	10
Bismuth			150	30
Lithium			100	10
Cyanide	CLP SOW[d]	CLP SOW[d]	10	2
Hexavalent Chromium	SW7196	NA	50	NA
Common Anions			(mg/L)	(mg/kg)
Nitrate-Nitrite	E353.2[e]	E353.2[e]	0.2	2[f]
Chloride	E325.1[e]	SW9250[g]	1.0	5[f]
Sulfate	E375.2[e] or E375.4[e]	E375.2[e] or E375.4[e]	5	50[f]
Fluoride	E340.2[e]	E340.2[e]	0.1	0.025[f]

**Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 10 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Indicator Parameters				
Total Nitrogen	E353.1[e]	NA	0.10	NA
Total Phosphorous	E365.1[e]	NA	0.10	NA
Total Organic Carbon (TOC)	E415.1/E415.2[e]	NA	1	NA
Total Dissolved Solids (TDS)	E160.1[e]	NA	4	NA
Total Suspended Solids (TSS)	E160.2[e]	NA	10	NA
Cation Exchange Capacity	NA	SW9081[a,h]	NA	5 mg/L
Particle Size Analysis	NA	ASTM D422-63[i]	NA	NA
Specific Gravity	NA	ASTM D854-83[i]	NA	NA
Moisture Content	NA	ASTM D2974[i]	NA	NA
Organic Content	NA	ASTM D2974-87[i]	NA	NA
Hydraulic Conductivity	NA	ASTM D2434-68[i]	NA	NA
Relative and Minimum Density	NA	ASTM D4254-83[i]	NA	NA
Maximum Density	NA	ASTM D4254-83[i]	NA	NA
Explosives	SW8330	SW8330		(mg/kg)
HMX			20	3.0
RDX			6.0	2.5
NB			15	1.5
1,3-DNB			15	1.5
1,3,5-TNB			15	1.5
2,4-DNT			0.5	0.5
2,6-DNT			0.5	1.5
TNT			3.0	1.5
2A,4,6-DNT			3.0	1.5
Tetryl			3.0	2.5
PETN			TBD	TBD

Table VI.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 11 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Radionuclides			(pCi/L)	(Pci/g dry)
Gamma Spectrometry	E901.1[i]	E901.1[i]		
Americium-241 (soils)			NA	1[k]
Cobalt-60			20[j]	1[k]
Cesium-137			20[j]	1[k]
Bismuth-210m			15[j]	1[k]
Bismuth-207			15[j]	1[k]
Potassium-40			20[j]	10[k]
Radium-226 (soils)			NA	0.3[k]
Alpha Spectrometry	E907.0[e]	E907.0[e]		
Americum-241 (water)			1[j]	NA
Plutonium-238,239,240			1[j]	1[a]
Thorium-227,228,230,232			1[j]	1[a]
Uranium-234,235,238			1	0.6
Actinium-227			TBD	TBD
Radium-226	E903.1[i]	NA	1[q]	NA
Strontium-90	E905.1[i]	E905.1[i]	5	1[a]
Tritium	E906.0[i]	E906.1[i]	500	50[m]
Lanthanides	NA	CLP SOW Modification C		(mg/kg)
Lanthanum			NA	40
Cerium			NA	40
Praseodymium			NA	40
Neodymium			NA	40
Samarium			NA	40
Europium			NA	40
Gadolinium			NA	40
Terbium			NA	40

Table VL1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 12 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Lanthanides	NA	CLP SOW Modification C		(mg/kg)
Dysrposium			NA	40
Holmium			NA	40
Erbium			NA	40
Thulium			NA	40
Ytterbium			NA	40
Lutetium			NA	40
Asbestos	NA		NA	

NA = Not Applicable
TBD = To Be Determined

[a] For non-CLP analyses, these are expected method detection limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample column or weight, percent moisture (where applicable), and the dilution factor, if any. The quantitation limits for additional non-routine analytes attached to the TAL of CLP SOWs may vary, depending upon the results of laboratory studies.

[b] "U.S. EPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration," Document No. OLM01.8. Quantitation limits are contract-required quantitation limits (CRQLs) with the exception of additional organic compounds. The minimum quantitation limits will be reported by the laboratory.

[c] Medium Soil/Sediment CRQLs are 125 times the low soil/sediment CRQLs for volatile organic compounds and 60 times the low soil/sediment CRQLs for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-gram sample diluted to 200 mL

[d] "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration," Document No. ILM01.0. Quantitation limits are CRQLs except for vanadium, beryllium, antimony, aluminum, tin, bismuth, molybdenum, and lithium. The minimum quantitation limits will be reported by the laboratory.

[e] The 907.0 method will be used to perform the chemical separation, but alpha spectrometry will be employed to discriminate the isotopes. Actinium-227 is calculated from Thorium-227 analysis.

[f] Based on a 10-gram soil sample and 100 ml volume of extractant and a soil moisture content between 0 and 10 percent (rounded). Actual quantitation limit will vary with the sample and extractant amounts and depend upon the nature of the soil matrix.

[g] "Test Methods for Evaluation Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, U.S. EPA, Proposed Update II, June 1990.

[h] If soils are acidic, CEC will be determined by "Method of Soil Analysis, Part 2 Chemical and Microbiological Properties," by H.D. Chapman, American Society of Agronomists, 1965.

[i] "1991 Annual Book of American Society of Testing Materials Standards," Section 4, Construction, Volume 04.08, Soil and Rock, Building Stones, Geotextiles," ASTM 1990.

[j] Based on 900 ml sample size.

[k] Based on 650 gram dry sample.

[l] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.

[m] Dependent upon percent moisture in sample, based on 10 grams.

[n] Based on 2 gram dry sample.

[p] By calculation from Thorium-277.

[q] Based on 1000 ml sample size.

6.1.8. Water Level

Section 6.1.8 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.1.9. Oxidation-Reduction (Redox) Potential

Section 6.1.9 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2. LABORATORY ANALYTICAL METHODS

Section 6.2 in the OU9 Site-Wide QAPjP does not apply to the OU5 QAPjP.

Groundwater, surface water and soil/sediment samples collected for OU5 will be analyzed either in accordance with the EPA CLP Statement of Work (SOW) for the Target Analyte List (TAL) of inorganics and Target Compound List (TCL) of volatile, semivolatile, and pesticide/PCB organic compounds or in accordance with other standard analytical methods (e.g., American Society for Testing and Materials [ASTM] or EPA) where applicable. Laboratory quality control procedures for both CLP and non-CLP analyses are summarized in Table III.2. The versions of the CLP SOW for this program are: organic analyses, OLM01.8 (EPA 1990a) and inorganic analyses, ILM01.0 (EPA 1990b). Newer versions of the CLP SOW will not invalidate the data collected using the current revision of the SOW. Laboratory data reports for each analysis will contain sufficient information to perform data validation/review. Reporting requirements are identified in subsection 9.2.3. The following subsections summarize the analytical procedures.

The list of analytes for each analytical method and the program required detection limits are presented in Table VI.1 for groundwater, surface water, and soil/sediment samples. Additional compounds or elements have been added to the list of semivolatile and volatile organic compounds and metals. They are noted as such on Table VI.1. The limit of detection for each analyte is best expressed as a quantitation limit that is defined as the "lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions" (EPA 1986). This limit may vary significantly depending upon the sample matrix, and, as a final reported limit, will vary with the weight or volume of sample used, percent moisture (where applicable), and the dilution factor, if any. The limits listed in Table VI.1 are the minimum achievable quantitation limits expected from the laboratory with analysis of clean

sample matrices of a given sample volume or weight. Actual laboratory established quantitation limits are listed in the laboratory specifications attachments. The quantitation limits for the nonroutine parameters added to existing methods may vary once the method validation study is completed for each additional analyte.

If a laboratory must deviate significantly from the approved methodology set forth in the OU5 QAPjP, the laboratory will submit a Statement of Work (SOW) for approval prior to analysis. The SOW will follow the same outline as SW 846. The format of the SOW provides guidelines on performing the method and does not provide the step-by-step procedures on conducting the analysis. A copy of this SOW will be appended to this QAPjP and submitted for approval.

6.2.1. Volatile Organic Compounds

Section 6.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Groundwater and surface water samples will be analyzed for halogenated and aromatic VOCs using gas chromatography with a Hall electrolytic conductivity detector and a photoionization detector. The methodologies to be followed are EPA methods 8010 for halogenated compounds and 8020 for aromatic compounds (EPA 1986). These methods were chosen over the CLP SOW for groundwater samples in order to achieve lower detection limits. A capillary column (either RTX 502.2, DB-624 or equivalent), which can resolve those compounds listed on Table VI.I, will be required for this method to obtain better resolution. Because some of the additional VOCs may coelute with other compounds on the specified capillary column, a GC/MS confirmation or second column confirmation will be performed for any detection at the same retention times. If GC/MS confirmation is used, then the data must be reported per the CLP specifications as described in Subsection 9.2.3.

Surface water samples will be analyzed for halogenated and aromatic VOCs by the CLP SOW using gas chromatography/mass spectroscopy (GC/MS) as a means for compound identification. Capillary columns as specified in the method will be employed. A modification to the CLP SOW (Modification D) has been prepared to account for six additional volatile organic compounds: acrylonitrile, acetonitrile, trichlorotrifluoroethane, iodomethane, hexane, and diethyl benzene.

Soil/sediment samples will be analyzed for VOCs by the CLP SOW using gas chromatography/mass spectroscopy (GC/MS) as a means for compound identification and quantification. A modification to the CLP SOW (Modification D) has been prepared to account for six additional volatile organic compounds: acrylonitrile, acetonitrile, trichlorotrifluoroethane, iodomethane, hexane, and diethyl benzene.
EPA Method 8030 with the purge and trap technique (5030) will be used to identify acrylonitrile and acetonitrile in groundwater samples. This gas chromatography method uses a flame ionization detector to detect these volatile organic compounds.

6.2.2. Semivolatile Organic Compounds

Section 6.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Document number OLM01.8 (EPA 1990a), using gas chromatography/mass spectrometry, will be the methodology followed for semivolatile organic compound analysis of groundwater, surface water, and soil/sediment samples. Benzoic acid, 2-Benzyl-4 chlorophenol and benzyl alcohol have been added to this method. A modification (Modification D) to the CLP SOW has been prepared to accommodate these additional compounds.

6.2.3. Pesticides/PCBs

Section 6.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

The CLP SOW document number, OLM01.8 (EPA 1990a), will be used to analyze groundwater, surface water, and soil/sediment samples. This method uses gas chromatography for separating and identifying the TCL pesticide/PCB Compounds.

6.2.4. Metals

Section 6.2.4 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Groundwater, surface water, and soil/sediment samples will be analyzed for the TAL of metals according to the CLP SOW (EPA 1990b). Inductively coupled plasma (ICP) will be used to detect all the TAL metals with the exception of mercury, arsenic, lead, selenium, thallium, and potassium, which will be

detected by atomic absorption (AA) (flame AA for potassium, cold vapor AA for mercury, and graphite AA for the others). Additional elements to be detected by ICP are: bismuth, molybdenum, and tin. The additional element lithium will be detected by flame AA. These modifications to the method have been prepared as "Modification A" to the CLP SOW. ICP metals will also be digested according to EPA Method 200.7 with a fourfold concentration in order to reach lower detection limits for aluminum, antimony, beryllium, and vanadium.

6.2.5. Radionuclides

Section 6.2.5 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Groundwater, surface water and soil/sediment samples will be analyzed for isotopic plutonium, isotopic thorium, isotopic uranium and americium-241 (water) by alpha spectrometry (Method E907.0). Alpha spectrometry is used to detect alpha emissions from the isotopes of interest. A surface barrier detector is used for identifying plutonium, uranium and thorium isotopes. Specific isotopes from alpha spectrometry include americium-241 (water), plutonium-238, 239/240, uranium-234, uranium-235, uranium-238 and thorium-227 (for calculation of actinium-227) thorium-228, thorium-230, and thorium-232.

Strontium 90 is analyzed by E905.1 and radium-226 (water) by E903.1.

6.2.5.1. Alpha Spectrometry

Section 6.2.5.1 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Specific isotopes from alpha spectrometry include americium-241 (water), plutonium-238, 239/240, uranium-234, uranium-235, uranium-238 and thorium-227 (for calculation of actinium-227) thorium-228, thorium-230, and thorium-232. Soil samples are prepared using acid digestion procedures to concentrate the isotopes of interest in an aqueous matrix. The alpha emitting isotopes in these acid extracts and in water samples are precipitated from the aqueous solution. The precipitates are redissolved and subjected to a sequential separation of alpha isotopes by elution from anion/cation exchange resins. The separated alpha isotopes are counted using a surface barrier detector.

6.2.5.2. Strontium-90

Section 6.2.5.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.5.3. Gamma Spectrometry

Section 6.2.5.3 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Gamma spectrometry measures gamma radiation over a given spectrum and will be used to determine the gamma radiation levels in water and soil/sediment samples. Particular isotopes of interest that will be detected as gamma radiation are radium-226 (soil samples), bismuth-210 metastable, americium-241 (soil samples), cobalt-60, cesium-137, bismuth-207, polonium-210, and potassium-40. Analysis will be performed according to E901.1. The detection limits listed on Table VI.1 are based on cesium-137 and assume no interfering lines. Detection limits of individual isotopes may vary.

6.2.5.4. Tritium

Section 6.2.5.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.6. Explosives

Section 6.2.6 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Groundwater, surface water and soil/sediment samples will be analyzed for explosives using EPA SW846 Method 8330 high performance liquid chromatography (HPLC). A laboratory SOW based on this reference will define the protocol to be implemented in the determination of PETN.

6.2.7. Chloride, Nitrate-Nitrite, Sulfate, Ammonia, Fluoride and Total Phosphorous

Section 6.2.7 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.8. Total Kjeldahl Nitrogen

Section 6.2.8 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.9. Total Organic Carbon

Section 6.2.9 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Groundwater/surface water samples will be analyzed for total organic carbon (TOC), using EPA 415.1 or 415.2. Analysis consists of converting organic carbon to carbon dioxide, which is detected by a nondispersive infrared detector. Soil/sediment samples undergo a pyrolysis to release the carbon dioxide to be detected.

6.2.10. Nitrite, Soil pH, and Alkalinity

Section 6.2.10 in the OU9 Site-Wide QAPjP (DOE 1993) is applicable to the OU5 QAPjP for soil pH only.

Soil pH will be performed according to the SW-846 electrometric procedure; SW-9045.

6.2.11. Total Dissolved Solids (TDS) and Total Suspended Solids (TSS)

Section 6.2.11 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.12. Cation Exchange Capacity (CEC), Specific Gravity, Particle Size Analysis, Hydraulic Conductivity, Organic Content, Soil Moisture, and Relative Density

Section 6.2.12 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.13. Cyanide

Section 6.2.13 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.14. Lanthanides

Section 6.2.14 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

6.2.15. Clay Mineralogy

Section 6.2.15 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7. CALIBRATION PROCEDURES AND FREQUENCY

Section 7 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1. FIELD EQUIPMENT

Section 7.1 in the OU9 Site-Wide QAPjP (QAPjP) does not apply to the OU5 QAPjP.

Applicable field instruments to be used during the investigation will be calibrated according to the specifications set forth in the respective Mound Plant ER Program SOPs (Appendix A of the OU9 Site-Wide QAPjP (DOE 1993)). Instruments will be calibrated at least once per day during field use. Table III.1 in Section 3 summarizes the calibration procedures, frequency of calibration and acceptance criteria necessary for the calibration to be valid for applicable field measurements and field screening.

Records for each field instrument used as part of this program will be maintained to ensure its capability of providing accurate and precise measurements. Records will be maintained on instrument maintenance and calibration. Such records will be reviewed prior to their use in the field. Tracking of instrument records will be accomplished by assigning a unique number to each instrument that will correspond to its records file.

Summaries of the field measurement and field screening instruments that may be used in the field during the environmental investigation are presented in the OU9 Site-Wide QAPjP (DOE 1993).

7.1.1. Photoionization Detector (PID)

Section 7.1.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.2. Explosimeter/Combustible Gas Indicator (CGI)

Section 7.1.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.3. Specific Conductance Meter

Section 7.1.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

pH Meter

7.1.4. pH Meter

Section 7.1.4 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.5. Datalogger and Pressure Transducer or Equivalent Water Level Measuring Device

Section 7.1.5 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.6. Zinc Sulfide Alpha Scintillometer

Section 7.1.6 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.7. Field Instrument for the Detection of Low-Energy Radiation (FIDLER)

Section 7.1.7 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.8. Dissolved Oxygen Meter

Section 7.1.8 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.9. Oxidation-Reduction (Redox) Potential

Section 7.1.9 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.1.10. Flame Ionization Detector (FID)

Section 7.1.10 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.2. LABORATORY EQUIPMENT

Section 7.2 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Laboratory instrument calibrations typically consist of two types, initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine

instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range with one standard being near, but above the instrument detection limit (IDL) and one near the upper limit of the detector. The instrument response over that range is commonly expressed as a correlation coefficient (e.g., UV-visible/infrared spectrophotometry) or by a response factor, amount/response (e.g., for GC, GC/MS, or high-performance liquid chromatography). Continuing calibration usually includes measurement of one or more calibration standards. The response is compared to the initial measured instrument response.

Instrument calibration procedures for CLP analyses will be performed according to the CLP SOW for inorganic and organic analyses. For non-CLP analyses, calibration procedures will be performed as described in the EPA or ASTM analytical method and in the approved laboratory SOWs. Calibration procedures for all laboratory analyses, along with frequency and acceptance criteria, are summarized in Table III.2 in Section 3. Summaries of calibration procedures are discussed in subsections of the OU9 Site-Wide QAPjP (DOE 1993).

7.2.1. Gas Chromatographic (GC) Analyses

Section 7.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Gas chromatography will be used for analysis of pesticides/PCBs (CLP SOW for organic analysis). Initial calibration is performed when chromatographic conditions are changed (e.g., change in flow rate, detectors, new column) or as required in the CLP SOW for pesticide/PCB analysis. A minimum of three standards for pesticide/PCB analysis of different concentrations, as specified in the method, are analyzed to determine the linearity of the gas chromatograph. Response factors for each compound are calculated (as specified in the methods) from the results, and a calibration curve generated. Linearity requirements and allowed percentage breakdown of endrin and 4,4'-DDT for pesticide/PCB analysis are presented in the methods.

The CLP SOW for pesticide/PCB analysis requires that the retention times be established and the retention time windows be determined for the target compounds and surrogate compound. The procedures and acceptance criteria are established in the methods.

7.2.2. Gas Chromatography/Mass Spectrometry (GC/MS) Analyses

Section 7.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPJP.

7.2.3. Inductively Coupled Plasma (ICP) and Atomic Absorption (AA) for Metals and Lanthanides and Spectrophotometry for Cyanide

Section 7.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.2.4. Alpha Spectrometry

Section 7.2.4 in the OU9 Site-Wide QAPjP (DOE 1992) applies to the OU5 QAPjP.

7.2.5. Gamma Spectrometry

Section 7.2.5 in the OU9 Site-Wide QAPjP (DOE 1992) applies to the OU5 QAPjP.

7.2.6. Liquid Scintillation

Section 7.2.6 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.2.7. High Performance Liquid Chromatography (HPLC)

Section 7.2.7 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.2.8. Colorimetry Ion Selective Electrode and Total Organic Carbon (TOC) Analysis

Section 7.2.8 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception.

Nitrite and Ammonia will not be analyzed in OU5.

7.2.9. pH Meter

Section 7.2.9 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.2.10. Cation Exchange (CEC), Specific Gravity, Particle Size Analysis, Hydraulic Conductivity, Organic Content, Soil Moisture, and Relative Density

Section 7.2.10 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

7.2.11. Clay Mineralogy

Section 7.2.11 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

8. INTERNAL QUALITY CONTROL CHECKS

Section 8 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception.

Table III.2 as referenced in this section of the OU9 Site-Wide QAPjP (DOE 1993) is replaced with Table III.2 in this OU5 QAPjP.

8.1. SCREENING AND FIELD MEASUREMENTS

Section 8.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exception.

Table III.1 as referenced in this section of the OU9 Site-Wide QAPjP (DOE 1993) is replaced with Table III.1 in this OU5 QAPjP.

8.2. FIELD SAMPLING

Section 8.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following additions.

All field blanks exhibiting levels of target parameter contamination in excess of 5X the analyte quantitation limit goal will require immediate notification of Project Manager. The project team will assess the impact on samples collected in association with the contaminated blank and implement appropriate corrective action (re-sampling, field procedure correction, etc.). Project validation of the associated sample data should result in qualification of the resulting information, without any potential limitations or restrictions on its useability.

OU5 field duplicates will be defined in area-specific sampling plans. Every attempt will be made through planning and implementation to utilize collocated field duplicates, which evaluate the heterogeneity of the sampled media and the reproducibility of the sampling procedures.

8.3. LABORATORY ANALYSES

Section 8.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exceptions.

Table III.2 in the OU9 Site-Wide QAPjP (DOE 1993) is replaced with Table III.2 in this OU5 QAPjP.

Discussions of Calibration Check Compounds (CCCs) and Systems Performance Check Compounds (SPCCs) no longer apply to EPA CLP SOW OLM01.8 (EPA 1990a) protocol; therefore, the EPA CLP SOW reference should be removed from their definition here. The CCC and SPCC terminologies are still commonly used and are utilized in SW846 methods; therefore, inclusion of the definitions are still appropriate in this section.

The definition of "Qualitative Verification" should be referenced as "Qualitative Identification". In general terms this applies to both Tentatively Identified Compounds (TICs) as defined by EPA CLP protocol and to those compounds identified during screening processes and single column GC analysis.

9. DATA REDUCTION, VALIDATION AND REPORTING

9.1. FIELD AND TECHNICAL DATA

Section 9.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.1.1. Field and Technical Data Reduction

Section 9.1.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.1.2. Field and Technical Data Validation

Section 9.1.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.1.3. Field and Technical Data Reporting

Section 9.1.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.2. LABORATORY DATA

9.2.1. Laboratory Data Reduction

Section 9.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.2.2. Laboratory Data Validation

Section 9.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.2.2.1 Chemical and Radiological Data

Section 9.2.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following additions.

Non-CLP Data

OU5 Non-CLP project data validation will be conducted in accordance with SAIC Validation Procedures for Non-CLP Parameters. These are consistent with the guidance provided in Section 9.2.2 of the OU9 QAPjP, while being more explicit in detail.

9.2.2.2 Other Laboratory Data

Section 9.2.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

9.2.3. Laboratory Data Reporting

9.2.3.1 Chemical and Radiological Data Reporting

Section 9.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following additions.

All laboratory data will be reported as a complete data deliverable packages as defined in the OU9 Site-Wide QAPjP. These will include CLP SOW protocol deliverables for volatile organic and semivolatile organic compounds, pesticides and PCBs, and inorganics for water and soil samples.

Full analytical information will also be provided in data packages for explosive analysis, common anion analysis, indicator compound analysis, radiochemical analysis, and lanthanide analysis.

For all analysis reports, U.S. EPA defined data qualifiers will be required. All qualifiers used in any analytical report will be defined in the case narrative. The nine U.S. EPA defined data qualifiers for organic analysis including explosive analysis are:

U Indicates element was analyzed for but not detected. Report as the Project Required Method Detection Limit (PRMDL). The PRMDL must be reported upon the basis of dilutions made and percentage moisture for soils.

J Indicates an estimated value.

1. A value less than the Project Required Quantitation Limit (PRQL) but greater than PRMDL is reported. The PRQL must be adjusted for dilutions made and percentage moisture for soil.

2. A Tentatively Identified Compound (TIC) compound is reported and the quantitation is estimated based upon assumption of a response factor of 1:1 with the internal standard.

N Indicates presumptive evidence of a compound. This flag is used only for tentatively identified compounds, where identification is based on a mass spectral library search.

P Used for pesticide/Aroclor target analyte when there is greater than 25% difference for detected concentrations between the two GC columns.

C This flag is used only for pesticides where the identification has been confirmed by GC/MS as required for single component pesticides present in concentrations equal to or greater than 10 nanograms per microliter (ng/µl) in the final extract.

B The compound was found in the blank as well as the sample. TICs must also be flagged as well as Target Compound List Compounds.

E Compounds identified whose concentrations exceed the calibrated range of the instrument receive this flag. When the sample is diluted and reanalyzed and compounds found in the original analysis are diluted out, both results are reported on separate analytical reports.

D Identifies all compounds quantified when a sample has been diluted and reanalyzed.

A Indicates a TIC is a suspected aldol-condensation product.

Other flags may be required to properly qualify the results for a specific situation. The flag selected must be clearly defined in the Case Narrative. If more than five qualifiers are required for a sample, the "X" flag will be used to combine several other qualifiers and an explanation will be given in the Case Narrative. The "X" flag is also used in validating pesticide/PCB data packages to indicate that the compound is presumed present because the retention time falls within the retention time range of a multiple peak compound that has been detected and could be mistaken for an Arochlor or other multiple peak compound isomer. The combinations of flags "BU" or "UB" are prohibited because the B flag is used only if the compound is found in the sample.

Method qualifiers for reporting the type of metals analysis are:

P ICP

A Atomic Absorption Spectrophotometer (AAS) flame

F AAS furnace

CV Cold Vapor

NA Analyze not required

Data qualifiers for reporting metals concentrations are:

B The reported value is less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).

E The value is estimated due to interference. An explanation is required under comments on the form or on the cover page if the interference applies to all samples in the set.

M Duplicate injection precision is not met; GFAA analyses are performed in duplicate. The absorbance/concentration values must agree within ± 20 percent).

N The percentage recovery of the spiked sample is not within the control limits.

S The reported value was determined by the method of standard additions (MSA).

W The analysis spike, a spike added to the sample digestate, has a percent recovery out of control limits (85-115%), and the sample absorbance is less than 50 percent of the spike absorbance.

• The Relative Percentage Difference (RPD) for duplicate analyses is not within control limits.

+ The correlation coefficient for the MSA is less than 0.995.

No combination of S, W, and + can be used. These flags are mutually exclusive.

General qualifiers for anion, indicator compound analysis and radiochemical analysis are:

U Indicates the element of compound was analyzed for but not detected above the project required method detection limit.

J Indicates an estimated value.

R Indicates that the data are unusable. The compound may or may not be present.

B The compound was detected in the analytical method blank as well as the sample.

D Identifies reported values were determined subsequent to sample dilution.

Additional flags may be required to properly qualify the results for specific parameters and methodologies. These qualifying flags must be clearly defined in the individual Case Narratives, Validation Reports, and final project reports.

Electronic data deliverables must be reviewed and compared to hardcopy data information. All discrepancies must be resolved, corrective action taken and formal documentation included in Validation Reports.

9.2.3.2 Other Laboratory Data

Section 9.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10. PERFORMANCE AND SYSTEM AUDITS

Section 10 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10.1. FIELD AUDITS

Section 10.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10.2. LABORATORY AUDITS

Section 10.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10.2.1. Laboratory System Audits

Section 10.2.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10.2.2. Laboratory Performance Audits

Section 10.2.2 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10.2.3. Laboratory Monitoring

Section 10.2.3 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

10.3. NONCONFORMANCE REPORTS AND CORRECTIVE ACTIONS

Section 10.3 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

Nonconformance Reports (NCRs) will be prepared by the QAO or his/her designee for each finding to document any problem impacting the integrity of the project resulting in or potentially resulting in a failure to meet a quality assurance objective. To ensure the appropriate action or actions are implemented to resolve the problem and prevent any recurrence, a Corrective Action (CA) report will also be prepared by the task manager or his/her designee. The procedures to be used for the preparation of NCRs and CAs are presented in Section 13 of this QAPjP and the OU9 Site-Wide QAPjP (DOE 1993).

10.4. ENTRANCE AND EXIT BRIEFINGS

Section 10.4 is not in the OU9 Site-Wide QAPjP (DOE 1993). This is an additional section for this OU5 QAPjP.

System audits and performance audits conducted by the QAM or his/her designee, will be preceded by an entrance briefing and followed by an exit briefing. The entrance briefing will address the purpose and objectives of the audit and facilitate access to all personnel and information necessary to accomplish the audit. The exit briefing will provide a summary of the findings and ensure that corrective actions are implemented as rapidly as possible.

11. PREVENTIVE MAINTENANCE

11.1. FIELD EQUIPMENT

Section 11.1 in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP.

11.2. LABORATORY EQUIPMENT

Section 11.2 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Instrument maintenance logs will be kept with each laboratory instrument and will be updated by the operator or his/her designee whenever either routine or nonroutine maintenance is performed on the instrument.

Laboratory personnel responsible for sample receipt and storage will record refrigerator and freezer temperatures at least once per day. Any changes in temperatures beyond specified ranges will be reported immediately to maintenance personnel, the laboratory quality assurance officer, and the laboratory director. Immediate notification to the sample shipper will be made if any laboratory samples have been compromised during storage or during shipment to the laboratory.

12. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Section 12 in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

Precision and accuracy for field operations are given in related Mound Plant ER Program SOPs. All field information are reviewed relative to those criteria. Information outside the acceptable limits of variation will be assessed by the EG&G subcontractor for usability. The initial and primary responsibility for monitoring the quality of field operations lies with the sampling crew. Samplers and field team leaders will verify that quality procedures are followed and that the resulting sample location, and procedures are within acceptance criteria. If acceptance criteria limits are exceeded, appropriate corrective actions must be taken and documented in the appropriate field logs and reports.

Mound Plant ER Program SOPs outline and define precision and accuracy criteria for sampling information. Examples of this quality information are: well location as performed by professional survey, groundwater well purging stabilization criteria (SOP 2.1), and borehole sampling interval and core recovery criteria (SOP 5.1).

13. CORRECTIVE ACTION PROTOCOLS

13.1. INTERNAL CORRECTIVE ACTIONS

Section 13.1 of the OU9 QAPjP (DOE 1993) applies to the OU5 QAPjP.

13.1.1 Corrective Actions Resulting from Audits

Section 13.1.1 of the OU9 QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exceptions or additions indicated below.

Figure 13.1, Corrective Action Report form will be replaced by the attached SAIC Corrective Action Report form. This form will be completed in accordance with SAIC QA Administrative Procedure No. QAAP 16.1, included as Attachment 2 to this document.

A Nonconformance Report (NCR), will be completed to report any nonconformance with a quality assurance procedure. The attached SAIC Nonconformance Report form (Figure 13.2) will be completed in accordance with SAIC QA Administrative Procedure No. QAAP 15.1, included as Attachment 3 to this document.

13.1.2 Corrective Actions Resulting from a Past Activity

Section 13.1.2 of the OU9 QAPjP (DOE 1993) applies to the OU5 QAPjP with the exceptions noted above.

13.1.3 Corrective Actions Resulting from an Activity at the Time of Occurrence

Section 13.1.3 of the OU9 QAPjP (DOE 1993) applies to the OU5 QAPjP.

13.2. LABORATORY CORRECTIVE ACTION

Section 13.2. in the OU9 Site-Wide QAPjP (DOE 1993) applies to the OU5 QAPjP with the following exceptions or additions indicated below.

Corrective actions precipitated by exceedance of analytical acceptance criteria identified in Tables III.1

SHEET _____ OF _____

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

CORRECTIVE ACTION REPORT

CAR NO.	REVISION NO.	DATE

RESPONSIBLE ORGANIZATION

DESCRIPTION OF CONDITION

RECOMMENDED CORRECTIVE ACTION

RESPONSE DUE

QA/QC OFFICER Signature Date

PROGRAM /PROJECT MANAGER Signature Date

ROOT CAUSE

MEASURES TO PREVENT RECURRENCE

PLANNED COMPLETION DATE

TASK LEADER Signature Date

RESPONSE [ ] ACCEPT
[ ] REJECT

QA/QC OFFICER Signature Date

PROGRAM OR PROJECT MANAGER Signature Date

COMPLETION DATE

TASK LEADER Signature Date

CLOSURE DATE

QA/QC OFFICER Signature Date

PROGRAM OR PROJECT MANAGER Signature Date

Figure 13.1. Corrective Action Report.

NONCONFORMANCE REPORT	DATE OF NCR	NCR NUMBER
	LOCATION OF NONCONFORMANCE	PAGE _____ OF _____
INITIATOR (Name/Organization/Phone)	FOUND BY	DATE FOUND

RESPONSIBLE ORGANIZATION/INDIVIDUAL

DESCRIPTION OF NONCONFORMANCE

A INITIATOR _____ Date _____ QA/QC OFFICER _____ Date CAR REQ'D YES ☐ NO ☐

DISPOSITION, PROBABLE CAUSE AND ACTIONS TAKEN TO PREVENT RECURRENCE:

PROPOSED BY: _____

B NAME _____ Date _____ INITIATOR _____ Date

VERIFICATION OF DISPOSITION AND CLOSURE APPROVAL

☐ ACCEPTABLE ☐ NOT ACCEPTABLE

REINSPECTION/RETEST REQUIRED YES ☐ NO ☐

IF YES: _____ Date _____ Result

QUALITY ASSURANCE: _____

C NAME _____ Date

Figure 13.2. Non Conformance Report.

and III.2 of this document will involve administrative, sample handling, documentation, instrumentation, calibration, analytical method, and data calculation issues. Potential actions are identified in the OU9-QAPjP (DOE 1993.) Tables III.1 and III.2. Resolution or corrective actions will generally initiate re-calibration, re-measurement, re-analysis, or re-sampling. In all circumstances the useability of the data must be evaluated and data must be qualified as necessary based on the technical judgement of the analyst, reviewers, and validators.

14. QUALITY ASSURANCE REPORTS TO MANAGEMENT

Section 14. in the OU9 Site-Wide QAPjP (DOE 1993) does not apply to the OU5 QAPjP.

The active participation of management in a project is fundamental to the success of this QA/QC Plan. Management will be aware of project activities and will participate in development, review, and operation of the project. Management will be informed of QA status and activities through the receipt, review, and/or approval of reports. Quality assurance reports to management will consist of prior notification of activities and reports on activities. Reports will encompass both routine reports and special reports, including written reports and memoranda documenting data assessment activities, results of data validations, audits, nonconformances, corrective actions, and quality notices.

QA documentation includes:

- regular quality status reports from the QA Officer;
- laboratory and project-specific QA/QC plans and procedures;
- post audit reports and audit closures;
- surveillance reports;
- CARs; and,
- NCRs.

The management hierarchy receiving some or all of the reports will include DOE DAO (the RPM), the EG&G Mound Manager of Environmental Restoration, the DOE AL Program Manager, and the Subcontractor Project Manager. Reports may be distributed to other ER Subcontractors at the discretion of the DOE RPM and the EG&G Mound ER Manager. In addition, periodic assessment of QA/QC activities and data PARCC will be conducted and reported by the analytical laboratories as specified in the project specific QAPjP.

Project management will inform the QA Officer, as appropriate, of the QA status of the project, especially any significant quality accomplishments and/or deficiencies. Project personnel are required to inform the QA Officer, Project Manager, or project support staff of all nonconformances or quality failures.

All QA Records concerning the project (e.g., internal and external correspondence, SAP, QAPjP, QAAPs,

field logbooks and forms, COC forms, data packages, audit reports, surveillance reports, NCRs and CARs.) will be submitted to the CRF for dual storage and retrieval.

At the conclusion of the project, the QA Officer will prepare a complete report covering all aspects of QA as it pertains to the project. This will be in the final report. Included in this report will be all CARs, NCRs, documented changes to the QAPjP, as well as the detailed data validation report.

The data validation report will be a detailed accounting of the data validation process. At a minimum, the report will cover holding times, calibration checks, and QA checks as stated in Section 9. Included will be an assessment as to whether the QA objectives were met as they relate to PARCC.

Prior notification of all quality assurance activities will be provided to all managers through the vehicle of RI/FS monthly progress reports that also contain information about all RI/FS activities, and through special trip notices that notify managers of contractor and subcontractor travel. Monthly RI/FS progress reports will routinely discuss upcoming activities, including field work and schedule audits. Any of the managers listed above may use the notification to identify the need for, and schedule quality assurance audits in connection with, scheduled field work.

Monthly reports will also describe the progress, the completions, and the results of quality assurance activities. Descriptions of the completion of activities will serve as notice to all managers of the availability of quality assurance reports. Results of quality assurance activities may be summarized for inclusion in monthly reports. Each quality assurance activity shall be documented in a report separate from any summary or description included in the monthly RI/FS progress report.

The QA Officer and the QA Manager will prepare routine reports to management indicating effectiveness of the laboratory quality assurance program. The QA Officer will prepare a monthly summary report of the internal review activities of laboratory performance and submit the report to the quality assurance/quality control director. Reports of the semiannual system audits will be distributed to the laboratory management, project management, and QA management.

15. REFERENCES

DOE. 1993. "Remedial Investigation/Feasibility Study, Operable Unit 9, Site-Wide Quality Assurance Project Plan Revision 2, (Draft Final). Environmental Restoration Program, U.S. Department of Energy, Albuquerque Field Office, Albuquerque, NM. March 1993.

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EPA. 1983. "Methods for Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency, EPA-600/4-79-020. March 1983.

EPA. 1986. "Test Methods for Evaluating Solid Waste." Laboratory Manual Physical/Chemical Methods, SW-846, Volumes 1A, 1B, and 1C, third edition. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. November 1986.

EPA. 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (INTERIM FINAL)." Document No. EPA/540/G-89/004, OSWER Directive 9355.3-01. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. October 1988.

EPA. 1990a. "U.S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration." Document No. ILM01.0 including revisions 1.1 through 1.8. U.S. Environmental Protection Agency. March 1990.

EPA. 1990b. "U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration." Document No. ILM01.0. U.S. Environmental Protection Agency. March 1990.

EPA. 1991. "U.S. EPA Region V Model Quality Assurance Project Plans Specific to Superfund Projects." U.S. Environmental Protection Agency. June 17, 1991.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

OPERABLE UNIT 5

QUALITY ASSURANCE PROJECT PLAN

APPENDIX A

ATTACHMENTS 1 through 4

Attachment 1

SOPs for Petrex Environmental Survey

SOPs for Groundwater Sampling Using HydroPunch

SOPs for Groundwater Sampling Using Drill-Stem Techniques

SOPs for Geophysical Surveys

Attachment 1

SOPs for Petrex Environmental Survey

STANDARD OPERATING PROCEDURES

FOR APPLYING

THE PETREX TECHNIQUE

TO

ENVIRONMENTAL SOIL GAS SURVEYS

March 1988

Revised August 1990

Attachment 1

PETREX SOIL STANDARD OPERATING PROCEDURES FOR ENVIRONMENTAL APPLICATIONS AND FIELD PROCEDURES

I. Standard Operating Procedures (SOPs) for Applying the PETREX Technique to Environmental Soil Gas Surveys.

1. Purpose of Document

2. Sample Production and Preparation
   - 2.1 Charcoal Sieving
   - 2.2 Charcoal Bonding
   - 2.3 Collector Container
   - 2.4 Wire Cleaning
   - 2.5 Packaging for Client
   - 2.6 Quality Control and Quality Assurance
   - 2.7 Custody Document

3. Field Operations
   - 3.1 Locating Sample Sites
   - 3.2 Soil Coring
   - 3.3 Collector Placement
   - 3.4 Site Identification
   - 3.5 Exposure Time
   - 3.6 Collector Retrieval
   - 3.7 Collector Numbering
   - 3.8 Collector Shipment
   - 3.9 Decontamination

4. Collector Analysis
   - 4.1 Numbering Check
   - 4.2 Sample Holding
   - 4.3 Instrumentation
   - 4.4 Calibration
   - 4.5 Instrument Parameters
   - 4.6 Mass Spectrometer Analysis and QA/QC
   - 4.7 Data Filing
   - 4.8 Schedule of Maintenance

5. Data Interpretation Presentation
   - 5.1 Map Generation
   - 5.2 Compound Identification
   - 5.3 Relative Flux Determination
   - 5.4 Data Interpretation
   - 5.5 Additional Uses of PETREX Collectors
   - 5.5.1 Headspace
   - 5.5.2 Depth Profiling
   - 5.6 Data Presentation

6. Interpretation of PETREX Maps

II. Guide to PETREX Environmental Survey Field Procedures

I. Survey Installation
- A. Preparation
- B. Field Procedures
  1. Orientation
  2. Installation Through Pavement
  3. Installation in Loose Soil
  4. Installation in Frozen or Hard Soils
  5. Installation at Depth
  6. Installation Under Water
- C. Time Tests
- D. Triplicate Wires
- E. Blanks
- F. Ambient Air Samples
- G. Sample Location Map Submittal

II. Survey Retrieval
- A. Preparation
- B. Field Procedures
- C. Labelling and Submittal
- D. Shipping

III. Addendum
- A. Grab Samples

IV. Appendix

Useful Information
Compounds Detectable by PETREX Samples
Materials Used In Installation
Materials Used In Retrieval
Materials Kept In Bag, Vest, etc.
Field Instructions For Picking-up And Shipping PETREX Collectors
Sample Submittal Form
Chain of Custody

STANDARD OPERATING PROCEDURES FOR APPLYING THE PETREX TECHNIQUE TO ENVIRONMENTAL SOIL GAS SURVEYS

1.0 OPENING STATEMENT CONCERNING THE PURPOSE OF THIS DOCUMENT

As the title of this document points out, the steps and information herein are the "Standard Procedures" for carrying out a Petrex environmental survey. Possible deviations from standard procedures may occasionally be implemented onsite by our field staff to adjust for unique survey conditions. The Petrex Technique is also frequently used for oil and gas, geothermal, and mineral exploration which force slight variations on these "Standard Operating Procedures". Also, surveys performed in winter in frozen ground offer a unique situation and slightly different field practices.

The fact that the standard procedures may occasionally be altered is done to maintain quality service while using the Petrex Technique. It must also be understood that the ion flux data from one survey at a given site and a given time interval should not be compared to the flux numbers from another survey. Since the data is semi-quantitative, only the flux patterns of a survey or the relative difference between flux values off two samples from the same survey should be considered during interpretation.

If any questions arise upon review of this document, please address your questions to NERI technical staff at:

Northeast Research Institute, Inc. (203) 677-9666
309 Farmington Avenue, Suite A-100, Farmington, Connecticut 06032

-or-

Northeast Research Institute, Inc. (303) 238-0090
605 Parfet Street, Suite 100, Lakewood, Colorado 80215

2.0 SAMPLE PRODUCTION AND PREPARATION

2.1 Charcoal Sieving

The static VOC (Volatile Organic Compound) collector is prepared by applying presieved activated charcoal to the end of a ferromagnetic wire.

2.2 Charcoal Bonding

The details of the procedure for preparing the activated charcoal is proprietary information. The procedure results in the production of a collector consisting of size-sorted activated charcoal bonded to the area within 1 cm of the end of a ferromagnetic wire with a Curie point of 358°C.

2.3 Collector Containers

Culture tubes, measuring 25 mm X 125 mm and having a screw cap closure, are washed in a biodegradable detergent, rinsed in methanol, and baked at 180°C for one hour.

2.4 Wire Cleaning

The previously constructed wires are cleaned by heating in a special apparatus at 358°C a total of 35 times under high vacuum. The wires are cleaned in lots of 32 wires. From each lot, two wires are removed for immediate analysis to verify the cleanliness of the lot. The remaining 30 wires are then sealed in one clean culture tube under an inert atmosphere and placed in inventory.

2.5 Packaging for Client

Immediately prior to shipping the wires to the field, the tubes containing 30 wires are removed from inventory and the wires are repackaged under an inert atmosphere in individual tubes. All of the repackaged tubes contain two wires. Ten percent of these have three wires. The collectors are packaged by bagging in Ziploc bags in an inert atmosphere. These bags are then placed in inventory in a temperature-controlled room. The basis for having two wires in each tube is that it allows NERI to analyze one wire by our standard Thermal Desorption-Mass Spectrometry (TD-MS) while the second sample is available for TD-GC/MS or as a backup to the TD-MS. The third wire in selected samples from each survey is used to establish optimum instrument parameters.

2.6 Quality Control and Quality Assurance

Prior to releasing stocked wires for a field survey, two single wires from each lot are checked for cleanliness and collecting potential. This QA/QC phase measures and documents collector preparedness when leaving the laboratory. One of these wires is analyzed without exposure in order to demonstrate that the lot is clean, and the other wire is exposed to hexane vapor for two seconds and then analyzed in order to verify that the charcoal is highly adsorptive. The triplicate wires are used when the wires return from the field. These wires help determine the required machine sensitivity and act as a measure of reproducibility.

2.7 Custody Document

A "custody document" accompanies each group of collectors leaving the laboratory and remains with the group until the collectors have been exposed, analyzed, and disposed of.

3.0 FIELD OPERATIONS

3.1 Locating Sample Sites

Sample placement sites, usually predetermined on an accepted survey proposal, are located from a nearby, surveyable landmark using a compass and pacing or some other measuring device (e.g., pacing wheel, hip chain, or tape measure). A transit may be used for more accurate placement, but such accuracy is seldom required.

3.2 Soil Coring

Once a sample site has been established, a hole is cored to a predetermined depth (sample placement depth is held constant for a given survey). This is accomplished using a variety of tools depending on the nature of the material to be cored. The holes should be vertical and as free from debris as possible. When the sampling is performed in areas covered by asphalt or concrete, generator-powered rotary hammer drill with a carbide-tipped bit is used to drill a 1-1/2 inch diameter hole in the cover. A hand auger is used to remove the cuttings and road base from the hole.

3.3 Collector Placement

Immediately after the hole is cored, a collector tube is removed from the Ziploc bag and the bag is resealed. The cap is then removed from the tube, and the tube is placed vertically, open end down, into the hole. The hole is then backfilled with the soil core which was removed. The cap is placed in a clean Ziploc bag

and stored until collector retrieval. Collectors placed under asphalt or concrete are treated the same as those in uncovered soil, except for modifications to permit easy retrieval and to avoid potential down-hole contamination from surface cuttings. To allow retrieval of these collectors, a piece of galvanized wire is twisted around the neck of the tube and run to the surface so that the sample may be recovered by pulling the retrieval wire. An aluminum plug is then placed near the top of the hole, and the remainder of the hole is plugged with quick setting hydraulic cement.

3.4 Site Identification

Each site is flagged using pin flags, spray paint or ribbon flagging, and the site location is marked and numbered on a base map. A field notebook is used to record the date, collector number, site location description, soil type, and general observations.

3.5 Exposure Time

Time calibration collectors are included as part of every survey. These are QA collectors used to monitor sample loading during the survey. These collectors are placed in an area of known or suspected contamination, and sets are retrieved and analyzed at intervals to indicate the appropriate residence time for survey samples. Separate "travel blank" collectors are also included as a QC measure in every survey. These collectors are transported along with the survey collectors but the tubes are never opened. These control collectors monitor for potential contamination during transport or placement.

3.6 Collector Retrieval

The collectors are retrieved when the time calibration collectors reveal that there has been sufficient loading of gases on the charcoal absorbent. In the field, the soil is removed until the tube is exposed. A cap is taken from the sealed Ziploc bag. The Viton seal is checked to make sure it is seated inside the cap. The culture tube is removed from the hole and any dirt that is on the threads of the tube is wiped off with a clean cloth. In the event the tube is broken or cracked, the collector wire is transferred to a new tube using forceps. The tube is capped and sealed. All flagging material is retrieved.

