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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91OR21949

Field Sampling Plan for the Remedial Investigation/ Feasibility Study-Environmental Impact Statement for the St. Louis Site

St. Louis, Missouri

July 1993

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FIELD SAMPLING PLAN FOR THE REMEDIAL INVESTIGATION/ FEASIBILITY STUDY-ENVIRONMENTAL IMPACT STATEMENT FOR THE ST. LOUIS SITE

ST. LOUIS, MISSOURI

JULY 1993

Prepared for

United States Department of Energy

Oak Ridge Operations Office

Under Contracts DE-AC05-91OR21949

and DE-AC05-91OR21950

By

Bechtel National, Inc.

and

Science Applications International Corporation

Oak Ridge, Tennessee

FOREWORD

A work plan-implementation plan (WP-IP) has been prepared to document actions and evaluations performed during the scoping and planning phase of the remedial investigation/feasibility study-environmental impact statement conducted for the St. Louis, Missouri, site. Remedial action at the St. Louis site is being planned as part of the Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program.

Because portions of the St. Louis site are on the Environmental Protection Agency's (EPA) National Priorities List, the response actions (i.e., removal and remedial actions) to be carried out by DOE at the site are subject to review by EPA Region VII, the Missouri Department of Natural Resources, and the public under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act. Section 120(a)(1) of CERCLA, as amended, clarifies the applicability of CERCLA to hazardous sites owned or controlled by federal departments and agencies and requires that remedial actions at hazardous DOE sites satisfy the requirements of CERCLA. Executive Order 12580 delegates to DOE the authority to conduct CERCLA response actions at sites under its control. Consistent with this order, DOE is the lead agency for remedial actions at the St. Louis site. DOE plans and activities for the site are being overseen by EPA Region VII, and a formal interagency agreement (federal facilities agreement) coordinating DOE's and EPA's respective roles has been signed. The major elements of the agreement are described in Subsection 1.4.2 of the WP-IP (BNI 1993a).

The WP-IP also includes descriptions of project organization and project controls and delineates schedules for tasks to be performed to fulfill the requirements of both CERCLA and the National Environmental Policy Act, which requires consideration of the consequences of a proposed action as part of the decision-making process. Ancillary plans include this field sampling plan (FSP), the quality assurance project plan (QAPjP), the health and safety plan, and the community relations plan. The

FSP directs the field work for radiological, chemical, and geological remedial investigation (RI) activities at the St. Louis site. The QAPjP is written in conjunction with the FSP; together they constitute the sampling and analysis plan.

DOE has been conducting characterization activities at the St. Louis site for over 10 years. The results of these activities have been published in an RI report. A review of these activities indicated some limited data gaps that required further investigation. This FSP directs only the data gap sampling activities to be conducted at the site. The results from this additional sampling are expected to provide all the remaining information necessary to conduct a feasibility study for the site.

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ACRONYMS

AEC	Atomic Energy Commission
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
BNAE	base/neutral and acid extractable
BNI	Bechtel National, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CME	Central Mine Equipment
DI	deionized (water)
DOE	Department of Energy
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
FFA	federal facilities agreement
FSP	field sampling plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC/MS	gas chromatography/mass spectrometry
HISS	Hazelwood Interim Storage Site
HSP	health and safety plan
ICPAES	inductively coupled plasma atomic emission spectrophotometry
MED	Manhattan Engineer District
NPL	National Priorities List
OR	Department of Energy Oak Ridge Field Office
ORNL	Oak Ridge National Laboratory

ACRONYMS
(continued)

OSHA	Occupational Safety and Health Administration
PDCC	Project Document Control Center
PQAS	project quality assurance supervisor
QA/QC	quality assurance/quality control
QAPjP	quality assurance project plan
RI	remedial investigation
RI/FS-EIS	remedial investigation/feasibility study-environmental impact statement
SAIC	Science Applications International Corporation
SHSO	site health and safety officer
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
TCLP	toxicity characteristic leaching procedure
TMA/E	Thermo Analytical/Eberline
VOA	volatile organics analysis
VOC	volatile organic compound
WP-IP	work plan-implementation plan