3.7 Collector Numbering

Each tube is immediately numbered according to the scheme established in the field notes and on the base map. The collector number is written on adhesive labels which are applied to the tu cap. No two sites may have the same number.

3.8 Collector Shipment

Once the collectors have been retrieved, they are sealed in Ziploc bags and then wrapped with bubble packing. Material such as Styrofoam peanuts or newsprint can introduce possible contaminants to the collectors and should not be used for packaging. The collectors, field notes, base map, and chain-of-custody document are either hand carried back to NERI's analytical laboratories, or are shipped by overnight carrier service.

3.9 Decontamination

All down-hole equipment and tool parts which contact excavated soil are constructed of heavy gauge steel and have no natural or synthetic components which could absorb and retain most soil-borne organic contaminants. These tools are decontaminated between use at each sampling location by rotation through a four step cleaning process. These steps are:

1. Immersion and vigorous scrubbing in a mild solution of laboratory grade detergent until all visual accumulations of soil are removed.

2. Thorough rinsing with potable water.

3. Spray rinsing with methyl alcohol.

4. Air Dry.

All derived liquids (and sediment) are contained in dedicated disposable vessels.

4.0 COLLECTOR ANALYSIS

4.1 Numbering Check

Upon receipt of the collectors, the number on each tube is recorded and any missing or duplicated numbers are noted. A missing number generally indicates that the collector could not be retrieved. Samples with identical numbers generally cannot be used unless their true site location can be established.

4.2 Sample Holding

A Petrex soil gas sample consists of a minute quantity of various volatile organic compounds sorbed onto a charcoal element and enclosed in a protective container with a near impervious Viton seal.

Maximum sample holding time is a function of both the chemic stability of the sorbed compounds and the integrity of the seal or the container.

It has been the experience of Northeast Research Institute, Inc. (NERI) that Petrex soil gas samples that are properly repackaged after retrieval from the field and stored under environmentally controlled conditions typically remain compositionally and quantitatively unchanged through periods of greater than four months.

All samples scheduled for analysis via Curie-point pyrolysis/mass spectrometry are analyzed within three weeks of retrieval from the field.

4.3 Instrumentation

Thermal desorption is accomplished using a Fisher radio frequency power supply and a Curie point pyrolyzer designed by NERI and Extrel. The mass spectrometer used is an Extrel SpectrEL quadrupole mass spectrometer. The analysis is controlled and recorded by DEC PDP 11/23 microcomputer. Following the analysis, all data are collected and archived on a PDP 11/73 microcomputer. Data for all active jobs are stored on both of the PDP 11 computers, as well as on magnetic tape. Data for all completed jobs are stored on magnetic tape in perpetuity.

4.4 Calibration

An Extranuclear Quadrupole Spectrometer equipped with a Curie-point pyrolysis/thermal desorption inlet is used for collector analysis. Mass assignment and resolution are manually adjusted using a Perfluorotributylamine (PFTBA) standard. A linear correction, based on the known spectrum of PFTBA, is calculated. This correction is applied to a second PFTBA spectrum. If correct mass (M/Z) values are obtained, the operator proceeds to the next turning step. If not, Step 1 is repeated until correct masses are obtained.

Peak intensity ratios are set from the major peaks in the PFTBA spectrum using the following values:

Mass (M/Z)		Spectrum Intensities
69	=	100%
131	=	25%±5%
219	=	35%±5%
502	=	5%±2%

During the ion signal for mass (M/Z) 69 of PFTBA is measured at a preset sample pressure and detector voltage and compared to previous values at the same setting.

Electron energy is set to 70 electron volts and emission is set at 12 milliseconds. All other operating parameters, such as scans, scan range, mass offset are established in the computer program. These values may only be changed by the laboratory manager.

Tuning is performed at the beginning of a run, so that an individual survey is analyzed at the same set of instrument conditions. The samples are analyzed in random order.

4.5 Instrument Parameters

The instrument is operated with the following parameters.

Vacuum	-	$< 3 \times 10^{-6}$ torr
Ionization Energy	-	70.0 eV
Ionization Current	-	12.0 mA
Desorption Time	-	5.0 sec
Desorption Temperature	-	358°C
Number of Scans/Sample	-	30
Scan Rate	-	1,250 amu/sec

4.6 Mass Spectrometer Analysis and QA/QC

Each collector wire is analyzed in random order. The entire group of survey collectors are analyzed as one run without interruption from other surveys.

The organic gases adsorbed on the carbon are thermally desorbed from the carbon, separated according to ion mass, counted, and a mass spectrum of masses from 29 to 240 is obtained.

Periodic (approximately every 20 samples) machine background analyses are performed as a QC measure to assure minimal influence from internal communication. If there are peaks that are not related to atmospheric gases, the supervisor is notified and the mass spectrometer is shut down and cleaned as necessary.

A written sample number record is kept during the analysis to prevent accidental cross numbering.

The mass spectrometer control program prompts the operator with a warning if a sample number is entered that has already been used. The operator then checks the current number, along with the disk storage location of the previously entered number, to resolve the true numbering situation.

4.7 Data Filing

The raw data file generated by the sample analysis is labeled for storage under a unique file name.

4.8 Schedule of Maintenance

1,000 Samples Cleaning of sample introducion area, ion source, and expansion chamber by in-house technicians.

4,000 Samples: Above noted procedures plus cleaning of lenses and quadrapoles

Annually: Preventative maintenance program conducted by manufactures's service representative.

5.0 DATA INTERPRETATION AND PRESENTATION

5.1 Map Generation

The sample location maps are created by placing the field base map on a digitizing board and entering each site as an X-Y coordinate relative to an orgin. The relative ion counts for each compound can then be plotted at the sample locations. Cultural and topographic features can also be digitized onto the map as reference points.

5.2 Compound Identification

The mass spectrum that is drawn for each sample is compared to a library of mass spectra derived from known volatile organic compounds. Several thousand pure compound spectra have been developed by the Bureau of Standards and are available for spectra comparison. NERI has also developed its own library of spectra through headspace analysis of pure compounds using the Petrex wires. Once a compound has been identified in this manner, the ion current or "flux" for this compound is defined as the total ion current for the "parent peak" or least interfered peak of that compound.

5.3 Relative Flux Determination

The process of determining ion currents (relative intensities) of indicator peaks is computerized. All ion current data are extracted from the original data file and are processed for identification.

The relative ion current intensity (relative intensities) of the gases that are desorbed from the collectors are matched with sample locations on a map of the survey area. These relative intensities are useful for inferring the areal extent of contamination and relative differences in the concentrations of the compounds in the soil or groundwater. This can aid in determining the location of source areas or direction of movement of contamination.

These surface collections and analyses cannot be used to determine the depth to the source contaminants or the precise concentration at depth.

Because compounds can be differentiated by their spectra, analyses from the carbon collectors can be used to help differentiate multiple compounds and multiple source areas within a single survey.

5.4 Data Interpretation

Once the relative intensities for a compound are mapped, the data can be contoured to reveal those areas with "hot spots" and the orientation of plume migration. All other available data, such as geologic setting, soil types, groundwater conditions, type of contaminant, site history, and other factors are taken into account as the interpreter draws his conclusions.

5.5 Additional Uses of Petrex Collectors

Some of the other uses of the Petrex Technique that are utilized in surveys are headspacing of soil and water samples and depth profiling.

5.5.1 Headspace

A headspace soil sample is analyzed by collecting approximately 25 grams of soil, which are transferred to a thermochemically cleaned headspace container. Several adsorption wires are added and the headspace container is sealed and allowed to equilibrate for up to 24 hours, depending on the level of contamination. The wires are then removed and prepared for desorption mass spectrometric analysis as described earlier. An identical process is performed for screening water samples.

5.5.2 Depth Profiling

In order to determine if the source of the soil gas signal is near surface or in a deeper vadose/saturated zone, depth profiling can be used.

At each selected location, shallow bore holes are drilled a few feet apart to depths such as 1, 2, 4, and 6 feet deep. After all the loose cuttings and cavings have been removed from the bottom of the hole, a core of soil may be taken for headspace analysis. Next, a Petrex collector is lowered into the hole and backfilled. The collectors remain in place for the same length of time as the survey wires.

Each of the sampling methods addresses a different aspect that will help indicate the nature of the VOC source. In the case of composite soil sampling, detection of VOCs during analysis implies that the VOCs are actually contained within the soil matrix. When the VOC is anthropogenic in nature, the VOC presence is indicative of soil contamination at that depth interval.

When performing an in situ time-integrated sampling program with Petrex collectors, the collector serves as both an extended headspace sampler relative to the soil matrix in its immediate vicinity, as well as measuring the soil gas flux through that zone during the exposure period.

Soil gas movement through the vadose zone is theorized to be a diffusion process. If the headspace data indicate that the VOC is not present in the soil matrix, then the in situ depth profiling collectors should show a relative increase of ion counts as the depth increases. By combining both pieces of data, the nature of the VOC source (near surface or deep vadose/saturated) can be inferred.

5.6 Data Presentation

Once the data have been compiled, interpreted, and mapped, a report is produced for the client's use. Also, the maps are printed which display the relative intensity of the compounds of the client's specifications. These reports and maps are for the client's use only, and no report or map is released to anyone else without prior written consent of the client. This confidentiality policy is never breached.

6.0 INTERPRETATION OF PETREX MAPS

The policies outlined in this Standard Operating Procedure are strictly followed on each survey. It should be noted that the relative intensities for any compound at one sample location can only be compared to another location within the same survey for the same compound. Relative intensities of different compounds cannot be compared to each other. Also, the relative intensities of one survey cannot be compared to the relative intensities of any other survey, even between two surveys at different times of the year over the same site. However, the same "hot spots" and plumes should contour in the same place over multiple surveys at a given site, allowing for migration.

I. SURVEY INSTALLATION

A. Preparation

Start with the list "Field Materials Necessary for Installation." (Appendix A), it lists almost everything; more than you will probably need for any one particular job. But, the utility of each item is worth considering.

B. Field Procedures

1. Orientation

Each field geologist has his/her own way of doing things and the conditions of the field often demand additional modifications to one's routine. Thus, the following is only a description of procedures that have a direct effect on the integrity of the data and the overall quality of the survey.

On arriving for the first time on site, take the time to give the greater part of the study area a look-over. This will help plan out what special activities or materials survey installation may require (i.e., whether you will need access to an area presently locked-up, inventory moved, an extra extension cord, utilities plan, etc).

Often the north arrow on site plans is only approximate, or describes true north. To accurately determine the orientation of the survey grid in the field take some time to get a bearing on one or two "cultural" features of the site, i.e.: The wall of a building or the curb of a roadway that is also present on your sample locations map, and determine its orientation with respect to magnetic north.

If you know the declination of the site and wish to base everything on true north, go ahead and convert, otherwise just use magnetic and make a note of it. (Caution: A Brunton pocket transit or similar expensive compass is a very sensitive instrument and is easily perturbed by local magnetic fields from power lines, machinery, and industrial activities.) Next, on your sample location map (with a protractor) determine the proposed orientation of the sampler grid with respect to one of these cultural features. From these two bearings combined, find the magnetic heading of the grid. (Figure 1)

Then choose a reference point, one sample location that can be easily and accurately determined both on the map and on the ground. Establish the grid on this point and work off from it running $+/-90^{o}$ and backsighting 180^{o}.

In an environment where you cannot use your compass or it is unnecessary, as inside a factory or industrial complex, it is usually a simple task to determine collector placement on the basis of permanent interior features such as aisles, columns, wall openings, etc.

Measuring distance: In many situations it is impractical if not impossible to use a tape measure, wheel or hip chain, especially over rugged terrain or obstructed floor space. Pacing is a remarkably accurate alternative. If you have not already done so, establish for yourself a comfortable, reproducible pace.

Take extensive field notes. This cannot be stressed enough. There is always the chance that you will not be available for survey retrieval and another geologist will have to rely heavily on written instructions to pinpoint less obvious sample locations. So make a note of everything: start and finish dates with times of day, bag numbers, names of people on site, clients, consultants, authorities, field crew (including yourself), the weather, the physical conditions of the study area (steep sloping to the southwest, the prevalence of surface water), ground cover (grass, weeds, pine needles, dirt, gravel, asphalt) and soil type (sand over clay, loam, etc.) note secondary details too, such as discoloration of the ground, stressed vegetation, the evidence of subsurface structures including pipes, tanks.

On completing the installation of a survey and before leaving the site, go over your notes and field map(s). Correlate the information present in both. Check-off each sampling location and see that any notes about sampling locations or modifications to the grid are complete.

2. Installation Through Pavement

When drilling through pavement, particularly asphalt, frequently brush away all dust, sand, and dirt from the mouth of the borehole. Try to drill downward in a steady uniform manner, disturbing the mouth and walls of the bore hole as little as possible. Upon reaching your finished depth and before removing the drill, completely brush all soil and debris away from the mouth of the hole. Pull the bit out of the hole carefully in an effort to keep dirt from shallower levels from falling to the bottom of the borehole.

Also, do not allow visible accumulations of soil from one sample location to be transferred on the drill bit to the next location. In general, when installing samplers in any ground cover avoid allowing things from the surface and near surface from falling into the hole including leaves, roots, chips of asphalt, concrete, etc.

Do not leave open any sampler boreholes. After digging or drilling any borehole even if the sampler is to be installed at a later time seal it over immediately with aluminum foil to reduce the possibility of contaminating materials or vapors entering the hole.

Handle samplers with clean hands/gloves. Be wary of gasoline or oil from the generator and hammer drill, spray paint, volatile substances from the environment: oily floors, tools, etc.

If samplers are to be installed below any type of pavement or in hard digging material, like gravel, you will need to attach a length of wire (approximately 24 inches) to each Petrex tube so that it can be pulled from its hole on retrieval. The best material for this purpose is 16 or 18 gauge galvanized steel "Guy" wire that has been baked in an oven for at least 1 1/2 hours at 150°C. To attach the wire wrap a turn of wire

(near its end) around the mouth of the Petrex tube (cap in place) just above the threads where the bottle begins to widen. Twist the ends snugly.

Bring the wire against the side of the tube and about halfway up make a 90^{o} bend and wrap a full loop around the tube. Thread the free end beneath the origin of the loop and pull up and tight. (Figure 2)

When actually installing the samplers the cap should be unscrewed and removed from the tube very near the mouth of the borehole. Be sure the black cap liner which actually creates the seal is also removed with the cap. The sampler (open end down) should then be dropped immediately into the hole and the caps with liners intact should be placed in a clean plastic bag and saved for retrieval.

Do not open a Petrex sampler directly in the wake of a passing vehicle. Allow exhausts and strong odors to first dissipate if possible. If a strong odor remains in the area an ambient air sample should be taken.

With a wooden dowel or the handle of your hammer gently push the sampler down to the soil at the bottom of the hole.

Immediately after the sampler is in place, cap off the borehole at least with a tight aluminum foil plug. An aluminum foil plug is not an impenetrable cap. If there is a significant risk of contamination of a collector by atmospherics or tampering, consider capping it over with quick-plug cement (or soil, etc.) as soon as possible.

A borehole through pavement is capped with quick drying hydraulic cement. To prevent the liquid cement from flowing downward and cementing the sampler in place, the hole should first be plugged tightly with a ball of foil. Tap a ball of foil into the hole with your hammer, 1 to 1 1/2 inches down is sufficient. Simply be sure the foil ball contacts the wall of the bore hole around its full perimeter, otherwise fresh cement will seep past. (See Figure 3).

Be clean. Even if others that were there before have trashed the place, leave no mess. Use a broom and dust pan for cement dust and dirt, wire snippings, bits of flagging, aluminum foil, etc.

Flagging: A sample location is flagged solely to help direct returning field crew to its precise position. Often this object must be weighed against the risk of encouraging curiosity and, thus, tampering (especially in areas of public access), and generally creating an unsightly environment of orange and pink markings. Suggestions: Use flagging materials sparingly, and in low profile (close to the ground), consider: Lawn mower blades, adolescents, etc. Take accurate notes: X and Y distances from permanent objects.

3. Installation in Loose Soil

In soft diggable soil and at standard sampler placement depths a borehole should be dug to a depth of at least 8 inches using a garden trowel or a core shovel (a spade which as been modified for Petrex Sampler Placement). After sampler placement this borehole may simply be backfilled with the material excavated in creating the hole. Sampler retrieval will then entail re-excavation in order to expose and firmly grasp the sampler tube.

When installing collectors in a tended lawn, first use the chisel end of your hammer to chop out a round plug of sod. Lay the sod aside, sink your borehole, install the collector, backfill, and finally replace the sod plug pressing it lightly into place. (Figure 4)

When actually installing the samplers the cap should be unscrewed and removed from the tube very near the mouth of the borehole. Be sure the black cap liner which actually creates the seal is also removed with the cap. The sampler (open end down) should then be dropped immediately into the hole and the caps with liners intact should be placed in a clean plastic bag and saved for retrieval.

Mark the sample location in your notebook and flag the sample location so that the sample can be located for retrieval.

4. Installation in Frozen or Hard Soils

In hard to dig materials such as gravel and frozen soil or sediments that cave in easily and risk packing tightly, it is a good idea to place some sort of plug or cap of aluminum foil above the collector to keep backfilled and wall materials from completely repacking the hole around the sample. Samplers should also be rigged with retrieval wire in case a borehole dose collapse or the sample freezes to the ground.

A single square foot of foil is sufficient material for any one cap or plug. In shallow, large diameter boreholes, such as those made with a core shovel or core tube/hammer, a sheet of foil can be folded in a 6 inch square and pressed into the mouth of the hole to about 1/4 the way down to form a concave cap. (Figure 5)

Where a sampler has been installed in a narrow borehole, such as that made with a hammer drill, it is often best to stuff the hole above the sampler with several loose foil plugs. Crumple a sheet of foil into a loosely made ball 2 to 3 inches in diameter. Then roll the ball between both hands, like modelling clay, to form a cylinder the diameter of the hole. This plug and one or two others, nearly filling the hole, will prevent the walls from caving in for most of its length. A cap of a few inches of soil will finish it off well.

When actually installing the samplers the cap should be unscrewed and removed from the tube very near the mouth of the borehole. Be sure the black cap liner which actually creates the seal is also removed with the cap. The sampler (open end down) should then be dropped immediately into the hole and the caps with liners intact should be placed in a clean plastic bag and saved for retrieval.

Mark the sample location in your notebook and flag the sample location so that the sample can be located for retrieval.

5. Installation at Depth

In areas where near surface contamination is to be avoided, samplers should be placed at depth. A motorized soil auger with a 2 to 4 inch diameter auger bit can be used to place samples up to 12 feet deep. Try to drill downward in a steady uniform manner, disturbing the mouth and walls of the bore hole as little as possible. Upon reaching your finished depth and before removing the auger, completely brush all soil and debris away from the mouth of the hole. Pull the bit out of the hole carefully in an effort to keep dirt from shallower levels from falling to the bottom of the borehole.

Insert a 1 1/2 inch diameter hollow metal pipe (which has been precut to the depth of the hole) into the hole. (The pipe should be cleaned with soap and water or steamed cleaned before being used.) Make sure the pipe is inserted 1/2 to 1 inch into the hole bottom. The pipe is used to prevent the hole from collapsing and to prevent near surface soil contamination from seeping into the hole. Inserting a small amount of an uncontaminated clay material such as bentonite around the pipe will also prevent near surface soil contamination from seeping down the borehole and under the pipe. (Figure 6)

Insert the sampler with retrieval wire attached into the pipe and lower to the bottom of the hole. Cap the top of the pipe with aluminum foil as well as the area between the pipe and the edge of the hole. Seal the top of the hole with quick drying hydraulic cement.

When actually installing the samplers the cap should be unscrewed and removed from the tube very near the mouth of the borehole. Be sure the black cap liner which actually creates the seal is also removed with the cap. The sampler (open end down) should then be dropped immediately into the hole and the caps with liners intact should be placed in a clean plastic bag and saved for retrieval.

Mark the sample location in your notebook and flag the sample location so that the sample can be located for retrieval.

6. Installation Under Water

Samplers installed in shallow water conditions (such as stream beds, swamps, intertidal zones, ponds or shallow lakes) must be encased in a polyethylene bag. To do this the cap with black liner is first removed

from the sampler and the sampler is then enclosed in a permeable polyethylene bag (such as a ziplock bag). The polyethylene bag prevents water and sediment from entering the sampler. As much air as possible is removed from the bag before the bag is sealed. The bagged sampler is then taped with open end down to a sturdy wooden or metal rod with a strong tape (such as duct tape). The caps with liners intact should be placed in a clean plastic bag and saved for retrieval.

In soft bottom sediments the rod can be used to push the sampler into the sediment to a depth of 8 to 14 inches. In hard sediments a shovel or auger can be used to make a hole in the sediments so that the sampler and rod can be inserted. The rod should make locating the sampler easier upon retrieval. (Figure 7)

This sampling method requires that the sampler be exposed to the open air much longer than other sampling methods. Therefore an ambient air sample might be a good idea when installing samplers underwater.

Mark the sample location in your notebook before continuing.

C. Time Tests

A Petrex passive soil gas survey is typically in the field anywhere from one to four weeks before retrieval. The length of the field exposure period depends on the rate at which a significant portion of survey wires become "loaded". For instance, should conditions at a site combined to produce a high VOC soil gas flux rate, survey collectors, in principle, would load rapidly and a total exposure time of two weeks or less would most likely be in order.

To assess the loading rate of a particular survey a number of Petrex samplers are installed on site strictly for time calibration. These "time tests" are installed at given survey grid points (usually 5 per survey) where contaminant flux is expected to be highest. Then approximately one and two weeks after installation the first and second weeks' (respectively) time calibration samplers are retrieved and shipped overnight to Lakewood for analysis.

A time test location consists of one survey sampler and two time calibration samplers, installed concurrently, each in its own borehole, separated 1 to 2 feet from its neighbors. A rough triangular array is usually best for ease of future identification. It is a good idea to install all time tests at the start of the survey so that they can get working right away and all at the same time.

D. Triplicate Collectors (TRIPs)

A bag of 25 Petrex samplers will typically contain 2 to 4 triplicate samplers (three samplers in one tube). These "TRIP's" should be placed strategically in the survey grid, i.e., where you expect to encounter high contaminant flux (source areas) and low contaminant flux (background). Record their location in your field notes along with your observations, and indicate each TRIPs expected relative level of exposure on your sample submittal form. This planned placement of TRIP's will help the mass spec operator adjust the machine's sensitivity to its optimal value.

E. Travel Blanks

Two samplers are kept, unopen, in a Ziplock storage bags in which the survey samplers are shipped and are to accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One of these Travel Blanks should be returned with the first set of time calibration samplers. The other Travel Blank should be returned with the survey samplers.

F. Ambient Air Samples

Ambient air samples should be taken wherever noticeable or suspected odors are present. Also if uncapped samplers are exposed to the open air for a prolonged time an ambient air sample might be a good idea.

Ambient air is sampled by exposing a PETREX sampler to the ambient air for a minimum of 30 seconds. The sampler is then resealed and labeled. Make a note of the time of day and length of the exposure in your notebook.

G. Sample Location Map Submittal

Upon completion of sampler installation, it is important for the consultant to submit to NERI a correct version of the sample location map. All features to be incorporated into the map should be clearly marked. NERI will then be able to digitize this map for draft and final map production.

NERI final maps are produced on a Sun cad system. If possible the consultant should send a cad drawing file containing all site features and sample locations on a 5 1/4 inch floppy disk.

II. SURVEY RETRIEVAL

A. Preparation

Prepare by consulting "materials used in retrieval" (see Appendix) to help in bringing together and packaging all the things you will need. Remember that while everything else can be purchased on site or improvised, sampler caps, field map (s), field notes, and extra, clean, empty Petrex tubes to replace those broken in the field are indispensable.

B. Field Procedures

Survey retrieval is less equipment intensive and can typically be accomplished in half the time it takes to perform an installation. However, proper procedures and attention to detail are no less critical.

Particular attention must be given to: Avoiding contamination in excavating, sealing, and packaging the samplers; maintaining clear, unambiguous and orderly sample numbering and record keeping, and accurately recording significant observations.

Try to retrieve samplers in the order in which they were installed. The larger the survey the more significant this becomes in assuring uniform field exposure.

Even before entering the field you can at least fill out a sheet of labels with sample numbers 1 through __, and if it is going to rain while in the field you can also affix a label to each cap to avoid having to handle each label with cold, wet fingers. Tip: Standard ball point pen is very water resistant compared to most other markers and is thus ideal for labeling.

On arriving at each sampling location and before beginning to excavate the sampler, procure one sampler cap (with clean black liner in place) and a handi-wipe and place them within quick, easy reach so that there is no searching or fumbling for them when needed.

Ideally, the aim of one's actions in the retrieval process is to cause the least disturbance to, and contamination of, the atmosphere within the sampler tube while removing the sampler from the environment of the borehole.

The key to this is swift, fluid action: Maintain the sampler in an open-end-down position and handle it with hands clean of potential accumulations of volatile materials (oils, pine tar, etc.). If the sampler has been wrapped with retrieval wire, snip it off completely. If the sampler was placed under water remove polyethylene bag and tape. Then, thoroughly clean soil away from the threads and lip of the bottle with a clean cloth used solely for this purpose (and changed, as conditions demand). Screw the cap on firmly until you feel and hear the lip of the tube seal against the gasket at the base of the cap. No need to strain or twist real hard or you risk breaking the tube and injuring yourself. Visually inspect the contact between the tube and liner to ensure that the seal is uniform and unobstructed.

If the mouth of the sampler is clogged with soil when it is first removed from the borehole, tap the sampler gently against the side of your boot. If this does not shake it loose, gently dig out the greater part of the plug with a clean knife blade, or whatever is available, without disturbing the wire. Then quickly wipe off the threads and lip and screw on the cap.

If the sampler should break during retrieval, transfer the wires from the broken tube, with forceps, to a clean empty Petrex tube. Make note of this in field notes, and later, on the sample submittal form.

Next step: Label. If the cap does not already carry the numbered label, press it on firmly to the top of the cap, especially firmly around the edges. Labels often exhibit poor adhesion if 1) the top of the cap is wet or moist, and 2) the cap is cold. Either way, first vigorously rubbing the top of the cap against warm, dry clothing will usually remedy the situation.

Before stowing the sealed sampler back in the Ziploc bag with the others, be sure the exterior of the tube is relatively clean of sand and clay, water and oils, etc. There is no reason to introduce surplus potential contaminants to the bag of samples or cause the mass spec operator to get his work station dirty.

After retrieval, check-off the location on the map and mark it down in the notebook that sample # so and so was retrieved. Circling the sample number entry in the book with red ink and adding brief comments to the margin, such as "H_2O at BTTM" or "Broken tube, wire transferred," or "missing", etc., where applicable, is sufficient.

Fill-in and cover the borehole. Where samplers have been installed through pavement this is a must. Fill the hole with whatever is at hand, gravel, aluminum foil plug, etc. and finish off to grade with hydraulic cement or asphalt patch. Make it look good, smooth, finished, as often these locations are noticeable for a long time to come.

If the sampler was installed at depth remove pipe and fill the hole with a clean fill material.

Sampling through bare soil or overgrown terrain, i.e., woods, landfills, back lots, roughly filling in the excavation with loose soil and debris is adequate in most instances. However, some clients are particular, in which case be prepared to fill up and top off the boring with something: extra soil, gravel, sand etc. where there is grass or vegetation replace the "divet."

Lastly, collect all flagging materials (although in overgrown areas you may wish to leave some markings at each location to help navigating from point to point until all samplers have been retrieved.)

After all samplers have been retrieved and before leaving the site, take a moment to look over the field map and notebook and check to see that every sampler is accounted for and that all observations have been recorded, that you feel are significant, concerning the condition of the site or specific locations. Also, consider last minute measurements for the accurate mapping of significant features, grab samples of soil, water, site specific chemical compounds, and mixtures.

C. Petrex Sample Labelling and Sample Submittal

In the field, Petrex samplers should be labeled one by one the moment they are retrieved and resealed. A small, self-adhesive label with the appropriate sample location number should be affixed to the clean, dry, upper surface of the blue cap. Be sure to underline the number written on the label, Example:

The numbering system of an entire survey (even those surveys composed of several isolated survey areas) should be sequential starting at 1 and ending with the highest sample location number. Adhere strictly to the numbering system of the sample location map. No number should be repeated. No number should be written illegibly.

As a sample is retrieved and labeled, circle the location number on the field map and in your field notes (preferably in red ink) and record any pertinent observations, i.e., DUP =; H_2O at BTTM of hole; blank; sample tampered with; tube broken on recovery, wires transferred immediately to spare tube; etc.

Once all survey samplers have been retrieved, triplicate samplers must be relabelled and a sample submittal form must be completed. See the example form in the appendix.

In relabelling triplicates you must assign a unique sample number to the third wire comprising the three. Each triplicate wire sampler is to be labeled with its original sample location number (thus, representing two wires) and a second number (representing the third wire) starting at the next highest value to the total number of sample locations. For example: For a survey consisting of 60 Petrex collectors, the first triplicate used, placed at location 5, would be relabelled ,

the next TRIP, from location 17, would be labeled , etc.

Travel blanks are to be labeled next, in sequential order, with single numbers starting up where the last triplicate left off. If the last TRIP is labeled . , the first travel blank is labeled

Lastly, fill out a sample submittal form.

D. Shipping Petrex Samples

After all samplers are labeled and accounted for, they should be packaged for shipping.

Package and ship all samplers to NERI in Lakewood, Colorado in the same fashion they had been sent to you, i.e., in orderly clusters of 20 to 25, sealed in a heavy gauge Ziploc bag (squeezing out all the air possible) and wrapped in several turns of bubble wrap. Tape each bundle securely with at least three winds of masking tape. Two around its girth and one across its ends.

Choose a sturdy cardboard box one that has not begun to lose its rigidity. If you can, place a layer of bubble wrap between the collector bundles and the inside walls of the box. Do not over-stuff the box with collectors, better struggle with two boxes than with one large one with a couple of shattered tubes inside.

Include the sample submittal form, sample number and location map, and Chain of Custody with the samplers being shipped.

Tape the box up well with packing tape, cover all the seams, top and bottom.

Samplers should always be shipped via <u>overnight</u> courier (e.g., Federal Express priority one) to avoid subjecting them to uncontrolled, possibly contaminating environments for greater than 24 hours. If the weekend is approaching and "overnight" entails an extra day or two day hold over before delivery on Monday morning, do not ship the samples out until the beginning of the week. In the interim stow the boxed-up samplers in a place where you know they will be safe (preferably in a no-smoking area or room).

A D D E N D U M

A. GRAB SAMPLES

A grab sample is a quantity of material collected at an instant in time from a discrete location within the environment under study. This includes soil, sediments, surface water, ground water, and all synthetic materials relevant to the site, such as building materials, waste materials, and chemical substances used, stored, or manufactured on-site.

Grab samples can be used to: verify the existence of contaminants discovered through the Petrex soil gas survey; help identify possible exotic compounds present as contaminants where Petrex data may be insufficient; provide information to aid in the statistical modelling of contaminant elution; quantify contaminant concentrations in the media sampled.

Frequently a grab sample will be subject solely to an analysis of headspace gases. Other analyses for environmental samples include purge and trap for volatile organics, and solvent extraction for semivolatile organics. If samples are being collected for known analyses, consult with laboratory personnel beforehand to determine what quantities are required. Samples that you feel may yield critical data should be collected in duplicate.

When collecting samples of undiluted chemical compounds or mixtures for headspace analysis, especially volatile substances or those presenting some hazard in handling, remember, a little goes a long way. Only a small quantity, on the order of 2 ml or less, is needed.

Strict sampling protocol requires all environmental samples be kept refrigerated in transport and storage. In an informal routine, it is still a good idea to keep samples cool when possible.

To prevent contamination in either direction, collect samples in clean, sturdy containers, such as empty Petrex tubes or VOA vials and seal all containers, individually, in Ziploc bags.

Do <u>not</u> ship any soil or water samples with the PETREX collectors.

A P P E N D I X

USEFUL INFORMATION

NORTHEAST RESEARCH INSTITUTE, INC.
Farmington Office
309 Farmington Avenue, Suite A-100
Farmington, Connecticut 06032
Telephone: (203) 677-9666
FAX: (203) 677-7008
Contacts:
Mark H. Hatheway, Senior Geologist

NORTHEAST RESEARCH INSTITUTE, INC.
Lakewood Office
605 Parfet Street
Lakewood, Colorado 80215
Telephone: (303) 238-0090
FAX: (303) 238-2522
Contacts:
Paul Harrington, Field Supervisor

NORTHEAST RESEARCH INSTITUTE, INC.

COMPOUNDS DETECTABLE WITH PETREX SAMPLERS

The following compounds have been detected in soil gas with PETREX collectors and identified by mass spectrometry. Verification was obtained from duplicate PETREX collectors using GC/MS or other qualitative analytical instrumentation.

Most volatile compounds are detectable from ground water sources. Semi-volatiles and the most soluble of volatiles may be detectable only from shallow ground water or vadose zone sources. The following list is intended for use as a guide to developing environmental strategies. It should not be applied to specific sites and situations without advice from Northeast Research Institute (NERI) personnel.

AROMATIC HYDROCARBONS *(Benzene-Based)*

All aromatic hydrocarbons from C_6 (Benzene) to C_{12} (e.g., C_6 Alkyl Benzene) – including specifically identified:

- Benzene
- Toluene
- Xylenes
- Ethyl methyl benzene
- Ethyl benzene
- Trimethyl benzenes
- Propyl benzenes

ALKANES *(Aliphatics/Paraffins)*

All alkane hydrocarbons from C_4 (Butane) to C_{15} (Pentadecanes), C_2 (Ethane), alkanes with various alkyl groups attached, and all cycloalkanes with various alkyl groups attached – including specifically identified:

- Ethane
- Butanes
- Pentanes
- Hexanes
- Heptanes
- Octanes
- Nonanes
- Decanes
- Undecanes
- Dodecanes
- Tridecanes
- Octadecanes
- Cyclopropane
- Cyclobutanes
- Cyclopentanes
- Cyclohexanes
- Cycloheptanes
- Cyclo-octanes
- Cyclononanes
- Cyclodecanes
- Octyl cyclopropane
- Methyl cyclopentane
- Methyl propiy cyclopentane
- Methyl hexane
- Trimethyl hexane
- Methyl cyclohexane
- Trimethyl cyclohexane
- Ethyl methyl cyclohexane
- Ethyl -methylethyl cyclohexane
- Methyl octa decane
- Dimethyl heptane
- Dimethyl octane
- Ethyl methyl octane
- Dimethyl undecane

ALKENES *(Olefins)*

All alkenes from C_3 (Propylene) to C_{15} (Pentadecene), alkenes with various alkyl and other hydrocarbon groups attached, and C_4 to C_{15} cycloalkenes including those with various alkyl groups and other hydrocarbons attached – including specifically identified:

- Ethylene
- Propylene
- Butenes
- Pentenes
- Hexenes
- Heptenes
- Octenes
- Nonenes
- Decenes
- Cyclobutene
- Cyclopentene
- Cyclohexene
- Cycloheptene
- Cyclo octene
- Cyclononene
- Cyclodecene
- Methyl pentene
- Methyl cyclohexene

ALKYNES Alkynes from C_2 to C_{10}

DIENES Dienes from C_4 to C_{10}

STYRENES Styrene, Methyl styrene, and C_2 to C_4 styrenes

VOLATILE HALOGENATED COMPOUNDS

*Vinyl chloride**
Chloromethane
*Methylene chloride**
Chloroform
Carbon tetrachloride
Chloroethane
Dichloroethanes
Trichloroethanes
Tetrachloroethanes
Dichloropropanes
Dichloroethenes
Trichloroethene
Tetrachloroethene
Dichloropropene
Trichloropropene
Chlorobenzene
Chlorotoluene
Dichlorodifluoromethane
Trichlorofluoromethane
Bromoform
Dibromoethane
Bromodichloromethane
Dibromochloromethane
Bromodichloropropane

* *Compounds exhibiting a low affinity to activated carbon*

SEMI-VOLATILE ORGANICS

Hexachloroethane
Hexachlorocyclohexane
Hexachlorobutadiene
Hexachloropentadiene
Dichlorobenzenes
Tetrachlorobenzene
Hexachlorobenzene
Dibromochloropropane
Phenol
Methyl phenol
C_2 - C_3 phenols
Naphthalene
Methyl naphthalenes
C_2 - C_4 Naphthalenes
Chlorophenols
Chloronaphthalenes
Chlorobenzotrifluoride
Dichlorobenzotrifluoride
Trichlorobenzotrifluoride
Nitrobenzene
Nitrotoluene
Dinitrotoluene
Anthracene
Phenanthrene
Acenaphthalene

SULPHUR COMPOUNDS

Hydrogen Sulfide
Sulfur Dioxide
Carbon Disulfide
Carbonyl Sulfide

OTHER DETECTABLE COMPOUNDS

Ethanol
Methoxyethanol
Propanol
Butanol
Dimethyl Butanol
Hexanol
Nonanol
MEK
Butanone
Methyl Butanone
Hexanone
Methyl Hexanone
Tridecanone
Aldehyde
Benzaldehyde
Acetaldehyde

MIXTURES

The PETREX Technique can detect and characterize fresh and aged hydrocarbon mixtures including:

Gasolines (leaded/unleaded)
Diesel fuels
Jet fuels (JP4/JP5)
Aviation gasoline
White gasoline
Hydraulic fluids
Lubricants (Light oils to greases)
Cutting oils
Coolants
Seal oils
Creosotes

MATERIALS USED IN INSTALLATION

1. Petrex Collectors (Plus 15 Time Tests, 5 Blanks, Extras)
2. Proposal and Map(s)
3. Time Test/Retrieval Protocol Sheet, Labels
4. Notebook and Clipboard
5. Ruling Scale and Calculator
6. Measuring Tape and/or Wheel
7. Poly Rope and/or HIP Chain
8. Chalk
9. Spray Paint
10. Pin Flags
11. Ribbon Flagging
12. Machete
13. Coring Shovel
14. Coring Tube with 8 Pound Sledge Hammer
15. Geologist's Hammer
16. Hand Auger
17. Hammer Drill (plus 2 bits)
18. Generator (plus gasoline container)
19. Extension Cord
20. Dolly
21. Vice-Grips
22. Safety Glasses
23. Ear Plugs
24. Gloves
25. Knee Pads
26. Flashlight
27. Pliers and Wire Snips
28. Retrieval Wire (baked)
29. Wooden Dowel
30. Aluminum Foil
31. Quick-Plug Cement
32. Container for H_2O
33. Mixing Bucket
34. Trowel and Spatula
35. Broom and Dust Pan
36. Utility Bucket
37. Scrub Brush
38. Lab Soap
39. Cooler
40. Extra Zip-Lock Bags
41. Extra Petrex Tubes (empty) With Caps
42. First Aid Kit
43. Personal Protective Equipment (Respirator, Hard Hat, Tyvec, etc.)
44. Road Maps
45. Wooden or Metal Rod
46. Hip Boots

MATERIALS USED IN RETRIEVAL

1. Caps and Bags
2. Map(s) and Field Notes
3. Extra Petrex Tubes (empty) With Caps
4. Extra Zip-Lock Bags
5. Labels
6. Proposal
7. Compass
8. Measuring Tape
9. Trowel
10. Tongs
11. Hammer
12. Chisel
13. Screwdriver (large flat)
14. Pliers (needle nose)
15. Wire Snips
16. Forceps
17. Safety Glasses
18. Gloves
19. Knee Pads
20. Flashlight
21. Handi Wipes
22. Broom and Dust Pan
23. Garbage Bags
24. Aluminum Foil
25. Quick-Plug Cement
26. Container for H_2O
27. Mixing Bucket
28. Spatula
29. Sample Submittal Forms
30. Bubble Wrap
31. Packing Tape
32. Duffle Bag(s) (carry-on size)
33. Personal Protective Equipment (Respirator, Hard Hat, Tyvec, etc.)
34. Road Maps

MATERIALS KEPT IN BAG, VEST, ETC.

1. Compass
2. Rock Hammer
3. Chisel
4. Screwdriver (large and miniature flat head)
5. Pliers
6. Wire Snips
7. Tongs
8. Forceps
9. Pocket Knife
10. Sampling Spoon
11. Note Pad
12. Ruling Scale and Protractor
13. Pens (red and black ink)
14. Pencil
15. Magic Marker (bold, indelible)
16. Ribbon Flagging
17. Retrieval Wire
18. Petrex Tubes (empty) With Caps
19. Electrical Tape
20. Handi Wipes
21. Safety Glasses
22. Ear Plugs
23. Gloves
24. Rain Suit and Gaitors
25. Hat

Please return with samples when pickup is complete.

WIRE SUBMITTAL FORM

NERI PROJECT NUMBER: 1309E DATE: 3/11/91

NERI PROJECT MANAGER: MHH / (Client's Initials)

1) TOTAL NUMBER OF TUBES ENCLOSED 45

2) GREATEST SAMPLE NUMBER 48

3) MISSING SAMPLE NUMBERS: 2, 10, 18

4) DATE SHIPPED FROM FIELD: 3/12/91

5) TRAVEL BLANKS: 46, 47, 48

6) NOTES: #5 Broken During Pickup - Wires Transferred #20, #21, and #22 H_2O at bottom of hole

NERI-WEST
605 PARFET STREET, SUITE 100
LAKEWOOD, COLORADO 80215
(303) 238-0090

LAB USE ONLY

7) REPLICATE SAMPLES:

8) LAB NOTES:

PETREX ENVIRONMENTAL SURVEY
Chain of Custody Document

Job Number_____ (Please refer to this job number with all correspondence and shipments)

FIELD DATA:

Facility_____

Location_____

_____

Field Manager_____ Phone_____

PYMS LAB DATA:

Instrument_____

Operator_____

Phone_____

Sample Nos._____

GC/MS LAB DATA:

_____

_____

_____

_____

SAMPLE DATA:

Number of Samples_____
Date Shipped to Field_____
Date Received in Field_____
Condition as Recd. in Field_____
Received By_____
Date Shipped from Field_____
Date Received from Field_____
Conditions as Recd. in Lab_____
_____
Number Received_____
Received By_____

SAMPLE TRANSFER DATA:

	Relinquished By:	Relinquished To:	Date:	Time:	Reason:
1.					
2.					
3.					
4.					
5.					
6.					