UNITS OF MEASURE

°C	degree Celsius
cm	centimeter
dpm	disintegrations per minute
ft	foot
g	gram
gal	gallon
h	hour
in.	inch
keV	kiloelectron volt
kg	kilogram
km	kilometer
L	liter
lb	pound
m	meter
MeV	megaelectron volt
μCi	microcurie
μg	microgram
μmhos	micromhos
mg	milligram
ml	milliliter
mph	miles per hour
pCi	picocurie

1.0 INTRODUCTION

In 1974 the United States Congress authorized the Atomic Energy Commission (AEC), a predecessor agency to the U.S. Department of Energy (DOE), to institute the Formerly Utilized Sites Remedial Action Program (FUSRAP). The objective of FUSRAP, now managed by DOE, is to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

DOE is conducting a comprehensive review and analysis leading to remedial action for a set of properties located in Hazelwood, Berkeley, and St. Louis, Missouri, under FUSRAP. The properties, collectively referred to as the St. Louis site, are:

- The St. Louis Downtown Site (SLDS) and vicinity properties
- The St. Louis Airport Site (SLAPS) and vicinity properties
- The Latty Avenue Properties [Hazelwood Interim Storage Site (HISS), Futura Coatings, Inc., and vicinity properties]

The vicinity properties are residential, commercial, industrial, and municipal properties near SLDS, SLAPS, HISS, and Futura Coatings, Inc., that were radioactively contaminated as a result of uranium processing at SLDS and subsequent transportation and storage of processing residues at SLAPS and HISS. HISS, operated by DOE, is a temporary storage site on property currently owned by Jarboe Realty and Investment Company. Excavated soil from several vicinity properties is currently stored at HISS, pending a decision on final disposition.

SLAPS, the SLAPS vicinity properties, and the Latty Avenue Properties have been placed on the Environmental Protection Agency's (EPA) National Priorities List (NPL), a list of sites identified for remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (referred to simply as CERCLA). Placement of the properties on the NPL requires the signing of a federal facilities agreement (FFA) by DOE and EPA that clearly delineates and coordinates the roles of both agencies in the CERCLA process.

As part of the CERCLA process, DOE has prepared a remedial investigation (RI) report and a work plan-implementation plan (WP-IP), which cover previous characterization activities at the site. This second phase of sampling is designed to fill data gaps that were identified as a result of these previous characterization activities. Results from this data gap sampling effort will be used in conjunction with existing data to support a feasibility study.

This field sampling plan (FSP) is intended to provide direction for the second phase of sampling at the St. Louis site. Section 2.0 identifies the objectives of the RI activities and the technical approach for achieving them. Section 3.0 lists the types of samples and measurements that are required; Section 4.0 summarizes the frequency at which these samples and measurements will be taken. Section 5.0 describes the procedures to be used during analysis of the samples. Section 6.0 provides details of the operating plan to be followed during the sampling effort. Section 7.0 describes additional characterization activities that may be necessary based on the results of this sampling effort.

1.1 SITE CHARACTERIZATION RATIONALE

The RI field activities described in this FSP are intended to complete characterization of the St. Louis site with respect to DOE's responsibilities as defined in the FFA. Information from previous investigations of the site has been used to determine data needs.

The previous characterization activities were based on historical documentation and field surveys. Contamination at FUSRAP sites is primarily radioactive and resulted from Manhattan Engineer District (MED) and AEC activities. Based on historical records, characterization of the Plant 5 area at SLDS has been very limited. The Plant 5 area was not historically associated with MED/AEC activities (Mason 1977). Although Plant 5 is radioactively contaminated, the contamination originated from a columbium/tantalum extraction process conducted by Mallinckrodt under a private contract. Plant 6E at SLDS was historically associated with MED/AEC activities. Because of construction in the Plant 6E area, Bechtel National, Inc. (BNI) had previously conducted walkover surveys of the area and performed limited sampling. Results indicate that contaminant levels are below regulatory guidelines. For these reasons, sampling in the Plant 5 and 6E areas will be very limited; characterization of these areas is not considered to be part of the data gap sampling effort.