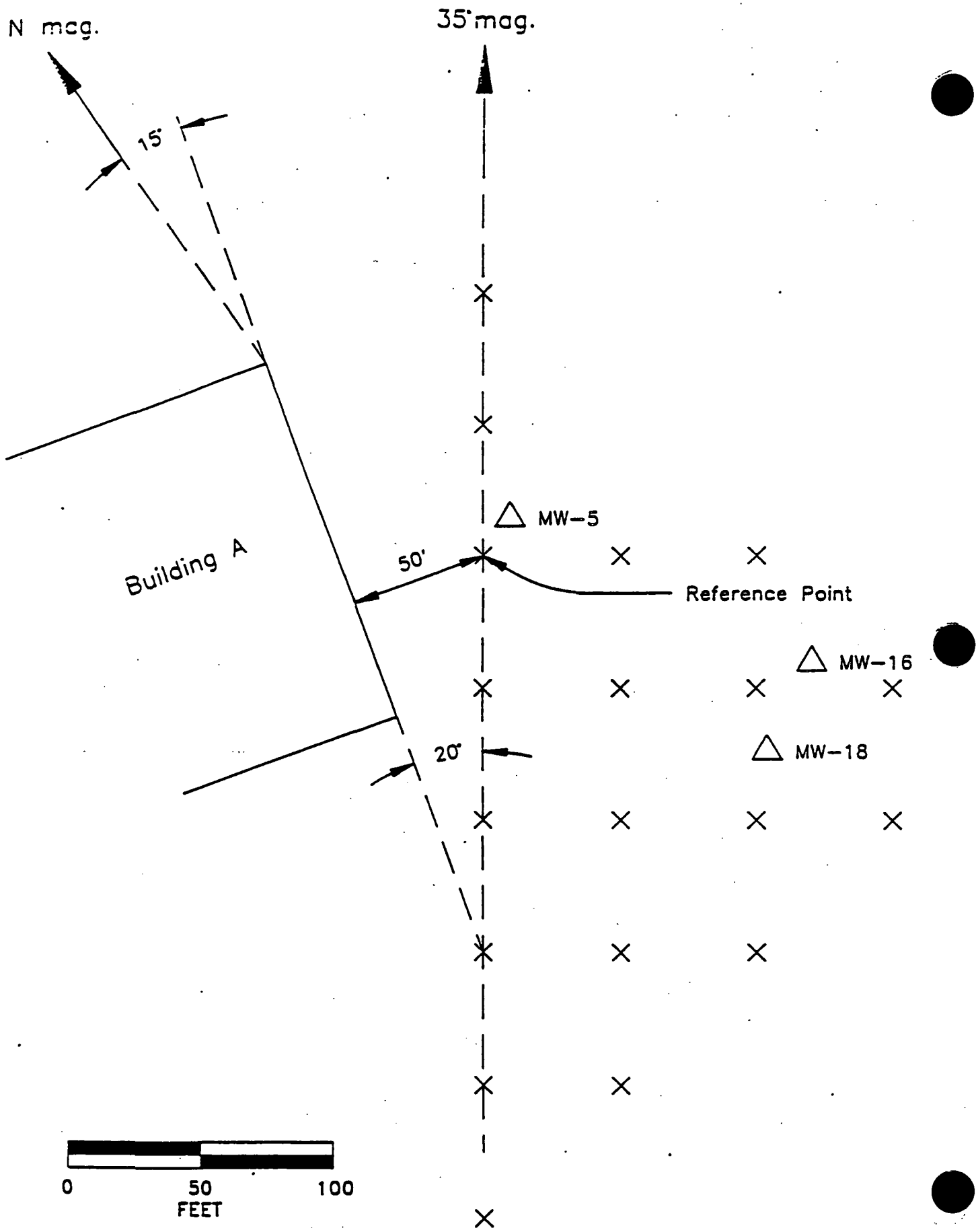
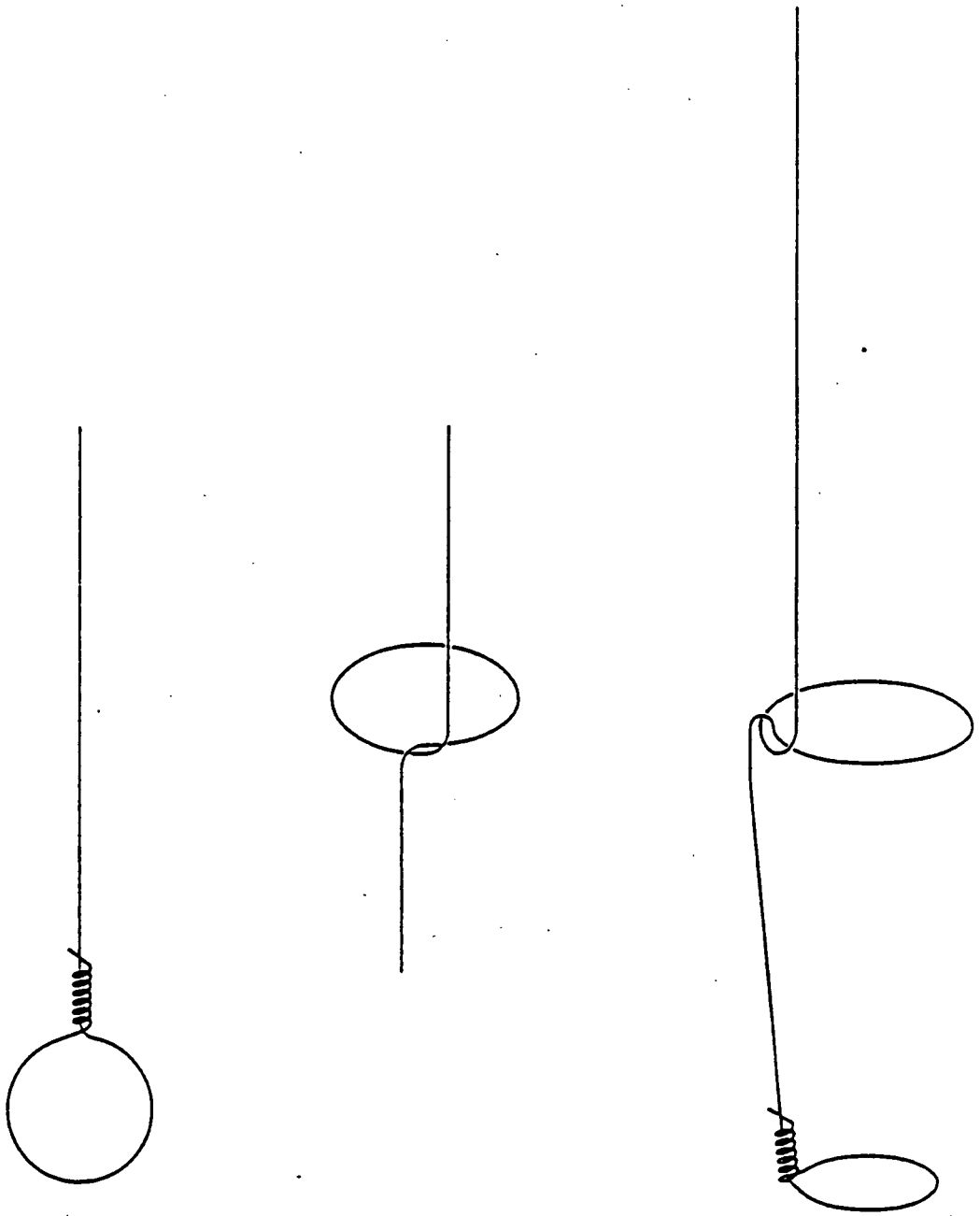

N mcg.
35° mag.
15°
MW-5
Building A
50'
Reference Point
MW-16
20°
MW-18
0
50
100
FEET

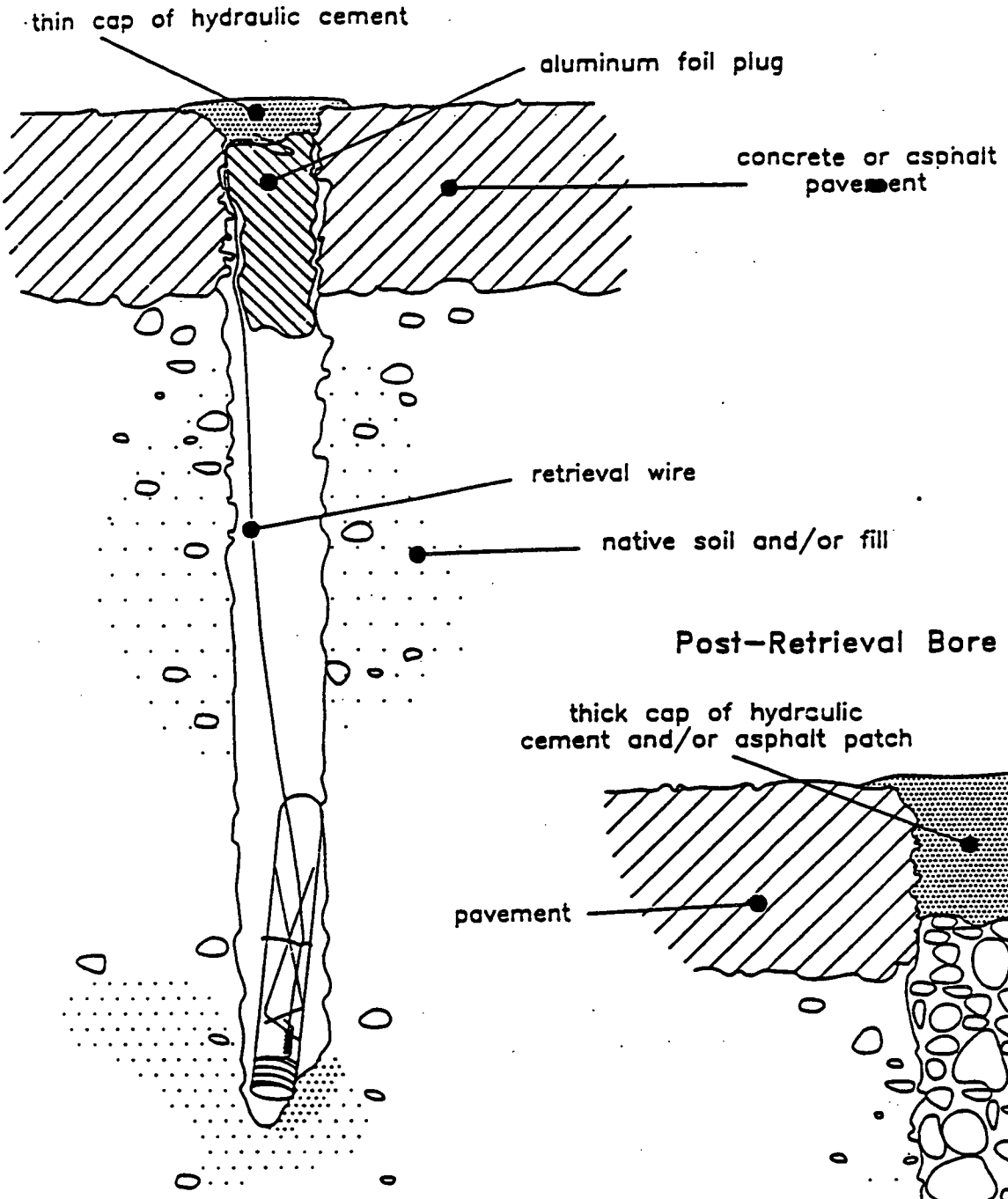
Figure 1

Retrieval Wire Wrapping Technique
Figure 2

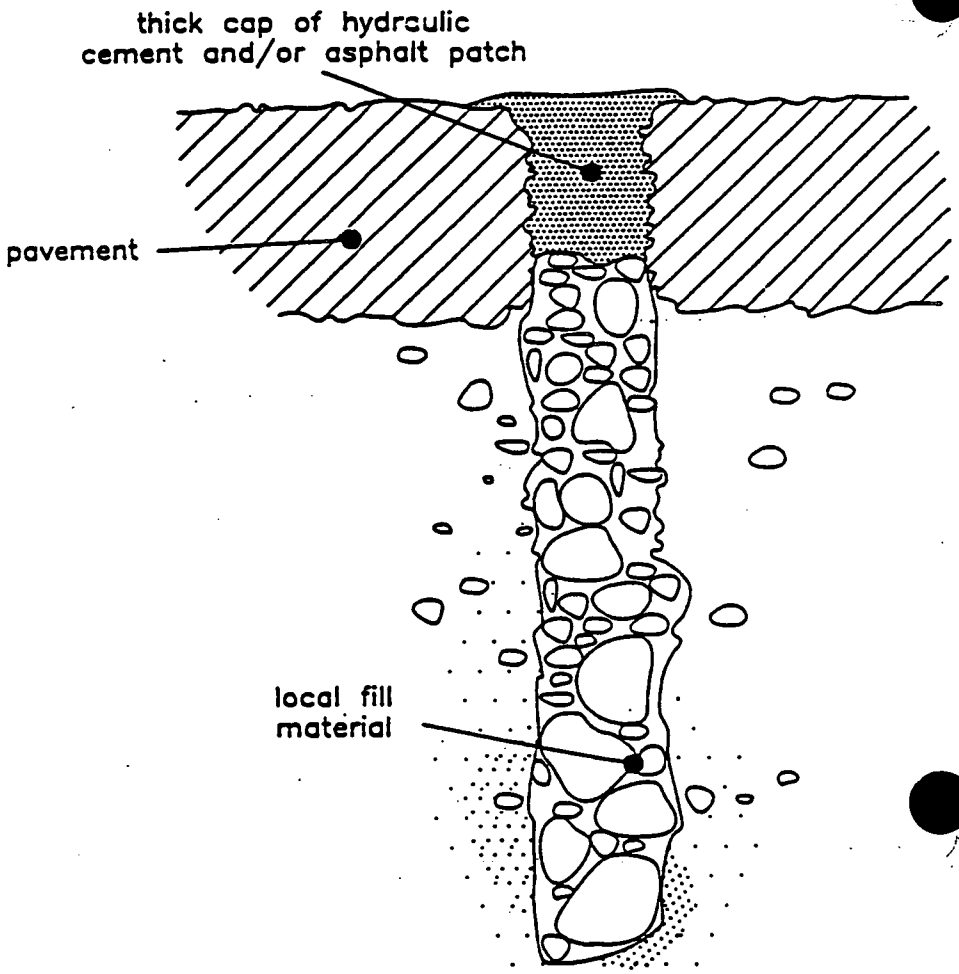


Collector Installation Through Surface Pavement

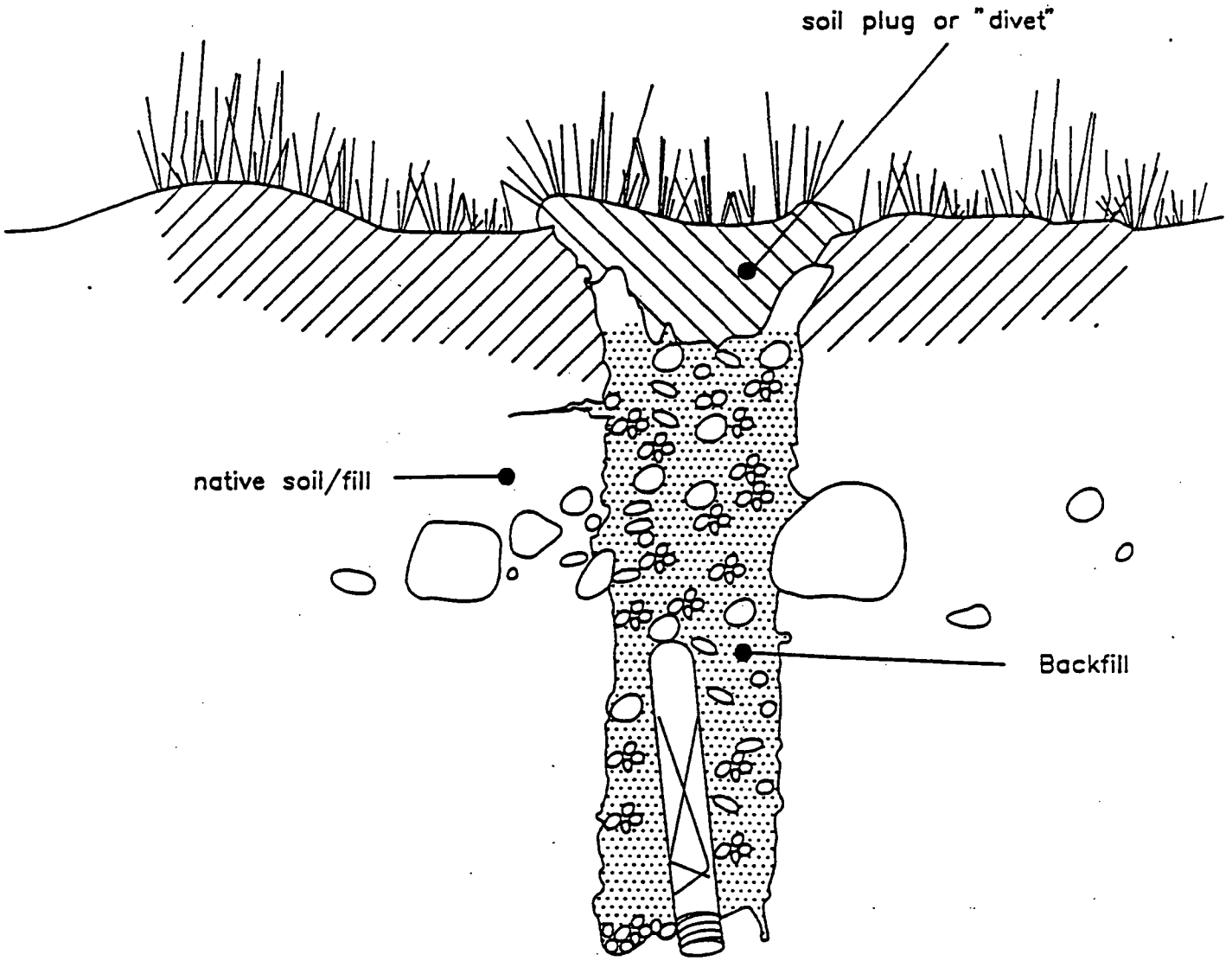
Figure 3



Post-Retrieval Bore Hole Patching

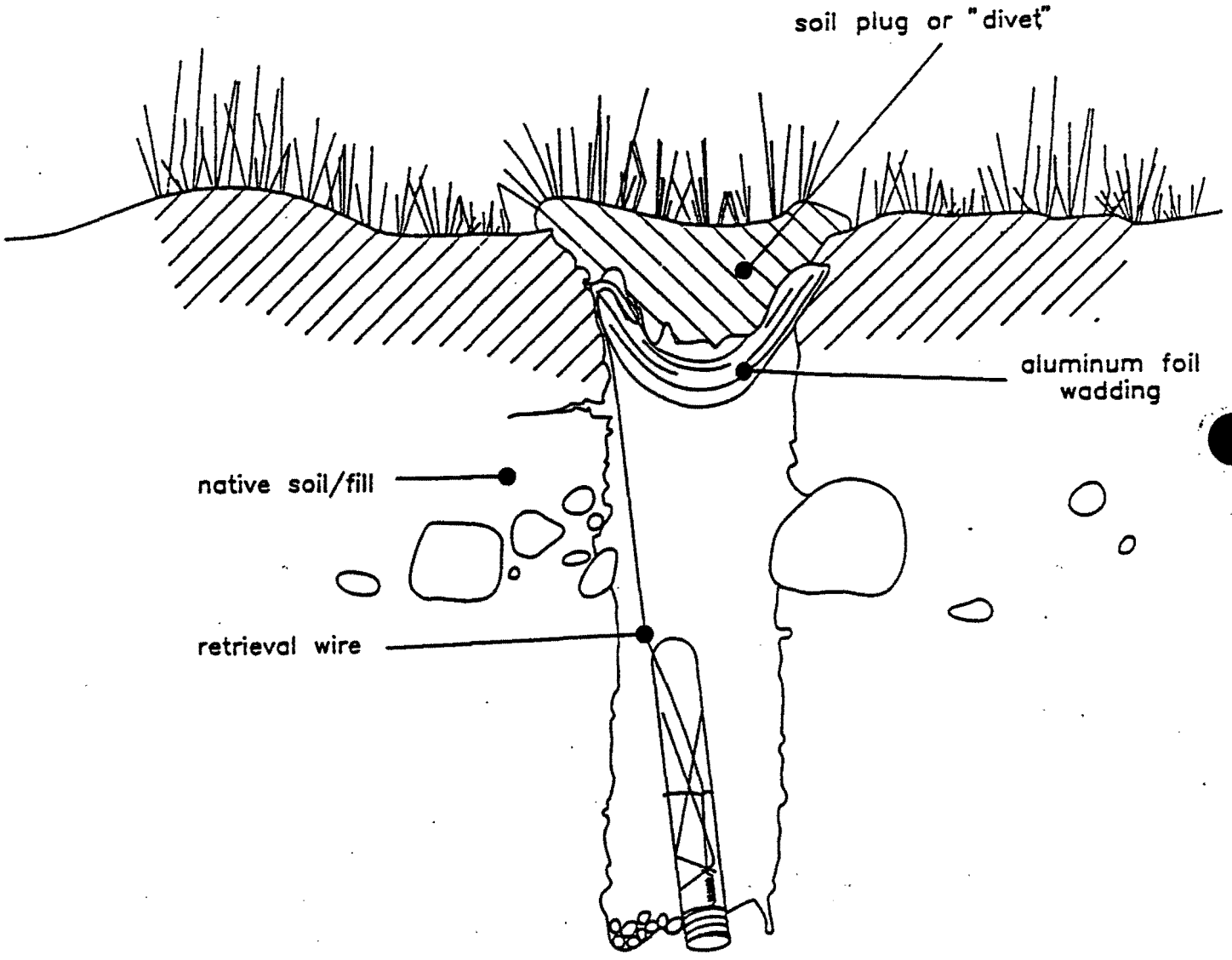


Collector Installation Through Exposed Earth
Figure 4



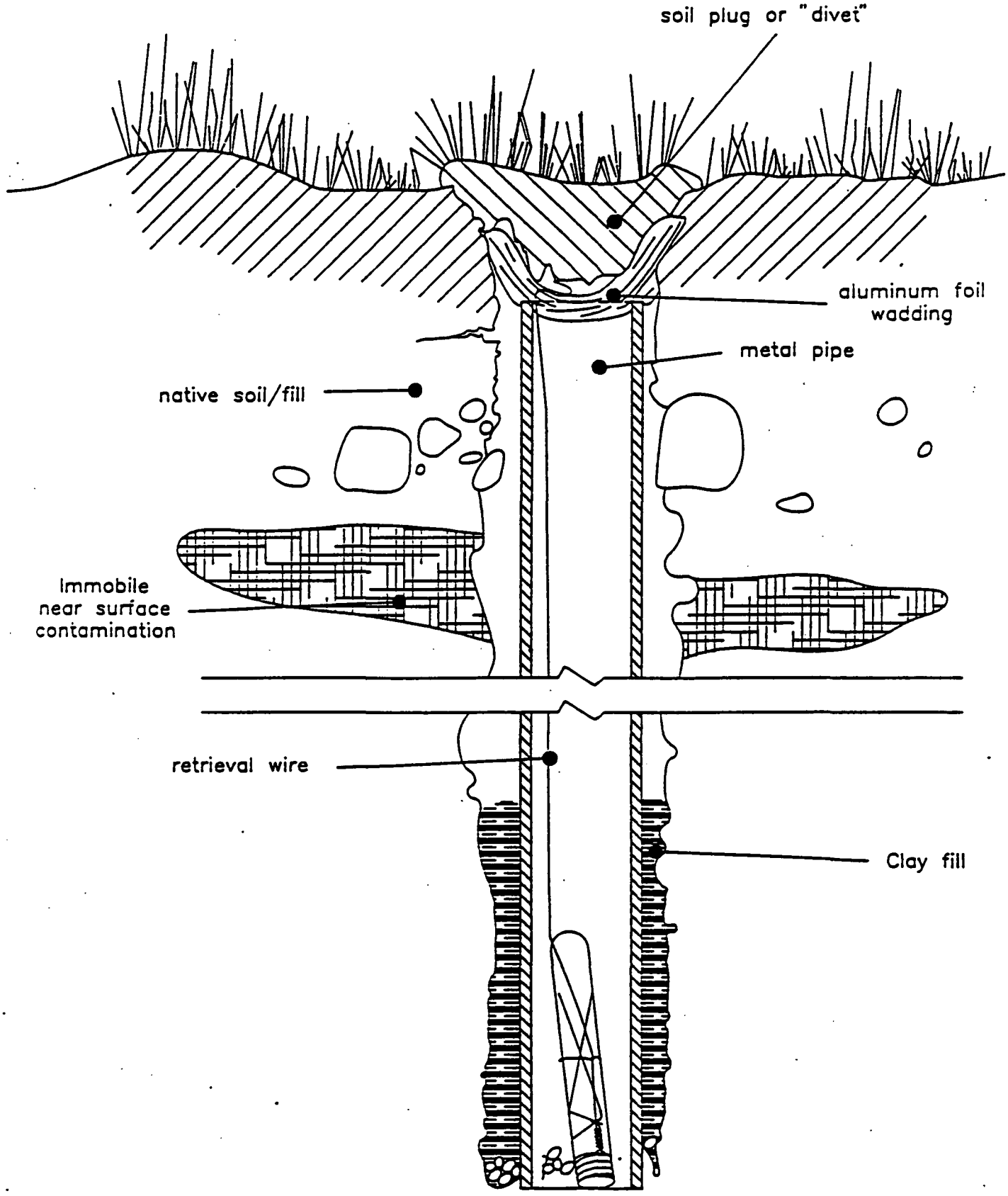
Collector Installation Through Frozen Earth

Figure 5



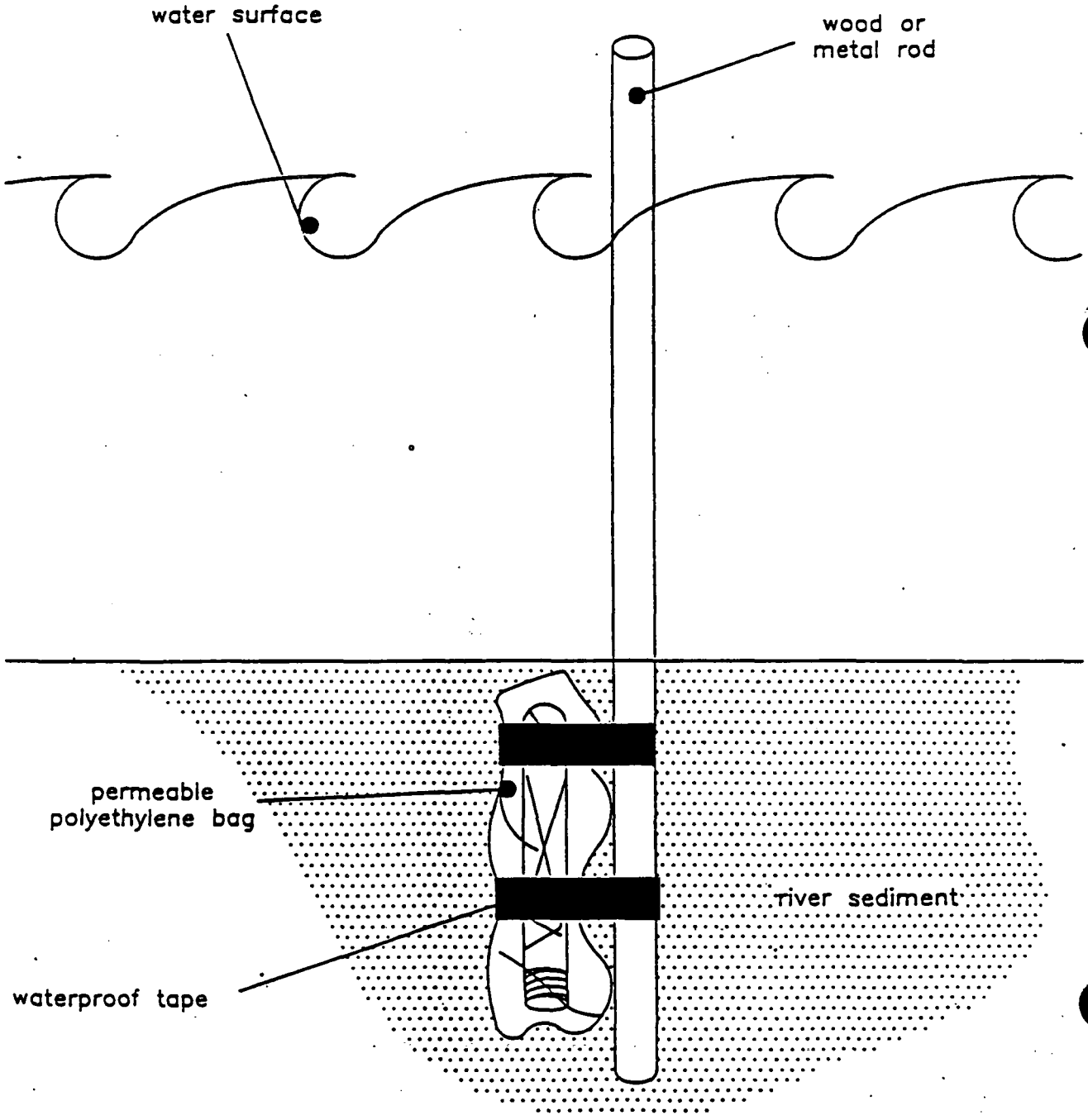
Collector Installation at Depth

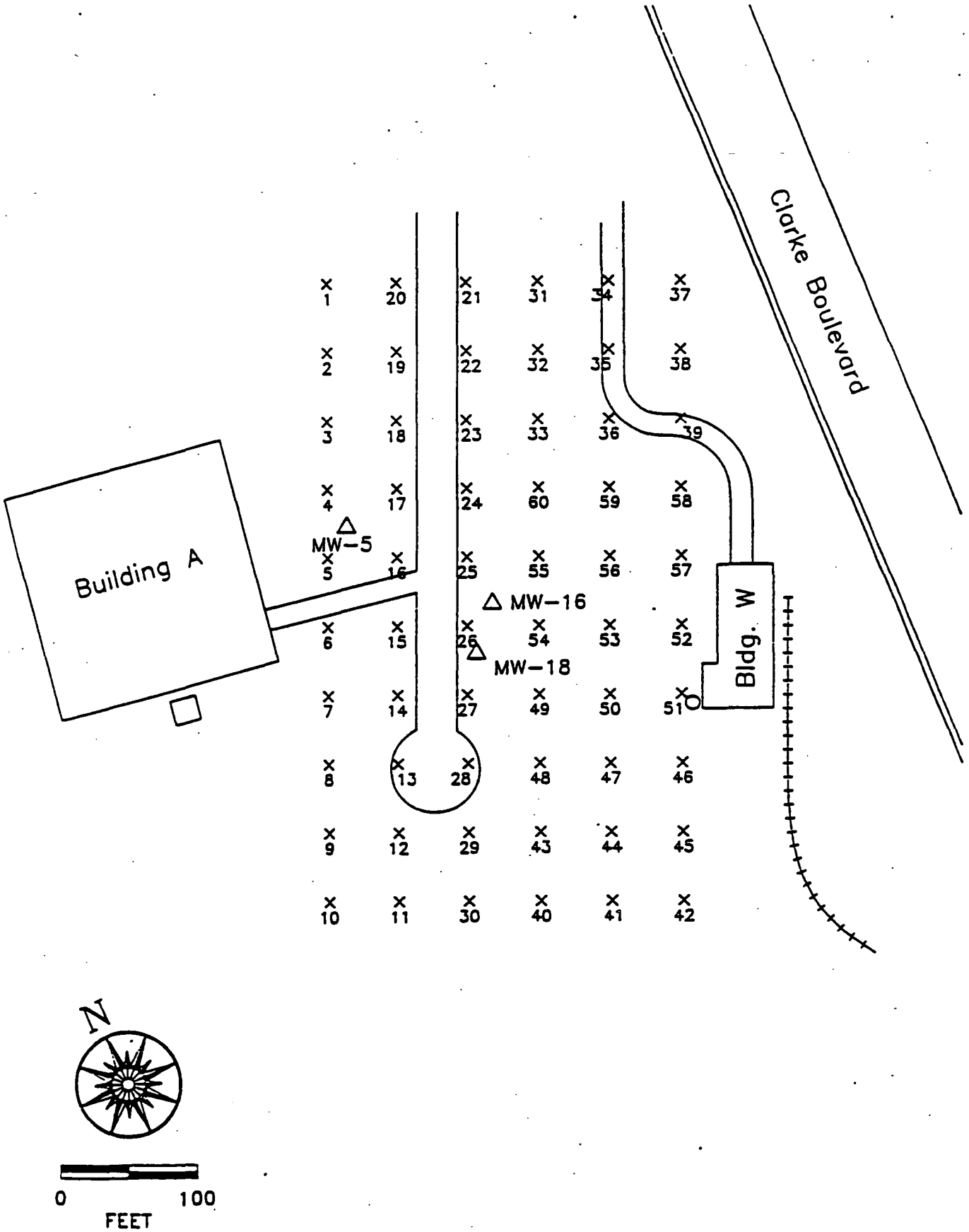
Figure 6



Collector Installation Under Water

Figure 7




Clarke Boulevard
Building A
Bldg. W
MW-5
MW-16
MW-18
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
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32
33
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37
38
39
40
41
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46
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48
49
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51
52
53
54
55
56
57
58
59
60
N
0
100
FEET

Figure 8

Attachment 1

SOPs for Groundwater Sampling Using HydroPunch

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING USING A NON-RESERVOIR TYPE HYDROPUNCH OR CONE PENETROMETER GROUNDWATER SAMPLING DEVICE

1. PURPOSE

The purpose of this procedure is to describe the technique to obtain a representable groundwater sample at a discrete interval without interference from other water-bearing intervals using a non-reservoir type (ie. accessible to a bailer or pump) HydroPunch or cone penetrometer groundwater sampling device.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

This procedure will discuss the generalized groundwater sampling techniques applicable to a non-reservoir type HydroPunch or cone penetrometer groundwater sampling device. The non-reservoir type of HydroPunch or cone penetrometer groundwater sampling device is connected to the surface by a sample line allowing for large sample volumes to be collected.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1 through 1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples

1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurements on Ground and Surface Water Samples
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer
2.5	Sampling Monitoring Wells with a Submersible Pump
2.6	Sampling Monitoring Wells with a Peristaltic Pump
2.8	Sampling for Volatile Organics
3.1	Water Level Measurement
4.1	Soil Boring
4.2	Rock Boring

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that permission to discharge or a containment system is available to collect purged water.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms.

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Determine the depth of the interval to be sampled as described in the FSP or WP. Locate an appropriate decontamination area, staging area, and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

3.3.1. Procedure for Setting Up the Non-Reservoir Type HydroPunch or Cone Penetrometer Groundwater Sampling Device Prior to Sampling

The sampling procedure can be generalized into a three-stage process: advance, set, and collect.

A. With the drive cone and sealed screen section attached, the penetrometer rod is pushed or driven into the ground. After reaching the top of the desired sample interval, the drive mechanism is pulled back exposing the screen to the formation and sample interval.

B. After the drive cone and screen section are set, the water level inside the penetrometer rod (or discharge tube) will be measured according to SOP 3.1. If possible, the top of the drive cone will then be sounded and the depth setting of the screen interval determined.

C. A minimum volume of water, equal to three times that contained within the screen section and penetrometer rod (or discharge tube), will be purged (or until nearly dry). Purging will continue until the discharge parameters (pH, temperature, and specific conductance) stabilize according to SOP 2.1. The water level within the screen section and penetrometer rod (or discharge tube) will be measured (if possible) with each water volume purged, and recorded on the field data sheet.

D. Purged water will be containerized in accordance with SOP 2.1.

E. Purging will be conducted utilizing a bailer or pump (bladder, submersible, or peristaltic) capable of delivering any sediment that may be found with the water.

3.3.2. Procedure for Collecting Samples

The sample collection will follow the standard groundwater sampling techniques per SOPs 2.3 through 2.6. After filling the last sample container, a final set of discharge parameters (pH, temperature, and specific conductance) will be measured to identify significant changes in water quality over the period of the sampling event.

3.4. Postoperation

3.4.1. Field

A. Following sample collection the penetrometer rod will be retracted. If the screen section is also retracted, that section and the section of penetrometer rod immediately above the screen will be cleaned with a pressure washer between multiple samples at a single location, and decontaminated between locations, according to SOP 1.6. The bailer or pump will be decontaminated after each sampling according to SOP 1.6.

B. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign or initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for subsequent delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Cordry, Kent, 1991. *HydroPunch II - The Second Generation: A New In-Situ Ground Water Sampling Tool*, Proceedings of the NWWA Outdoor Action Conference, May 13-16, 1991, Las Vegas, NV, pp. 733-746.

Kaback, Dawn and Chris Bergren, 1990. *Testing a Ground Water Sampling Tool: Are the Samples Representative?*, Proceedings of the NWWA Outdoor Action Conference 1990, pp. 403-417.

QED, 1992. *How to get Accurate Ground Water Samples Without Installing Wells*, Ann Arbor, MI.

QED, 1993. *Site Investigation Without Wells*, Ann Arbor, MI.

5.1. APPENDIX

Equipment and Supplies Checklist

APPENDIX 5.1.

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stainless Steel Housed Submersible Pump Capable of Delivering Water with High-Solids Content, or Decontaminated Teflon or Stainless Steel Purge Bailer with Rope

_____ Decontaminated Teflon Sample Bailer with Rope

_____ Teflon or Other Chemically Inert Tubing

_____ Sample Containers and Preservatives

_____ Field Logbook

_____ Manual or Powered Winch

_____ Sampling Gloves

_____ Insulated Coolers

_____ Zip-lock Plastic Bags

_____ Ice

_____ Labels

_____ Water-level Indicator

_____ Chain-of-Custody Forms

_____ Stainless Steel Screen Section

_____ Penetrometer Rods

_____ Alconox

_____ Trash Bags

_____ Plastic Sheeting

_____ Any Additional Supplies Listed in Associated Procedures, as Needed

Attachment 1

SOPs for Groundwater Sampling Using Drill-Stem Techniques

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING USING DRILL-STEM TECHNIQUES

1. PURPOSE

The purpose of this procedure is to describe the technique to obtain a representable groundwater sample at a discrete interval without interference from other water-bearing intervals during drilling operations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

This procedure will discuss the generalized groundwater sampling techniques applicable to hollow-stem auger, cable tool, and Rotasonic drilling methods.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1 through 1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination

2.1	Presample Purging of Wells
2.2	Field Measurements on Ground and Surface Water Samples
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer
2.5	Sampling Monitoring Wells with a Submersible Pump
2.8	Sampling for Volatile Organics
3.1	Water Level Measurement
4.1	Soil Boring
4.2	Rock Boring
4.3	Monitoring Well Installation

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that permission to discharge or a containment system is available to collect purged water.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms.

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Determine the depth of the interval to be sampled during drilling as described in the FSP or WP. Locate an appropriate decontamination area, staging area, and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

3.3.1. Procedure for Setting Up the Drill-Stem Prior to Sampling

The sampling procedure can be generalized into a four-stage process: advance, clean, withdraw, and collect. For Rotasonic or cable tool drilling, drive casing will be advanced to the top of the desired sample interval. Until reaching the top of the interval, the drilling will proceed as specified in the appropriate field procedure (i.e., SOPs 4.1 and 4.2).

A. After reaching the top of the desired sample interval, a 0.010" slotted stainless steel well point, approximately 2 to 4 inches in diameter and 2 to 5 feet in length and equipped with an inflatable packer, will be advanced through the drive casing and into the formation. The well point will be driven such that the packer is located at the bottom of the drive casing and the well point is adjacent to the sample interval. The packer will then be inflated, isolating the water column above the packer from the groundwater in the formation, at sample intervals. The same procedure will be followed for hollow-stem auger drilling, except that the well point will be advanced directly through the auger stem.

B. After the well point is set and the packer inflated, the water level inside the well point and steel well pipe will be measured according to SOP 3.1. The bottom of the well point will

then be sounded and the depth setting of the screen interval determined.

C. A minimum volume of water, equal to three times that contained within the well point and pipe will be purged from the well point (or until nearly dry). Purging will continue until the discharge parameters (pH, temperature, and specific conductance) stabilize according to SOP 2.1. The water level within the well point and riser pipe will be measured with each water volume purged, and recorded on the field data sheet.

D. Purged water will be containerized in accordance with SOP 2.1.

E. Purging will be conducted utilizing a bailer or submersible pump capable of delivering any sediment that may be found with the water.

3.3.2. Procedure for Collecting Samples

The sample collection will follow the standard groundwater sampling techniques per SOPs 2.4 or 2.5. After filling the last sample container, a final set of discharge parameters (pH, temperature, and specific conductance) will be measured to identify significant changes in water quality over the period of the sampling event.

3.4. Post Operation

3.4.1. Field

A. Following sample collection the packer will be deflated and the well point removed from the boring. The well point and the section of well pipe immediately above the point will be cleaned with a pressure washer between multiple samples at a single location, and decontaminated between locations, according to SOP 1.6. The bailer or pump will be decontaminated after each sampling according to SOP 1.6.

B. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign or initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for subsequent delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

ASTM, 1986. *Annual Book of ASTM Standards*, Section 11. Volume 11.04, D4448-85A.

Johnson Division, UOP, Inc. 1985. *Ground Water and Wells, A Reference Book for the Water Well Industry*. Johnson Division, UOP, Inc., Saint Paul, MN.

Nielson, D.M. and G.L. Yeates, 1985. *A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells*. Ground Water Monitoring Review 5:38-98.

5.1. APPENDIX

Equipment and Supplies Checklist

APPENDIX 5.1.
EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stainless Steel Housed Submersible Pump Capable of Delivering Water with High-Solids Content, or Decontaminated Teflon or Stainless Steel Purge Bailer with Rope

_____ Decontaminated Teflon Sample Bailer with Rope

_____ Teflon or Other Chemically Inert Tubing

_____ Sample Containers and Preservatives

_____ Field Logbook

_____ Manual or Powered Winch

_____ Sampling Gloves

_____ Insulated Coolers

_____ Zip-lock Plastic Bags

_____ Ice

_____ Labels

_____ Water-level Indicator

_____ Chain-of-Custody Forms

_____ Slotted Well Point

_____ Riser Pipe

_____ Inflatable Packer

_____ Alconox

_____ Trash Bags

_____ Plastic Sheeting

_____ Any Additional Supplies Listed in Associated Procedures, as Needed

Attachment 1

SOPs for Geophysical Surveys

GEOPHYSICAL SURVEYS
SUBTASK-SPECIFIC
HEALTH AND SAFETY PLAN
and
TECHNICAL PROCEDURES

July 1992

Prepared By:

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
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TECHNICAL PROCEDURE

MAGNETOMETER/GRADIOMETER SURVEYS

1.0 PROCEDURE

This technical procedure presents technical guidance on the use of magnetic gradiomter surveys for environmental or engineering investigations. Such investigations are commonly performed to collect subsurface magnetic data that could be interpreted either geologically or directly for environmental and/or engineering purposes.

2.0 SCOPE

2.1 The procedure applies to all SAIC personnel and their contractors who may perform the work or process the data.

2.2 The procedure describes the responsibilities of personnel involved in the surveys, field operations, processing and interpretation of the data. It provides or cites reference materials applicable to general information on commonly used field methods; instruments; collecting, processing, interpreting and presenting the data.

2.3 Attaining accuracy and validity are integral parts of the investigation. Accordingly, planning and performing the surveys require confidence that the data collected meet acceptable Quality Assurance requirements. This procedure provides guidance toward meeting those requirements.

2.4 The following Sections provide more detailed guidance: 3.0 RESPONSIBILITIES OF PERSONNEL, 4.0 EQUIPMENT, 5.0 DETAILED PROCEDURE, 6.0 CALIBRATION, 7.0 QUALITY ASSURANCE RECORDS, 8.0 REFERENCES, 9.0 DEFINITIONS, 10.0 ATTACHMENTS.

3.0 RESPONSIBILITIES OF PERSONNEL

3.1 The Principal Investigator (PI) is responsible for assuring compliance with this procedure. The PI shall plan the survey, select the appropriate field equipment, perform or oversee the data collection, data reduction, data processing, interpretation and report preparation. The PI shall assign appropriate personnel and designate responsibilities for the different tasks. The PI shall require that all personnel involved in the investigation have the appropriate qualifications, training and skills to adequately perform the assigned tasks.

3.2 All personnel shall have a working knowledge of the appropriate Technical and Quality Assurance Procedures.

4.0 EQUIPMENT

4.1 Several manufacturers of modern magnetometer/gradiometer instruments and compatible data loggers are available for collecting data suitable to the two classes of applications discussed in this Technical Procedure. The Technical Procedure for Magnetometer Surveys is a companion document to this Procedure.

The types of magnetometers/gradiometers commonly used include fluxgate and total-field. Magnetic gradiometers are differential magnetometers that measure the magnetic gradient at a site rather than the Earth's Magnetic Field. The instruments are especially useful for surveys that involve measuring shallow magnetic features because the anomalies from gradient measurements tend to resolve the individual components contained in a complex magnetic anomaly. These individual components, in the form of individual anomalies, can be interpreted to locate and define the shape and depth of the causative body. The gradiometer also is more sensitive to shallow magnetic sources than is a standard magnetometer. The method has the further advantage in that any regional and temporal variations in the Earth's Magnetic Field are automatically removed.

4.2 Each type of magnetometer/gradiometer has different specifications and ranges of sensitivity. Therefore, each type has specific advantages and disadvantages. The PI is responsible for selecting the appropriate instrument.

4.3 The magnetometer/gradiometer instruments can record the Earth's Magnetic Field, its local perturbations, as well as the magnetic gradient at each station, all simultaneously. Thus, three types of data are recorded at the same station at no additional cost. Normally, for environmental or engineering applications, the Earth's Magnetic Field is of little importance. The other two sets of data can be used in interpretations of the local magnetic sources.

4.4 Other field equipment may be required, including surveying equipment for determining distances between and elevations of stations, measuring tape (non-metallic), field computers, and tools for field repair of equipment.

5.0 DETAILED PROCEDURE

5.1 Magnetometer/gradiometer surveys measure the Earth's Magnetic Field, its local perturbations, and the magnetic gradient. For environmental/engineering investigations, the surveys generally focus on obtaining data in the shallow subsurface, generally less than 100 feet.

5.2 Prior to conducting any magnetometer/gradiometer survey, a determination is made by the PI as to the applicability and potential effectiveness of the survey in meeting the requirements of the investigation. The PI shall justify the decision. A site visit may be required to provide appropriate information to make the decision.

5.3 If the decision and justification are accepted by the Project Manager, then the PI plans the survey. Planning shall be applicable to the type of survey (reconnaissance, detail). The PI shall select the spacings between stations (grid), the data logger, field computer and other equipment.

5.4 Prior to conducting the survey, calculations shall be made that define the smallest target that would produce an interpretable magnetic and gradient anomaly based on the calculations, the selected spacings of stations and the sensitivity of the magnetometer/gradiometer. The calculations shall provide for anomaly discrimination between the two sets of anomalies.

5.5 The PI selects the appropriately trained staff, assigns tasks and assures that appropriate training has been completed prior to beginning the investigation.

5.6 Station locations and elevations shall be surveyed prior to conducting the magnetometer/gradiometer surveys. A base map shall be prepared that shows the station locations, their elevations, and potential sources of interference, e.g., fences, buildings, buried pipes or electric lines that produce current or overhead transmission lines.

5.7 Prior to conducting the surveys, a determination is made regarding the potential interference caused by atmospheric effects (e.g., electric storms, magnetic storms). If such effects occur during the surveys, then the surveys shall be delayed until the effects are determined not to interfere with the collection of useful data.

5.8 Prior to conducting the surveys, the equipment shall be calibrated (Section 6.0).

5.9 A base station is selected in an area sufficiently removed from sources of magnetic interference. The base station may be automated by placing a second magnetometer at that location and have the instrument record measurements at selected intervals. Alternatively, the base station may be occupied periodically during the course of each day's survey and measurements taken manually. All measurements at the base station are to be taken at the beginning and end of each day's survey; the intervals of measurements to be taken at the base station are to be defined by the PI.

5.10 For the survey, the equipment is to be connected according to the specifications of the manufacturer. Examples of such connections include sensor(s) to console, console to data logger, data logger to computer.

5.11 Data collection operations are described, in general, in the instruction manual provided by the manufacturer. If deviations from such instructions are made by the PI or designee and are documented in the logbook or on the data sheets (Section 7.0).

5.12 Recording of the data may be done automatically using a data logger compatible with the magnetometer/gradiometer or manually using data sheets. Most data loggers have a built-in menu for entering background information and for collection of data correlated with the station locations. These data are stored in the data logger and later transferred to a computer for data reduction and analysis. Use of the data logger shall follow the manufacturer's instructions. The amount of data stored by the data logger depends on its storage capacity. If the data logger reaches its capacity, the PI or designee shall assure that the data are immediately transferred to an appropriate secondary storage source, even if the survey has to be interrupted during the day.

5.13 Data sheets for entering data may be used in place of or in addition to the data logger. An example of a data sheet is given in Section 10.

5.14 The data shall have all appropriate corrections applied prior to interpretations. Commercially available computer software is generally used. Data reductions are commonly made by the computer; interpretations may be made by the PI or designee using

the computer. Graphic presentations also are commonly made using computer software. All software packages used shall be identified by name, manufacturer, and version. Limitations of the software package shall be described, if known.

5.15 Data reduction, analysis and interpretation, if done manually, shall follow standard methods (Section 8.0). Any deviations from these methods shall be described in detail.

5.16 Presentation of the data, data reduction, methods of analysis and interpretations shall be presented in a report that contains all appropriate information necessary so that an independent third party reviewer can evaluate the results of the survey.

5.17 Limitations of the equipment, data, data analysis, interpretations and other pertinent information to the study shall be identified and included in the report.

6.0 CALIBRATION

6.1 Calibration of the equipment (magnetometer/gradiometer) is generally done by the manufacturer according to the manufacturer's standards. Documentation of such calibration and periodic updates shall be requested and, if available, shall be provided upon request.

6.2 Field checks shall be made before, periodically during the survey, and after each day's survey to assure the equipment is operating satisfactorily. Field checks are commonly described in the instruction manual supplied by the manufacturer.

6.3 If the equipment is not operating properly, field repairs shall be made. Such repairs shall be entered, in detail, in the logbook or on the data sheets. If repairs can not be made, the survey shall not proceed. A replacement unit shall be obtained from the same manufacturer or leasing agent (see Section 4.1).

6.4 A field check of the data collected by the replacement unit shall be done at the base station, at randomly selected stations and shall be compared to the data collected by the original unit. Comparison of the two data sets shall demonstrate statistical significance (Section 8.0) using the sensitivity range of the instruments as the criterion for defining the confidence limits. The data used and the statistical analysis shall be documented in the logbook or data sheets and included in the report.

7.0 QUALITY ASSURANCE RECORDS

7.1 Documents and data shall be prepared and submitted according to governing Project Procedures. Documents and data shall include station locations and elevations, sources of interference, maps, field sketches, photographs, field data (diskettes, data sheets), logbook, and any other information considered pertinent by the PI or designee to the investigation.

7.2 All documents shall be submitted according to requirements with Project Procedures.

8.0 REFERENCES FOR MAGNETOMETER/GRADIOMETER SURVEYS

Dobrin, M. B., 1976, Introduction to Geophysical Prospecting: McGraw Hill Book Co., Inc., New York, NY, 3d Edition, p.