Although Coldwater Creek is another previously investigated area for which data gaps may exist, no additional sampling in the creek itself will be conducted during the data gap sampling effort. BNI previously sampled Coldwater Creek and detected spots of contamination in the areas where sedimentation is most likely to occur. BNI currently conducts environmental monitoring along Coldwater Creek and monitors stormwater that discharges into the creek from SLAPS and HISS. If environmental monitoring data indicate that contaminated material is being released from the properties into the stream, additional sampling may be initiated.

During March 1991, the St. Louis area experienced high winds that damaged the synthetic cover on one of the interim, low-level-waste storage piles at HISS. Wind speeds in the St. Louis area at the time of this incident were reported at 56.3 km/h (35 mph), with gusts up to 112.6 km/h (70 mph). Because some soil was seen blowing from the pile before water could be applied, limited surveys were conducted on properties immediately downwind of the property. These properties had been previously characterized by DOE in 1987.

Results of the 1987 characterization indicated that essentially the entire property adjacent to HISS and several areas downwind of HISS contained radionuclides in excess of DOE cleanup guidelines for soil. A survey conducted in 1991 focused on a truck loading dock, the interior of a truck trailer that was open and facing the storage pile during the high winds, and the exterior of an office building immediately adjacent to HISS. None of the data exceeded DOE's guideline for transferable surface contamination, indicating minimal deposition of contaminated soil from the storage pile. In addition, a limited number of soil samples was collected from downwind properties at areas not exhibiting radioactive contamination during the 1987 survey, and the absence of additional contamination was confirmed. A limited amount of fixed contamination was detected on some of the building exteriors; therefore, additional limited surveys will be conducted.

The approach for investigating these buildings will be consistent with previous procedures for potentially contaminated buildings at SLDS and other properties. The buildings will be surveyed as part of the release survey conducted at the completion of remedial action for each individual property; this approach will minimize the disruption of normal activities at the properties. In addition, if surveys of building exteriors are conducted before remedial action begins, the results can be difficult to interpret because of the time that could elapse between characterization of buildings and remedial action; the nature of the contamination can change depending on factors such as climatological effects, effectiveness of dust suppression measures during remedial action for soil in the immediate areas of buildings, and the plating of radon and radon daughters onto building surfaces, which can lead to erroneous survey results. Finally, data for these buildings are not a prerequisite for the feasibility study process because building rubble is not the driving factor in volume estimates and would have very little effect on screening remedial action alternatives.

1.2 ORGANIZATION AND RESPONSIBILITIES

1.2.1 Project Organization

FUSRAP is conducted as a team effort with multiple organizations responsible for its accomplishment. DOE is responsible for the overall implementation of FUSRAP. DOE Headquarters provides oversight and coordination and contracts Oak Ridge Institute for Science and Education and Oak Ridge National Laboratory (ORNL) to designate sites and properties for

FUSRAP. These two organizations independently verify the successful completion of remedial actions leading to the release of properties from FUSRAP.

The DOE Oak Ridge Operations Office (ORO) manages day-to-day FUSRAP activities. DOE-ORO has contracted BNI and Science Applications International Corporation (SAIC) to assist in the performance of FUSRAP. BNI serves as project management contractor, and SAIC serves in an independent role as environmental studies contractor with the primary responsibility of writing technical documents for FUSRAP. Argonne National Laboratory and ORNL are also contracted by DOE-ORO to act as technical support contractors.

The remedial action process for the St. Louis site will be conducted based on the project management structure for FUSRAP (Figure 1-1). The flow of the remedial action process is shown in Figure 1-2, which also identifies the organization responsible for each step in the process.

1.2.2 Coordination and Responsibilities for Field Work

As project management contractor for FUSRAP, BNI manages and conducts all RI field activities necessary to implement the field work delineated in the remedial investigation/feasibility study-environmental impact statement (RI/FS-EIS) report. Typically, these activities include development and procurement of subcontract services; development, implementation, and overview of plans; collection and review of data, including sampling results, quality assurance/quality control (QA/QC) submittals, and sample tracking and custody; technical guidance to onsite personnel; report preparation; cost management; and schedule control. SAIC provides field support to assist in resolving problems that may be encountered during field sampling activities and to ensure that all field sampling activities are conducted in a manner consistent with the FSP.