Kearey P., and Brooks, M., 1984, An Introduction to Geophysical Exploration: Blackwell Scientific Publications, Palo Alto, CA, 296 p.

Natrella, M. G., 1966, Experimental Statistics: National Bureau of Standards Handbook 91: U. S. Government Printing Office, Washington, D. C., 396 p.

Telford, W. M., Geldart, L. P., Sheriff, R. E., and Keys, D. A., 1976, Applied Geophysics: Cambridge University Press, New York, N. Y., 860 p.

9.0 DEFINITIONS

Base station. A location used as a reference where magnetometer/gradiometer readings are taken either automatically or manually. The value of the Earth's Magnetic Field at this location remains constant and variations in the measurements are due primarily to diurnal changes in the Field. These variations are subtracted from the constant value and the differences are used to correct the values recorded at other stations in the survey.

Magnetometer. An instrument that measures the Earth's Magnetic Field and perturbations of the field caused by local concentrations of magnetic substances.

Magnetic Gradiometer. An instrument that measures the magnetic gradient at a station.

Magnetometer Survey. A geophysical survey method designed to measure the Earth's Magnetic Field and the magnetic response (presence and distribution) of magnetic substances below the ground that cause perturbations in the Earth's Magnetic Field.

Magnetic Gradiometer Survey. A geophysical method designed to measure the magnetic gradient at a station.

Range of Sensitivity. The lower and upper limits of the magnetometer/gradiometer's response to detect magnetic substances.

Station. Location for taking a magnetometer/gradiometer reading.

10.0 ATTACHMENTS

TECHNICAL PROCEDURE

ELECTROMAGNETIC SURVEYS

1.0 PROCEDURE

This technical procedure presents technical guidance on the use of electromagnetic surveys for environmental or engineering investigations. Such investigations are commonly performed to collect subsurface conductivity (the reciprocal of resistivity) data that could be interpreted either geologically or directly for environmental and/or engineering purposes.

2.0 SCOPE

2.1 The procedure applies to all SAIC personnel and their contractors who may perform the work or process the data.

2.2 The procedure describes the responsibilities of personnel involved in the surveys, field operations, processing and interpretation of the data. It provides or cites reference materials applicable to general information on commonly used field methods; instruments; collecting, processing, interpreting and presenting the data.

2.3 Attaining accuracy and validity are integral parts of the investigation. Accordingly, planning and performing the surveys require confidence that the data collected meet acceptable Quality Assurance requirements. This procedure provides guidance toward meeting those requirements.

2.4 The following Sections provide more detailed guidance: 3.0 RESPONSIBILITIES OF PERSONNEL, 4.0 EQUIPMENT, 5.0 DETAILED PROCEDURE, 6.0 CALIBRATION, 7.0 QUALITY ASSURANCE RECORDS, 8.0 REFERENCES, 9.0 DEFINITIONS, 10.0 ATTACHMENTS.

3.0 RESPONSIBILITIES OF PERSONNEL

3.1 The Principal Investigator (PI) is responsible for assuring compliance with this procedure. The PI shall plan the survey, select the appropriate field equipment, perform or oversee the data collection, data reduction, data processing, interpretation and report preparation. The PI shall assign appropriate personnel and designate responsibilities for the different tasks. The PI shall require that all personnel involved in the investigation have the appropriate qualifications, training and skills to adequately perform the assigned tasks.

3.2 All personnel shall have a working knowledge of the appropriate Technical and Quality Assurance Procedures.

4.0 EQUIPMENT

4.1 Several manufacturers of modern electromagnetic instruments and compatible data loggers are available for collecting data suitable to the two classes of applications discussed in this Technical Procedure. The instruments are especially useful for surveys that involve measuring shallow sources of the ground conductivity or metallic objects, not necessarily iron-bearing.

4.2 The equipment made by different manufacturers and their different models all operate on the same principle. A transmitter coil includes an alternating electric current into the ground. this current generates a secondary, local magnetic field in the ground that is proportional to the value of the electric current flowing within the transmitter coil. This secondary time-varying magnetic field that results from the induced alternating current produces very small electrical currents in the immediate area. These secondary induced electrical currents in the immediate area. These secondary induced electrical currents are detected by a receiver coil; the receiver coil also detects the primary electric currents directly from the transmitter coil. The primary and secondary electric fields are related to the conductivity of the Earth materials.

4.3 There are two components of the induced magnetic field. The first is the out-of-phase component (quadrature component) which measures the ground conductivity as described above. The second is the in-phase component which is more sensitive to large metallic objects (e.g., buried metal drums, non-ferrous metal).

4.4 The transmitter and receiver coils are commonly oriented so that they are co-planar and parallel, either both coils oriented horizontally or both oriented vertically. Some models have the orientations fixed in a case whereas other models have separate coils that are oriented manually. For some types of surveys, the coils need not be oriented co-planar and parallel.

4.5 The depth of penetration of the induced electrical currents depends on (1) the orientation of the coils, (2) the spacing between the coils, (3) the frequency of the induced electrical current, and (4) the conductivity of the ground. The operator can control the orientation of the coils by rotating them from the horizontal co-planar orientation (vertical dipole) to the vertical co-planar orientation (horizontal dipole). For those models that have separate coils, the operator can control their separation. If the instrument allows for changes in frequency, then the operator can control that variable.

4.6 Each type of electromagnetic instrument has different specifications and ranges of sensitivity. Therefore, each type has specific advantages and disadvantages. The PI is responsible for selecting the appropriate instrument.

4.7 The electromagnetic equipment records the apparent ground conductivity between the two coils and at different depths depending on the coil's orientation, spacing between the coils, frequency content of the induced current, and conductivity of the ground.

4.8 Other field equipment may be required including surveying equipment for locating distances between and elevations of the stations, measuring tape (non-magnetic), field computers, and tolls for field repair of equipment.

5.0 DETAILED PROCEDURE

5.1 For environmental/engineering investigations, the electromagnetic surveys focus on obtaining data in the shallow subsurface, generally less than 200 feet.

5.2 Prior to conducting any electromagnetic survey, a determination is made by the PI as to the applicability and potential effectiveness of the survey in meeting the requirements of the investigation. The PI shall justify the decision. A site visit may be required to provide appropriate information to make the decision.

5.3 If the decision and justification are accepted by the Project Manager, then the PI plans the survey. Planning shall be applicable to the type of survey (reconnaissance, detail). The PI shall select the spacings between stations (grid), the data logger, field computer and other equipment.

5.4 Prior to conducting the survey, calculations shall be made to define the smallest target that would produce an interpretable electromagnetic anomaly based on the calculations, the selected spacings of stations and the sensitivity of the electromagnetic unit. Different amplitudes of anomalies will result from the measurements made by the different models of electromagnetic units. The calculations shall provide for determinations of depth to expected changes in layered conductivity or to specific isolated anomalies.

5.5 The PI selects the appropriately trained staff, assigns tasks and assures that appropriate training has been completed prior to beginning the investigation.

5.6 Station locations and elevations shall be surveyed prior to conducting the electromagnetic surveys. A base map shall be prepared that shows the station locations, their elevations, and potential sources of interference [e.g., metallic materials (fences, buildings), electrical current (underground or overhead transmission lines)].

5.7 Prior to conducting the surveys, a determination is made regarding the potential interference caused by atmospheric effects (e.g., electrical storms). If such effects will occur during the surveys, then the surveys shall be delayed until the effects are determined not to interfere with the collection of useful data.

5.8 Prior to conducting the surveys, the equipment shall be calibrated (Section 6.0).

5.9 A base station is selected in an area sufficiently removed from sources of interference. The purposes of the base station are to provide a location for field calibration of the instrument, to provide a field check on whether or not drift in the equipment is occurring, whether or not sources of interference (e.g., distant electrical storms) are affecting the readings. The base station shall be occupied periodically during the course of each day's survey. All readings at the base station are to be

taken at the beginning and end of each day's survey; the intervals of readings to be taken at the base station are to be defined by the PI.

5.10 For the survey, the equipment is to be connected according to the specifications of the manufacturer. Examples of such connections include sensor(s) to console, console to data logger, data logger to computer.

5.11 Data collection and field operations are described, in general, in the instruction manual provided by the manufacturer. If deviations from such instructions are made by the PI or designee and are documented in the logbook or on the data sheets (Section 7.0).

5.12 Recording of the data may be done automatically using a data logger compatible with the electromagnetic unit or manually using data sheets. Most data loggers have a built-in menu for entering background information and for collection of data correlated with the station locations. These data are stored in the data logger and later transferred to a computer for data reduction and analysis. Use of the data logger shall follow the manufacturer's instructions. The amount of data stored by the data logger depends on its storage capacity. If the data logger reaches its capacity, the PI or designee shall assure that the data are immediately transferred to an appropriate secondary storage source, even if the survey has to be interrupted during the day.

5.13 Data sheets for entering data may be used in place of or in addition to the data logger. An example of a data sheet is given in Section 10.

5.14 The data shall have all appropriate corrections applied prior to interpretations. Commercially available computer software is generally used. Data reductions are commonly made by the computer; interpretations may be made by the PI or designee using the computer. Graphic presentations also are commonly made using computer software. All software packages used shall be identified by name, manufacturer, and version. Limitations of the software package shall be described, if known.

5.15 Data reduction, analysis and interpretation, if done manually, shall follow standard methods (Section 8.0). Any deviations from these methods shall be described in detail.

5.16 Presentation of the data, data reduction, methods of analysis and interpretations shall be presented in a report that contains all appropriate information necessary so that an independent third party reviewer can evaluate the results of the survey.

5.17 Limitations of the equipment, data, data analysis, interpretations and other pertinent information to the study shall be identified and included in the report.

6.0 CALIBRATION

6.1 Calibration of the equipment is generally done by the manufacturer according to the manufacturer's standards. Documentation of such calibration and periodic updates shall be requested and shall be provided upon request.

6.2 Field checks shall be made before, periodically during the survey, and after each day's survey to assure the equipment is operating satisfactorily. Field checks are commonly described in the instruction manual supplied by the manufacturer.

6.3 If the equipment is not operating properly, field repairs shall be made. Such repairs shall be entered, in detail, in the logbook or on the data sheets. If repairs can not be made, the survey shall not proceed. A replacements unit shall be obtained from the same manufacturer or leasing agent (see Section 4.1).

6.4 A field check of the data collected by the replacement unit shall be done at the base station, at randomly selected stations and shall be compared to the data collected previously by the original unit. Comparison of the two data sets shall demonstrate statistical significance (Section 8.0) using the sensitivity range of the instruments as the criterion for defining the confidence limits. The data used and the statistical analysis shall be documented in the logbook or data sheets and included in the report.

7.0 QUALITY ASSURANCE RECORDS

7.1 Documents and data shall be prepared and submitted according to governing Project Procedures. Documents and data shall include station locations and elevations, sources of interference, maps, field sketches, photographs, field data (diskettes, data sheets), logbook, and any other information considered pertinent by the PI or designee to the investigation.

7.2 All documents shall be submitted according to requirements with Project Procedures.

8.0 REFERENCES FOR ELECTROMAGNETIC SURVEYS

Dobrin, M. B., 1976, Introduction to Geophysical Prospecting: McGraw Hill Book Co., Inc., New York, NY, 3d Edition, p.

Kearey P., and Brooks, M., 1984, An Introduction to Geophysical Exploration: Blackwell Scientific Publications, Palo Alto, CA, 296 p.

Natrella, M. G., 1966, Experimental Statistics: National Bureau of Standards Handbook 91: U. S. Government Printing Office, Washington, D. C., 396 p.

Telford, W. M., Geldart, L. P., Sheriff, R. E., and Keys, D. A., 1976, Applied Geophysics: Cambridge University Press, New York, N. Y., 860 p.

9.0 DEFINITIONS

Base Station. A location used as a reference where electromagnetic readings are taken.

Electromagnetic Instrument. An instrument that measures the ground conductivity or local concentrations of metallic substances.

Electromagnetic Survey. A geophysical survey method designed to measure the ground conductivity and the response (presence and distribution) of conductive substances below the ground.

In-Phase Component. One of two components of the induced magnetic field.

Out-Of-Phase Component (Quadrature Component). One of two components of the induced magnetic field.

Range of Sensitivity. The lower and upper limits of the electromagnetic unit's response to detect ground conductivity.

Station. Location for taking an electromagnetic reading.

10.0 ATTACHMENTS

Attachment 2

SAIC Quality Assurance Administrative Procedure

Corrective Action

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
QUALITY ASSURANCE PROGRAM PLAN R2

SECTION 16.0 Corrective Action

16.1 Purpose

This section describes the requirements and responsibilities for identifying, documenting, and resolving corrective actions originating from significant conditions adverse to quality. R2

16.2 Requirements

Significant conditions adverse to quality will be identified promptly and corrected as soon as practical. The cause of the condition will be determined and corrective action taken to preclude recurrence. The identification, cause, and corrective action will be documented and reported to appropriate levels of management. Follow-up action will be taken to verify implementation of the corrective action.

16.3 Scope

The requirements of this section apply to all quality related corrective actions from any source that are determined to be significant conditions adverse to quality or potentially reportable occurrences as defined by DOE Order 5000.3A. The need for corrective actions may be identified from assessments, plans, audits, appraisals, surveillances, investigations, events, reviews, and nonconformances.

16.4 Responsibilities

16.4.1 SAIC Corporate Officer in Charge

The SAIC Corporate Officer in Charge is responsible for the oversight of Corrective Action activities.

16.4.2 Program or Project Manager

The Program or Project Manager is responsible for:

(a) Ensuring that significant conditions adverse to quality are identified and evaluated, and that those for which SAIC is responsible are controlled, while those which are the responsibility of other organizations are reported. R2

(b) Acting as the Facility Manager in the Occurrence Reporting System (ORS) process. R2

(c) Reviewing corrective action reports (CARs) and ORS reports.

(d) Prioritizing corrective actions to be taken commensurate with the significance of the condition.

(e) Identifying and reporting conditions adverse to quality.

(f) Reviewing and concurring with the Corrective Action Reports (CARs).

16.4.3 SAIC Quality Assurance/Quality Control (QA/QC) Officer

The SAIC QA/QC Officer is responsible for:

(a) Determining the significance of deficiencies, nonconformances, and other reported conditions adverse to quality and their reportability as occurrences to DOE per DOE Order 5000.3A.

(b) Initiating a Corrective Action Report (CAR) once the review has determined the deficiency, nonconformance, or other adverse condition is of significance.

(c) Assigning a unique number to the CAR or Occurrence Reports and making an entry on the CAR/Occurrence Report Log.

(d) Assuring that activities identified as significant conditions adverse to quality are controlled until a resolution is reached.

(e) Tracking the status of all CARs and Occurrence Reports.

(f) Investigating and validating CARs and Occurrence Reports.

(g) Evaluating proposed corrective action for each CAR or Occurrence Report.

(h) Verifying implementation of corrective action for each CAR or Occurrence Report.

(i) Closing out the CAR or Occurrence Report upon verification of related corrective actions.

16.5 Application

16.5.1 Root Cause Analysis

The Corrective Action System and the ORS will provide for the analysis of the objective evidence associated with significant conditions adverse to quality and will determine their root causes.

16.5.2 Corrective Action(s)

Corrective Action(s) taken will be commensurate with the importance, complexity, and safety considerations of the condition, and should resolve the root cause of the problem.

16.5.3 Significant Conditions Adverse to Quality

Significant conditions adverse to quality are conditions where established operating limits, specifications, standards, or administrative control systems have not been adhered to and the results could have unacceptable consequences to the SAIC activity. R2

When a significant condition adverse to quality has been identified, appropriate management will be informed immediately of the condition and a determination of reportability per DOE Order 5000.3A will be made. R2

16.5.4 Reporting

A CAR and/or an Occurrence Report will be issued for significant conditions adverse to quality. R2

16.5.5 Prioritizing Corrective Actions

After identifying the corrective action, a priority (commensurate with the significance of the condition) for implementing that action will be determined.

16.5.6 Corrective Action Tracking

The SAIC QA/QC Officer will track the corrective action or occurrence status. The CAR or Occurrence Report will not be formally closed out until the corrective action is completed, verified, and documented. R2

16.6 Corrective Action Report (CAR)/Occurrence Report (OR)

16.6.1 Initiation of the CAR/OR

The SAIC QA/QC Officer completes the CAR/OR form once it is determined that the deficient condition creates a significant condition adverse to quality. R2

Each CAR/OR will be reviewed and concurred with by the Program or Project Manager. R2

With concurrence complete, a unique number is assigned to the CAR/OR by the SAIC QA/QC Officer and entered on the CAR/OR Log. R2

A response due date of thirty (30) working days from the date of issue will be assigned to the CAR. Response dates other than 30 working days must be agreed upon and documented on the CAR.

ORS notification shall be made independent of the CAR process as prescribed by DOE Order 5000.3A. R2

16.6.2 Response

The cognizant technical person will evaluate any CAR/OR received, determine the root cause of the condition, and propose corrective action to rectify the problem and prevent recurrence.

If other organizations are involved in the resolution of the CAR/OR, the cognizant technical person will obtain input from the other organizations for all actions required to resolve the condition.

The response is documented on the CAR/OR, approved by the Program or Project Manager, and returned to the SAIC QA/QC Officer. R2

16.6.3 Action Completion and Reporting

Completion of the agreed upon action will be reported in the CAR/OR and will be forwarded to the SAIC QA/QC Officer for review and acceptance for closure.

16.6.4 CAR/OR Review/Closure

The SAIC QA/QC Officer verifies that action(s) to rectify and prevent recurrence of the identified condition has been completed. Verification will be performed and documented on the CAR/OR. R2

16.7 Records

Information related to corrective action activities will be designated as records and maintained in accordance with Section 17.0, Records. R2

Attachment 3

SAIC Quality Assurance Administrative Procedure

Control of Conforming Items and Services

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
QUALITY ASSURANCE PROGRAM PLAN R2

SECTION 15.0 Control of Nonconforming Items

15.1 Purpose

This section describes the responsibilities and requirements that ensure nonconforming items (i.e., materials, equipment, components, data, processes, and services) are consistently identified and segregated to prevent further use or processing, and that the nonconforming items are evaluated and dispositioned, and the results documented.

15.2 Requirements

Items not conforming to specified requirements will be controlled to prevent inadvertent installation or use. Control measures employed will provide for identification, documentation, evaluation, segregation or disposition of nonconforming items, and notification of affected organizations.

15.3 Scope

This section applies to all Science Applications International Corporation (SAIC) activities. SAIC personnel or SAIC subcontractors will initiate a Nonconformance Report (NCR) upon discovering any nonconforming item. R2

15.4 Responsibilities

15.4.1 SAIC Corporate Officer in Charge

The SAIC Corporate Officer in Charge is responsible for the oversight of Control of Nonconforming Items.

15.4.2 Program or Project Manager

The Program or Project Manager is responsible for:

(a) Reviewing all NCRs.

(b) Concurring in the probable cause, proposed disposition, and action to prevent recurrence.

(c) Assisting in obtaining the required approvals when necessary.

15.4.3 SAIC Quality Assurance/Quality Control (QA/QC) Officer R2

The SAIC QA/QC Officer is responsible for:

(a) Evaluating the validity of nonconformances.

(b) Assigning NCR numbers to formally open an NCR.

(c) Authorizing the release of nonconforming items from designated hold areas.

(d) Ensuring and approving, along with the NCR initiation, that corrective actions are performed and completed satisfactorily per the approved disposition. R2

(e) Signing and checking the NCR indicating that disposition was completed satisfactorily.

(f) Updating the NCR log, removing Hold Tags, and distributing completed copies of the NCR when closed.

(g) Reviewing all NCRs with regard to significance and additional reporting requirements. R2

15.4.4 SAIC Personnel

All SAIC personnel and SAIC subcontractors are responsible for: R2

(a) Initiating an NCR when a nonconforming item is identified.

(b) Informing the affected organizations.

(c) Coordinating the NCR with the SAIC QA/QC Officer. R2

15.4.5 Responsible Organization/Individual

The Responsible Organization/Individual is responsible for: R2

(a) Identifying the probable cause of the nonconformance.

(b) Proposing dispositions and justification (if any) for the NCR.

(c) Specifying action to prevent recurrence.

15.5 Basis for Issuing Nonconformance Reports

Nonconformance reports will be written to identify and control items having characteristics that do not conform to specified requirements (procedures, instructions, drawings, purchase orders, etc.) and items with no specific requirements stated, which may be unacceptable or indeterminate in their function, operation, or use.

An NCR is not required if the controlled document requires inspections or tests and has a preapproved disposition and a procedure (approved by the Program or Project Manager and the SAIC QA/QC Officer) to be followed if a nonconforming item is identified. The inspection or test report will note the noncompliance, the action taken to correct the noncompliance, and the acceptance of the corrected item. R2

Any item found to be in noncompliance to specified requirements will be documented on an NCR, even if the nonconforming item is reportable by another control system (e.g., Corrective Action Report, Incident Report).

Administrative items such as office supplies may be exempted from this procedure by the Program or Project Manager.

15.6 Identification of Nonconforming Items

When a nonconforming item exists, the cognizant technical person will stop further processing or use of this item. This will be followed by placing a Hold Tag on or near the item as soon as practical and by preparing an NCR.

Hold Tags will be completed by the initiator of the NCR. The Hold Tag will include the NCR number, name of the initiator, date, and description of nonconforming item(s), and will be sequentially numbered to reflect the number of Hold Tags associated with the NCR. The Hold Tag will be legible. The identification method will not adversely affect the characteristics or function of the item.

15.7 Nonconformance Report Form

As a minimum, an NCR form will contain the following information:

- Date of NCR. R2
- Unique numerical identification.
- Location of the item.
- Name, organization, and phone number of individual initiating report.
- Date and name of individual discovering the nonconformance.
- Responsible Organization/Individual. R2

- Description of the nonconformance. R2
  - Requirements, including the specific reference document by title, revision and, as applicable, its unique identification.
  - As-found condition(s).
  - Disposition, probable cause, actions taken to prevent recurrence, name of responsible individual proposing the disposition, and date of proposed disposition. R2
  - Review by initiator of disposition, probable cause, and actions taken to prevent recurrence. R2
- Date and results of any required reinspection or retesting to verify acceptability of completed work. R2
- Verification results of completed work.

The NCR numbering system will reflect the current calendar year; NCR designation; the organization, project, or division designation; and a sequential report number (example: 90-NCR-SAIC-0001). This NCR number must be the same as the NCR number on the corresponding Hold Tag. R2

15.8 Disposition, Probable Cause, and Actions Taken to Prevent Recurrence

The proposed disposition will be documented on the NCR form by the responsible organization/individual. The disposition will state the action required to correct the nonconformance. R2

The organization providing the statement of disposition is responsible for determining the probable cause of the nonconforming item and for entering the probable cause on the NCR form. If the probable cause cannot be readily determined, enter *Cause Not Known* on the NCR form. R2

After determination of the probable cause, the responsible technical person will complete the NCR form by specifying actions to prevent recurrence. This can be performed either when the disposition is initiated or prior to closure of the NCR. When an action to prevent recurrence is not applicable, enter *Action Taken To Prevent Recurrence Not Applicable* on the form. R2

15.9 Approvals

The NCR will identify the organizations responsible for initiating and approving each section.

Each section of the NCR form instructions will stipulate the minimum signatures required for further processing. Additional signatures may be appropriate and can be added by the organization completing each section.

15.10 Verification and Closure

The responsible technical person will inform the SAIC QA/QC Officer when the actions stated in the disposition are complete. R2

The Initiator of the NCR will review and approve or disapprove the disposition, probable cause, and actions taken to prevent recurrence. If approved by the Initiator, the NCR will then be forwarded to the SAIC QA/QC Officer for verification and closure. R2

The SAIC QA/QC Officer ensures that actions were performed and completed satisfactorily per the approved disposition. R2

If the SAIC QA/QC Officer determines that the completed actions do not comply with the stated disposition, or that the results of the actions were unsatisfactory, the organization responsible for the disposition will be notified. The NCR remains open until the required work has been satisfactorily completed. R2

When all work required per the disposition has been satisfactorily completed and approved by the SAIC QA/QC Officer, the NCR is "ACCEPTABLE", closed, signed, and dated by the SAIC QA/QC Officer. R2

The SAIC QA/QC Officer updates the NCR log, removes the Hold Tags, and distributes completed copies of the NCR when closed. R2

15.11 Conditional Releases of Nonconforming Items

In certain instances, it may be necessary or appropriate to use, or allow further processing of, a nonconforming item prior to closure of the NCR. Depending on the circumstance and use of the item, a *Conditional Release* of the nonconforming item can be obtained.

15.12 Records

Information related to the control of nonconforming items will be designated as records and will be maintained in accordance with Section 17.0, Records. R2

Attachment 4

Laboratory Specifications for PACE, Inc.

Mixed Waste and Radiological Laboratory

Contents

1. INTRODUCTION

The laboratory specifications attachment serves the purpose of providing elements of the Operable Unit 5 Quality Assurance Project Plan (QAPjP) that are specific to a named laboratory. Providing the information in the form of an attachment allows for the use of more than one laboratory for an investigation. It is intended that scheduling conflicts and laboratory capacity minimized with the provision of laboratory specifications attachments. This attachment, Attachment 4, provides information on PACE, Inc. Laboratory in Denver, Colorado.

2. LABORATORY RESPONSIBILITIES

Pace, Inc. is required to meet the quality requirements presented in the QAPjP. The following is a summary of present certifications for PACE-Denver, as well as information regarding participation by PACE in performance evaluation programs.

- PACE-Denver is currently approved by the Army Corps of Engineers, Missouri River Division. PACE is certified for Volatile Organics, Semivolatile Organics, Pesticides/PCBs, Herbicides, BTEX, Petroleum Hydrocarbons, Metals, Cyanide and Radionuclides in water and soil.
- PACE-Denver is currently accredited by the EPA for the analyses of Radionuclides in Drinking Water.
- PACE-Denver is currently certified by the State of Colorado and South Carolina for the analyses of Volatile Organics, Metals, and Nitrate/Fluoride.
- PACE-Denver is currently accredited by the American Industrial Hygiene Association (AIHA).
- PACE-Denver participates in the EPA Water Pollution (WP) Performance Evaluation Program for Organic and Inorganic parameters.
- PACE-Denver participates in the EPA Water Supply (WS) Performance Evaluation Program for Organic and Inorganic parameters.
- PACE-Denver participates in the EPA Cross-check and Intercomparison Studies Programs for Radionuclides.
- PACE-Denver participates in the DOE-EML Performance Evaluation Program for Radionuclides.
- PACE-Denver participates in the NIOSH Proficiency Analytical Testing (PAT) program for Airborne Volatile Organics, Metals and Silica.
- PACE-Denver also participates in multiple industry sponsored round-robin programs.

Matrices analyzed by PACE include soil, groundwater, surface water, organic soil and hazardous wastes, radioactive mixed wastes and ambient air samples. The following are specific PACE, Inc. Laboratory quality-assurance related responsibilities:

Regional Office Director

- reports directly to the Group Vice President of PACE, Inc.;
- supervises the Quality Assurance Officer (QAO), department managers, and/or section supervisors;
- supervises lab managers with overall responsibility to personnel, quality, technical competence, turnaround time and technical expansion;
- provides resource for implementation of Quality Assurance Plan at laboratory; and
- must follow PACE policies and Standard Operating Procedures (SOPs).

Quality Assurance Officer

- reports to Regional Director;
- oversees the QA/QC Coordinator activities and responsibilities;
- creates and employee training plan in conjunction with the employee's supervisor;
- reviews and evaluates data integrity and validity and recommends corrective actions as appropriate;
- oversees implementation of the Quality Assurance Plan;
- responsible for overseeing the overall quality performance and quality improvement of the regional office;
- initiates and coordinates the development of the SOP process, and monitors adherence to regulatory requirements to established SOPs;
- coordinates audit visits and responses to external audits, and conducts appropriate regional office audits;
- acts as regulatory liaison for methods, requirements, and certification;
- aids in the production and review of Quality Assurance Project Plans;
- develops and revises the regional Laboratory Quality Assurance Plan;

- monitors Total Quality Management program efforts; and
- supervises laboratory participation in inter-laboratory accreditation and proficiency programs.

Manager of Client Services

- reports to Regional Office Director;
- manages projects involving initial client contact, coordination of sampling requirements and bottle needs, verification of accurate check-in of samples, monitoring status of analysis, providing response to client inquiries, and invoice and client report review.
- acts as "key client contact" for designated clients; and
- reports out-of-control or nonconforming situations to Quality Assurance Officer.

Laboratory Manager

- reports directly to the Laboratory Director;
- implements the Quality Assurance Plan within the laboratory;
- manages daily laboratory analytical operations and supervises quality control activities performed as part of routine analytical operations;
- supervises the preparation and maintenance of laboratory records;
- oversees the log-in of all samples into the Lab Data Management System and supervises sample storage facilities;
- leads the training of analysts in laboratory operations and analytical procedures;
- evaluates analytical techniques, procedures, instrumentation, and quality control procedures and provides recommendations to the laboratory;
- recommends standards for purchasing instrumentation, equipment, reagents, gases, and chemicals;
- reports all out-of-control and nonconforming situations to Quality Assurance Officer;
- coordinates laboratory reports and results review for department.

Sample Custodian & Control Technician

- reports directly to the Manager of Client Services;
- processes incoming samples, inspects samples to ensure they are in good condition, signs appropriate chain of custody documents to receive samples, assigns lab numbers to all samples and logs information into the Lab Data Management System;
- routes paperwork to the appropriate personnel;
- stores samples appropriately for quick access and controls access to samples to protect those stored under custody.

Analyst

- reports directly to Laboratory Manager;
- analyzes and prepares environmental samples in an efficient and organized manner, using approved PACE methodologies;
- documents reagent preparation, analytical response and observations, calculations of results and quality assurance data;
- enters data into PACE lab data management system and monitor computer printouts, reviews PACE methodologies; and
- reports out-of-control situations.

3. ANALYTICAL METHODS

PACE, Inc. Laboratory has been identified to perform the chemical and radiological analyses listed in Table III.1. The analytical methodologies are specified in Section 6 of the QAPjP. Table III.1 also identifies the laboratory quantitation limits which are the project required limits specified in Section 6 of the QAPjP. PACE, Inc. has developed Standard Operating Procedures for the analysis of isotopic plutonium, thorium, and uranium that are based on EPA Method 908.0.

TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 1 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Volatile Organic Compounds (VOCs)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
Chloromethane			10	10
Bromomethane			10	10
Vinyl Chloride			10	10
Chloroethane			10	10
Methylene chloride			5	5
Acetone			10	10
Carbon disulfide			5	5
1,1-Dichloroethene			5	5
1,1-Dichloroethane			5	5
1,2-Dichloroethene (total)			5	5
Chloroform			5	5
1,2-Dichloroethane			5	5
2-Butanone			10	10
1,1,1-Trichloroethane			5	5
Carbon Tetrachloride			5	5
Vinyl Acetate			10	10
Bromodichloromethane			5	5
1,2-Dichloropropane			5	5
cis-1,3-dichloropropene			5	5
Trichloroethene			5	5
Dibromochloromethane			5	5
1,1,2-Trichloroethane			5	5
Benzene			5	5
trans-1,3-dichloropropene			5	5
Tribromomethane			5	5
4-Methyl-2-pentanone			10	10

**TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 2 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Volatile Organic Compounds (VOCs) (cont.)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
2-Hexanone			10	10
Tetrachloroethene			5	5
Toluene			5	5
1,1,2,2-Tetrachloroethane			5	5
Chlorobenzene			5	5
Ethylbenzene			5	5
Styrene			5	5
Xylenes (total)			5	5
Additional compounds:				
Acrylonitrile			100	100
Acetonitrile			100	100
Diethylbenzene			5	20
Trichlorotrifluoroethane			5	10
Hexane			10	10
Iodomethane			NA	10
Semivolatile Organic Compounds (SVOC)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
Phenol			10	330
bis(2-chloroethyl) ether			10	330
2-Chlorophenol			10	330
1,3-Dichlorobenzene			10	330
1,4-Dichlorobenzene			10	330
Benzyl alcohol			10	330
1,2-Dichlorobenzene			10	330
2-Methylphenol			10	330
bis(2-chloroisopropyl) ether			10	330

**TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 3 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Semivolatile Organic Compounds (SVOC) (cont'd)	CLP SOW[b] Modification D	CLP SOW[b] Modification D		Low Soil/Sediment[c]
4-Methylphenol			10	330
N-nitroso-di-n-dipropylamine			10	330
Hexachlorethane			10	330
Nitrobenzene			10	330
Isophorone			10	330
2-Nitrophenol			10	330
2,4-Dimethylphenol			10	330
Benzoic Acid			50	1600
bis(2-chloroethoxy) methane			10	330
2,4-Dichlorophenol			10	330
1,2,4-Trichlorobenzene			10	330
Naphthalene			10	330
4-Chloroaniline			10	330
Hexachlorobutadiene			10	330
4-chloro-3-methylphenol			10	330
(para-chloro-meta-cresol)				
2-Methylnaphthalene			10	330
Hexachlorocyclopentadiene			10	330
2,4,6-Trichlorophenol			10	330
2,4,5-Trichlorophenol			50	1600
2-Chloronaphthalene			10	330
2-Nitroaniline			50	1600
Dimethylphthalate			10	330
Acenaphthylene			10	330
2,6-Dinitrotoluene			10	330
3-Nitroaniline			50	1600

TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 4 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Semivolatile Organic Compounds (SVOC) (cont'd)	CLP SOW[e] Modification D	CLP SOW[e] Modification D		Low Soil/Sediment[c]
Acenaphthene			10	330
2,4-Dinitrophenol			50	1600
4-Nitrophenol			50	1600
Dibenzofuran			10	330
2,4-Dinitrotoluene			10	330
Diethylphthalate			10	330
4-Chlorophenyl-phenyl ether			10	330
Fluorene			10	330
4-Nitroaniline			50	1600
4,6-Dinitro-2-methylphenol			50	1600
N-nitrosodiphenylamine			10	330
4-bromophenyl-phenylether			10	330
Hexachlorobenzene			10	330
Pentachlorophenol			50	1600
Phenanthrene			10	330
Anthracene			10	330
Di-n-butylphthalate			10	330
Fluoranthene			10	330
Pyrene			10	330
Butylbenzylphthalate			10	330
3,3'-Dichlorobenzidine			20	660
Benzo(a)anthracene			10	330
Chrysene			10	330
bis(2-Ethylhexyl)phthalate			10	330
Di-n-ocrylphthalate			10	330
Benzo(b)fluoranthene			10	330

**TABLE 3.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 5 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Semivolatile Organic Compounds (SVOC) (cont'd)	CLP SOW[e] Modification D	CLP SOW[e] Modification D		Low Soil/Sediment[c]
Benzo(k)fluoranthene			10	330
Benzo(a)pyrene			10	330
Indeno(1,2,3-cd)pyrene			10	330
Dibenzo(a,h)anthracene			10	330
Benzo(g,h,i)perylene			10	330
Additional Compounds				
2-benzyl-4-chlorophenol			10	330
Volatile Organic Compounds (VOCs), Groundwater				
Purgeable Halocarbons	SW5030/ SW8010[g]	NA		
Vinyl chloride			1.0	NA
Trichlorofluoromethane			2.0	NA
1,1-dichloroethene			1.3	NA
Methylene chloride			5.0	NA
1,1-dichloroethane			0.7	NA
Trichloromethane			0.5	NA
1,1,1-trichloroethane			0.3	NA
Carbon tetrachloride			1.2	NA
1,2-dichloroethane			0.3	NA
Trans-1,2-dichloroethene			1.0	NA
Cis-1,2-dichloroethene			1.0	NA
Trichloroethene			1.2	NA
1,2-dichloropropane			0.4	NA
Bromodichloromethane			1.0	NA
Dibromomethane			2.0	NA
2-chloroethyl vinyl ether			1.3	NA
Cis-1,3-dichloropropene			3.4	NA

TABLE 3.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 6 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Purgeable Halocarbons (cont'd)	SW5030/ SW8010[g]	NA		
Trans-1.3-dichloropropene			3.4	NA
1.1.2-trichloroethane			0.2	NA
Tetrachloroethene			0.3	NA
Dibromochloromethane			0.9	NA
1-chlorohexane			1.0	NA
Chlorobenzene			2.5	NA
1.1.1.2-tetrachloroethane			1.0	NA
Bromoform			2.0	NA
1.1.2.2-tetrachloroethane			0.3	NA
1.2.3-trichloropropane			1.0	NA
Phenyl bromide			2.0	NA
Chlorotoluene			1.0	NA
1.3-dichlorobenzene			3.2	NA
1.4-dichlorobenzene			2.4	NA
1.2-dichlorobenzene			1.5	NA
Bis(2-chloroisopropiy) ether			20	NA
Additional Compounds:				
Trichlorotrifluoroethane			2	NA
Purgeable Aromatic Compounds, Groundwater	SW5030/ SW8020[g]	NA		
Benzene			2.0	NA
Chlorobenzene			2.0	NA
1.2-Dichlorobenzene			4.0	NA
1.3-Dichlorobenzene			4.0	NA
1.4-Dichlorobenzene			3.0	NA
Ethylbenzene			2.0	NA
Toluene			2.0	NA

TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 7 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Purgeable Aromatic Compounds, Groundwater (cont'd)	SW5030/ SW8020[g]	NA		
Xylenes			2.0	NA
Additional Compounds:				
Diethylbenzene			1	NA
Vinyl acetate			3	NA
Carbon disulfide			5	NA
Acetone			20	NA
Methylethyl ketone (2-butanone)			10	NA
Methylisobutyl ketone (4-methyl-2-pentanone)			5	NA
Additional Compounds:				
Acrylonitrile	SW5030/ SW8030[g]	NA	10	100
Acetonitrile	SW5030/ SW8030[g]	NA	10	100
Pesticides and PCBs	CLP SOW[e]	CLP SOW[e]		
alpha-BHC			0.05	1.7
beta-BHC			0.05	1.7
delta-BHC			0.05	1.7
gamma-BHC (Lindane)			0.05	1.7
Heptachlor			0.05	1.7
Aldrin			0.05	1.7
Heptachlor epoxide			0.05	1.7
Endosulfan I			0.05	1.7
Dieldrin			0.10	3.3
4,4'-DDE			0.10	3.3
Endrin			0.10	3.3
Endosulfan II			0.10	3.3

**TABLE IL1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 8 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Pesticides and PCBs (cont'd)	CLP SOW[b]	CLP SOW[b]		
4,4'-DDD			0.10	3.3
Endosulfan sulfate			0.10	3.3
4,4'-DDT			0.10	3.3
Methoxychlor			0.5	17.0
Endrin ketone			0.10	3.3
Endrin aldehyde			0.10	3.3
alpha-Chlordane			0.05	1.7
gamma-Chlordane			0.05	1.7
Toxaphene			5.0	170.0
Aroclor-1016			0.5	33.0
Aroclor-1221			0.5	67.0
Aroclor-1232			0.5	33.0
Aroclor-1242			0.5	33.0
Aroclor-1248			0.5	33.0
Aroclor-1254			0.5	33.0
Aroclor-1260			0.5	33.0
Metals (Target Analyte List)	CLP SOW[b] Modification A	CLP SOW[b] Modification A		(mg/kg)
Aluminum			20	4
Antimony			10	2
Arsenic			10	2
Barium			200	40
Beryllium			1	0.2
Cadium			5	1
Calcium			5000	1000
Chromium			10	2
Cobalt			50	10
Copper			25	5

TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits Surface Water/Groundwater and Soil/Sediment Samples (page 9 of 12)

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Metals (Target Analyte List) (cont'd)	CLP SOW[d] Modification A	CLP SOW[d] Modification A		(mg/kg)
Iron			100	20
Lead			3	0.6
Magnesium			5000	1000
Manganese			15	3
Mercury			0.2	0.04
Nickel			40	8
Potassium			5000	1000
Selenium			5	1
Silver			10	2
Sodium			5000	1000
Thallium			10	2
Vanadium			10	2
Zinc			20	4
Additional Elements:				
Molybednum			20	2
Tin			50	10
Bismuth			150	30
Lithium			100	10
Cyanide	CLP SOW[d]	CLP SOW[d]	10	2
Hexavalent Chromium	SW7196	NA	50	NA
Common Anions			(mg/L)	(mg/kg)
Nitrate-Nitrite	E353.2[e]	E353.2[e]	0.2	2[f]
Chloride	E325.1[e]	SW9250[g]	1.0	5[f]
Sulfate	E375.2[e] or E375.4[e]	E375.2[e] or E375.4[e]	5	50[f]
Fluoride	E340.2[e]	E340.2[e]	0.1	0.025[f]

**TABLE 3.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 10 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Indicator Parameters				
Total Nitrogen	E353.1[c]	NA	0.10	NA
Total Phosphorous	E365.1[c]	NA	0.10	NA
Total Organic Carbon (TOC)	E415.1/E415.2[c]	NA	1	NA
Total Dissolved Solids (TDS)	E160.1[c]	NA	4	NA
Total Suspended Solids (TSS)	E160.2[c]	NA	10	NA
Cation Exchange Capacity	NA	SW9081[c,d]	NA	5 mg/L
Particle Size Analysis	NA	ASTM D422-63[e]	NA	NA
Specific Gravity	NA	ASTM D854-83[e]	NA	NA
Moisture Content	NA	ASTM D2974[e]	NA	NA
Organic Content	NA	ASTM D2974-87[e]	NA	NA
Hydraulic Conductivity	NA	ASTM D2434-68[e]	NA	NA
Relative and Minimum Density	NA	ASTM D4254-83[e]	NA	NA
Maximum Density	NA	ASTM D4254-83[e]	NA	NA
Explosives	SW8330	SW8330		(mg/kg)
HMX			20	3.0
RDX			6.0	2.5
NB			15	1.5
1.3-DNB			15	1.5
1.3.5-TNB			15	1.5
2.4-DNT			0.5	0.5
2.6-DNT			0.5	1.5
TNT			3.0	1.5
2A.4.6-DNT			3.0	1.5
Tetryl			3.0	2.5
PETN			TBD	TBD

**TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 11 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Radionuclides			(pCi/L)	(Pci/g dry)
Gamma Spectrometry	E901.1[i]	E901.1[i]		
Americium-241 (soils)			NA	1[k]
Cobalt-60			20[j]	1[k]
Cesium-137			20[j]	1[k]
Bismuth-210m			15[j]	1[k]
Bismuth-207			15[j]	1[k]
Potassium-40			20[j]	10[k]
Radium-226 (soils)			NA	0.3[k]
Alpha Spectrometry	E907.0[o]	E907.0[o]		
Americum-241 (water)			1[j]	NA
Plutonium-238,239,240			1[j]	1[o]
Thorium-227,228,230,232			1[j]	1[o]
Uranium-234,235,238			1	0.6
Actinium-227			TBD	TBD
Radium-226	E903.1[i]	NA	1[q]	NA
Strontium-90	E905.1[i]	E905.1[i]	5	1[o]
Tritium	E906.0[i]	E906.1[i]	500	50[m]
Lanthanides	NA	CLP SOW Modification C		(mg/kg)
Lanthanum			NA	40
Cerium			NA	40
Praseodymium			NA	40
Neodymium			NA	40
Samarium			NA	40
Europium			NA	40
Gadolinium			NA	40
Terbium			NA	40

**TABLE III.1. Analytical/Methods, Parameters, and Quantitation Limits
Surface Water/Groundwater and Soil/Sediment Samples
(page 12 of 12)**

Parameters	Analytical Methods		Quantitation Limits[a]	
	Water	Soil/Sediment	Water (µg/L)	Soil/Sediment (µg/kg)
Lanthanides	NA	CLP SOW Modification C		(mg/kg)
Dysrposium			NA	40
Holmium			NA	40
Erbium			NA	40
Thulium			NA	40
Ytterbium			NA	40
Lutetium			NA	40
Asbestos	NA		NA	

NA = Not Applicable
TBD = To Be Determined

[a] For non-CLP analyses, these are expected method detection limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending upon the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample column or weight, percent moisture (where applicable), and the dilution factor, if any. The quantitation limits for additional non-routine analytes attached to the TAL of CLP SOWs may vary, depending upon the results of laboratory studies.

[b] "U.S. EPA Contract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration," Document No. OLM01.8. Quantitation limits are contract-required quantitation limits (CRQLs) with the exception of additional organic compounds. The minimum quantitation limits will be reported by the laboratory.

[c] Medium Soil/Sediment CRQLs are 125 times the low soil/sediment CRQLs for volatile organic compounds and 60 times the low soil/sediment CRQLs for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-gram sample diluted to 200 ml.

[d] "U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration," Document No. ILM01.0. Quantitation limits are CRQLs except for vanadium, beryllium, antimony, aluminum, tin, bismuth, molybdenum, and lithium. The minimum quantitation limits will be reported by the laboratory.

[e] The 907.0 method will be used to perform the chemical separation, but alpha spectrometry will be employed to discriminate the isotopes. Actinium-227 is calculated from Thorium-227 analysis.

[f] Based on a 10-gram soil sample and 100 ml volume of extractant and a soil moisture content between 0 and 10 percent (rounded). Actual quantitation limit will vary with the sample and extractant amounts and depend upon the nature of the soil matrix.

[g] "Test Methods for Evaluation Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, U.S. EPA, Proposed Update II, June 1990.

[h] If soils are acidic, CEC will be determined by "Method of Soil Analysis, Part 2 Chemical and Microbiological Properties," by H.D. Chapman, American Society of Agronomists, 1965.

[i] "1991 Annual Book of American Society of Testing Materials Standards," Section 4, Construction, Volume 04.08, Soil and Rock, Building Stones, Geotextiles," ASTM 1990.

[j] Based on 900 ml sample size.

[k] Based on 650 gram dry sample.

[l] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.

[m] Dependent upon percent moisture in sample, based on 10 grams.

[n] Based on 2 gram dry sample.

[o] By calculation from Thorium-277.

[p] Based on 1000 ml sample size.

4. LABORATORY SAMPLE CUSTODY PROCEDURES

4.1. Sample Receipt

Sample shipments are received at the sample receiving area. Sample custodians verify the number of shipping containers received against the numbers listed in the shipping manifest/chain of custody. Any damage to the shipping containers or other discrepancy observed is noted on the chain of custody before signing it. A copy is kept for future reference.

The external chain of custody must be signed by the carrier for relinquishment of samples and signed by the sample custodian personnel for sample receipt. The actual chain of custody may be supplied by PACE Inc. or may be the client's own form. The chain of custody remains in the project file at all times.

Sample Verification

Upon arrival of a sample shipment, sample control personnel perform sample inspection. PACE's Inc's sample I.D. and Condition Sheet serves as a checklist of procedures to follow and as documentation of the following:

1. Presence/absence of custody seals or tapes of the shipping containers and the condition of the seals (i.e., intact, broken).

2. Presence/absence of chain of custody; (if present, is it complete?).

3. Presence/absence of sample tags; (if present, are they removable?).

4. Agreement/non-agreement between the sample tags, chain of custody, and any client documentation.

5. Condition of the samples when received, including:

- Sample temperature
- Intact, broken/leaking
- Headspace in VOA vials
- Sample holding time
- Sample pH when required

If discrepancies are found, the PACE Inc. project manager is contacted immediately (verbally and by using a Discrepancy Report Form). If the project manager is not available, the QC manager is contacted for further directions. A copy of the Discrepancy Report Form is attached to the project data package.

Sample Log-in General Policies

Upon completing sample receipt/custody procedures, all sample and analysis data must be completed and documented on the chain of custody or accompanying forms for input into the Lab Data Management System (LDMS). Sample and analysis data must include the following:

(1) client name and contact
(2) client number
(3) PACE project number
(4) PACE project manager
(5) sample descriptions
(6) due date; and
(7) list of analyses requested

Sample and requested analyses data are input into the LDMS on the day of receipt. A Sample and Analysis Data Entry Form (SADEF) is generated immediately by the LDMS. The SADEF is to be reviewed against the chain of custody. Sample containers are labeled with the corresponding sample number and the stamped date of receipt. Samples are then ready for storage.

The SADEF is distributed to the PACE Inc. Project Manager with a photocopy of the chain of custody (include a copy of the Discrepancy Report if applicable), the QC project file with the original chain of custody, the Organic or Inorganic Department Managers as it applies for RUSH samples, and to the client.

When Samples Are Received With No Paperwork

If delivered by a client, the client is asked if previous arrangements were made for analysis (and with whom). The client completes a chain of custody and/or request for analysis, relinquishes samples to sample custodian personnel, and is given a copy of the COC.

If received by courier or shipping, the following procedures are taken:

1st: Routine client file is checked

2nd: Anticipate Sample Alert File is checked

3rd: Sampling Kit Request File is checked

4th: PACE key client contact is consulted

5th: QA department manager is consulted to determine the designated PACE project manager,

6th: Information is requested from the PACE project manager.

If analysis information cannot be determined on the day of sample receipt, sample data entry personnel proceed to assign sample numbers and put samples on hold. Follow-up with project manager occurs until the analyses are determined and samples can be properly logged in.

4.2. Sample Storage

Samples for analysis are properly stored in the lab according to container type, preservative, and type of security required by the project. Samples are stored immediately upon receipt to prevent sample degradation.

All refrigerated storage areas are maintained at 1 to 4 degrees C. The temperature is monitored and recorded daily. If the temperature falls outside the limit of 1 to 4 degrees C, corrective action is to be taken as follows and appropriately documented. Temperature is monitored at 30 minute intervals with the refrigerator door closed. QA Manager is notified if the problem persists longer than one hour. Samples are relocated to a proper storage environment if temperature cannot be maintained after corrective actions are implemented.

Samples within each project are stored in sample number order. Waters and soils are generally stored on labeled separate shelves.

Volatile samples within a project are stored in numerical order in vial containers. The holders are then stored where space permits in one of the designated volatile organic refrigerated storage areas. Semivolatile samples within a project are stored in numerical order in a designated, refrigerated storage area. Pure product or potentially heavily contaminated samples are tagged as "hazardous" and stored within a secured area, separate from other samples. This area is used only for hazardous samples and is labeled per OSHA requirements. Volatile samples within a special project are stored in sample number order in vial containers. The holders are then stored as space permits in the Special Project VOA refrigerated storage area. Asbestos samples require no refrigeration. Samples are taken to asbestos lab for storage.

4.3. Sample/Data Access and Internal Chain of Custody

PACE Inc. has implemented standard operating procedures to assure the integrity of samples and data so that they are not degraded or disclosed to unauthorized personnel. In order to ensure that this policy is maintained, the laboratory facilities are under controlled access. Only employees are allowed into the laboratory facilities; visitors must register at the front desk.

Samples are removed from their proper location by designated personnel and returned to the storage area immediately after the required sample quantity has been taken. This minimizes unnecessary time spent searching for samples and helps prevent matrix degradation from prolonged exposure to room

temperature. After the final report is sent and clients are allowed adequate time to review the results, the samples are properly discarded or returned to the client. PACE Inc. normally completes the sample analysis within 15 working days after receipt. Holding times may require faster turnaround times.

Upon client request, additional and more rigorous chain of custody protocols for samples and data can be implemented. For samples involving a high degree of confidentiality or potential litigation, PACE, Inc. has developed extensive sample and data handling protocols to assure the scientific and legal defensibility of the report submitted. These protocols include those specified by the USEPA Contract Laboratory Program.

Analysts and technicians follow strict internal chain of custody procedures to further ensure the validity of all data. All samples are signed out in a sample custody log book when they are removed for analysis. The sample ID, date, time, analyst, and lab of analysis is recorded in the sample custody log or equivalent. Samples are signed back in noting date, time, and storage location, upon return.

4.4. Excess Sample Disposition

Samples not totally consumed during the analyses are returned to the client. It is the project manager's responsibility to ensure that proper disposal has taken place. If the sample is water or wastewater and is considered non-hazardous by the project manager, it may then (by request) be properly disposed of at PACE Inc. facilities and not returned to the client.

The project manager and client receive written notification at the time of project initiation in the following manner:

a. The project proposal states the following paragraph in its Conditions and Terms Statement: PACE, Inc. Standard Operating Procedures is to return all samples of hazardous materials or wastes to the client at project completion, and PACE, Inc. reserves the right to return or dispose of all samples at our discretion.

b. The SADEF and cover letter states that PACE, Inc. reserves the right to return all samples at their discretion and is printed out by the LDMS at sample check-in. The SADEF and cover letter are sent to the project manager and to the client by the sample custodian personnel.

Upon completion of laboratory analysis and/or the project, the LDMS automatically prints a report, invoice and sample disposition form. This form is part of the report package and is routed to the project manager. The Sample Disposition Form contains the client name, address, and contact; PACE Inc. project number; client project I.D.; PACE Inc. sample I.D.; and PACE Inc. project manager name.

Hazardous Material/Waste Sample Disposition Option

The preferred method for disposition of excess hazardous material/waste samples is to return the excess sample to the client. It may not be feasible to return samples in all cases or the client may require PACE Inc. to dispose of excess samples. PACE Inc. will dispose of excess hazardous samples when required and will charge a disposal fee to recover costs for management and disposal.

5. LABORATORY DATA REDUCTION PROCEDURES

All records and data are generally logged into hard cover bound books.

The extractions section utilizes method-specific bound books to record all data pertaining to sample extraction and preparation. An extraction benchsheet is used to transfer information to GC and GC/MS with each extracted sample or batch. The organic and inorganic departments utilize benchsheets, maintained by analysts, specific for injection data and instrument maintenance. Spectras and chromatograms are filled by acquisition date.

The individual analysts and technicians are responsible for maintaining accurate legible records and logs in accordance with standard operating procedures. The supervisors are responsible for ensuring adherence to procedures. Secondary review of all records and logs is performed by someone other than the person generating the document, preferably the department supervisor. Evidence of secondary review is provided on the document as initials and review date by the secondary person.

Final results are entered into the LDMS system by the analyst, independently reviewed/validated by another analyst or supervisor experienced in the method, and approved by the department manager/lab director. Calculations using raw data to obtain final concentrations are performed according to the procedures described in the specified analytical method. Figure 5.1. describes the flow of samples through the laboratory.

Laboratory data reduction procedures are provided in the CLP SOW. All quality criteria (accuracy, precision, control limits, etc.) are reviewed and approved by the technical staff and independently monitored by the Quality office. Data outside control limits will be reported with a qualifier on the CLP reporting forms in the CLP data packages. Case narratives will note any out-of-control situations for non-CLP analyses. The report is approved and signed by the department manager or director.

EXHIBIT 16

LABORATORY SAMPLE FLOW SCHEMATIC

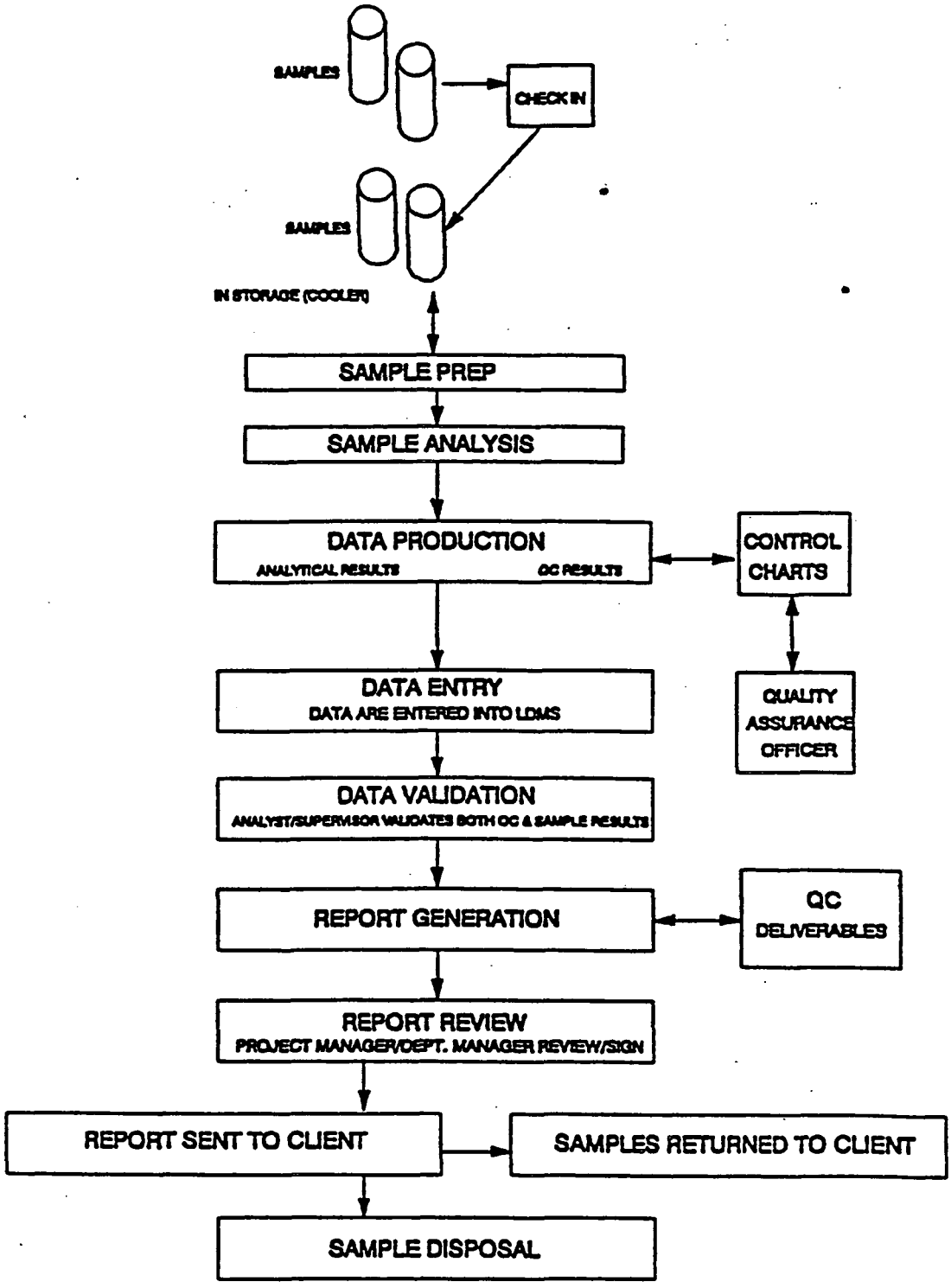

Figure 5.1. Laboratory Sample Flow Schematic

Each project is assigned to a project manager. The project manager is responsible for tracking sample progress in the laboratory and ensuring delivery of the product as specified by the client.

Complete project files are periodically inventoried and stored off-site in a secure facility. Electronic data are copied onto computer tape, inventoried and stored off-site in a secured facility.

6. LABORATORY DATA VALIDATION PROCEDURES

Prior to the final production of analytical reports, laboratory data are reviewed and verified according to the CLP SOW procedures. Precision and accuracy of the analyses are evaluated with the quality control sample results. Table VI.1. presents acceptance criteria for the quality control samples.

Data validation consists of review of data processing and data reporting. A percentage of all data processed will be checked by an independent analyst. Data reports are reviewed against the processed data by the analyst or group leader. The project manager reviews the data report to ensure that it meets project requirements, and then gives final approval of issuance of the laboratory report.

Table VI.1. Acceptance Criteria for Quality Control Samples and Instrument Calibration

	Matrix spike % recovery	Surrogate spike % recovery	RPD duplicate samples	Initial Calibration Linearity	Calibration Verification	LCS/EPA QC Sample
GC	Within calculated control limits	Within calculated control limits	<maximum RPD acceptance limit	RSD is less than or equal to 20%	+ 15% of true value or initial response	+ 15% of true value or EPA limit
MS	Within calculated control limits	Within calculated control limits	<maximum RPD acceptance limit	RSD is less than or equal to 30%	+ 30% of initial average RF	+ 15% of true value or EPA limit
General Chemistry	Within calculated control limits	N/A	0-67 if <10x MDL 0-20 if >10x MDL	Correlation coefficient > 0.995	+ 10% of true value	+ 15% of true value or EPA limit
Metals	Within calculated control limits	N/A	0-67 if <10x MDL 0-20 if >10x MDL	Correlation coefficient > 0.995	+ 10% of true value	+ 15% of true value or EPA limit

7. PREVENTIVE MAINTENANCE

Pace maintains service contracts for most major analytical equipment including all chromatography instruments, balances, atomic absorption, and inductively coupled plasma instruments. All instruments and equipment receive routine preventive maintenance, which is recorded in instrument specific maintenance logs. Routine maintenance insures that all equipment is operating under optimum conditions, reducing the possibility of instrument malfunction (consequently affecting sample results).

8. SPECIFIC PROCEDURES TO ASSESS PRECISION AND ACCURACY

The Quality Control Program at PACE Inc. uses precision and accuracy data to determine the acceptability of analytical results. Precision refers to results reproducibility and accuracy measures the degree of difference between observed and true values. One of every 20 analyses performed at PACE Inc. is run in duplicate (precision). Also, one of every 20 samples is spiked with a standard to assist in evaluating the accuracy of the method. Once 20 sets of precision and accuracy data have been obtained, a quality control chart is prepared. The Shewhart technique is the statistical method used to construct the charts. The quality control charts provide a quick visual means for monitoring the daily performance of the laboratory.

A. Accuracy

The actual test result is compared to the theoretical result of 100% recovery and the percent recovery is calculated. The percent recovery must fall within specific control limits for the results to be accepted and subsequent data validated.

B. Precision

The results of the duplicate analyses are computed and the absolute relative percent difference (RPD) is calculated. The RPD must fall within set control limits for the results to be accepted and subsequent data validated. A one-sided distribution with zero as a target value is typical, given absolute value requirements (CLP).

C. Warning Limits

Warning limits represent the 95% confidence interval and are equal to the mean value for the control sample, plus or minus two standard deviations (+/-2S). Exceeding these limits is a warning that the analytical system may be approaching an out-of-control situation, and should be inspected for possible source of error continuing the analysis. Analysts will inform the QAO of such problems.

Environmental Restoration Program

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
OPERABLE UNIT 5
FIELD SAMPLING PLAN

Mound Plant
Miamisburg, Ohio

FINAL
(Revision 0)

PREPARED FOR:
EG&G MOUND APPLIED TECHNOLOGIES
AND
THE U.S. DEPARTMENT OF ENERGY

PREPARED BY:
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December 1993

93-0020

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ACRONYMS

AOC	Area of concern
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Contaminant of Concern
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FFA	Federal Facilities Agreement
FIDLER	Field Instrument for Detection of Low Energy Radiation
FSP	Field Sampling Plan
FS	Feasibility Study
HSP	Health and Safety Plan
IDM	Investigation Derived Materials
LEL	Lower Explosive Limit
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Act
OU	Operable Unit
o.d.	outer diameter
PCB	Polychlorinated Biphenyls
pCi/g	pico - Curies per gram
PERAT	Preinvestigation Evaluation of Remedial Action Technologies
PID	Photoionization Detector
ppb	parts per billion
PP	Plutonium Processing
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Records of Decision
RTG	Radioisotopic Thermal Generator
SAP	Sampling and Analysis Plan
SM	Special Metallurgical
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TOC	Total organic carbon
TOX	Total organic halogens
VOC	Volatile organic compound
WTS	Waste Transfer System

ACKNOWLEDGEMENTS

This Operable Unit 5 Field Sampling Plan was prepared by Science Applications International Corporation in Dayton, Ohio, under prime contract DE-AC04-88DP43495, issued to EG&G Mound Applied Technologies, Inc. by the U.S. Department of Energy, and pursuant to Basic Ordering Agreement Number 52264. The contributors to this document include: T. Tank, M. Giordano, S. Lanter, J. Goyert and other SAIC personnel.

Senior review and editorial reviews were completed by D. Reed, M. Walsh, D. Kroplin, and D. Palmieri.

1. INTRODUCTION

This Field Sampling Plan (FSP) presents introductory background information concerning the known and suspected contaminants present in Operable Unit (OU) 5 soils and the various areas of concern (AOCs) in which contamination has been found or is believed to exist. This FSP also discusses the sampling objectives, locations, depths, quantities, sample designations, handling and analysis requirements, as well as sample collection, equipment and procedures that will be employed to collect field data in the OU5 AOCs. Each of these topics is addressed in a separate section of this FSP. The plan follows the guidance document for conducting Remedial Investigations/Feasibility Studies (RI/FS) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (EPA 1988). In addition, requirements for other specific details as delineated in the Federal Facilities Agreement (FFA) have been incorporated. This FSP and the OU5 Quality Assurance Project Plan (QAPjP) (DOE 1993a) form the Sampling and Analysis Plan (SAP) (DOE 1993b) for OU5 South Property at the Mound Plant, as required by CERCLA.

OU5 consists of approximately 220 acres of the 306 acre Mound Plant. OU5 currently includes 11 of the 17 AOCs listed in the OU9, Site-Wide Work Plan (DOE 1992a). Two of the areas on that list (Areas 5 and 20) have been incorporated into the OU2 scope (their locations are on the Main Hill). The other four AOCs (Building 72 Storage Area, Spoils Disposal Area, Dredge Spoil Drying Beds, and Sludge Drying Beds) are currently active areas and investigation at this time would not be beneficial. Consequently, these areas are not addressed in this document. The balance of the OU5 land area (non-AOCs) will be investigated under addendums to the OU5, RI/FS Work Plan (DOE 1993c) and this FSP. The specific field sampling requirements (sample quantity, location, existing data, etc.) for each known AOC within OU5 is presented in appendix form. The sampling team will also adhere to provisions of the OU5, RI/FS Work Plan (DOE 1993c), the OU5 Health and Safety Plan (HSP) (DOE 1993d), the OU5 QAPjP (DOE 1993a), and the Mound Plant Standard Operating Procedures (SOPs) as attached to the OU9 QAPjP (DOE 1993e).

The initial 11 AOCs are listed in Table I.1. This table will be updated to include new AOCs as they are appended to this FSP. This method will allow a quick check on the number of AOCs currently identified and in which appendices the detailed sampling plans and existing data regarding that AOC can be found.

The geographical extent of OU5 is shown in Figure 1.1. Introductory descriptive background information is presented in the following sections of this FSP with detailed summaries located in the companion

Table I.1. Current List of OU5 Areas of Concern

Grouping	Designation Name/Number	Description
Waste Water Treatment	Sewage Disposal Building Area	Located within Area 3
Drum Storage Areas	- Area 3	Storage and redrumming area
	- Area 9	Former thorium storage and redrumming area
Ground Disposal Areas - Soil	- Area 8	Contaminated soils from Areas 9 and 1
	- Area 12	Contaminated soil from Area 1 and SM Building operations
	- Area 21	Old bunker
	- Area 22	Orphan soil
Ground Disposal Areas - Construction Spoils	- Area 7	Soil from SW cave, contaminated ventilation exhaust system, and crushed empty thorium drums
	- Area 10	Concrete from Unit 4 Dayton operations
	- Area 13	Polonium - contaminated wood
	- Area J	Dredged material disposal and hillside catch basin

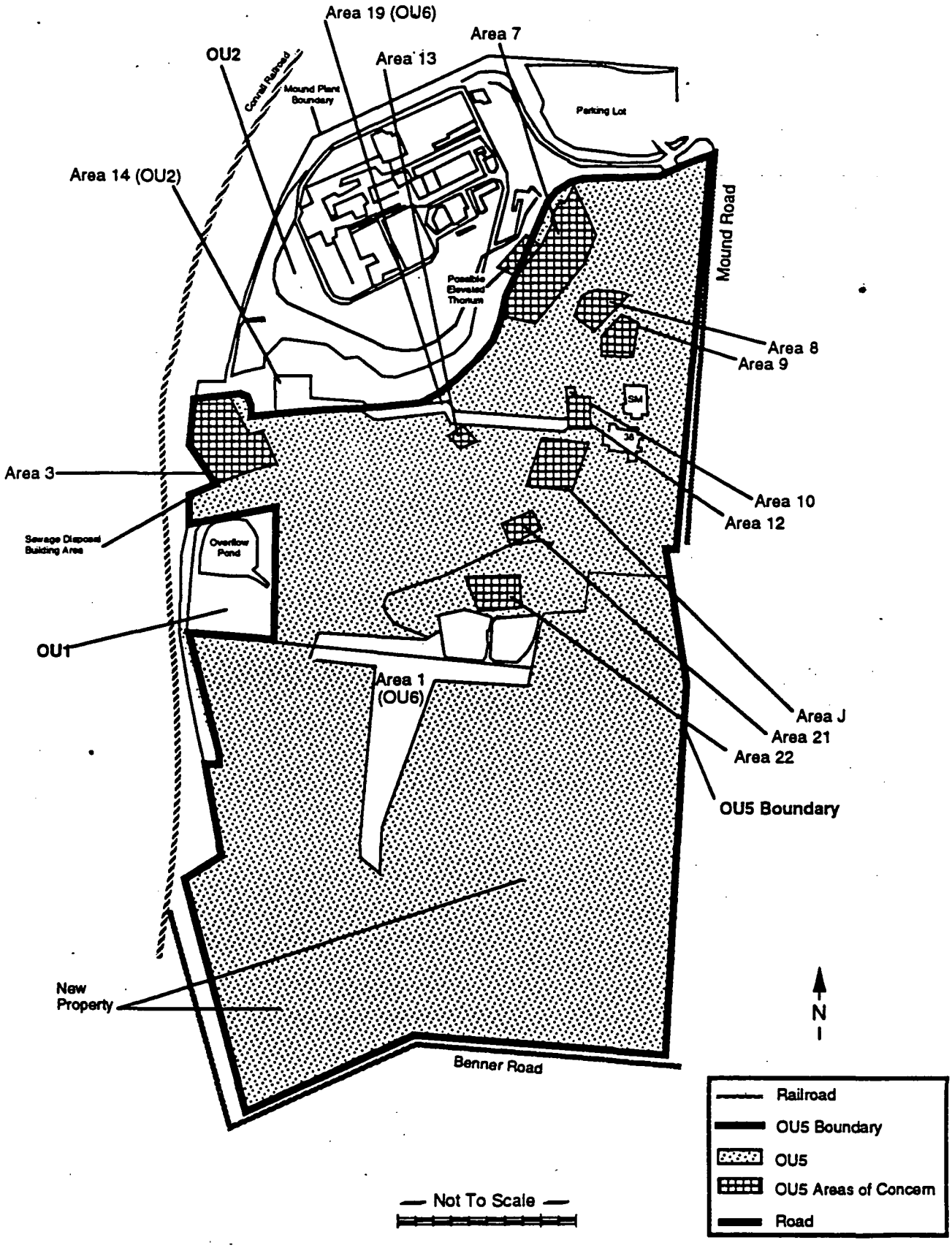


Figure 1.1. Operable Unit 5, Areas of Concern at Mound Plant

document, the OU5, RI/FS Work Plan (DOE 1993c). This document, along with the OU5 QAPjP (DOE 1993a), the OU5 HSP (DOE 1993d), and the OU5, RI/FS Work Plan (DOE 1993c), provide the necessary guidance for conducting field activities.

The initial 11 AOCs to be investigated under this FSP (see Table I.1.) contain varying amounts of radioactive contaminants (principally plutonium-238, thorium-232, radium-226, cesium-137, cobalt-60, actinium-227, and tritium-3), along with trace concentrations of chemical contaminants, mostly industrial solvents and other volatile organic compounds (VOCs) (DOE 1992a, 1993b, 1993c). For some of these AOCs (Area 7, Area 8, Area 12 and Area J) more than 100 data points are available from previous surveys and sampling efforts. For some of the other AOCs, particularly Area 10, Area 13 and the sewage disposal building area (within Area 3), very little data is available from previous surveys and sampling activities. No data is available for Area 22. An analysis of the available data, using United States Environmental Protection Agency (EPA) guidance (EPA 1989), provides an average concentration of the radioactive contaminants for most of these areas, and enables a crude estimate of the lateral and vertical distribution of these contaminants in some of the areas. However, the chemical contaminant data is very limited and is qualitative in nature (i.e., some soil gas data is available for Area 7, Area 3, and Area J). No conclusions can be drawn regarding the lateral or vertical extent of any chemical contamination that may be present in the 11 AOCs because RI quality data (using regulatory agency-approved techniques for both sampling and analysis) has not been acquired at this time.

According to EPA guidance (EPA 1984), answers to the following questions should be available after the existing data has been acquired and analyzed:

- What are the probable sources of the contamination?
- What are the important transport routes?
- What is the geographic extent of the contamination?
- What average concentrations of contaminants exist at different locations?
- Do localized areas of high concentrations exist?
- What are the minimum relative levels of detectability?
- What are the soil characteristics that affect transport and distribution of the contaminants in soil?

If the answers to these questions are not available, EPA indicates that a conceptual model of the site cannot be adequately developed. Consequently, a conceptual site dispersion model for the AOCs cannot be adequately developed. In these circumstances, EPA recommends that an exploratory study (pilot or phased approach) be accomplished. Specifically, EPA states, "In the cases where there is not enough data available for designing the soil sampling study, an exploratory study becomes an essential element of the planning process. Properly designed, the exploratory study is simply phase one of a multi-phase sampling

effort." Therefore, further exploratory activities are warranted in OU5 to determine the sampling locations of subsequent sampling efforts and to acquire the data needed to prepare revised work plans, QAPjPs, field sampling protocols, Data Quality Objectives (DQOs), and a risk assessment.

On the basis of existing data, a field sampling strategy has been developed for each of the initial 11 AOCs in OU5. This strategy employs a review of field screening data for those areas where sufficient data is available to support this approach in determining the appropriate number and location of additional sampling points. This strategy also incorporates the use of the phased approach discussed above to acquire the additional data needed to fully develop the complete sampling protocols for the AOCs. As described in Section 4 of the OU5, RI/FS Work Plan (DOE 1993c), a variety of field screening techniques, geophysical surveys, hydrogeologic investigations, soil and sediment sampling and other appropriate field sampling methodologies will be employed to obtain the necessary information to complete the RI/FS in OU5. In addition, the Mound Plant Soils Screening facility will be used to verify random samples of the radiological screening and also to verify the contamination levels of all samples shipped from the facility.

The sampling objectives, rationale, and historical sampling results data can all be found in the OU5, RI/FS Work Plan (DOE 1993c). This FSP provides the essential information for the field sampling crew to:

- locate the area to be sampled;
- identify the exact location of each sample;
- take the sample with appropriate equipment and materials; and,
- package, and ship the samples for analysis.

There are also guidance and requirements for health and safety concerns, as well as quality assurance and quality control (QA/QC) procedures.

The general CERCLA schedule to conduct the work identified in this FSP is exhibited in Section 6. of the OU5, RI/FS Work Plan (DOE 1993c). In addition, a detailed schedule containing each phased activity will be supplied for regulator review prior to the field programs being implemented.

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

Sampling activities will be conducted by experienced personnel who are trained with field sampling procedures, protocols, and specified equipment. All personnel will have the required training in health and safety procedures and will be involved in the medical monitoring program as required by the Occupational Safety and Health Act (OSHA).

Before sampling can commence, the following people and their major responsibilities will be assigned:

Task Manager	is primarily responsible for administration and has task oversight responsibilities;
Field Team Leader	is responsible for the overall operation and safety of the field sampling team;
Site Safety Officer	is primarily responsible for all safety procedures and operations, to insure proper training is documented, and to perform surveillances;
Sampling Crew	is responsible for performing the on-site tasks necessary to fulfill the objectives and following FSP procedures to collect samples; and,
Quality Assurance (QA) Officer	is responsible for insuring documentation is proper to track samples and generate sufficient QA/QC field samples per the OU5 QAPjP.

Required training will include site specific procedures outlined in the OU5 HSP (DOE 1993d) and the Mound Plant Environmental Restoration (ER) Program SOPs. The QA officer will provide training on sample collection, designation, and handling for the sampling crew so that performance of these tasks is correct. Surveillance will be performed by the QA officer to insure compliance with the Mound Plant ER Program SOPs and the OU5 QAPjP (DOE 1993a).

All required training will be documented and training records will be kept with the field crews as they work in the AOCs and non-AOCs of OU5.

3. SITE BACKGROUND

3.1. MOUND PLANT DESCRIPTION

Mound Plant is located at the southern city limits of Miamisburg, Ohio, approximately 10 miles southwest of Dayton, Ohio (Figure 3.1.). The major topographic feature in the region is the Great Miami River, which flows from north to south just west of the plant. The plant occupies 306 acres on two adjacent hills, the Main Hill and the Special Metallurgical/Plutonium Processing (SM/PP) Hill, overlooking an abandoned section of the Miami-Erie Canal and the Great Miami River.

Mound Plant originated as part of the Manhattan Engineer District to support a technical organization chartered in 1943 to determine the chemical and metallurgical properties of polonium. This work was performed for the United States Army at several locations in the Dayton, Ohio, area. In 1946, 182 acres adjacent to the city of Miamisburg were purchased for the permanent Mound Plant site. Work being performed at the Dayton units was moved to this site in 1948. An additional 124 acres of adjoining land to the south (the "New Property") was later added and remains undeveloped.

Currently, Mound Plant is an integrated research, development, and production facility that operates in support of the United States Department of Energy (DOE) weapons and energy programs. Mound Plant manufactures non-nuclear components and tritium-containing components for nuclear weapons and assembles small heat sources into Radioisotopic Thermal Generators (RTGs) for the space and defense programs. The production of heat sources employed plutonium-238 because of its relatively short half-life (87.7 years) and high specific activity.

The original polonium operations and subsequent plutonium processing have contributed to the radioactive contamination of the AOCs addressed by this OU. A more detailed discussion of Mound Plant operations is found in the OU9, Site-Wide Work Plan (DOE 1992a) and OU9, Site Scoping Report Volume 7: Waste Management Report (DOE 1993g).

3.2. OPERABLE UNIT 5 DESCRIPTION

OU5 is the geographic area of the site which includes and is south and east of the main service road. OU5 is broadly defined as the SM/PP Hill, the New Property, and those AOCs not geographically within the boundaries of OU1 and OU2.

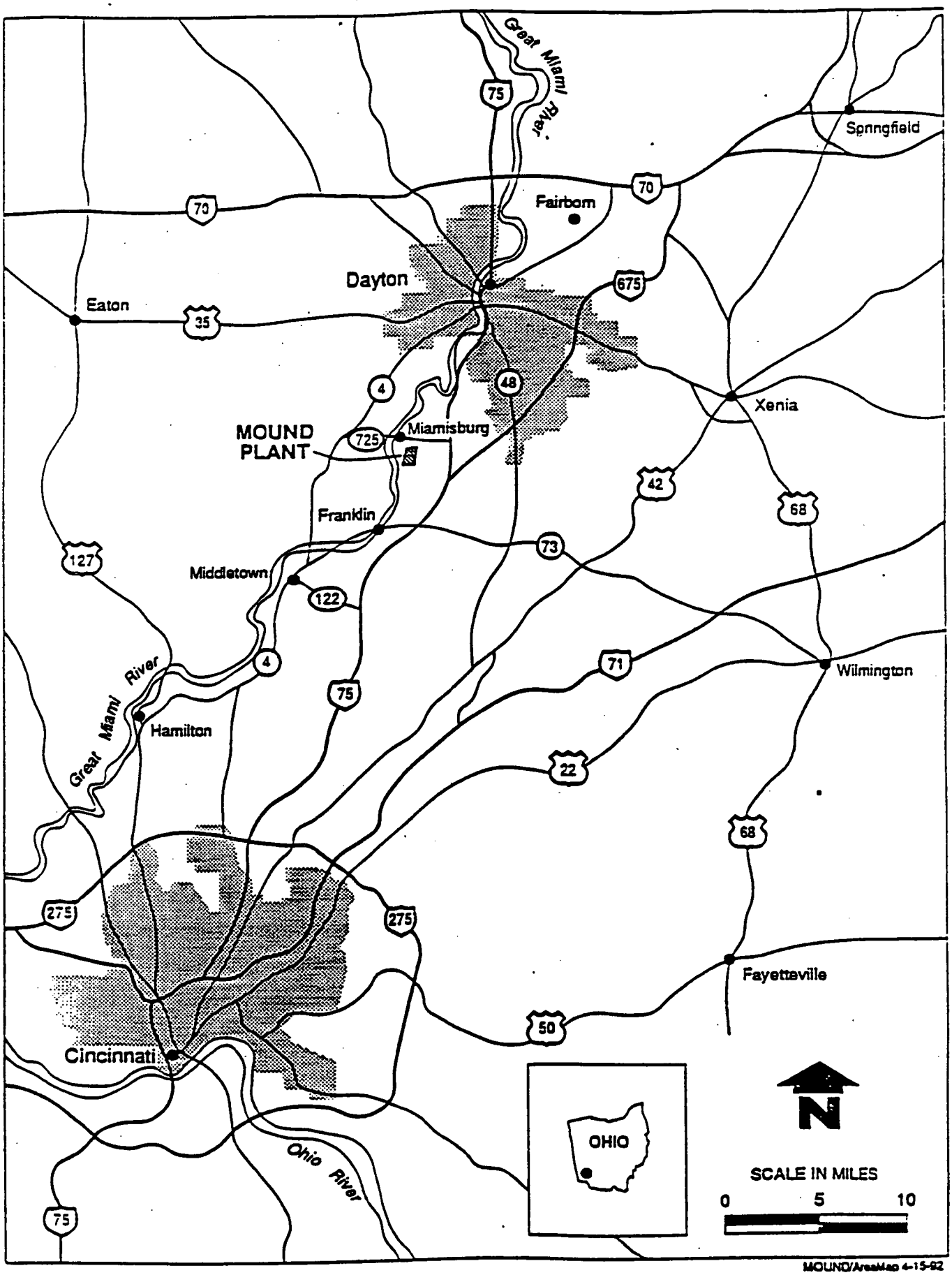


Figure 3.1. Location of Mound Plant, Miamisburg, Ohio

Although the original intent of the OU5 description was to group areas having radioactively contaminated soils together, the scope of OU5 responsibilities also requires the determination of the nature and extent of chemical contamination (partial Target Compound List (TCL) (VOCs), TCL pesticides/Polychlorinated Biphenyls (PCBs), TCL semi-volatile organic compounds (SVOCs), and Target Analyte List (TAL) inorganic compounds) in the OU5 soils, and determination of the nature and extent of groundwater contamination if an OU5 AOC is identified as a groundwater contamination source. The initial list of non-radioactive chemicals of concern (COCs) will be the same as approved for OU9 work.

Within the OU, a number of AOCs are known to be contaminated with radioactive materials (principally plutonium and/or thorium). Other AOCs may have been contaminated by dispersion of material from contaminated AOCs through natural processes (wind, surface water, or groundwater transport, erosion, plants or animals) or by human actions (excavation, hauling, dumping, etc.). Some areas within OU5 may be uncontaminated. Since no verification has been done on these latter two area types, investigations will provide for those determinations.

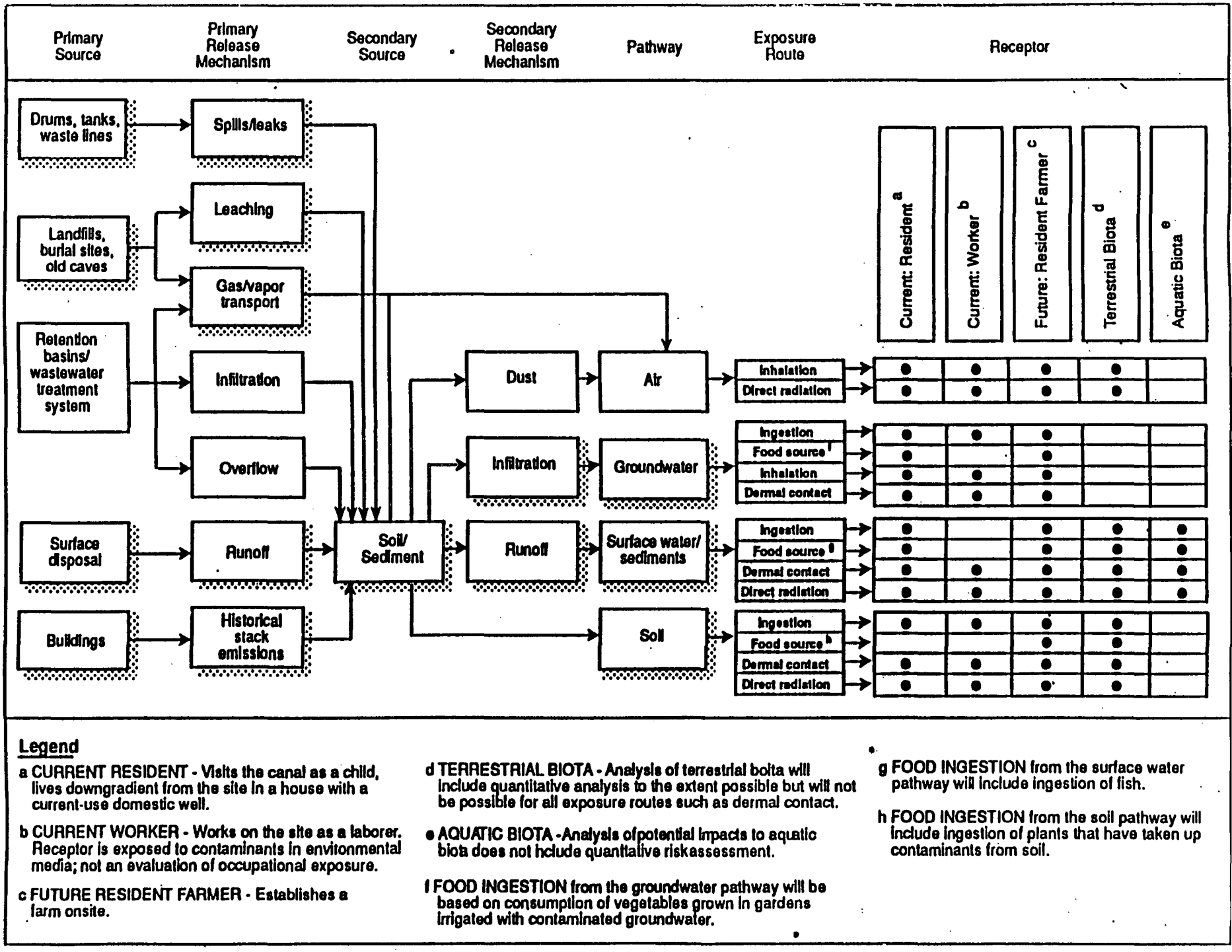
3.3. CONTAMINANTS AND TRANSPORT PATHWAYS

A tabulated, preliminary listing of contaminants in the 11 AOCs can be found in the OU5, RI/FS Work Plan (DOE 1993c). Each AOC is addressed in detail in the appendices to this FSP. Summaries of all existing contaminant data, surveys and past activities in these areas are delineated in the OU5, RI/FS Work Plan (DOE 1993c). Introductory information of concern to the sampling crews is presented in the appropriate FSP appendix for each AOC.

The possible transport pathways for these contaminants was investigated in the Preinvestigation Evaluation of Remedial Action Technologies (PERAT) (DOE 1991). The described conceptual site model is found here as Figure 3.2. (as updated from the OU9, Site-Wide Work Plan). Additional discussions of this conceptual site model can be found in the OU5, RI/FS Work Plan (1993c). The main pathway of concern in OU5 is soils. Surface water and sediments will also be investigated: Groundwater, if encountered during these other sampling activities, will be sampled. If contamination is found, its nature and extent will then be determined in the groundwater.

3.4. DATA GAPS TO BE ADDRESSED BY SAMPLING

The OU5 RI/FS Work Plan (DOE 1993c) provides a summary of existing data from each of the AOCs and discusses what additional sampling or surveys are required to generate the data necessary to complete the OU5 objectives. In general, contaminant extent, type, and concentrations (sources) are not currently



Legend

a CURRENT RESIDENT - Visits the canal as a child, lives downgradient from the site in a house with a current-use domestic well.

b CURRENT WORKER - Works on the site as a laborer. Receptor is exposed to contaminants in environmental media; not an evaluation of occupational exposure.

c FUTURE RESIDENT FARMER - Establishes a farm onsite.

d TERRESTRIAL BIOTA - Analysis of terrestrial biota will include quantitative analysis to the extent possible but will not be possible for all exposure routes such as dermal contact.

e AQUATIC BIOTA - Analysis of potential impacts to aquatic biota does not include quantitative risk assessment.

f FOOD INGESTION from the groundwater pathway will be based on consumption of vegetables grown in gardens irrigated with contaminated groundwater.

g FOOD INGESTION from the surface water pathway will include ingestion of fish.

h FOOD INGESTION from the soil pathway will include ingestion of plants that have taken up contaminants from soil.

Figure 3.2. Conceptual Site Model for Mound Plant Operable Unit 5

known. The FSP appendices will specify the quantity of data needed to fulfill the requirements of assessing the contaminant extent and calculations of impacts for risk assessment input for the initial AOCs. The non-AOCs and the seep/surface water/sediment investigations are described in Section 4 of this FSP.

4. SAMPLING OBJECTIVES, LOCATIONS, AND FREQUENCIES

The RI/FS objectives, as described in the OU5, RI/FS Work Plan (DOE 1993c), are to generate enough information to answer three basic questions:

1) Are the identified AOCs in OU5 contaminated?
2) Are any non-AOC areas contaminated?
3) What remedial action will be taken if any OU5 area is contaminated?

The data needs were specified in the OU5, RI/FS Work Plan (DOE 1993c) based on a review of existing site history and other information. To generate the missing data, this FSP provides the specifics on where, how many and what to sample. A multi-round phased approach will be used so that DQOs can be refined during the RI/FS process. This plan separates the soil media into two cases (existing AOCs and non-AOC areas) and discusses a third case, which incorporates other media (surface water, sediments and groundwater). The air media will be addressed by the OU9, Site-Wide Work Plan (DOE 1992a).

A three phase approach is anticipated for each of the listed cases. The first phase will be a Reconnaissance Sampling (Phase 1) activity to locate areas where intensive investigations are warranted. Phase 2 will consist of RI quality data gathering from prudently selected locations within the areas found by Phase 1 screening. If screening techniques (Phase 1 activities) fail to delineate AOCs, Phase 2 sampling will still be required to verify with RI quality data contamination concentrations exist below levels of concern. Phase 3 sampling (additional RI quality activities) will be required if Phase 2 data is insufficient to fully characterize the nature and extent of the AOC areas. Non-AOCs requiring Phase 3 sampling activities will be re-defined as AOCs. Characterization entails defining the nature and extent of any contamination found, as well as localized physical site parameters.

Phase 2 and Phase 3 plans will be added to this FSP after review of the Phase 1 surveys is complete. The Phase 2 and 3 plans will be added to the appendix for an existing AOC, where appropriate, or a new appendix will be created if the investigation will be in a newly located area.

4.1. EXISTING AREAS OF CONCERN

The existing AOCs have been delineated by historical information and/or past sampling at the site. In the cases where past sampling has been completed, screening-level activities or laboratory analysis were generally used without strict adherence to RI quality standards.

Each AOC is addressed in an appendix to this FSP. All available history and sampling data have been reviewed. In most AOCs, there is an insufficient amount of data to fully define the limits of contamination. In these cases, additional Phase 1 screening (Reconnaissance Sampling) will be performed to fully define the initial boundaries so that Phase 2 sampling (RI quality) can be planned.

Area 7 has the most historical data but not enough to fully characterize all portions of this AOC. There is enough data, however, to prepare a Phase 2 sampling scheme. Limited Phase 1 activities are planned to further investigate three adjacent areas. All other existing AOCs will follow the Phase 1, Phase 2 and possibly Phase 3 sequence as described below for non-AOC Areas. (Any minor exceptions are noted within the appendix for that specific AOC.)

Grid patterns within AOCs, and extending past the currently assumed boundary 25 feet, will be on a 25 foot by 25 foot pattern. This will give adequate coverage for both the gamma surveys and the soil gas surveys. Engineering judgement and manufacturers' recommendations will be used to determine the count times at each grid intersection (gamma survey), as well as the length of time for and specified distances between collector placements (soil gas surveys).

Geophysical surveys, to be done in all landfill-type AOCs (Area J, Area 7, Area 10 and Area 13), will be conducted on 20 foot by 20 foot grid patterns. This will allow coverage to identify subsurface anomalies that could be contaminant sources, locate the edges of the fill materials, and locate areas where intrusive sampling would be difficult.

4.2. NON-AOC AREAS

The balance of the OU5 land area (all Mound Plant property within OU5 boundaries not delineated as an existing AOC) will be screened using Phase 1 methods in an attempt to locate areas of possible contamination. If contamination is found, these areas will be further investigated with Phase 2 sampling and possibly Phase 3 activities, if required. Phase 1 activities entail the use of soil gas and gamma surveys. The soil gas survey will give an indication of chemical contamination (especially VOCs and SVOCs) located in the survey area. The gamma survey will indicate the presence of surface and/or near-surface radiological contamination from the low energy gamma emissions associated with the alpha decay of certain radioisotopes (principally plutonium and thorium). In areas where surface features or newly found historical data indicate burial of debris, geophysical techniques will be used to locate subsurface targets. This will provide location data on possible contaminant sources, the interface of backfill material and natural material or bedrock, and possible areas where intrusive sampling should be avoided.

The non-AOC areas are segregated into two parts: land mass on the original Mound Plant property, and the land mass of the New Property. Most activities at the plant, including the disposal and spilling of materials, occurred in the original property area. In the non-AOC region, a grid system will be used with a spacing of 100 feet for the Phase 1 sampling. This was selected because the smallest existing AOC (Area 13) is approximately 100 feet by 100 feet in surface dimensions. If the actual area to be found is conservatively assumed to be circular, a 100 foot by 100 foot grid would produce a 90 percent probability of identifying contaminated locations (EPA 1987a).

In the New Property area, contamination is much less likely. If found, it may follow a similar pattern as the existing Area 1, which is very large. For Area 1 investigations, a grid pattern of 200 feet by 200 feet will be used. This will provide better than a 95% probability of finding a target area of about 40,000 square feet (EPA 1987a) which is about the average size of the existing AOCs.

The grids will be aligned with lines running north-south based on True North. Each node, where the north-south lines intersect the east-west lines, will be a sample location. In the event that a node is located within an existing AOC, at a building, or other media site that will be sampled under another scheme, no sample will be taken. In either of the non-AOC areas, if locations are found that show soil staining or vegetation distress, these will be included as additional sampling nodes.

4.3. OTHER MEDIA

For sampling other media (surface water, sediments, and groundwater), OU5 will use the information that generated from OU9, Site-Wide initial assessment activities. These OU9 sampling activities will address:

- the plant drainage ditch;
- the ephemeral stream (in the New Property);
- known seeps; and,
- groundwater.

If contamination is found in the drainage ditch, stream or other sediment area assessed through the OU9, Site-Wide Work Plan in the South Property, the responsibility for preparation of the plans to investigate that area to determine the nature and extent of the contamination will fall under OU5. When this activity is warranted, an amendment to this FSP will be created as an appendix. All such amendments will go through the approval process prior to initiating field activities.

The same sequence of events will be followed for the known seeps located within OU5. If contamination is found, responsibility for the subsequent investigations will fall under OU5.

During the wet season, normally between March and May, a survey will be conducted to map all surface water, drainage, and seeps locations within the boundaries of OU5. If any are found that have not been assessed by OU9, they will be done at that time by OU9. Subsequent investigations of areas with contamination will be performed by OU5.

If during any investigation activities in OU5 groundwater is encountered, it will be sampled for the chemicals listed in the groundwater and seeps sections of the Sample Parameter list [OU5, RI/FS Work Plan (DOE 1993c)]. In the event no contamination is found, the locations will be published and OU9 will install a well, if needed in that area. In the case where groundwater contamination is found, OU5 will be responsible for determining the nature and extent, as well as, the source of the contamination. This activity could involve well installation, based on lithology and contaminant profile (soils and groundwater), piezometer usage, geophysical investigations and other techniques. A plan will be prepared and amended to this FSP (after the approval process), as an appendix, if this condition is encountered.

5. SAMPLE DESIGNATION

Each appendix, with the location and quantity of samples specifically listed, has also indicated the sample identification designations. These designations use the format as outlined in the OU9 QAPjP (DOE 1993e) and as further described in the OU5 QAPjP (DOE 1993a). This format is summarized in Table V.1.

Table V.1. Operable Unit 5 Sample Identification Plan

Sample Identifier: MNDXX-YYYY-ZZZZ	
Explanation of Sample Identifier	
MND	Mound Plant
XX	Sample Area Identifier as assigned by EG&G Mound (none have been assigned to date)
YYYY	Sample Location Number
ZZZZ	Sample Type and Sample Round or Depth
The first "Z" is the sample type (investigative or quality control) as indicated below	
0ZZZ	Field Sample
1ZZZ	Sample Duplicate
2ZZZ	Trip Blank
3ZZZ	Sample Blank/Ambient Blank
4ZZZ	Equipment Blank
6ZZZ	Bottle Lot Blank
Field QA samples will be assigned a sample location number and sample round of the last sample of the associated sampling group.	
The second "Z" identifies the sample matrix as indicated below	
Z0ZZ	Soil
Z1ZZ	Sediment
Z2ZZ	Water
The last two "Z" locations are utilized to identify sampling round or sampling depth	

6. SAMPLING EQUIPMENT AND PROCEDURES

The specific equipment and procedures for each AOC are delineated in the appendix that gives introductory information about that AOC. All field activities required to meet the objectives of the OU5, RI/FS Work Plan (DOE 1993c) will be accomplished using the ER Program SOPs as attached to the OU9 QAPjP (DOE 1993e). Should additional SOPs be needed, they will be attached to the OU5 QAPjP (DOE 1993a) [or OU9 QAPjP (DOE 1993e)] to insure activities are consistently performed between tasks. If a new technique is needed, or use of equipment not covered by the ER Program SOPs is specified in this FSP, a SOP will be generated and approved [for addition to the OU5 QAPjP (DOE 1993a)] prior to its use in the field.

Decontamination of the sampling equipment is also governed by the SOPs. All sampling spoils, designated as Investigation Derived Materials (IDM) and decontamination fluids will be containerized and stored on-site until a determination can be made as to the proper technique for treatment and/or disposal. The use of sampling methods will be consistent with those in 40 CFR 261, Appendix III. Another list of recommended methods to be used can be found in A Compendium of Superfund Field Operations Methods (EPA 1987b). The specific method and equipment choices are determined prior to the sampling activity and are listed in the appendix for the AOCs, if different than that in the SOPs or designated in the OU5, RI/FS Work Plan (DOE 1993c).

Decontamination liquids, drilling spoils, and contaminated personal protective equipment will be containerized and stored at Mound Plant. The sampling and analysis of these waste streams is not part of this FSP.

Quality control procedures for all field work, including the use of the screening apparatus (Phase 1 sampling) are delineated in the OU5 QAPjP (DOE 1993a). Prior to shipping any samples off-site a representative portion will be analyzed at the Mound Plant Soil Screening Facility. This will ensure the level of radiological contamination is low enough to ship to the laboratory and to adhere to DOE and United States Department of Transportation (DOT) regulations.

7. SAMPLE HANDLING AND ANALYSIS

The handling of a sample after its collection and prior to its analysis is an important aspect of any sampling effort. The procedures followed during this phase of sampling may be critical in determining the quality of the analysis subsequently obtained and must be carefully specified in the sampling plan. The sample must first be containerized using properly selected and cleaned containers. The sample may require filtration and preservation prior to shipping. These requirements are summarized in Tables VII.1. and VII.2. and elaborated on in the OU5 QAPjP (DOE 1993a). The containers must be packaged for shipping and transported to the laboratory; special procedures may be required, depending on the hazardous nature of the sample. Proper chain of custody controls must be followed during collection and shipment of the sample. Special quality assurance procedures are also required during sample collection and shipment. Each of these aspects of sample handling are discussed in the following chapter. Prior to any sample leaving Mound Plant, the Soils Screening Facility will be used to verify the level of radiological contamination.

7.1. SAMPLE CONTAINERS AND TRANSFER

Improper sample handling or choice of containers may cause problems including loss of volatiles or changes within the sample. Improper choice of containers may cause the container to react with the sample creating analytical errors or the destruction of the container and loss of the sample. Containers may contribute contaminants to samples through leaching or surface desorption from container walls or deplete concentrations of sample constituents through adsorption. Improper transfer of the sample to the container may also result in loss of volatile constituents or other changes in quality.

This sampling plan specifies the type of sample containers to be used to collect samples, as well as the procedures to ensure that sample containers are free of contaminants prior to use and the method of transferring the sample to the container. Some of these specifics are addressed in the OU5 QAPjP (DOE 1993a).

7.1.1. Container Types

The most important factors to consider when choosing containers for hazardous material samples are compatibility of the container with the sample, resistance to breakage, and required sample volume. Containers must not melt, leach, rupture, or leak as a result of chemical reactions with the constituents of a sample. Thus, it is important to have some idea of the composition of the sample before the containers are chosen.

Table VII.1. Sample Containers, Volumes, Preservation, and Holding Times: Groundwater/Surface Water Samples
(page 1 of 2)

Parameter	Analytical Method	Container[a]	Minimum Volume	Preservation	Holding Time[b]
Volatile Organic Compounds	CLP SOW Modification D	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	HCL to pH <2 Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW Modification D	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Metals or Lanthanides	CLP SOW Modification A or C	Polyethylene bottle	1000 mL	HNO_3 to pH <2, Cool 4°C	6 months, 28 days (Mercury)
Cyanide	CLP SOW	Polyethylene bottle	500 mL	NaOH to pH >12 Cool 4°C	14 days
Nitrate-Nitrite	E53.2	Polyethylene bottle	500 mL	H_2SO_4 to pH <2 Cool 4°C	28 days
Fluoride	E340.2	Polyethylene bottle	500 mL	Cool 4°C	28 days
Sulfate Chloride	E375.2 or E375.4 E325.1	Polyethylene bottle	500 mL	Cool 4°C	28 days
Total Nitrogen Total Phosphorus	E351.3 E365.1	Polyethylene bottle	100 mL	H_2SO to pH <2, Cool 4°C	28 days
Total Organic Carbon	E415.1/E415.2	Amber glass bottle with Teflon-lined lid	250 mL	H_2SO_4 or HCL to pH <2, Cool 4°C	28 days
Total Dissolved Solids	E160.1	Polyethylene bottle	1000 mL	Cool 4°C	7 days

Table VII.1. Sample Containers, Volumes, Preservation, and Holding Times: Groundwater/Surface Water Samples (page 2 of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume	Preservation	Holding Time[b]
Total Suspended Solids	E160.2	Polyethylene bottle	1000 mL	Cool 4°C	7 days
Explosives	SW 8330	Amber glass bottle with Teflon-line lid	1 liter	Cool 4°C	7 days extraction/ 30 days analysis[c]
Radionuclides Gamma Spectrometry Plutonium Isotopes Thorium Isotopes Radium-226 Americium-241 Uranium Isotopes Strontium-90	 E901.1 E907.0 E907.0 E903.1 E907.0 E907.0 E905.0	Plastic cubetainer	2x4 liter	HNO_3 to pH <2 (15 mL 1 N HNO_3 per liter)	Not applicable
Tritium	E906.0	Glass bottle	250 mL	Cool 4°C	6 months

Note: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1, 1988.
[a]Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b]From date of collection.
[c]From date of extraction.

PCB = polychlorinated biphenyls
CLP = Contract Laboratory Program
SOW = Statement of Work
HNO_3 = Hydrochloric Acid

Table VII.2. Sample Containers, Volumes, Preservation, and Holding Times: Soil/Sediment Samples
(page 1 of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume/Weight	Preservation	Holding Time[b]
Volatile Organic Compounds	CLP SOW Modification D	Glass vial with Teflon-lined septum (no headspace)	120 mL (no headspace)	Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW Modification D	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	14 days extraction/ 40 days analysis[c]
Metals or Lanthanides	CLP SOW Modification A or C	Wide-mouth polyethylene bottle	1000 mL	HNO_3 to pH <2, Cool 4°C	6 months, 28 days (Mercury)
Cyanide	CLP SOW	Wide-mouth polyethylene bottle	100 grams	Cool 4°C	14 days
Fluoride	E340.2	Wide-mouth polyethylene bottle	50 grams	Cool 4°C	28 days
Nitrate-Nitrite, Chloride Sulfate	E353.2 SW9250 E375.2 or E375.4	Wide-mouth polythylene bottle	100 grams	Cool 4°C	28 days
Cation Exchange Capacity	SW9081	Wide-mouth polythylene bottle	100 grams	Cool 4°C	Not Applicable
Grain Size Distribution Specific Gravity Hydraulic Conductivity Relative Density Maximum Density Moisture Content	ASTM D422-63 ASTM D854-83 ASTM D2434-68 ASTM D4254-83 ASTM D4253-83 ASTM D2974-87	1 gallon wide-mouth plastic jar	5 lbs	None	Not Applicable

Table VII.2. Sample Containers, Volumes, Preservation, and Holding Times: Soil/Sediment Samples (page 2 of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume/Weight	Preservation	Holding Time[b]
Organic Content	ASTM D-2974-87	Wide-mouth ethylene bottle	500 grams	Airtight Cool 4°C	7 days
Explosives	SW8330	125-mL wide-mouth amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	7 days extraction/30 days analysis[c]
Radionuclides Gamma Spectometry Plutonium Isotopes Thorium Isotopes Uranium Isotopes Strontium-90	 E901.1 E907.0 E907.0 E907.0 E905.0	Wide-mouth nalgene bottle	750 grams	None	Not Applicable
Tritium	E906.0	Glass bottle	750 grams	Cool 4°C	6 months

Note: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1, 1988.
[a]Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b]From date of collection.
[c]From date of extraction.

PCB = polychlorinated biphenyls
CLP = Contract Laboratory Program
SOW = Statement of Work
NaOH = Sodium Hydroxide
HNO_3 = Nitric Acid
H_2SO_4 = Sulfuric Acid
HCL = Hydrochloric Acid

The containers to be used for the OU5 RI/FS activities are shown in Table VII.1.and VII.2. and are listed in the OU5 QAPjP (DOE 1993a).

7.1.2. Sample Transfer

The procedures used to transfer the sample from the collection device to the sample container will minimize any potential impact on the sample quality. Sample transfer is most important when dealing with aqueous samples such as those obtained in groundwater monitoring.

Aqueous samples will be transferred from the sampling equipment directly into the container that has been specifically prepared for that analysis. Samples will not be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers because losses of organic material onto the walls of the container or aeration may occur.

Aqueous samples collected for analysis of volatiles constituents will be transferred from the sample collection device to the sample container directly, with a minimum amount of turbulence. This procedure minimizes the loss of constituents through agitation/volatilization. Total organic halogens (TOX) and total organic carbon (TOC) samples are handled and analyzed as materials containing volatile organics. To minimize the possibility of volatilization, no headspace will exist in containers holding samples which will be analyzed for organics. Field logs and laboratory analysis reports will note the headspace in the sample container(s) at the time of receipt by the laboratory, as well as at the time the sample was first transferred to the sample container.

7.2. PRESERVATION OF SAMPLES

For best results, samples will be analyzed immediately after collection. Hazardous substances (non-radiological) are such complex mixtures that it is difficult to predict the physical, biological, and chemical changes that occur in the samples over time. The pH may change significantly in a matter of minutes; sulfides and cyanides may be oxidized or evolve as gases; and hexavalent chromium may slowly be reduced to the trivalent state. Certain positively charged ions may be partly lost as a result of adsorption to the walls of the sample containers. Micro-organisms may metabolize certain constituents or volatile compounds may be rapidly lost. Potential changes in low concentration water samples may be slowed down or prevented by refrigeration at four to six degrees Celsius, and/or by the addition of preservatives. Methods for sample preservation usually apply to one or two components or properties and may adversely impact the analysis for other constituents. Refrigeration may deter the evolution of volatile components and acid gases such as hydrogen sulfides and hydrogen cyanides, but it may also cause some salts to

precipitate at the lower temperature. On warming to room temperature for analysis, the precipitates may not redissolve making it difficult to determine the actual concentrations of dissolved sample constituents. Preservatives may retard bio-chemical changes; other additives may convert some constituents to stable hydroxides, salts, or compounds. However, preservatives may cause some compounds to be converted to other forms (such as the products of nitration and oxidation of organic components). The results of subsequent analyses may not reflect the original identity of the components.

The preservation techniques required by the OU5 QAPjP (DOE 1993a) are also found in Tables VII.1. and VII.2. for these FSP activities.

7.3. PACKING AND SHIPPING

Samples collected at any OU5 site will have to be transported for analysis. Where applicable, DOT regulations governing the shipment of hazardous materials will be followed. These regulations (40 Code of Federal Regulations (CFR) parts 171 through 179) describe proper marking, labeling, packaging, and shipment of hazardous materials, substances, and wastes. In particular, Part 172.402(h) of 49 CFR is intended to cover shipment of samples of unknown materials destined for laboratory analysis. Radiological contaminated samples are also governed by shipping regulations (DOT and 10 CFR).

The selection of proper handling procedures requires classification of the sample. The sample must be classified as to whether it contains a low, medium, or high concentration of hazardous substances. A low-concentration sample is one that contains less than 10 ppm of any one contaminant; most background samples fall into this category. A medium-concentration sample contains at least 10 ppm but less than 150,000 ppm of any one contaminant. A high-concentration sample has at least one contaminant at a level greater than 150,000 ppm (15 percent); this group includes most samples from drums and tanks. No high-concentration samples are expected to be found within the OU5 AOC.

7.4. DOCUMENTATION AND CHAIN-OF-CUSTODY PROCEDURES

All information pertinent to field activities including sampling must be recorded in various forms: logbooks, sample tags, photographs, etc. Proper documentation and document control are crucial to enforcement actions and preparation of Records of Decision (ROD) for the RI/FS process. Therefore, each field crew will keep detailed records of inspections, investigations, and photographs taken (EG&G photographer may have to be used) and thoroughly review all notes before leaving the site.

The purpose of document control is to assure that all documents for a specific project are accounted for when the project is completed. Accountable documents include items such as logbooks, field data records, correspondence, sample tags, graphs, chain-of-custody records, analytical records, and photos. Each document will bear a serial number and will be listed, with the number, in a project document inventory assembled at the project's completion. Waterproof ink must be used in recording all data in documents bearing serial numbers.

A documentation coordinator (or QA/QC officer) numbers all logbooks, sample tags, graphs, chain-of-custody records, etc. The coordinator records in a logbook the transfer of other logbooks and other serialized items to individuals who have been designated to perform specific tasks on the project. All project logbooks are to be turned over to the coordinator at the completion of each work period, and to a central file at the completion of the field activity.

7.4.1. Field Logbook

All information pertinent to a field activity will be entered in a bound book with consecutively numbered pages. The information entered into the logbook depends upon the type of investigation being conducted and is proceduralized in the SOPs. Field logbook entries will include the names of field personnel, dates and times of entries, weather conditions, and all specific information relating to the field activity being performed. Because sampling situations vary widely, notes will be as descriptive and inclusive as possible. Entries should be complete enough to allow for reconstruction of the sampling situation from the recorded information. If anyone other than the person to whom the logbook was assigned makes an entry, he/she must date and sign it. In addition, one QA surveillance will be performed for each field activity.

Observations or measurements taken where contamination of the field logbook may occur should be recorded in a separate bound and numbered notebook and later transferred to the project logbook. The originals are retained and the delayed entries are labeled as such. This procedure insures that the project logbook is not contaminated by contact in operational areas.

7.4.2. Chain-of-Custody Procedures

DOE must be able to provide the chain-of-custody for any samples which form the basis of analytical test results. Written procedures are available (as SOPs) and followed whenever RI/FS samples are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the

moment of its collection through analysis and its introduction as evidence in the RI report. Additional guidance on these procedures is delineated in the OU5 QAPjP (DOE 1993a).

The number of people involved in collecting and handling samples should be kept to a minimum. Field records will be completed at the time the sample is collected and will be signed or initialed, including the date and time, by the sample collector(s).

One member of the sampling team will be appointed field custodian. Samples are turned over to the field custodian by the team members who collect the samples. The field custodian documents each transaction and the sample remains in his/her custody until it is shipped to the laboratory.

Each sample is identified by affixing a pressure-sensitive, gummed label, or standardized tag, on the container(s). The minimum information recorded on the label or tag will include the following:

- name of collector;
- date and time of collection;
- place of collection; and,
- sample number.

If a label is not available, the same information will be recorded on the sample container legibly and with waterproof ink. The sample container will then be placed in a transportation case, along with the chain-of-custody record, pertinent field records, and analysis request form as needed. The transportation case must be sealed or locked. A custody seal will be placed on each sample container where it will be broken if the container is opened. A similar seal is also placed on the shipping case. Examples of these seals, tags, and forms can be found in the OU5 QAPjP (DOE 1993a).

8. HEALTH AND SAFETY

All activities occurring for the OU5 RI/FS investigations are governed by the OU5, RI/FS Work Plan (DOE 1993c). An additional control document is the OU5 HSP (DOE 1993d). This companion document to the FSP must be with the field crews whenever there are ongoing activities in OU5.

This HSP (DOE 1993d) includes a description of the required personnel protection equipment, a description of site access control, a review of any delineation of work areas (as specified in the appendices for each AOC), and personnel and equipment decontamination procedures. Along with the descriptions, the action level to stop work and/or increase the level of protection are listed in the OU5 HSP (DOE 1993d).

Included in the HSP (DOE 1993d) is a description of the levels of protection to be worn by the sampling crew, a description of the known hazards with an evaluation of the risks associated with OU5 sampling, a list of the key personnel and alternates, site emergency procedures, and additional information as required and suggested by the National Institute for Occupational Safety and Health (NIOSH), OSHA, and DOE.

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SITE SPECIFIC FIELD SAMPLING PLANS

APPENDICES 1-10

LIST OF APPENDICES

APPENDIX 1
SITE SPECIFIC FIELD SAMPLING PLAN
AREA 10 - CONCRETE FROM UNIT 4 DAYTON OPERATIONS
PARTIAL AREA 11 - CONTAMINATION FROM RECOVERABLE PLUTONIUM WASTE STORAGE DRUMS
AREA 12 - CONTAMINATED SOIL FROM AREA 1 AND SM BUILDING OPERATIONS

Background

Area 10

Area 10 is located in the east-central portion of Mound Plant on the western slope of the SM/PP Hill (Figure 1.1.). Covering an area that has been estimated to be 100 feet by 150 feet (15,000 ft^2), this site lies west of Building 33 and just north of Area 12. Accessibility to Area 10 is limited by the presence of heavy vegetation and the severity of the hillslope. Historically, the area has served as a disposal site for material generated from the demolition of the old Unit IV Dayton Operations dating back to 1950. Approximately six large pieces of concrete (3 feet by 4 feet in size) resulting from the demolition of the polonium processing facility at the former Unit IV currently lay in the brush in Area 10. Although the six concrete blocks were originally contaminated with polonium-210, this contaminant is no longer present due to its short half-life (138.4 days). In addition to the concrete waste, one hundred and sixty truckloads of demolition debris were brought to Mound from Dayton Unit IV (Halbach 1950) and 100 truckloads were brought from Dayton Unit III. It is not known how much of this was stored in Warehouse 10 or dumped in Area 10. The actual size of the area that has been affected by debris disposal, however, is unknown. Reportedly, more concrete debris is contained in the woods to the north of Area 10 and an extensive search for debris over the hillside has not been undertaken. According to the OU9, Site Scoping Report: Volume 5, (DOE 1993d) it is estimated that Area 10 has had from 0 to 10 feet of fill material added to the topographic surface that existed in 1946.

One surface soil sample from Area 10 (sample 0604) was collected during the Mound Site Survey Project (Stought, et al. 1988). Subsequent analysis of the sample identified an elevated plutonium-238 level of 11.8 pCi/g. This soil sample was not analyzed for chemical contaminants and it is not known where the sample was acquired in relation to the concrete blocks.

Because of its location on the slope of the SM/PP Hill, Area 10 is in a position to receive surface water runoff from adjacent topographically upgradient areas such as Area 12. Soils in Area 12 are known to contain elevated concentrations of plutonium-238 and thorium-232. Since there are no known

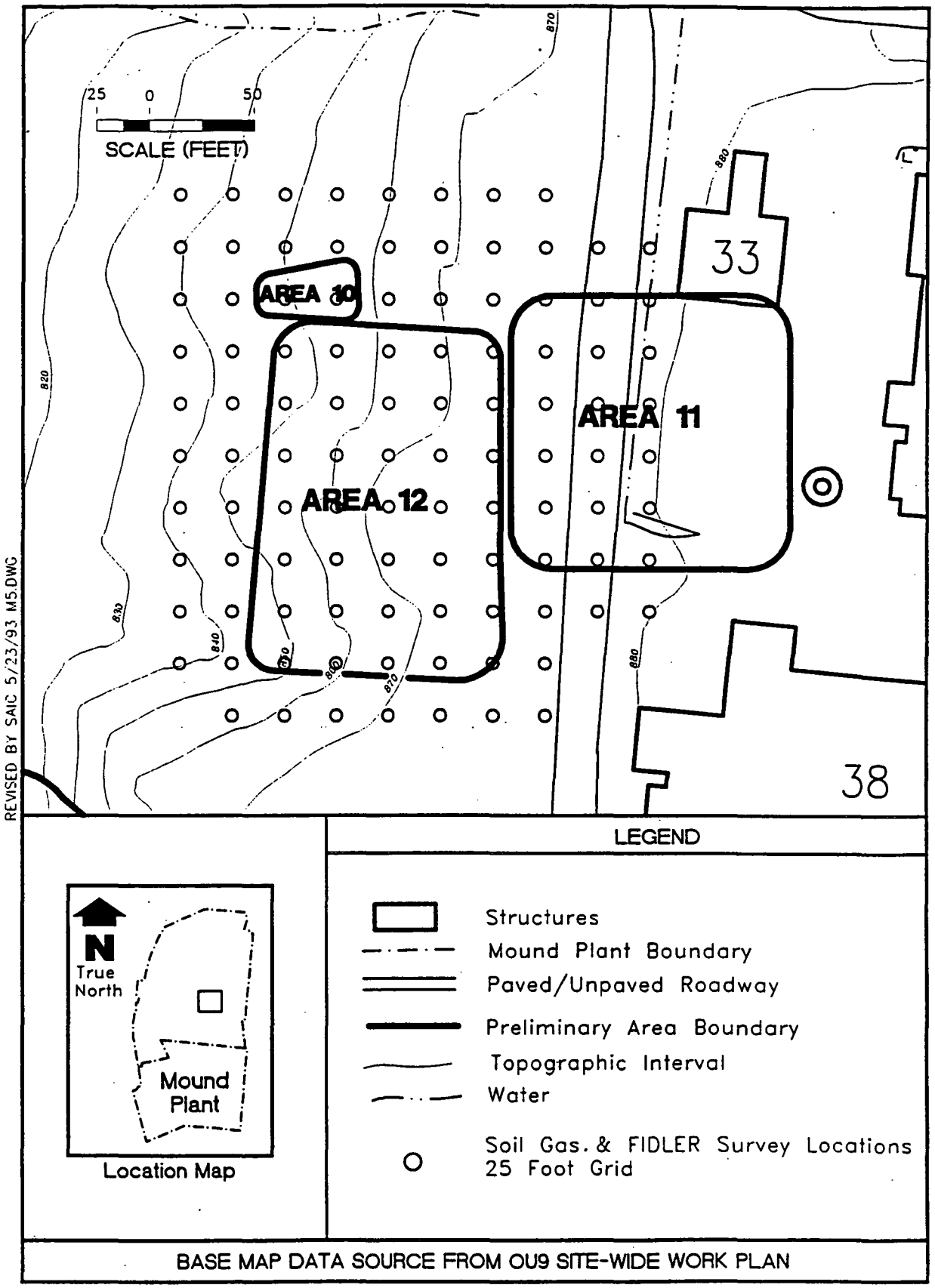

Figure 1.1. Soil Gas and FIDLER Screening Grid, OU5 Areas 10, 11, and 12

contaminants associated with the concrete blocks in Area 10, it is suspected that the plutonium-238 detected in the surface soil sample collected during the Mound Site Survey Project (Stought, et al. 1988) is a result of deposition from surface water runoff from sites like Area 12.

Area 12

Area 12 is situated on the western slope of the SM/PP Hill and adjoins Area 10 to the north (Figure 1.1.). It also lies on the northern side of the former location of the radioactive waste line trench. According to various reports, the size of Area 12 may range from 19,000 ft^2 to 30,000 ft^2.

As in Area 10, Area 12 also has a history of being a depository for waste material and is, therefore, identified as a potential site of contaminated soils. Beginning in the 1950s, more than 100,000 yd^3 of construction spoils were placed in this area. In 1965, soil contaminated with thorium-232 was transferred to Area 12 from Area 1, when the latter was scraped to remove the surface contamination. Also in 1965, soil contaminated with thorium-232 and plutonium-238 from the SM Building was deposited over Area 12 (DOE 1992a). Local sources of contamination are also known or suspected in several sites surrounding Area 12. Soil overburden containing low-level thorium contamination was disposed in a site just to the south of Area 12 (now called Rader's Hill) when the Waste Transfer System (WTS) pipeline was removed by the Decontamination and Decommissioning (D&D) program.

Based on reports by DOE (1986) and Stought, et al. (1988), the known radioactive contaminants at Area 12 are mainly plutonium-238 (0.01 to 1,000 pCi/g), thorium (2 to 1,000 pCi/g), and cobalt-60 (1 to 2 pCi/g). Results of the environmental sampling performed as part of the Mound Site Survey project (Stought, et al. 1988) indicates that the soils of Area 12 are generally contaminated north of the Area 19 waste lines. Both plutonium and thorium contamination was found in that study to a depth of 15 feet. During the 1982 to 1985 Radiological Site Survey (DOE 1993b), maximum plutonium-238 and thorium concentrations were found to be 313 pCi/g and 189.9 pCi/g, respectively. For core and surface sample locations, see the Plates contained in the Appendix A of the OU5, RI/FS Work Plan (DOE 1993c). These concentrations were detected in a sample collected from core location 0131 at a depth of 54 inches. In situ gamma spectroscopy for thorium-232 was performed at two core locations (0145 and 0291). The maximum thorium-232 concentration measured using this technique was 22 pCi/g. This concentration was detected in the samples collected from location 0145 at depths of 24 and 36 inches. Most core locations were sampled to a total depth of 132 to 180 inches; however, the maximum sampling depth to bedrock in this area is 120 to 234 inches. No information is available on the presence of possible chemical contaminants or Resource Conservation and Recovery Act (RCRA) hazardous constituents in Area 12.

Area 11

Only that portion of Area 11 which is located west of and includes the plant roadway will be assessed by OU5. The remaining section of this Area (east of the roadway) will continue to be addressed by the D&D Program.

Area 11 is located on the SM/PP Hill, just west of the SM Building (Figure 1.1.). From the early 1960s to 1965, this area was used for the storage of plutonium-contaminated equipment and waste packages from the SM Building. Some of the drums of recoverable plutonium wastes were found to be leaking in 1964 and were moved to the open field south of the SM Building for overpacking. This D&D site will be evaluated by OU5 for the land area which lies west of the plant road. Past sampling [e.g., Mound Site Survey Project Report and the D&D Program (1989)], show significant levels of plutonium-238 and at least one sample above 5 pCi/g of thorium. Maximum concentrations were found to be 64,000 pCi/g and 69 pCi/g of plutonium and thorium, respectively.

Sampling Objectives

The objectives of the RI/FS sampling in Areas 10, 11 and 12 are to:

1. confirm the levels of plutonium-238, cobalt-60, and thorium in the soils;
2. determine if other radioactive contaminants are present and at what concentrations/locations;
3. determine if chemical (i.e. non-radioactive) contaminants are present and their concentrations/locations;
4. characterize the lateral and vertical extent of radioactive and non-radioactive contamination in soils and groundwater (if encountered);
5. obtain data to define the sources of contamination (if any); and,
6. obtain data to develop the conceptual site model or Areas 10, 11, and 12.

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 10 is limited to selected radionuclides in one surface soil sample, and no data is available regarding the vertical distribution of radioactive contaminants. Although data from nine core borings provide information on the vertical distribution of contaminants in Area 12, the full lateral extent of contamination has not been evaluated there. Additionally, no chemical (non-radioactive) contaminant data is available for either area. Six cores

were taken and analyzed for plutonium and thorium in Area 11. The data gives ranges of values and some indication of vertical extent. Additional samples will need to be taken for determination of nature and extent. This determination will include other radiological isotopes and non-radiological chemicals. A phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For these areas, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination using a Field Instrument for Detection of Low Energy Radiation (FIDLER) in accordance with ER Program SOP 6.7. All areas will be screened on a 25-foot grid (Figure 1.1.) beginning with one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and semi-volatile organic compounds (SVOCs) using the same grid pattern in these areas. The radioactive and soil gas screening surveys will be used to locate Phase 2 sampling points. In addition to the FIDLER and soil gas surveys, a geophysical survey consisting of electromagnetic and magnetometer/gradiometer techniques will be used. The primary objective of the geophysical survey is two fold: 1) to provide better resolution of an AOC boundary due to buried waste; and 2) to locate near-surface and subsurface objects that could impact subsequent intrusive investigations (e.g., borings). A 20-foot grid will be used as shown in Figure 1.2.

Under Phase 2, subsurface soil borings will be installed to obtain samples for the analyses of chemical and radioactive constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If required, a third phase of the field sampling

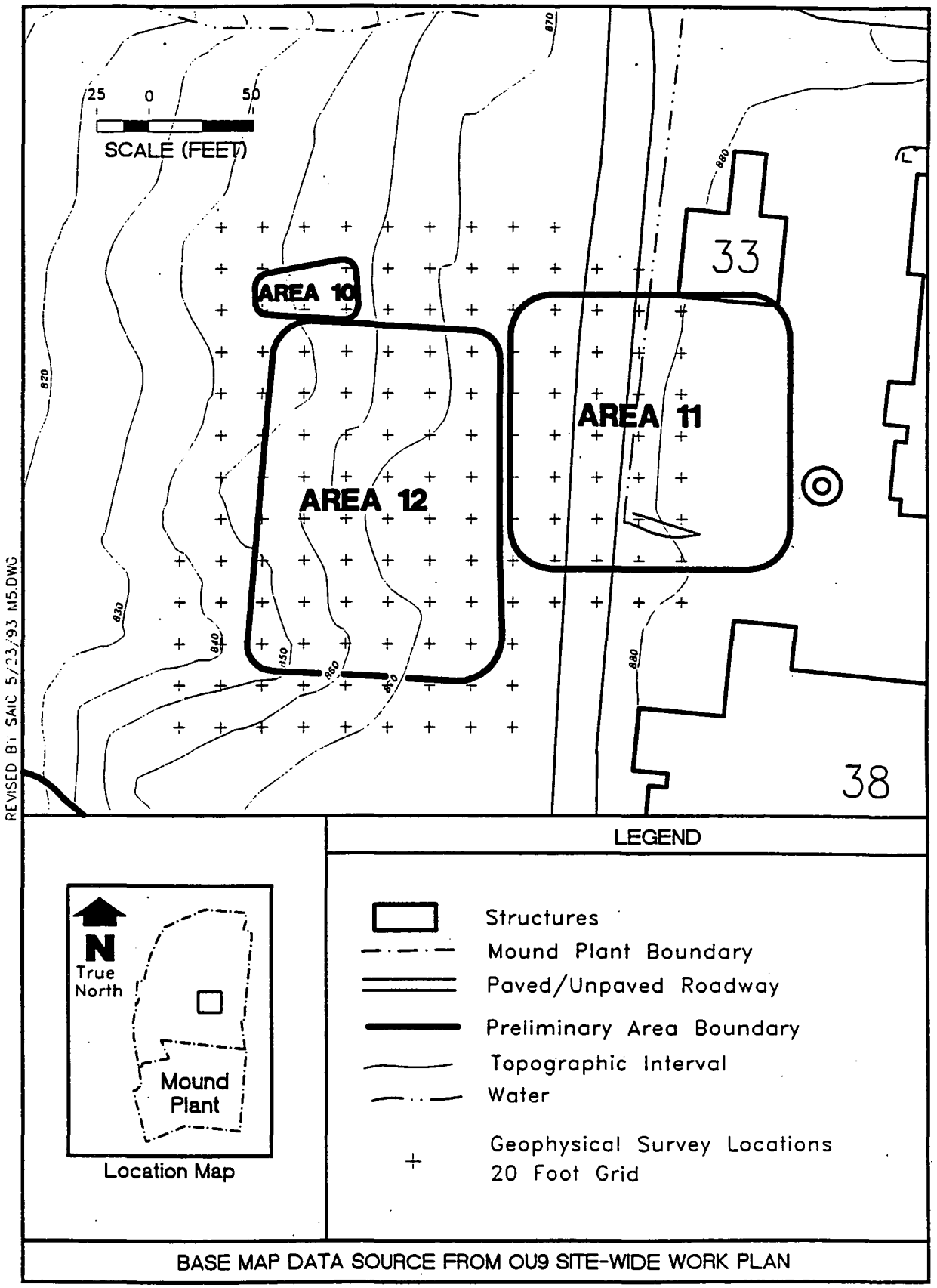

Figure 1.2. Geophysical Screening Grid, OU5 Areas 10, 11, and 12

plan will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of the groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radionuclides and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed at the gridded station locations at a depth of 18 inches and backfilled. A total of about 100 soil gas collectors will be placed within and around the known dimensions of Areas 10, 11 and 12 for this survey. In addition, five collectors will be installed for time calibration as described in the soil gas procedures presented in the SOP exhibited in the OU5 QAPjP (DOE 1993a), Attachment 1. Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the SOP.

As part of the Phase 1 exploratory study for a geophysical survey, electromagnetic and magnetometer/gradiometer techniques will be employed to identify areas of difficult drilling and areas possibly underlain by ferro-magnetic wastes (e.g. rebar, drums, etc.). As illustrated in Figure 1.2., the geophysical grid will be composed of 9 north-south lines spaced 20 feet apart, with stations located along the lines at 20 foot intervals. A total of approximately 126 stations will be used in the survey, although this number may vary depending on field conditions. Both terrain conductivity (EM-31) and magnetometer/gradiometer (GSM-19 and GSM-18 base station) surveys will be conducted at each station. The EM-31 instrument will be used to measure both the in-phase and out-of-phase (quadrature) components in both the vertical and horizontal dipole orientations. The in-phase component is more sensitive to metallic objects than is the quadrature phase, whereas the quadrature component is more sensitive to terrain conductivity and external sources of electric current. The magnetometer/gradiometer will be used to discriminate iron-bearing objects buried in the shallow subsurface.

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening, the soil gas survey, and the geophysical results according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipments lower detection limits), those spots would be the starting point for a statistically designed Phase 2 program. The results of the geophysical survey will also be considered in determining the number of samples required. If the survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will collected at each boring location using split-barrel samplers. Each soil core sample will be screened using a FIDLER for radionuclides, and a Photoionization Detector (PID) and Combustible Gas Indicator (CGI) for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent Lower Explosive Level (LEL) on the CGI. A sample will also be obtained for analysis if elevated reading are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch outer diameter (o.d), 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP SOPs 1.3, 1.4, 1.5, and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, cation exchange capacity (CEC), and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4 foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select the appropriate samples during drilling. The remainder of the soil sample will be extracted from the remaining sleeves or sampler and composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analysis. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will resume. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first

6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 20 feet or until bedrock is encountered.

Bedrock was not identified in previous borings in Area 10, but due to auger refusal during drilling, it is assumed to be at a depth of 7 or 8 feet below land surface. If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis following the procedures contained in the drilling SOP exhibited in the OU5 QAPjP (DOE 1993a), Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be obtained in accordance with SOP 2.9. All samples will be analyzed for the laboratory parameters as specified in the OU5 RI/FS Work Plan (DOE 1993c) DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program for Areas 10, 11 and 12 will be identified as specified in the OU5 QAPjP (DOE 1993a). Samples from each of the areas will be identified as indicated below.

For example, the soil gas designation codes for the first three samples obtained from the first sampling point in Area 10 would be:

MND31-0001-0001	for the first sample at location 1
MND31-0002-0001	for the first sample at location 2
MND31-0002-0002	for the second sample at location 2

The soil gas designation codes for the first three samples obtained from the first sampling point in Area 11 would be:

MND32-0001-0001	for the first sample at location 1
MND32-0002-0001	for the first sample at location 2
MND32-0002-0002	for the second sample at location 2

The soil gas designator codes for the first three samples obtained for the first sampling point in Area 12 would be:

MND33-0001-0001	for the first sample at location 1

MND33-0002-0001 for the first sample at location 2

MND33-0002-0002 for the second sample at location 2

This identification code scheme will be unique for each area and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 2
SITE SPECIFIC FIELD SAMPLING PLAN
AREA 3

Background

Area 3 is located in the lower valley area southwest of the Main Hill and includes buildings 19, 42, 55, and 57 (see Figure 2.1.). The total area is approximately 340 feet by 450 feet (153,000 ft^2). Area 3 was used for the storage and redrumming of 55-gallon drums containing thorium and plutonium-238 in the late 1950s and early 1960s. The buildings in this area serve a variety of purposes, including salvage operations, effluent monitoring, and sewage treatment. In 1954 and 1955, approximately 6,000 55-gallon drums containing thorium sludge were delivered to Mound Plant. Some of these drums were stored for prolonged periods in Area 3. Exposure to weathering and the internal exposure to corrosive solutions made it necessary to frequently redrum the thorium sludge. The redrumming operations and leakage during storage resulted in the release of thorium into the area soils. In 1965, the thorium-contaminated soil was excavated and the area was backfilled with clean soil (MRC 1985; Stought et al., 1988).

A small section of Area 3 near Building 19 may have been contaminated by a plutonium-238 waste line break in 1969, or during the cleanup operations following that event in the area, denoted Area 14, located approximately 600 ft northeast, see OU5 Work Plan Figure 1.1.. The maximum plutonium-238 concentration reported from samples collected in Area 3 was 50.6 pCi/g and the maximum thorium concentration was 5.3 pCi/g. Groundwater monitoring well sampling in the area has identified trace amounts of tritium, thorium and uranium.

In addition to the known radioactive contamination, Area 3 may also contain chemical contaminants, including organic solvents (acetone, trichloroethane, freons, isopropyl alcohol, methyl alcohol and paint thinners), waste oils, paints, spent plating solutions (chromic acid, cadmium cyanide, nickel sulfate, nickel chloride and copper cyanide), photoprocessing wastes (fixers, developers, bleaches and rinses), polymer wastes and other toxic waste materials. Results of groundwater monitoring has also identified some of these chemical contaminants, including 1,2-trans-dichloroethene, a degradation product of trichloroethane, as well as 1,2-dichloroethane and styrene. Soil gas data from Area 3 indicates that freon and TCE are other chemical contaminants within Area 3 (DOE 1992c).

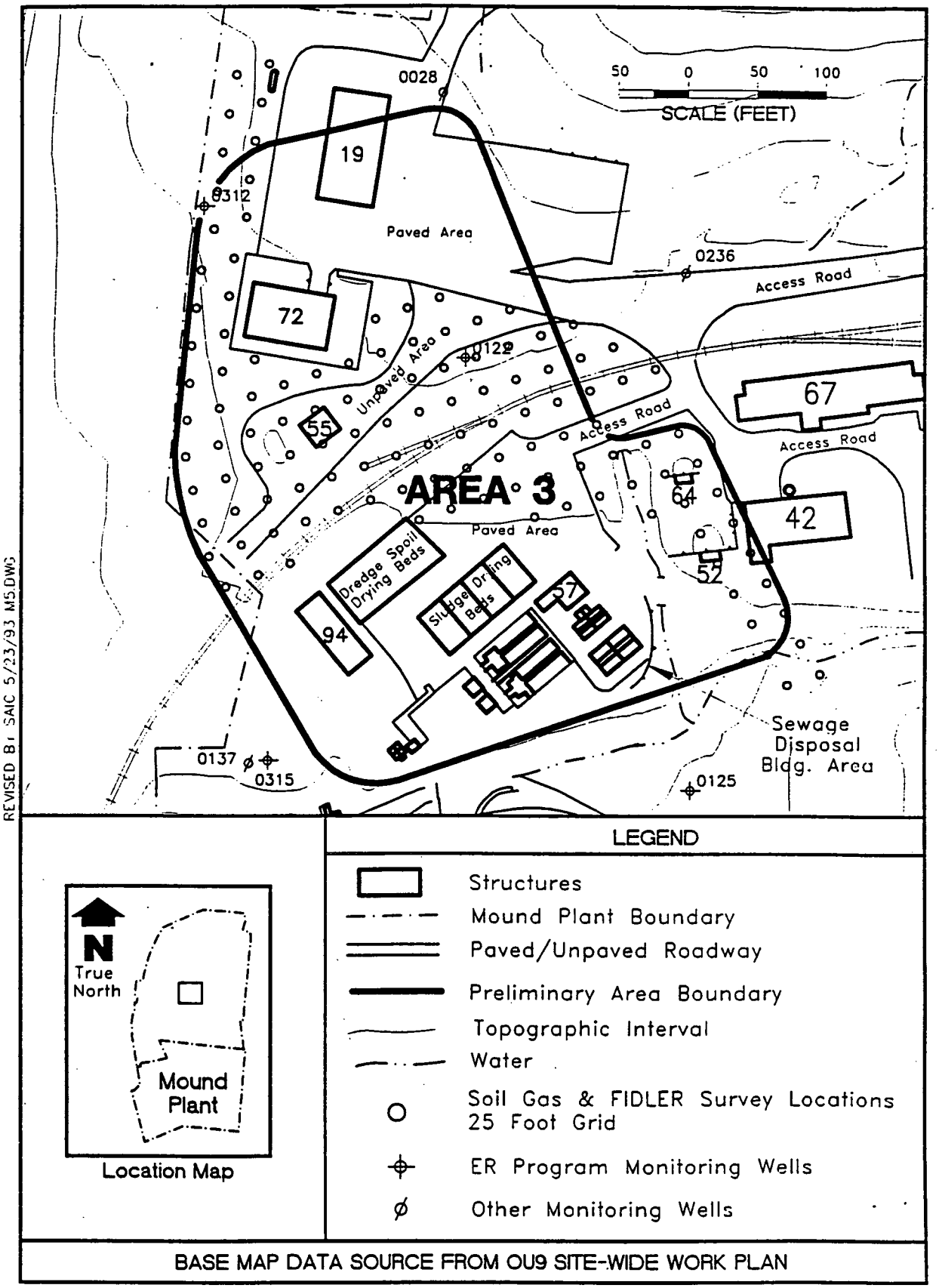

Figure 2.1. Soil Gas and FIDLER Screening Grid, OU5 Area 3

Sampling Objectives

The objectives of the RI/FS sampling in Area 3 are to:

1. confirm the levels of plutonium-238 and thorium-232 previously recorded, and the presence of tritium and uranium;

2. determine if other radioactive contaminants are present in detectable concentrations and at what locations;

3. determine if chemical (i.e., non-radioactive) contaminants are present and their concentrations/locations;

4. characterize the lateral and vertical extent of any radioactive and non-radioactive contamination in area soils and groundwater (if encountered);

5. obtain data to define the sources of contamination (if any); and

6. obtain data to develop conceptual site model for Area 3.

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 3, as indicated by previous studies, includes both radioactive and chemical (non-radioactive) constituents. Although the existing data on this area provides considerable insight into the types and concentrations of contaminants in this area, the lateral and vertical extent of the contamination is not sufficiently understood. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For Area 3, the reconnaissance phase (Phase 1) will consist of a field screening survey for radioactive contamination (plutonium and thorium) using a FIDLER as described in ER Program SOP 6.7. The area will be screened on a 25-foot grid (Figure 2.1.) beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an

elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate Phase 2 sampling points.

During Phase 2 of the field sampling program, subsurface soil borings will be excavated to obtain samples for the analyses of chemical and radionuclide constituents to meet the DQOs specified in the OU5 QAPjP (DOE 1993a). If necessary, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radioactive contaminants and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 25-foot grid pattern as shown in Figure 2.1., at a depth of 18 inches and backfilled. A total of 136 soil gas collectors will be placed within and around the known dimensions of the beds. In addition to the primary soil gas locations, five collectors will be installed for time calibration as described in the soil gas procedures presented in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the Soil Gas SOP (Attachment 1) in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening data and soil gas survey results conducted during Phase 1 (EPA 1989). If any "hot

spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be the starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring locations using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above site background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4 foot depth intervals until bedrock is encountered or, based on noticeable soil property or color differences, a field geotechnical engineer or geologist will select the appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil samples selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 20 feet.

Based upon data from previous investigations the depth to bedrock in this area is greater than 25 feet (DOE 1992b). If groundwater is encountered in sufficient quantity, a sample will be obtained for laboratory analysis following the procedures presented in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered an appropriate sample will be collected as described in SOP 2.9. All samples will be analyzed for the laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). This identification code scheme will be unique for the Area 3 and will not be repeated at any other AOC during the RI/FS in OU5. Prior to Phase 2 sampling, these sample identifications will be specified, along with the number of samples required, as an amendment to this appendix.

APPENDIX 3
SITE SPECIFIC FIELD SAMPLING PLAN
AREA 7: SOIL FROM THE SW CAVE, CONTAMINATED VENTILATION EXHAUST SYSTEM AND CRUSHED EMPTY THORIUM DRUMS AND POSSIBLE ELEVATED THORIUM AREA

Background

Area 7 is a large area, approximately 900 by 200 ft (180,000 ft.^{2}), in the area of Buildings 51, 66, and 98, which is the Mound Plant Fire Station (Figure 3.1.). This area was once a steep ravine that has a long history of debris disposal and infilling. The area contains crushed empty thorium drums, a polonium-contaminated washing machine, a thorium-contaminated flat bed truck, and soil containing actinium-227, radium-226, and thorium-228 from the SW Building, which was placed in an old septic tank behind Building 29 and may have been partially removed. Materials contaminated with polonium-210 were also buried on the side of the ravine, including an exhaust system from T Building, a stainless steel washing machine, and possible smaller items (Garner 1991).

During the Mound Site Survey Project (Stought, et al. 1988), Area 7 surface and subsurface soil samples were analyzed for cobalt-60, cesium-137, radium-226, americium-241, actinium-227, tritium, and mainly plutonium-238 and thorium. Significant levels (up to 1,400 pCi/g) of actinium-227 were found at two sample locations at the former location of the septic tank. The contamination appears to extend to a depth of at least 18 feet. Thorium contamination was limited to the surface soil with a maximum concentration of 20.52 pCi/g. The maximum subsurface thorium concentration was 18 pCi/g at a depth of 3 feet. Elevated thorium concentrations were found as deep as 19.5 feet. Two surface soil samples had tritium concentrations of 5.23 pCi/g and 0.69 pCi/g. Levels of plutonium-238 and radium-226 analyzed were below D&D established cleanup levels. The measured concentrations for cobalt-60, cesium-137, and americium-241 were below the lower detection limit of 0.5 pCi/g for each radionuclide.

No chemical data exists at Area 7 but a soil gas survey has been conducted at the site to screen for possible contaminants. All locations were sampled at a 5-foot depth except for two samples taken at a depth of 15 feet (Figure 3.2.). One sample taken at the 5-foot depth was a water sample. Tables III.1. and III.2. display summaries of positive detections and positive blank detections, respectively. Soil gas survey chemical hits are displayed in Figure 3.3. This data is useful for reconnaissance of areas with possible chemical contamination and developing a strategy for locating soil samples for the Phase 2 exploratory effort.

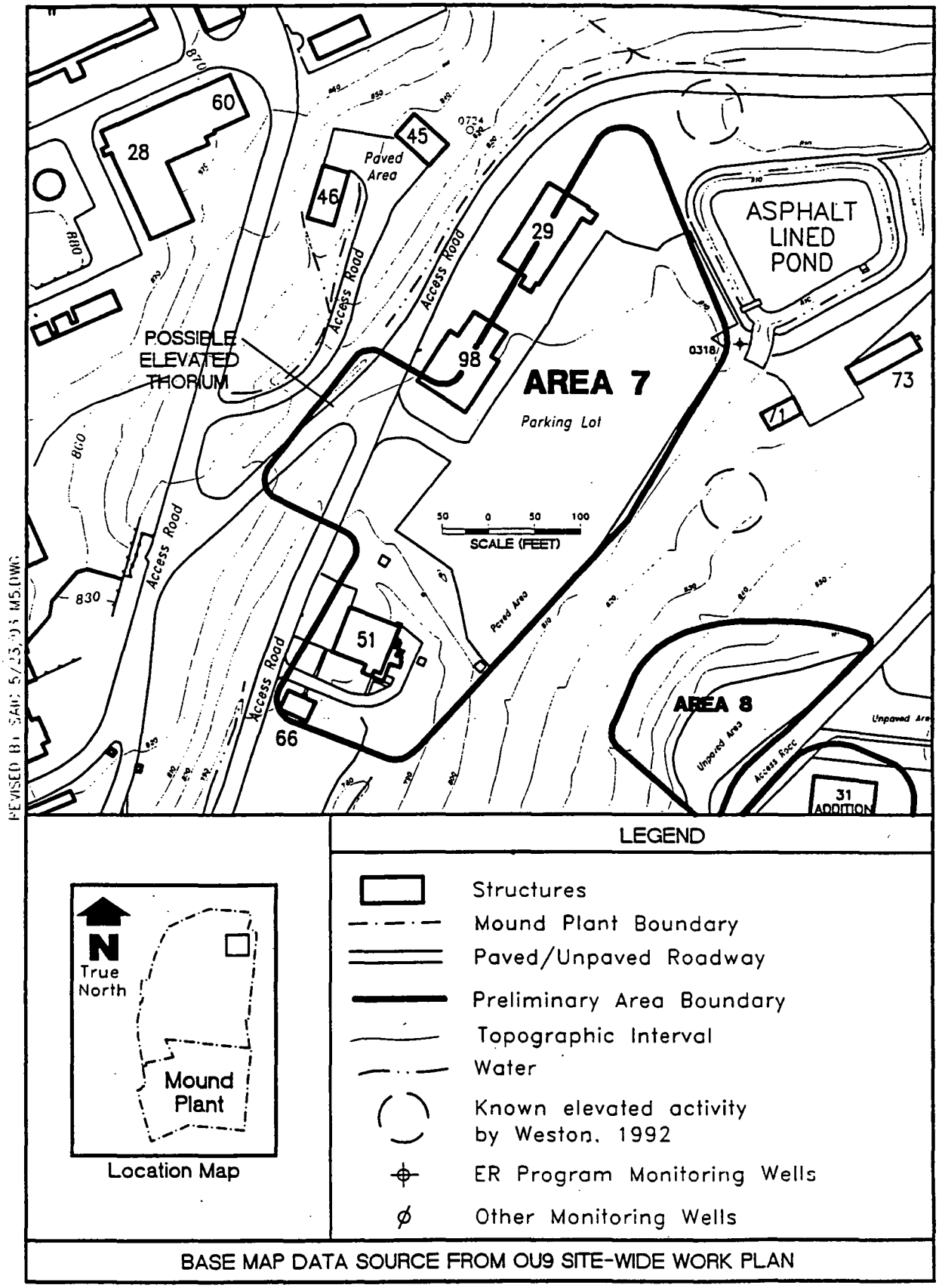

Figure 3.1. OU5, Area 7

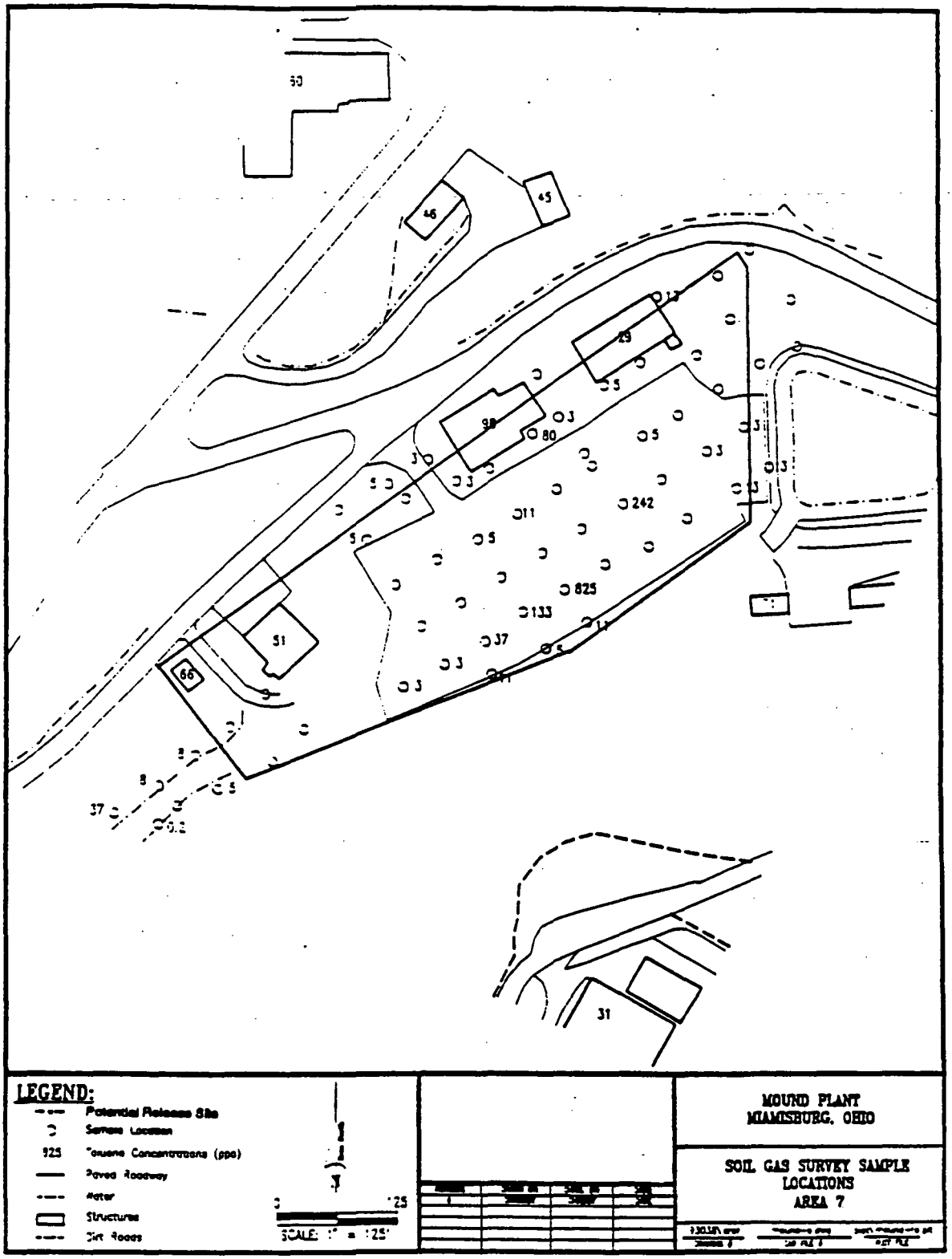

Figure 3.2. Soil Gas Survey Sample Locations, OU5 Area 7

Table III.1. Summary of Positive Detections-Area 7 (ppb)
page 1 of 2

SAMPLE ID	SAMPLE DATE	FREON 11	FREON 113	TRANS-1, 2-DCE	CIS-1,2-DCE	1,1,1-TCA	PCE	TCE	TOLUENE
MND-01-2021-0005	1 AUG 92	---	---	---	---	---	---	---	3
MND-01-2022-0005	1 AUG 92	---	---	---	---	---	---	---	3
MND-01-2023-0005	1 AUG 92	---	---	---	---	---	---	---	3
MND-01-2024-0005	1 AUG 92	---	---	---	---	---	---	---	3
MND-01-2025-0005	1 AUG 92	---	---	---	---	---	---	---	37
MND-01-2026-0005	1 AUG 92	---	---	---	---	---	---	---	133
MND-01-2027-0005	1 AUG 92	---	---	---	---	9	---	---	825
MND-01-2031-0005	1 AUG 92	---	---	---	---	---	---	---	13
MND-01-2032-0005	2 AUG 92	---	---	---	---	---	---	---	3
MND-01-2033-0005	2 AUG 92	---	---	---	---	---	---	---	3
MND-01-2034-0005	2 AUG 92	---	---	---	---	---	---	---	3
MND-01-2034-1005	2 AUG 92	---	---	---	---	---	---	---	3
MND-01-2036-0005w	3 AUG 92	---	---	---	---	---	---	---	242*
MND-01-2036-1005w	3 AUG 92	---	---	---	---	---	---	---	218*
MND-01-2039-0005	2 AUG 92	---	---	---	3	---	---	---	---
MND-01-2044-0005	3 AUG 92	---	---	---	---	---	---	---	13*
MND-01-2137-1005	24 AUG 92	---	---	---	---	6	---	---	5
MND-01-2138-0005	24 AUG 92	11	---	---	---	2	---	---	80
MND-01-2139-0005	25 AUG 92	32	4	---	---	---	---	---	3*
MND-01-2141-0005	25 AUG 92	---	---	---	10	---	---	---	5*
MND-01-2142-0005	25 AUG 92	---	---	---	---	---	---	---	11*
MND-01-2142-1005	25 AUG 92	---	---	---	---	---	---	---	11*
MND-01-2145-0005	25 AUG 92	---	---	---	---	---	---	---	5*
MND-01-2146-0005	25 AUG 92	---	33	---	---	---	6	---	---

Table III.1. Summary of Positive Detections-Area 7 (ppb)
page 2 of 2

SAMPLE ID	SAMPLE DATE	FREON 11	FREON 113	TRANS-1, 2-DCE	CIS-1,2-DCE	1,1,1-TCA	PCE	TCE	TOLUENE
MND-01-2147-0005	25 AUG 92	---	13	---	---	---	---	---	---
MND-01-2148-0005	26 AUG 92	---	---	---	---	22	---	---	---
MND-01-2149-0005	26 AUG 92	---	---	---	---	---	---	---	5*
MND-01-2149-1005	26 AUG 92	---	---	---	---	---	---	---	5*
MND-01-2150-0005	26 AUG 92	---	---	---	---	2	---	---	5*
MND-01-2162-0005	30 AUG 92	7	---	---	---	---	---	---	---
MND-01-2212-0015	26 SEP 92	---	10	---	---	---	---	---	---
MND-01-2213-0005	26 SEP 92	---	---	---	---	---	---	---	11
MND-01-2214-0005	26 SEP 92	---	---	---	---	---	7	---	5
MND-01-2215-0005	26 SEP 92	---	---	---	---	---	---	---	11

Notes:

Only sample locations having positive detections are shown.
*:Associated trip, ambient, equipment or field blank contained specified compound.
TRAN-12DCE = trans-1,2-dichloroethene
CIS-12DCE = cis-1,2-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene
TCE = trichloroethene

Table III.2. Summary of Positive Blank Detections-Area 7
(ppb)

SAMPLE ID	SAMPLE DATE	FREON 11	FREON 113	TRANS-1,2-DCE	CIS-1,2-DCE	1,1,1-TCA	PCE	TCE	TOLUENE
MND-01-2021-3002	2 AUG 92	---	---	---	---	---	---	---	3
MND-01-2036-5000w	3 AUG 92	---	---	---	---	---	---	---	59
MND-01-2036-2000	3 AUG 92	---	---	---	---	---	---	---	186
MND-01-2130-5000	19 AUG 92	---	---	---	---	---	---	---	3
MND-01-2147-3002	25 AUG 92	---	---	---	---	---	---	---	8
MND-01-2151-3002	26 AUG 92	---	---	---	---	---	---	---	11

Notes: Only QA/QC sample locations having positive detections are shown.
TRAN-12DCE = trans-1,2-dichloroethene
CIS-12DCE = cis-1,2-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene
TCE = trichloroethene

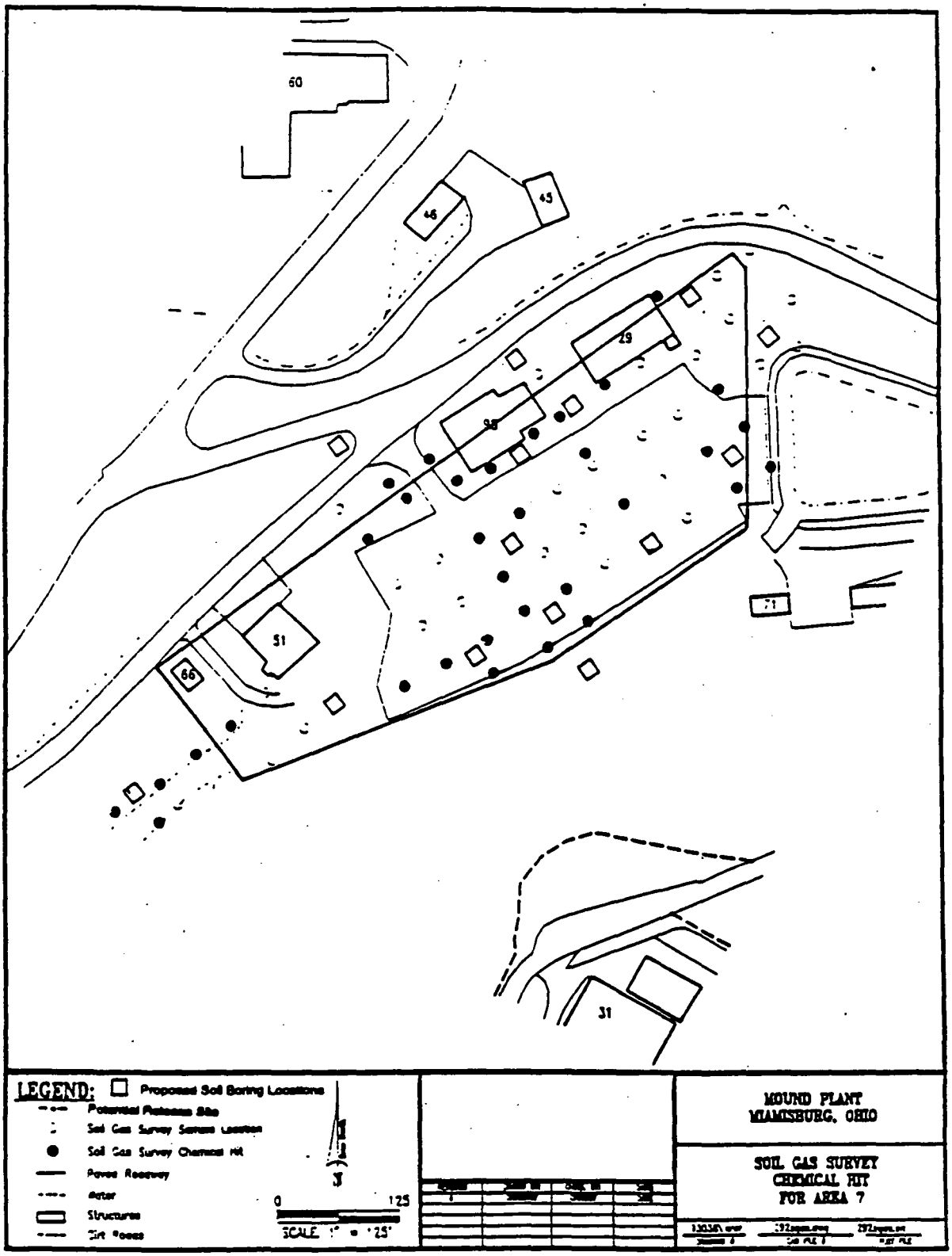

Figure 3.3. Soil Gas Survey Chemical Hit, OU5 Area 7

OU5 will also assess the area entitled "Possible Elevated Thorium" due to its proximity to Area 7. Historical data leads to the conclusion that similar materials contaminated both areas, or that the area is contaminated from Area 7 dispersions.

Monitoring well 111 is located south and downgradient of Area 7. This well has been sampled for hazardous constituents, and xylene has been detected. This well was also sampled in 1990 as part of the Mound Plant installation groundwater assessment program. Samples are being analyzed for plutonium, uranium, thorium, actinium-227, cobalt 60 and cesium-137.

A magnetic survey was performed at Mound Plant during September of 1990. Area 7 was surveyed by a magnetometer on a 5-foot by 5-foot grid. The purpose of the magnetic survey was to locate a buried truck, approximately 2,500 crushed, empty thorium drums, and other debris under the parking lot. Anomalies mapped were interpreted to relate to buried ferrous metal objects. A large zone of anomalous readings related to the buried truck, drums, and debris was located. An anomaly related to a drain pipe was also located. Both of these features were located in the north-central portion of the parking lot. Therefore, soil boring locations will be strategically selected to avoid contact between the drilling equipment and subsurface interferences.

Sampling Objectives

The objectives of the RI/FS sampling in Area 7 are to:

1. evaluate groundwater contamination downgradient of Area 7 by utilizing the existing OU9 wells;
2. confirm the levels of actinium-227 and thorium found during the Mound Site Survey Project in the two sections of Area 7;
3. confirm the absence of radiological contaminants in most of Area 7;
4. determine if chemical (i.e., nonradioactive) contaminants are present and determine their concentrations/locations;
5. characterize the lateral and vertical extent of radioactive and non-radioactive contamination in Area 7 soils and groundwater (if encountered);
6. obtain data to define the sources of contamination (if any); and,
7. obtain data to develop a conceptual site model for Area 7.

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 7 is comprised of surface and subsurface radiological data with adequate data available for determination of vertical extent. The results of a soil gas survey are available to provide a qualitative assessment of possible chemical contamination. No chemical data exists at this time to give any definition of nature and extent of chemical contamination. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by EPA for managing uncertainty during the RI/FS process under CERCLA.

For Area 7, the exploratory phase (Phase 1) will consist of soil sampling to verify the results of the soil gas survey. Because of noted areas of elevated activity along the perimeter of Area 7 (DOE 1992a), three small outlying areas will have FIDLER and soil gas field screening grids (Figure 3.4.). These FIDLER surveys will be conducted in accordance with ER Program SOP 6.7. The areas will be screened on a 25 foot grid (Figure 3.4.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

Under the Phase 2 soil sampling effort, 15 subsurface soil borings (Figure 3.1.) will be installed to obtain samples for the analyses of chemical and radioactive constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If required, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive or chemical) identified under Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the

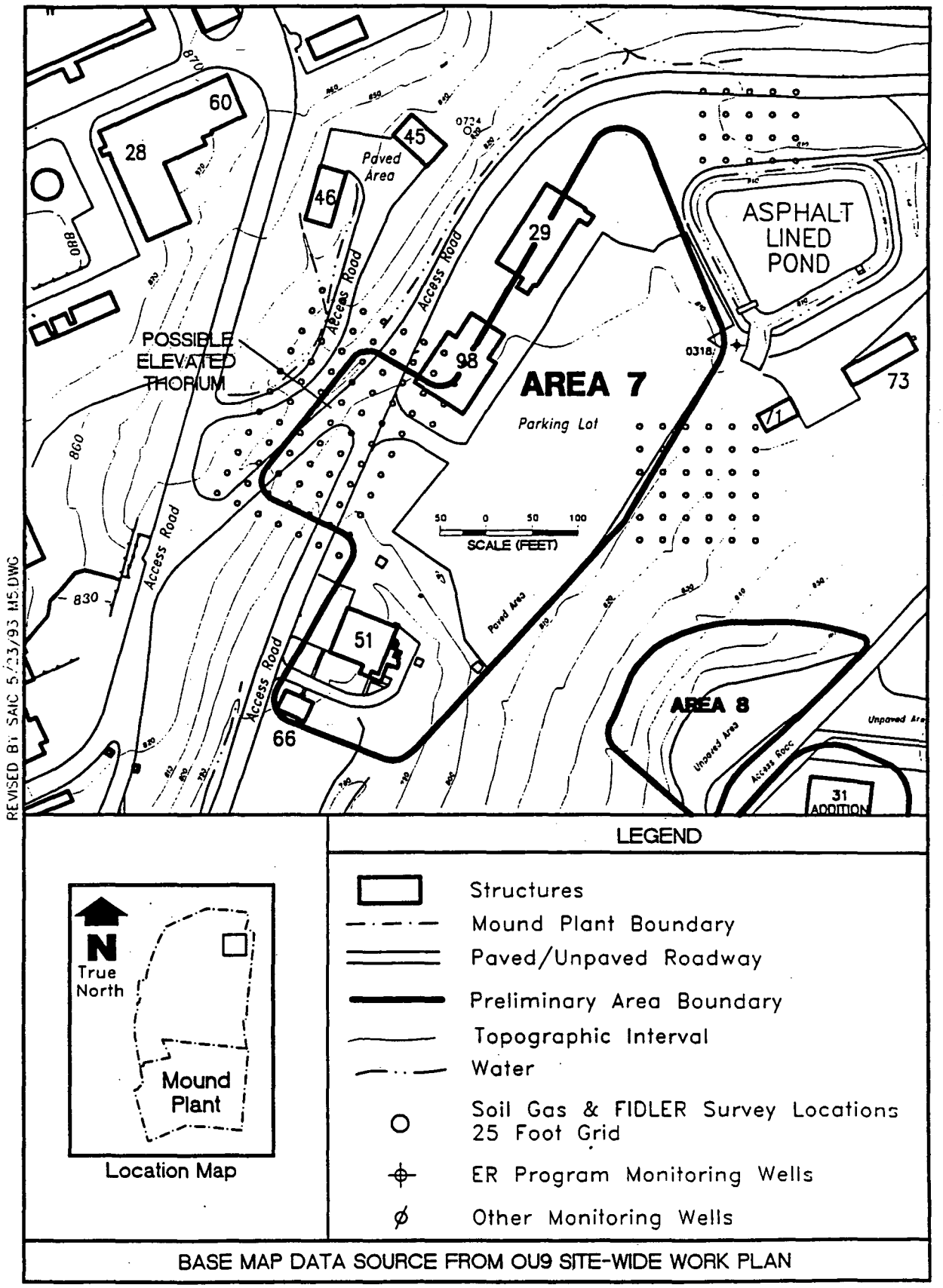

Figure 3.4. Soil Gas and FIDLER Survey Grids, OU5 Area 7

locations of elevated concentrations of radionuclides and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The number and locations of the samples to be collected during Phase 2 were determined on the basis of verifying the soil gas survey results conducted during Phase 1 (EPA 1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be the starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Because of the geophysical survey results, sample locations will be strategically placed to avoid subsurface interferences at the north-central portion of the parking lot. Since the vertical extent of the contamination was not determined by the Phase 1 data, continuous core samples will be collected at each soil boring location using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4 foot depth intervals until bedrock is encountered or based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select the appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated

FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, chemical and radiological samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 30 feet or until bedrock is encountered.

Based upon data obtained from previous investigations (DOE 1992b) the depth to bedrock in Area 7 ranges from 9 to 65 feet below land surface. If groundwater is encountered in sufficient quantity, a sample will be obtained for laboratory analysis following the procedures contained in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be collected as described in SOP 2.9. All samples will be analyzed for the laboratory parameters as specified in the OU5 Work Plan and the quality objectives of the OU5 QAPjP (DOE 1993a). In addition, samples will be analyzed for trans-1,2-dichloroethene, cis-1,2-dichloroethene, freon 11, freon 113, and lathanides.

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). For example, the soil gas designation codes for the first three samples obtained from the first sampling point would be:

MND21-2201-0001	for the first sample at location 1
MND21-2202-0001	for the first sample at location 2
MND21-2202-0002	for the second sample at location 2

This identification code scheme will be unique for Area 7 and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 4

SITE SPECIFIC FIELD SAMPLING PLAN

AREA 8 - CONTAMINATED SOILS FROM AREAS 1 AND 9

Background

Area 8 is approximately 100 feet by 200 feet (20,000 ft^2) in size and located in the eastern portion of Mound Plant on the SM/PP Hill (see Figure 4.1.). This area contains soils removed from Area 1 (D&D Program Site, OU6) and Area 9 that were contaminated by the repackaging of the thorium sludges from 1965 through 1966. Results of the Mound Site Survey Project (Stought, et al., 1988) indicate that Area 8 is contaminated with thorium (all isotopes) and plutonium-238 ranging in concentrations from 2 to 1,000 pCi/g and 0.01 to 100 pCi/g, respectively. The depths of this contamination range from as deep as 12 feet for thorium and 4.5 feet for plutonium-238. Data from previous borings in Area 8 indicate the depth to bedrock ranges from 8 to 12 feet. No information concerning the potential presence of chemical (non-radioactive) contamination in Area 8 is available.

Sampling Objectives

The objectives of the RI/FS sampling in Area 8 are to:

1. confirm the levels of thorium and plutonium-238 previously found;
2. determine if other radioactive contaminants are present and at what concentrations/locations;
3. determine if chemical (i.e., non-radioactive) contaminants are present and their concentrations/locations;
4. characterize the lateral and vertical extent of radioactive and non-radioactive contamination in Area 8 soils and groundwater (if encountered);
5. obtain data to define the sources of contamination (if any); and
6. obtain data to develop the conceptual site model for Area 8

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 8 is limited to radionuclides in the soils. No data is available regarding the lateral or vertical distribution of chemical (non-radioactive) contaminants. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

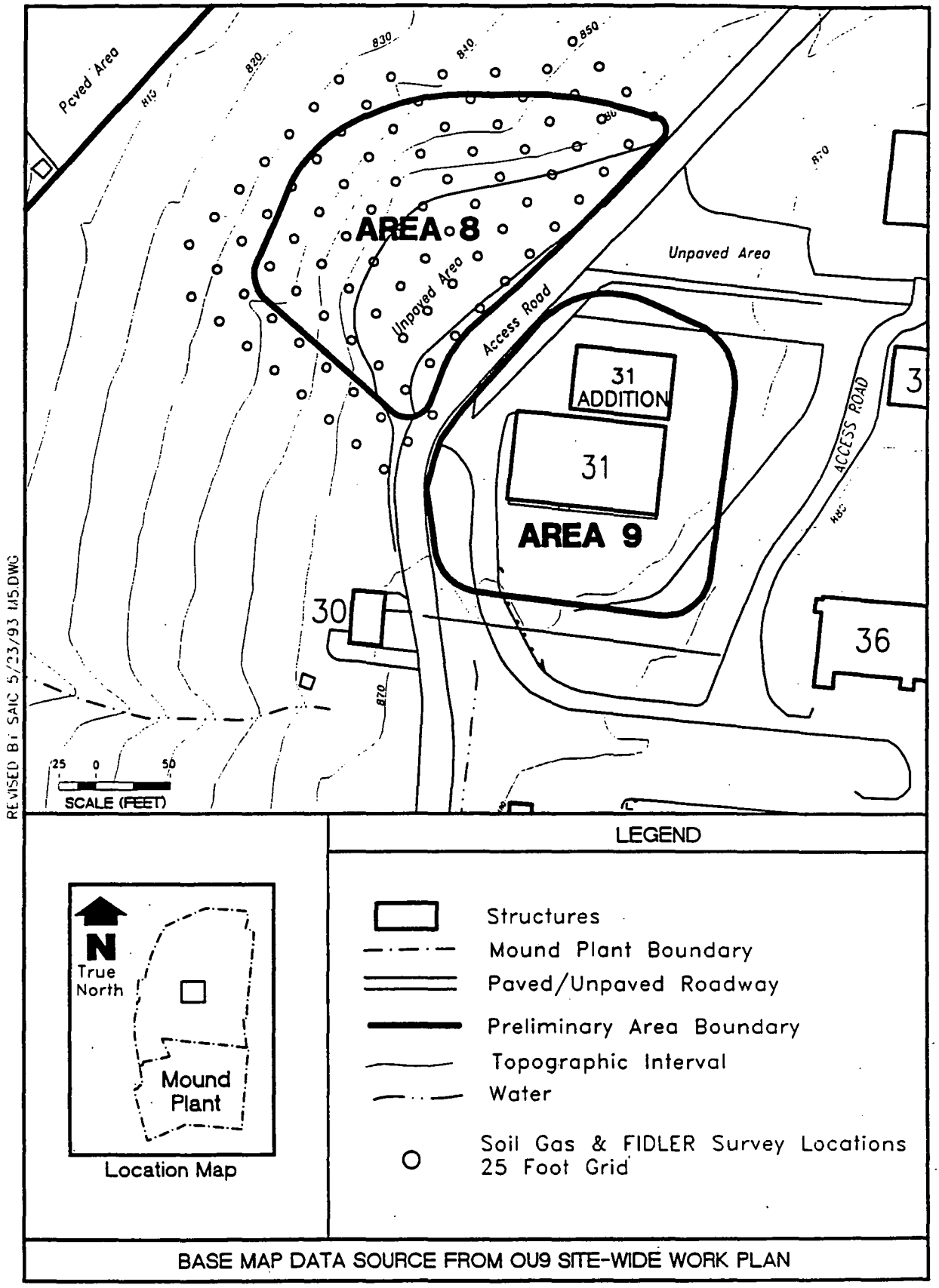

Figure 4.1. Soil Gas and FIDLER Sampling Grid, OU5 Area 8

For Area 8, the exploratory phase (Phase 1) will consist of a limited field screening survey for radioactive contamination (plutonium-238 and thorium) using a FIDLER in accordance with ER Program SOP 6.7. The area (only partially surveyed during the Mound Site Survey Project) will be screened on a 25-foot grid (Figure 4.1.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points.

Under Phase 2, subsurface soil borings will be installed to obtain samples for the analyses of chemical and radioactive constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If required, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radionuclides and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 25-foot grid pattern as shown in Figure 4.1., at a depth of 18 inches and backfilled. A total of 80 soil gas collectors will be placed within and around the known

dimensions of Area 8. In addition, five collectors will be installed for time calibration as described in the soil gas procedures presented in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening and soil gas survey results according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be a starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring locations using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4 foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select the

appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a depth of 20 feet or until bedrock is encountered (believed to be at depths ranging from 8 to 12 feet). If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis following the procedures presented in the drilling SOP exhibited in the OU5 QAPjP, Attachment 4. In addition, if any surface water is encountered an appropriate sample will be collected as described in SOP 2.9. All samples will be analyzed for the laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). This identification code scheme will be unique for Area 8 and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 5

SITE SPECIFIC FIELD SAMPLING PLAN

AREA 9 - FORMER THORIUM STORAGE/REDRUMMING AREA

Background

Area 9 is approximately 200 feet by 200 feet (40,000 ft^2) in size and is located under and around Building 31 on the north end of the SM/PP Hill in the eastern section of Mound Plant (Figure 5.1.). This area is currently used to stage both alpha and beta emitting solidified and packaged wastes prior to shipment to off-plant disposal locations. Some of the 6,000 55-gallon drums of thorium sludge received at Mound Plant in 1954 and 1955 were stored in this area. Prolonged exposure to weathering and the internal corrosive nature of the sludge made it necessary to frequently repackage the thorium sludge over a period of years. Samples obtained during the Mound Site Survey Project (Stought, et al, 1988) identified plutonium-238 (maximum concentration of 8.15 pCi/g) and thorium concentrations ranging from less than 2 pCi/g to 150 pCi/g. No chemical contamination data is available and the spatial distribution (lateral and vertical) of Area 9 contamination is unknown. The depth to bedrock in this area has been reported to be approximately 4 to 8 feet (DOE 1992b).

Sampling Objectives

The objectives of the RI/FS sampling in Area 9 are to:

1. confirm the levels of plutonium-238 and thorium (all isotopes) previously found;
2. determine if other radioactive contaminants are present and at what concentrations/locations;
3. determine if chemical (i.e., non-radioactive) contaminants are present and their concentrations/locations;
4. characterize the lateral and vertical extent of radioactive and non-radioactive contamination in Area 9 soils and groundwater (if encountered);
5. obtain data to define the sources of contamination (if any); and
6. obtain data to develop the conceptual site model for Area 9

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 9 is limited to radionuclides in surface and subsurface (18 to 54 inches deep) soils. No data is available regarding the vertical distribution of radioactive contaminants and no chemical (non-radioactive) contaminant data is available.

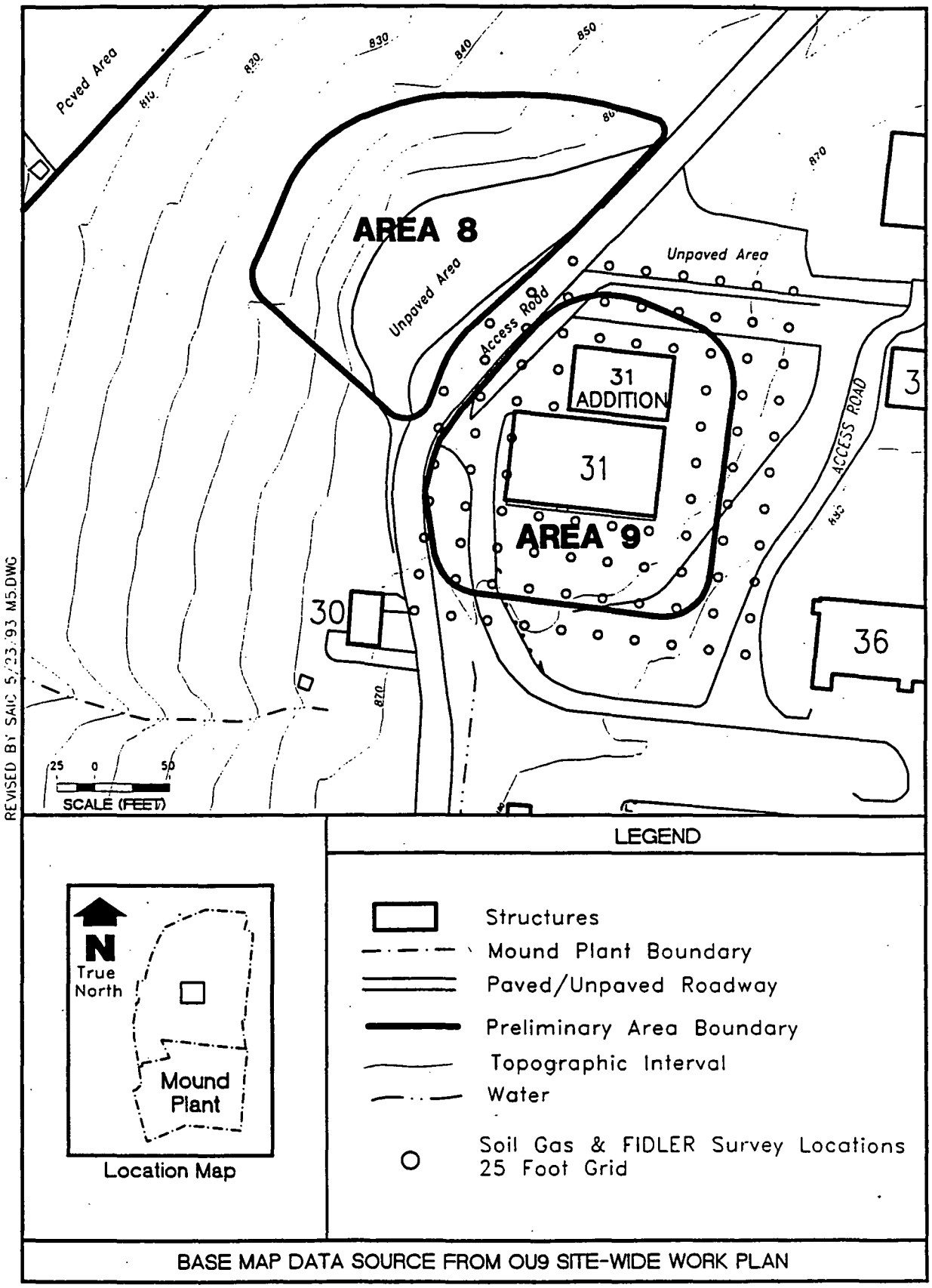

Figure 5.1. Soil Gas and FIDLER Survey Grid, OU5 Area 9

Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For Area 9, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination (plutonium-238 and thorium) using a FIDLER in accordance with ER Program SOP 6.7. The area will be screened on a 25-foot grid (Figure 5.1.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) an aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In a similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings will be taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points.

Under Phase 2, subsurface soil borings will be installed to obtain samples for the analyses of chemical and radioactive constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If required, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radionuclides and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 25-foot grid pattern as shown in Figure 5.1., at a depth of 18 inches and backfilled. A total of 84 soil gas collectors will be placed within and around the known dimensions of Area 9. In addition, five collectors will be installed for time calibration as described in the soil gas procedures presented in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening and soil gas survey results according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limit), those spots would be a starting point for a statistically designed Phase 2 program. The number of samples will be determined based upon a review of the FIDLER and soil gas data. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring locations using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d, 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4-foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 10 feet or until bedrock is encountered.

•Based upon data obtained during previous investigations (DOE 1992b) the depth to bedrock in Area 9 ranges from 4 to 8 feet. If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis following the procedures contained in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be collected as prescribed in SOP 2.9. All samples will be analyzed for the laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). This identification code scheme will be unique for Area 9 and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 6
SITE SPECIFIC FIELD SAMPLING PLAN
AREA 21 - OLD SW BUILDING RADIOACTIVE WASTE BUNKER

Background

Area 21 is approximately 110 feet by 175 feet (19,250 ft^2) in size and is located on the south central slope of the SM/PP Hill just south of Area J (Figure 6.1.). According to historical data (DOE 1993b) there were two bunkers located in this area: a large one for the storage of explosives and a smaller one for detonator storage during the period when Mound Plant was originally constructed. The large bunker (known as shack #2) was reportedly used extensively for the storage of high energy gamma emitting radioactive wastes. Drums stored in the shack were surveyed in June 1953 and readings on the order of 7.5 R/hr were recorded. The material in the drums was believed to be radioactive wastes from the radium-actinium program. The Mound Site Survey Program (Stought, et al., 1988) reportedly located the area by gamma survey and found elevated levels of radium-226. No radium-226 was subsequently found during the reconnaissance survey for the OU9 Site Scoping Report, Volume 3 (DOE 1993b). However, Area 21 contaminants do include plutonium-238 (0.1 to 1 pCi/g) and cesium-137 (0.1 to 100 pCi/g). Tritium and radium-226 were detected in a core some 60 inches deep (DOE 1993b) at 0.99 and 1.2 pCi/g, respectively. No information regarding the presence of chemical (non-radioactive) contamination in Area 21 is available. Mound Plant drawings (DOE 1992b) indicate that the depths to bedrock in this area range from 3 to 4 feet.

Sampling Objectives

The objectives of the RI/FS sampling in Area 21 are to:

1. confirm the levels of plutonium-238, cesium-137, radium-226, and tritium previously recorded;

2. determine if other radioactive contaminants are present in detectable concentrations and at what locations;

3. determine if chemical (i.e., non-radioactive) contaminants are present and their concentrations/locations;

4. characterize the lateral and vertical extent of radioactive and non-radioactive contamination in Area 21 soils and groundwater (if encountered);

5. obtain data to define the sources of contamination (if any); and,

6. obtain data to develop the conceptual site model for Area 21.

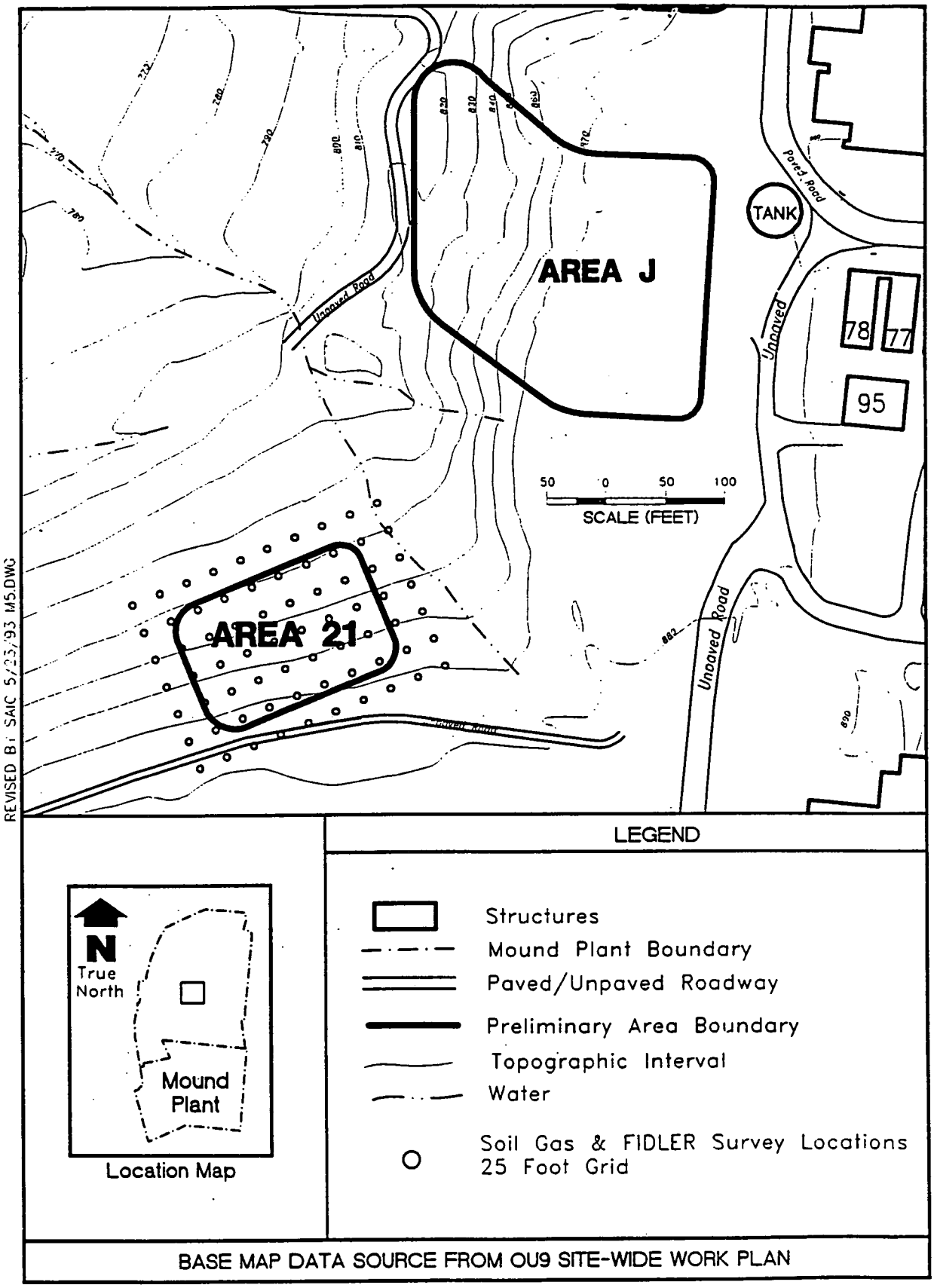

Figure 6.1. Soil Gas and FIDLER Survey Grid, OU5 Area 21

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 21 is limited to radionuclides in the soils. No data is available concerning the lateral or vertical distribution of chemical (non-radioactive) contamination is available. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For Area 21, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination (plutonium-238 and thorium) using a FIDLER as described in ER Program SOP 6.7. The area will be screened on a 25-foot grid (Figure 6.1.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points.

Under Phase 2, subsurface soil borings will be installed to obtain samples for the analyses of chemical and radionuclide constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If necessary, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will

be made of the area showing the locations of elevated concentrations of radioactive contaminants and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 25-foot grid pattern as shown in Figure 6.1., at a depth of 18 inches and backfilled. A total of 70 soil gas collectors will be placed within and around the known dimensions of Area 21. In addition to the primary soil gas locations, five collectors will be installed for time calibration as described in the OU5, RI/FS Work Plan (DOE 1993c). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening data and soil gas survey results according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be a starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring location using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4-foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 10 feet or until bedrock is encountered.

Based upon data from previous investigations the depth to bedrock in this area is probably less than 10 feet (DOE 1992b). If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis following the procedures contained in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be collected as prescribed in SOP 2.9. All samples will be analyzed for the OU5 laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). This identification code scheme will be unique for Area 21 and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 7
SITE SPECIFIC FIELD SAMPLING PLAN
AREA 22 - ORPHAN SOILS

Background

Area 22 is approximately 75 feet by 150 feet (11,250 ft^2) in size and is located in the southwest part of the SM/PP Hill, adjacent to Building 53 (Figure 7.1.). This area contains numerous piles of previously excavated soil from past construction activities at Mound Plant. Surface soil samples obtained during the Mound Site Survey Project (Stought, et al., 1988) identified cobalt-60 (10 to 1,000 pCi/g), cesium-137 (1 to 2 pCi/g), radium-226 (0.1 to 1 pCi/g) and plutonium-238 (maximum concentration of 1.67 pCi/g). No chemical contamination data is available and the spatial distribution (lateral and vertical) of Area 22 contamination is unknown.

Sampling Objectives

The objectives of the RI/FS sampling in Area 22 are to:

1. confirm the levels of cobalt-60, cesium-137, radium-226, and plutonium-238 previously found;
2. determine if other radioactive contaminants are present and at what concentrations/locations;
3. determine if chemical contaminants are present and their concentrations/locations;
4. characterize the lateral and vertical extent of radioactive and chemical contamination in Area 22 soils and groundwater (if encountered);
5. obtain data to define the sources of contamination (if any); and
6. obtain data to develop a conceptual site model for Area 22.

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 22 is limited to radionuclides in surface soils. No data is available regarding the vertical distribution of radioactive contaminants and no chemical (non-radioactive) contaminant data is available. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

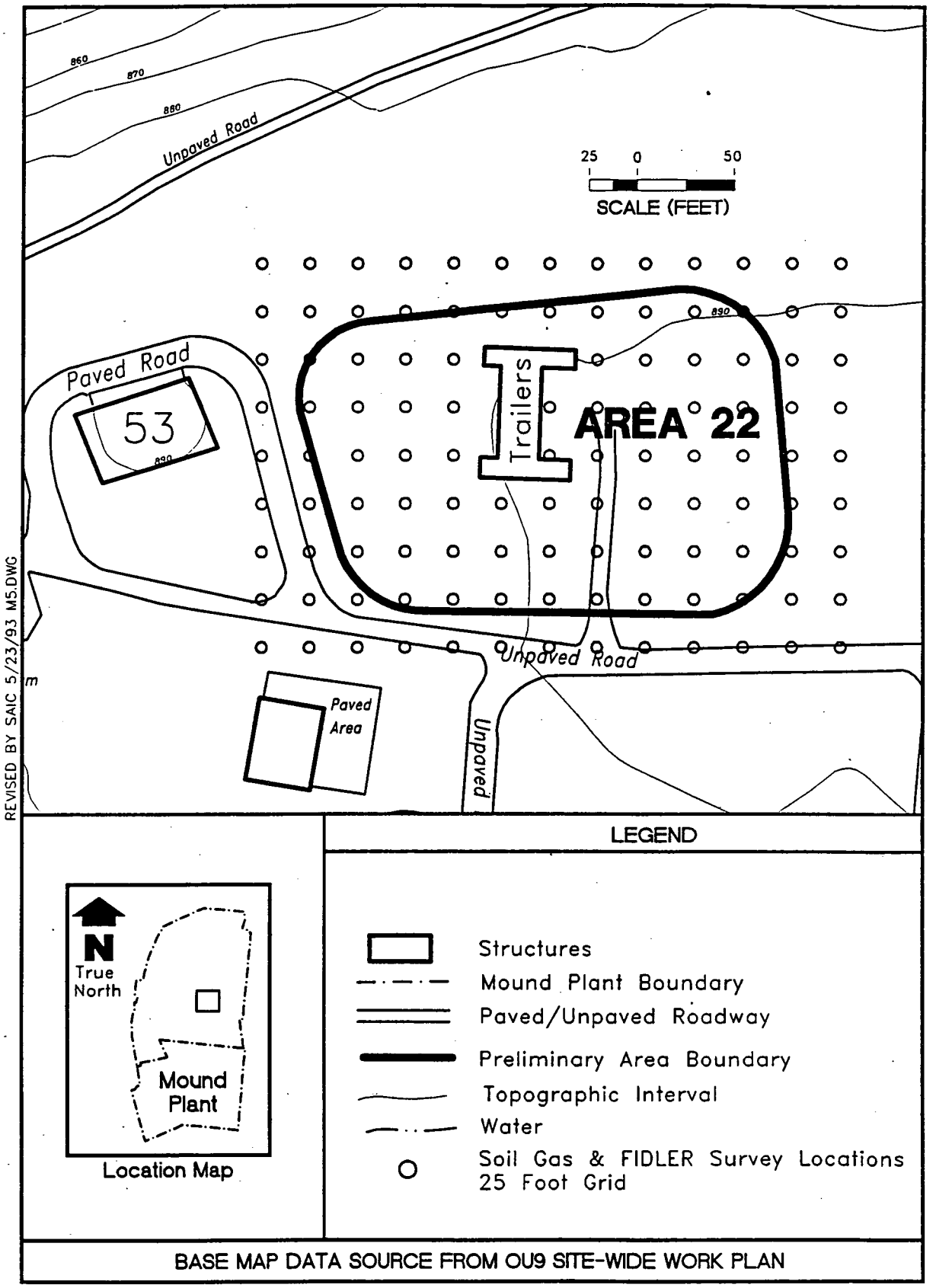

Figure 7.1. Soil Gas and FIDLER Survey Grid, OU5 Area 22

For Area 22, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination (plutonium-238 and thorium) using a FIDLER in accordance with ER Program SOP 6.7. The area will be screened on a 25-foot grid (Figure 7.1.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points. Under Phase 2, subsurface soil borings will be excavated to obtain samples for the analyses of chemical and radioactive constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If required, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radionuclides and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 25-foot grid pattern as shown in Figure 7.1. at a depth of 18 inches and backfilled. A total of 117 soil gas collectors will be placed within and around the known dimensions of Area 22. In addition, five collectors will be installed for time calibration as described in the soil gas procedures presented in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and

triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening and soil gas survey results according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be a starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring location using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (see SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4-foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select the appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated

FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 20 feet or until bedrock is encountered.

Based upon data obtained from previous investigations (DOE 1992b) the depth to bedrock in Area 22 ranges from 2 to 7 feet below land surface. If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis following the procedures presented in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be collected following the procedures in SOP 2.9. All samples will be analyzed for the OU5 laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). For example, the soil gas designation codes for the first 3 samples obtained from the first sampling point would be:

MND28-2201-0001	for the first sample at location 1
MND28-2202-0001	for the first sample at location 2
MND28-2202-0002	for the second sample at location 2

This identification code scheme will be unique for Area 22 and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 8
SITE SPECIFIC FIELD SAMPLING PLAN
SEWAGE DISPOSAL BUILDING AREA (Area 3)

Background

The Sewage Disposal Building Area is located southwest of the Main Hill near the southwestern border of Mound Plant near Building 94 within Area 3 (Figure 8.1.). The sanitary wastewater treatment plant at the Sewage Disposal Building area is used to treat sanitary wastewater produced by Mound Plant. It consists of the grit chamber, grit conveyor, comminutor, equalization basins, aeration basins, clarifiers, sand filters, and the chlorine contact chambers. Sources of wastewater include restrooms, showers, laundry facilities, lab sinks, floor drains, and the rinse water from a small refinishing system (Kearney 1988). The sludge produced by the treatment system is reported to contain plutonium-238 and thorium-232. Although the sludge does not have hazardous waste characteristics (Kearney 1988), its chemical composition is unknown. The system has been in operation since 1975 and is in good condition. Evidently, a spill allowed materials to enter a ditch to the south east of the equipment. This ditch area will be investigated following this plan.

Sampling Objectives

The objectives of the RI/FS sampling in the Sewage Disposal Building Area are to:

1. confirm the levels of plutonium-238 and thorium-232 previously recorded;
2. determine if other radioactive contaminants are present in detectable concentrations and at what locations;
3. determine if chemical (i.e., non-radioactive) contaminants are present and their concentrations/locations;
4. characterize the lateral and vertical extent of any radioactive and chemical contamination in area soils and groundwater (if encountered);
5. obtain data to define the source of contamination (if any); and,
6. obtain data to develop a conceptual site model for Area 3

Sampling Rationale

The existing data regarding the nature and extent of contamination in the Sewage Disposal Building Area is limited to radionuclides. No data concerning the lateral or vertical distribution of chemical (non-

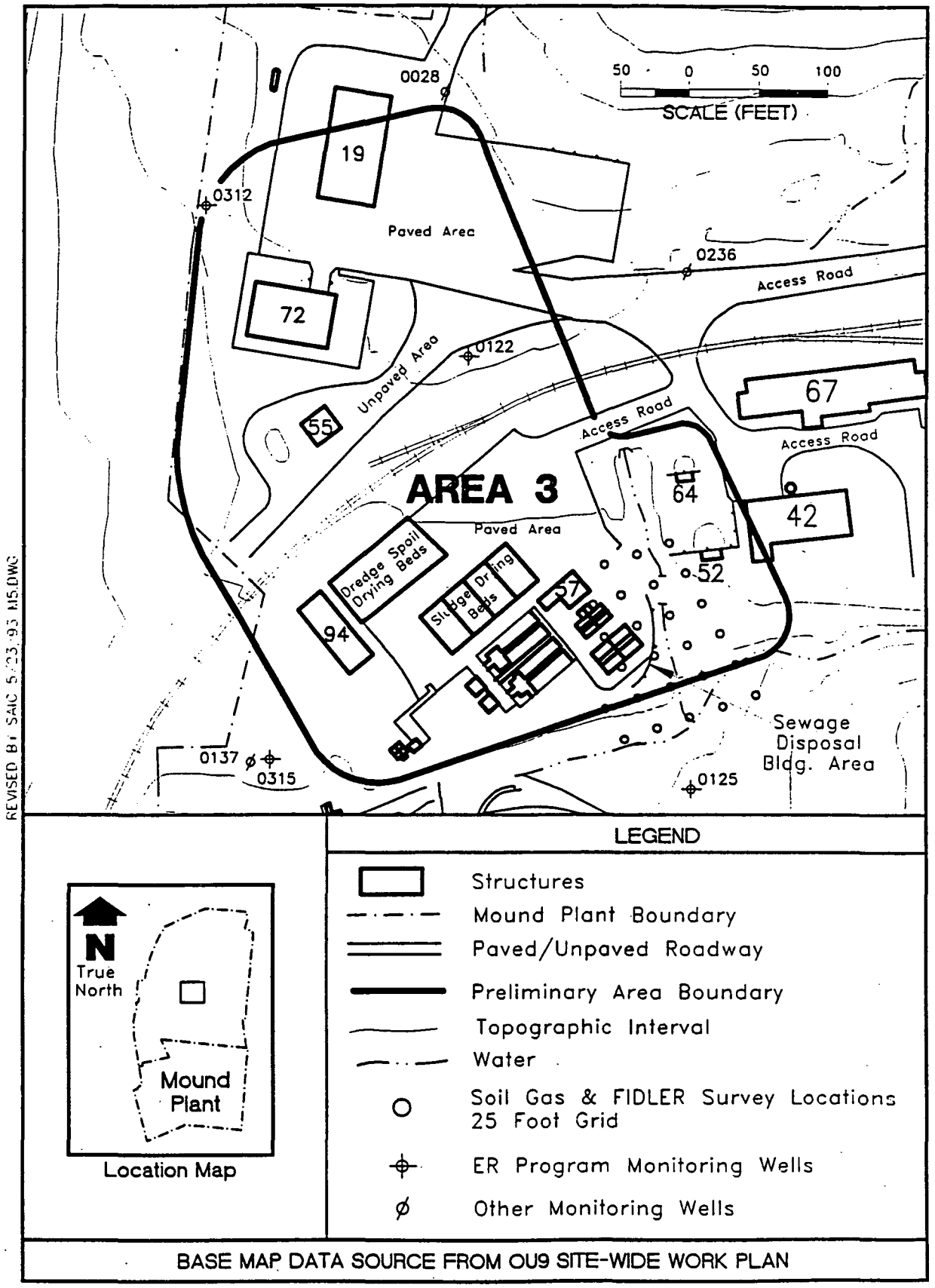

Figure 8.1. OU5 Sewage Disposal Building Area (Area 3)

radioactive) contamination is available. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For this area, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination (plutonium-238 and thorium) using a FIDLER as described in ER Program SOP 6.7. Due to its small size, the area will be screened on a 10-foot grid (Figure 8.1.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points.

Under Phase 2, subsurface soil borings will be installed to obtain samples for the analyses of chemical and radionuclide constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If necessary, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radioactive contaminants and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 10-foot grid pattern as shown in Figure 8.1., at a depth of 18 inches and backfilled. A total of 150 soil gas collectors will be placed within and around the ditch where this area is located. In addition to the primary soil gas locations, five collectors will be installed for time calibration as described in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening data and soil gas survey results according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be a starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 10-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring location using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including; TOC, CEC, and general physical parameters (Table VII.2.).

Samples will be taken at the surface and 4- foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 20 feet.

Based upon data from previous investigations the depth to bedrock in this area is greater than 25 feet (DOE 1992b). If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis following the procedures presented in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered an appropriate sample will be collected as described in SOP 2.9. All samples will be analyzed for the OU5 laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). This identification code scheme will be unique for the Sewage Disposal Building Area and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 9
SITE SPECIFIC FIELD SAMPLING PLAN
AREA 13 - POLONIUM CONTAMINATED WOOD

Background

Area 13 is approximately 100 feet by 110 feet (11,000 ft^2) in size and is located northeast of Building 49 in the Fire Test Area next to the plant drainage ditch and in the valley between the Main Hill and the SM/PP Hill (Figure 9.1.). However, the exact location of Area 13 is not known. This area was used to store wood structure material from the demolition of the Dayton operations (circa 1950) that was known to be contaminated with polonium-210. Soil samples taken in or near Area 13 during the Mound Site Survey Project (Stought et al., 1988) detected plutonium-238 at concentrations ranging from 0.34 to 5.74 pCi/g. No thorium was detected above 2 pCi/g in these samples. Since polonium-210 has a relatively short half-life (138.4 days), the contamination associated with the wood structures has decayed to stable lead (lead-206). The quantity of polonium-210 believed to be present on the contaminated wood was small and its radioactive decay would have produced very small quantities of lead (i.e., at concentrations below background levels). No information is available regarding any chemical (non-radioactive) contamination in this area.

Sampling Objectives

The objectives of the RI/FS sampling in Area 13 are to:

1. confirm the levels of plutonium-238 previously recorded;
2. determine if other radioactive contaminants are present in detectable concentrations and at what locations;
3. determine if chemical (i.e., non-radioactive) contaminants are present and their concentrations/locations;
4. characterize the lateral and vertical extent of radioactive and chemical contamination in Area 13 soils and groundwater (if encountered);
5. obtain data to define the sources of contamination (if any); and,
6. obtain data to develop the conceptual site model for a Area 13.

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area 13 is limited to radionuclides in the soils. No data is available concerning the vertical distribution of radionuclides in Area 13 and no

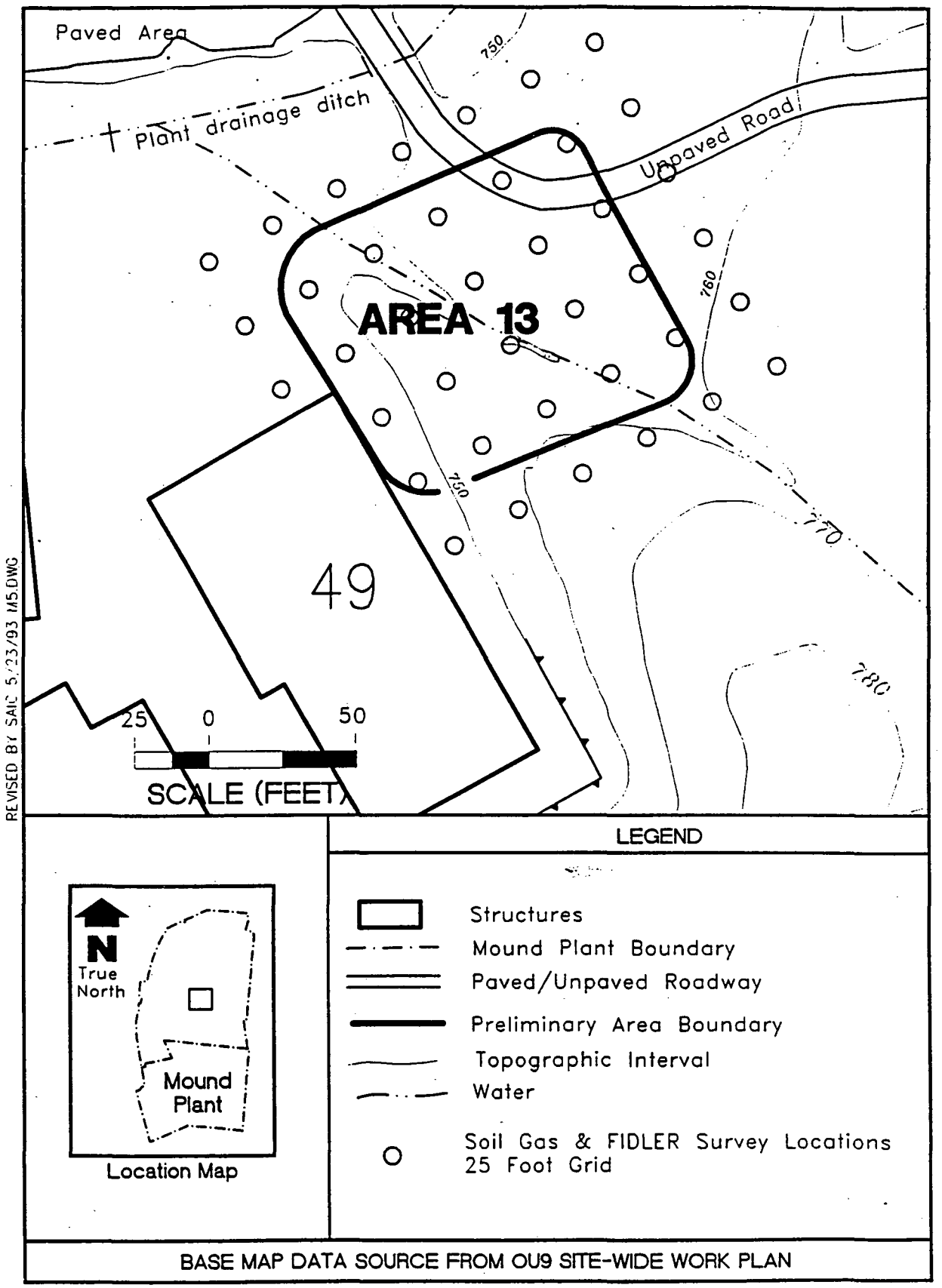

Figure 9.1. Soil Gas and FIDLER Survey Grid, OU5 Area 13

chemical (non-radioactive) contamination data is available. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For Area 13, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination (plutonium-238 and thorium) using a FIDLER as described in ER Program SOP 6.7. The area will be screened on a 25-foot grid (Figure 9.1.), beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) and aligned with the original area grid will be constructed. Additional readings will be taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be accomplished under the Phase 1 performed study to screen the area for VOCs and SVOCs. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points.

Under Phase 2, subsurface soil borings will be excavated to obtain samples for the analyses of chemical and radionuclide constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If necessary, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Sampling Locations and Frequency

During the field screening survey using the FIDLER any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radioactive contaminants and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will be placed in a 25-foot grid pattern as shown in Figure 9.1., at a depth of 18 inches and backfilled. A total of 46 soil gas collectors will be placed within and around the known dimensions of Area 13. In addition to the primary soil gas locations, five collectors will be installed for time calibration as described in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening data and soil gas survey results according to EPA guidance (1989). If any "hot spot" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be a starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring locations using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.).

Samples will be taken at the surface and 4-foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceed regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 20 feet or until bedrock is encountered.

Based upon data from previous investigations the depth to bedrock in this area is greater than 40 feet. If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analysis using the procedures presented in the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be collected in accordance with SOP 2.9. All samples will be analyzed for the OU5 laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a). This identification code scheme will be unique for Area 13 and will not be repeated at any other AOC during the RI/FS in OU5.

APPENDIX 10
SITE SPECIFIC FIELD SAMPLING PLAN
AREA J: THE HILLSIDE DISPOSAL AREA

Background

Area J, known as the hillside disposal area, is located on the west slope of the SM/PP Hills, north of Areas 21. (Figure 10.1.). This area was used from the early 1970s to the early 1980s for the disposal of construction residues such as excavated soils, concrete, piping, metal banding, plumbing fixtures, and roofing materials, which were either dumped or bulldozed over the side of the hill (DOE 1993b). Area J also includes 3 ponded areas that are located just down the slope (west) of the hill from where materials were dumped (DOE 1986). The exact sizes and locations of these ponded areas are open to interpretation and are presently being evaluated as potential wetlands under OU9 activities. Due to this lack of clarity, the ponded areas are not represented on any figures contained in this FSP appendix or the OU5 RI/FS Work Plan (DOE 1993c).

Twelve core locations and nine surface locations were sampled, either within or near Area J, as part of the Mound Plant Site Survey Project (Stought, et al., 1988). The maximum subsurface plutonium-238 concentration measured was 71.30 pCi/g in the sample taken at a depth of 18 inches from core location 0156. The maximum subsurface total thorium concentration measured was 30.42 pCi/g in the sample taken at a depth of 162 inches from core location 0160. The maximum surface plutonium-238 concentration measured was 46.45 pCi/g in the sample taken from location 0633. No thorium was detected above 2.0 pCi/g in any of the surface samples collected. Cobalt-60 was detected at a concentration of 3.0 pCi/g at a depth of 36 inches at core location 0150. Low levels of tritium were detected at a concentration of 6.84 pCi/ml in the surface sample collected at location 0633.

The upper (east), relatively flat portion of Area J was historically used to stage soils contaminated with thorium and plutonium. Soils and possible other debris were placed in the area as part of excavation projects, including a water line repair below the adjacent water tower, and possible plutonium-contaminated soils from the construction of the overflow pond in the mid-1970s (DOE 1986). The area may have also been referred to as the dredged materials disposal area (Area 11a) in the map of Hot Waste Burial Sites, reproduced in the Site Scoping Report: Volume 7 - Waste Management (DOE 1993c). In 1988, 150 half-size low specific activity boxes (approximately 150 cubic yards) of soil were removed from the area. Subsequent screening by the Mound Plant soil screening facility indicated levels of thorium and plutonium-238 below 2 and 146 pCi/g, respectively (Rader 1988).

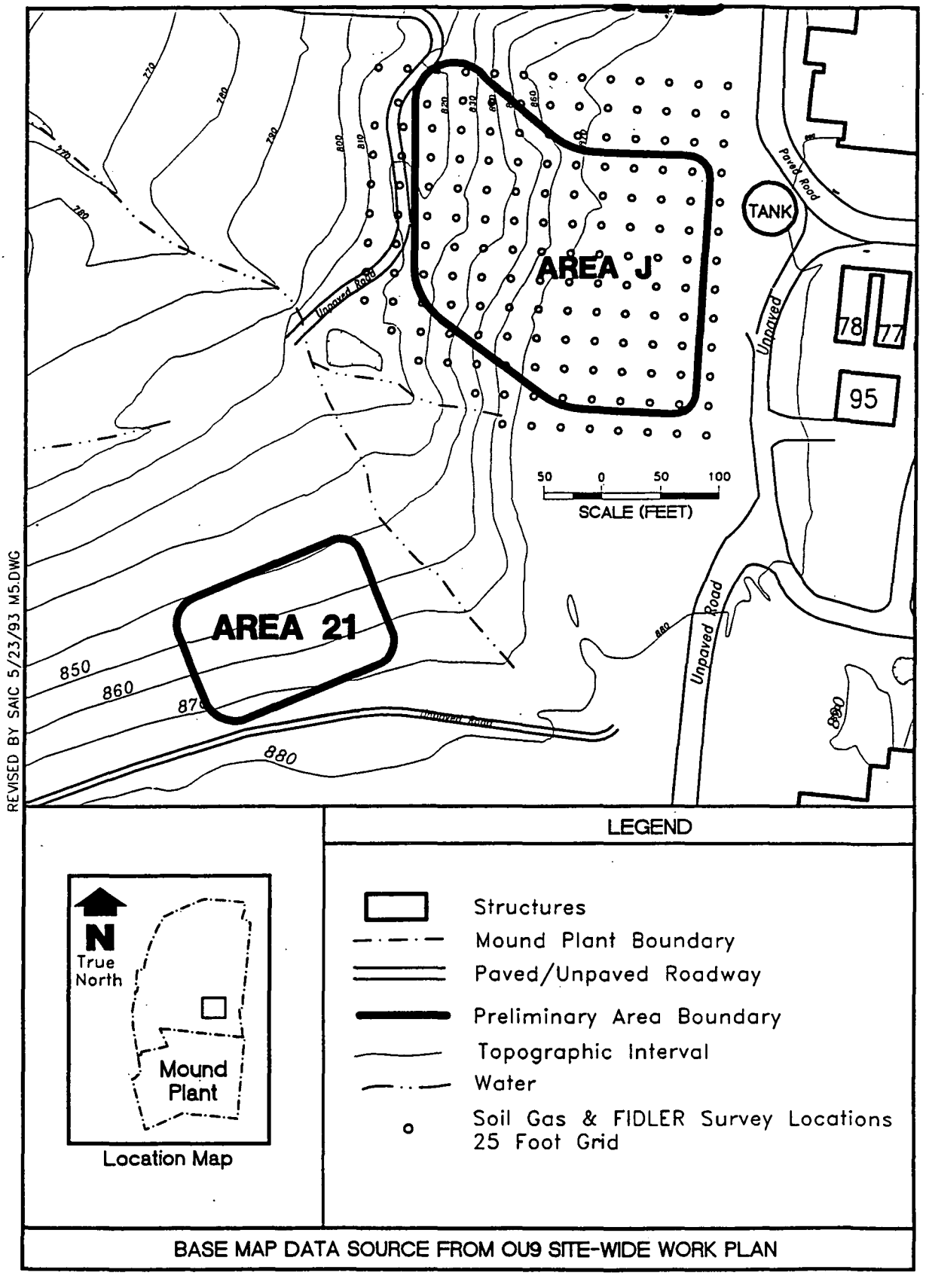

Figure 10.1. Soil Gas and FIDLER Survey Grid, OU5 Area J Hillside Disposal Area

No chemical data exists at Area J, but a soil gas survey has been conducted at the site to screen for possible contaminants. All samples were initially collected at 5-foot depths, but two were sampled at depths near 20-feet to test for VOCs near geophysical anomalies. No groundwater was encountered.

The total VOCs detection map (Figure 10.2.) displays the sample points and VOC "hits" in relation to Area J. Table X.1. summarizes positive detections from the Soil Gas Survey, while Table X.2. summarizes positive blank detections for the soil gas survey. This soil gas survey does not provide adequate coverage across Area J and is not situated in a grid pattern. It does provide an idea of what chemical contaminants are present at the site and can help focus efforts for a more thorough soil gas survey grid at the site.

Monitoring well 0325 is located west and probably downgradient of Area J. This well has been sampled and analyzed for hazardous constituents, and xylene has been detected. This well has also been sampled as part of the Mound Plant installation groundwater assessment program. This well, along with proposed well 326 and the three ponded areas, will be sampled as part of the OU5 Groundwater Characterization described in the OU5, RI/FS Work Plan (DOE 1993c).

In 1992, a detailed geophysical survey was conducted over approximately 90,000 square feet in Area J (DOE 1992c). The geophysical investigation consisted of both electromagnetic and magnetometer/ gradiometer surveys with the primary objective of locating near-surface and subsurface objects that could impact the implementation of subsequent detailed intrusive investigations for site characterization. These surveys were instrumental in defining the edge of the fill material and construction debris along the wester slope. Based on field observations and the interpretations of the geophysical data, most of the surveyed area probably contains construction debris. The geophysical data and field observations indicate that Area J contains a wide range of construction debris including 55-gallon drums, concrete blocks, ferrous and non-ferrous metal, plastic, rubber, and limestone blocks. A triangular-shaped area in the southwest part of the surveyed area may not contain substantial amounts of construction debris. More than 70 large individual geophysical anomalies were identified. Additional sources of anomalies are likely to exist but they were not identified either because the sources are below the limits of resolution of the instruments, or the anomaly associated with these sources were masked by larger anomalies in the area. Anomalies identified with the EM34-3XL instrument suggest the presence of debris buried approximately 20-feet below the surface in the upper area of the eastern third of Area J. Results of the geophysics will be used

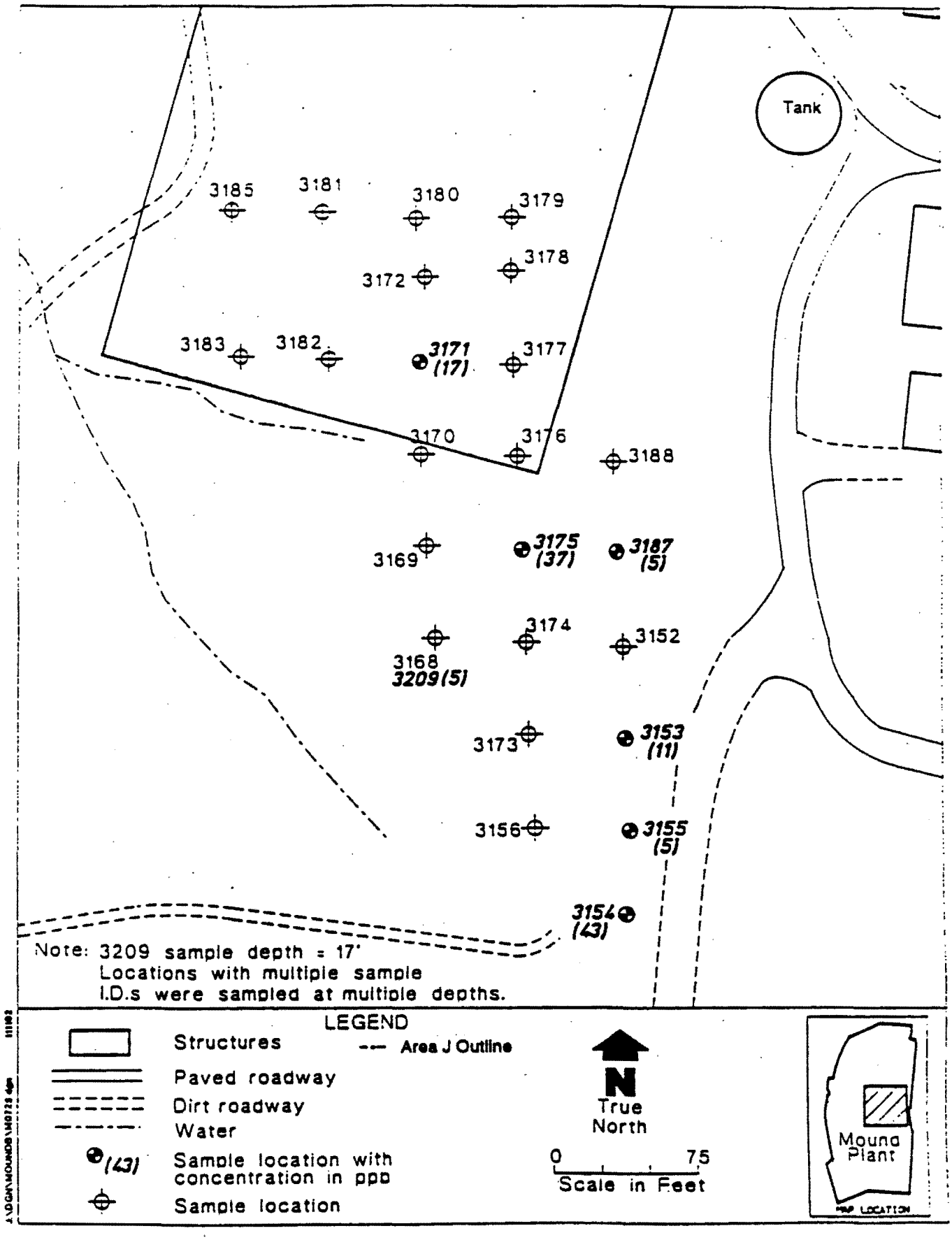

Figure 10.2. Total VOC Detection Map OU5 Area J

Table X.1. Summary of Positive Detections OU5 Area J Soil Gas Survey

Sample ID	Sample Date	Freon 11	Freon 113	TRAN-12DCE	CIS-12DCE	111TCA	PCE	TCE	Tolulene
MND-01-3153-0006	27 AUG 92	---	---	---	---	---	---	---	11
MND-01-3154-0006	27 AUG 92	43	---	---	---	---	---	---	---
MND-01-3154-1006	27 AUG 92	46	---	---	---	7	10*	13	---
MND-01-3155-0006	27 AUG 92	---	---	---	---	---	---	---	5
MND-01-3171-0006	31 AUG 92	2	---	---	---	---	15	---	---
MND-01-3173-0006	31 AUG 92	---	---	---	---	---	---	---	5*
MND-01-3175-0006	1 SEP 92	---	---	---	---	37	---	---	---
MND-01-3176-0006	31 AUG 92	---	---	---	---	---	---	---	6*
MND-01-3187-0006	1 SEP 92	5	---	---	---	---	---	---	---
MND-01-3209-0017	26 SEP 92	---	---	---	---	---	---	---	5

Notes: Only sample locations having positive detections are shown.
* Associated trip, ambient, equipment or field blank contained specified compound.
TRAN-12DCE = trans-1,2-dichloroethene
CIS-12DCE = cis-1,2-dichloroethene
111TCA = 1,1,-trichloroethane
PCE = tetrachlorethene
TCE = trichloroethene

Table X.2. Summary of Positive Blank Detections OU5 Area J Soil Gas Survey

Sample ID	Sample Date	FREON 11	FREON 113	TRAN-12DCE	CIS-12DCE	111TCA	PCE	TCE	Tolulene
MND-01-3153-3002	27 AUG 92	---	---	---	---	---	6	---	---

Notes: Only QA/QC sample locations having positive detections are shown.
TRAN-12DCE = trans-1,2-dichloroethene
CIS-12DCE = cis-1,2-dichloroethene
111TCA = 1,1-trichlorethene
PCE = tetrachlorethene
TCE = trichloroethene

as a guide in locating future borehole locations. The southwestern corner of Area J was not included in the previous geophysical surveys since it is heavily wooded and only naturally occurring materials are apparent at the surface.

Sampling Objectives

The objectives of the RI/FS sampling in Area J are to:

1. evaluate groundwater contamination downgradient and evaluating ponded areas or seeps nearby as part of the OU5 surface water and seeps analyses;
2. determine what radiological contaminants are present in Area J and at what concentration/locations;
3. determine if chemical (non-radioactive) contaminants are present and their concentration/locations;
4. characterize the lateral and vertical of radioactive and chemical contamination in Area J soils and groundwater (if encountered);
5. obtain data to define the sources of contamination (if any); and
6. obtain data to develop a conceptual site model for Area J.

Sampling Rationale

The existing data regarding the nature and extent of contamination in Area J is limited to radionuclides in surface soils. No data is available regarding the vertical distribution of radioactive contaminants and no chemical (non-radioactive) contaminant data is available. Therefore, a phased sampling approach will be implemented using the Observational Method recommended by the EPA for managing uncertainty during the RI/FS process under CERCLA.

For Area J, the exploratory phase (Phase 1) will consist of a field screening survey for radioactive contamination using a FIDLER in accordance with ER Program SOP 6.7. The area will be screened on a 25-foot grid (Figure 10.1.) beginning at one corner of a grid block and progressing in a serpentine pattern over the entire block, ending in the diagonally opposite corner of the block. If a location of elevated activity is found along the perimeter of the area grid, additional readings will be taken by projecting the grid line (transect) one established interval beyond the common node perimeter transect. In the event the new reading is also elevated, a partial grid with the new reading as the common node point (starting point) aligned with the original area grid will be constructed. Additional readings will be

taken one interval away from the starting point, in each of three directions along the partial grid. The reading process will be repeated until no elevated activity points are located. In similar manner, an elevated activity point located at an extreme corner of the area grid will have both transects projected out one established interval and readings taken. If additional readings are required, then a partial grid will be constructed until no further elevated activity points are located.

A soil gas survey will also be performed under the Phase 1 exploratory study to screen the area for VOCs and SVOCs in conjunction with soil gas data points already present. The radioactive and soil gas screening surveys will be used to locate the Phase 2 sampling points. Under Phase 2, subsurface soil borings will be installed to obtain samples for the analyses of chemical and radioactive constituents using the laboratory parameters specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a). If required, a third phase of the field sampling program will be performed to investigate any "hot spots" (radioactive and/or chemical) identified during Phase 2 and to determine the extent of groundwater contamination (if encountered).

Subsequent to the 1992 geophysical investigation in Area J, an inspection of the wooded site north of the supply line leading from the water tower revealed scattered construction debris over the surface. This area of obvious disposal covers approximately 70,000 ft^2 to 100,000 ft^2 and extends from near the top of the hill, down the entire slope, and into the northwest corner of Area J. As very little is known about this site, a Phase 1 exploratory study will be performed here.

As part of the exploratory study, a geophysical survey using electromagnetic and magnetometer/gradiometer techniques will be employed to identify areas of difficult drilling and areas possibly underlain by ferro-magnetic wastes (e.g. steel reinforcement bars, drums, etc.). To optimize the acquisition of data, the geophysical grid established in the 1992 survey of Area J will be extended into this area. The extended grid will consist of 25 north-south trending traverse lines spaced 10 feet apart, with stations located along the lines at 10 foot intervals (Figure 10.3.). A total of approximately 300 stations will be used in the survey, although this number may vary depending on field conditions.

Both terrain conductivity (EM-31) and magnetometer/gradiometer (GSM-19 and GSM-18 base station) surveys will be conducted at each station. The EM-31 instrument will be used to measure both the in-phase and out-of-phase (quadrature) components in both the vertical and horizontal dipole orientations. The in-phase component is more sensitive to metallic objects than is the quadrature phase, whereas the quadrature component is more sensitive to terrain conductivity and external sources of electric current.

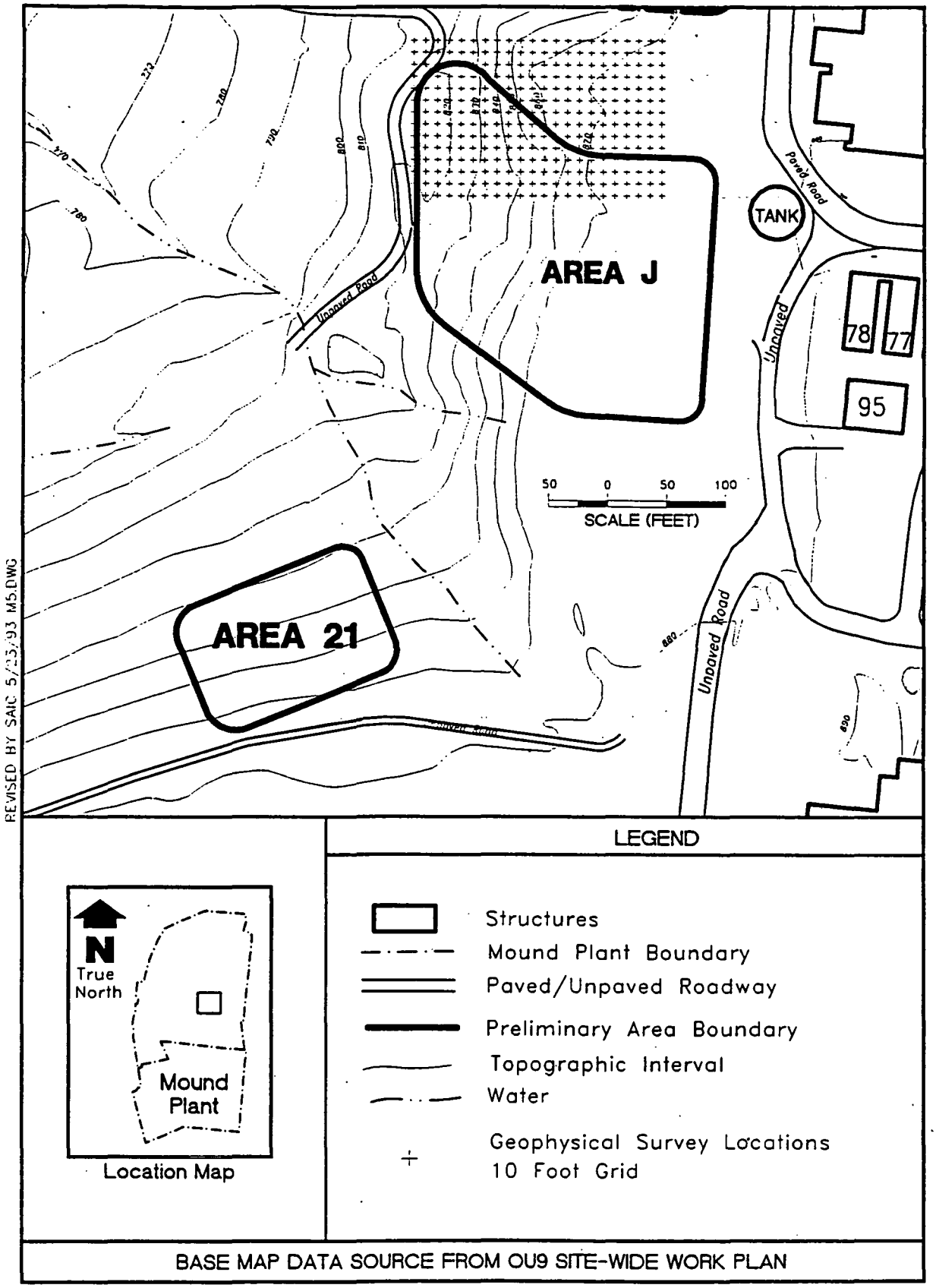

Figure 10.3. Geophysical Grid For OU5 Area J

The magnetometer/gradiometer will be used to discriminate iron-bearing objects buried in the shallow subsurface. An EM34-3XL instrument will also be used in both the vertical and horizontal dipole orientations to measure the quadrature phase component of the induced electromagnetic field. This unit will be used to better define the anomalies which cannot be differentiated with the EM-31. The EM-34-3XL measures apparent conductivity at greater depths than that measured by the EM-31, and has a maximum depth of electromagnetic penetration of approximately 20' to 40-feet depending on the mode of operation and the terrain conductivity.

Sampling Locations and Frequency

During the field screening survey using the FIDLER, any locations of elevated activity (readings above site background) will be staked and the levels documented in accordance with SOP 6.7. A sketch will be made of the area showing the locations of elevated concentrations of radionuclides and the physiogeographical features. If any FIDLER screening locations have to be moved, the changes will be documented on the form provided in SOP 6.7.

The soil gas collectors will also be placed in a 25-foot grid pattern as shown in Figure 10.1. at a depth of 18 inches and backfilled. A total of 156 soil gas collectors, will be placed within and around the known dimensions of Area J. In addition, eight collectors will be installed for time calibration as described in the soil gas procedures presented in the OU5 QAPjP (DOE 1993a). Four triplicate collectors (three samplers in one tube) will be included for QA/QC purposes. The locations of the time collectors and triplicate collectors will be recorded in the field logbooks. Two trip blanks will accompany the survey collectors as they are transported to and from the survey site and the analytical laboratory. One trip blank will be returned with the first set of time calibration samples; the other trip blank will be returned with the survey samplers. Ambient air samples will be collected as outlined in the OU5 QAPjP (DOE 1993a).

The number and locations of the samples collected during Phase 2 will be determined on the basis of the FIDLER screening and soil gas data, according to EPA guidance (1989). If any "hot spots" exist (e.g., detections are greater than the field equipment lower detection limits), those spots would be the starting point for a statistically designed Phase 2 program. If the FIDLER and soil gas survey results are inconclusive or fail to provide an adequate data base, the sample locations will be determined using the 25-foot grid established for the soil gas sampling. Since the vertical extent of the contamination will not be determined by the Phase 1 data, continuous core samples will be collected at each soil boring location using split-barrel samplers (SOP 4.1). Upon retrieval, these samples will be logged according to the criteria outlined in SOPs 5.1 and 5.3. Each soil core sample will be screened using a FIDLER for

radionuclides, and a PID and CGI for VOCs and combustible gases. A sample will be collected for VOC analysis if readings of greater than 1 ppm above background are recorded on the PID or greater than 10 percent LEL on the CGI. A sample will also be obtained for analysis if elevated readings are recorded by the FIDLER.

Samples for chemical and radiological analysis will be obtained using a 3-inch split-spoon sampler with liners (brass or stainless steel) or a 3-inch o.d., 24" long, brass or stainless steel thin-walled sampler (Shelby tube). The borings may be placed using a drill rig, mechanical auger, and/or hand auger at the discretion of the senior field geologist and program field manager. The samples shall be preserved, handled, placed into the appropriate containers, and labeled for shipment per Section 7. of this FSP and the OU5 QAPjP (SOPs 1.3, 1.4, 1.5 and 5.1 through 5.3).

During drilling for the chemical and radiological samples, soil sampling and borehole logging will be performed to conform to SOP 5.1. The soil sampling will be used to determine geotechnical, geologic, and geochemical parameters including: TOC, CEC, and general physical parameters (Table VII.2.). Samples will be taken at the surface and 4-foot depth intervals until bedrock is encountered or, based on noticeable soil property differences or color, a field geotechnical engineer or geologist will select the appropriate samples during drilling. The remainder of the sample will be composited in a stainless steel bowl. Part of this composited sample will be sent to the Mound Plant soil screening facility and the remainder will be sent to the analytical laboratory for the balance of the required analyses. If no elevated FIDLER or PID/CGI readings are obtained, the sample will be discarded as IDM and coring will be resumed. Any soil sample selected for physical parameters (geotechnical/geologic) testing that exceeds regional background radiation levels must be sent to a geotechnical laboratory licensed to receive radiological material. Regardless of the FIDLER or PID/CGI screening results, radiological and chemical samples will be collected in the first 6-inch interval from the surface and at 5-foot intervals in each borehole to a maximum depth of 10 feet or until bedrock is encountered.

Based upon data obtained from previous investigations (DOE 1992b) the depth to bedrock in Area J was 3-12 feet below land surface. At the maximum depth of fill material, this depth to bedrock is approximately 25 to 30 feet. If groundwater is encountered in sufficient quantity, a grab sample will be obtained for laboratory analyses using the drilling SOP exhibited in the OU5 QAPjP, Attachment 1. In addition, if any surface water is encountered, an appropriate sample will be collected as described in SOP 2.9. All samples will be analyzed for the OU5 laboratory parameters as specified in the OU5 Work Plan DQOs and the quality objectives of the OU5 QAPjP (DOE 1993a).

Sample Designation

All samples obtained during the various phases of the field sampling program will be identified as specified in the OU5 QAPjP (DOE 1993a).

For example, the soil gas designation codes for the first 3 samples obtained from the first sampling point would be:

MND32-1201-0001	for the first sample at location 1
MND32-2202-0001	for the first sample at location 2
MND32-2202-0002	for the second sample at location 2

This identification code scheme will be unique for Area J and will not be repeated at any other AOC during the RI/FI in OU5.