The BNI program manager is responsible to DOE for the successful completion of all aspects of the work. The program manager is supported by project managers and representatives from

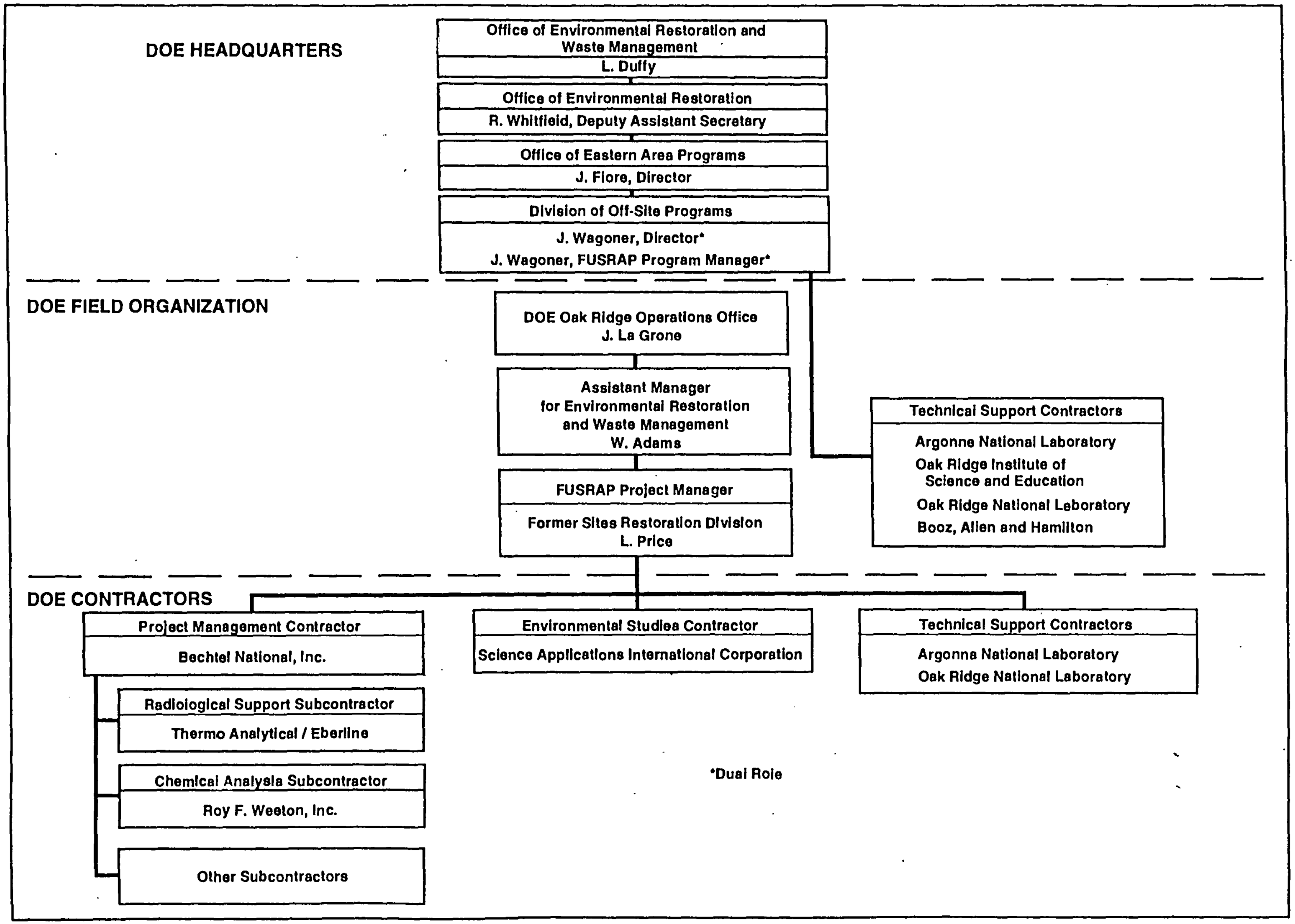

Figure 1-1
Project Organization

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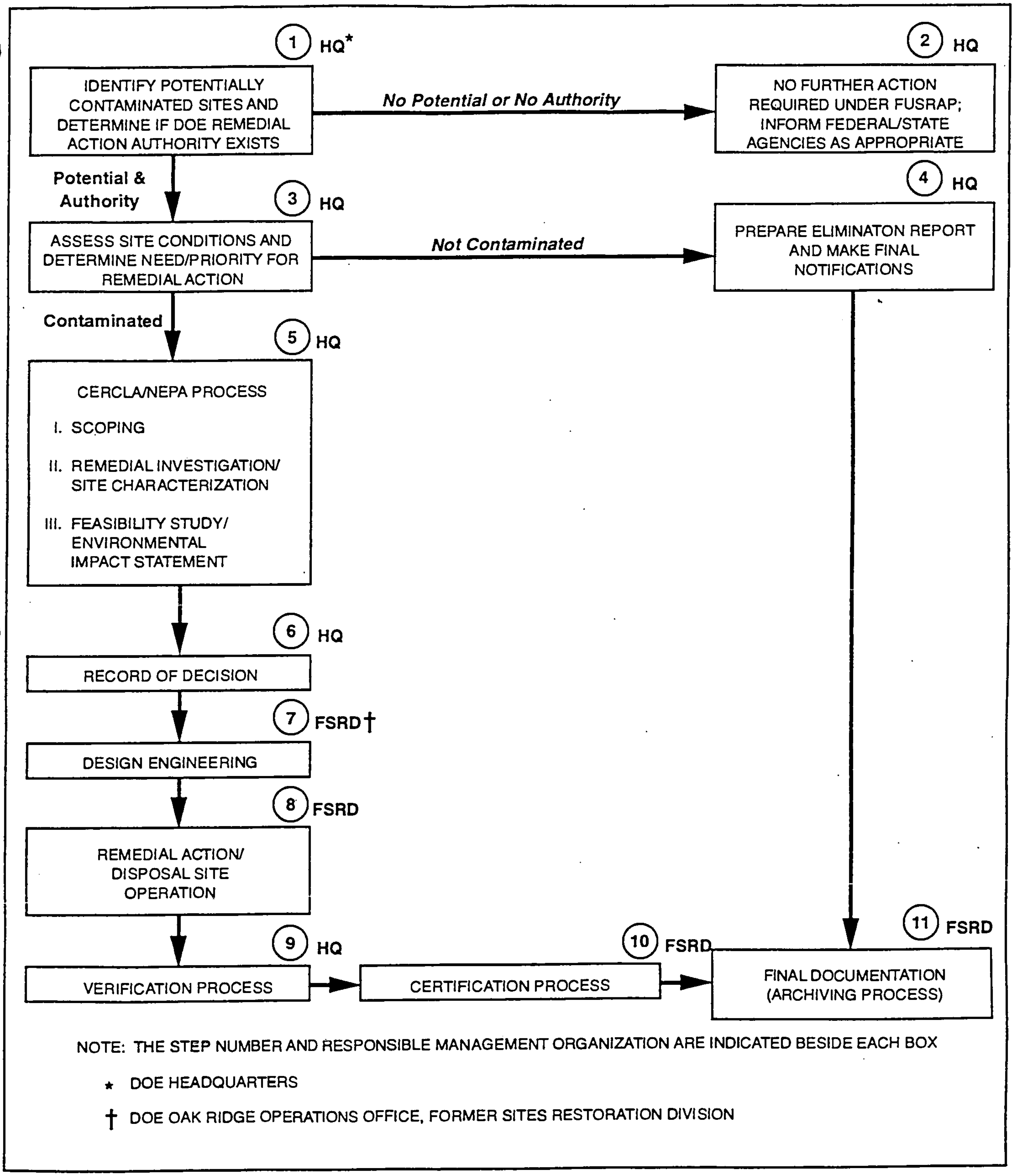

Figure 1-2
Project Coordination and Responsibility Matrix

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the following departments: Engineering and Technology; Construction; Environment Safety, Health, and Waste Management; Procurement; Quality Assurance; Administrative Services; Community Relations; and Project Controls. The responsibilities of the project managers and each group are described in the following paragraphs.

Project manager

- Implements overall guidance provided by BNI program manager on a site-specific basis

- Communicates directly with DOE-ORO site managers to implement DOE directives on a site-specific basis

- Manages a team of BNI technical professionals from each of the disciplines described below to accomplish the goals of the DOE site managers and the BNI program manager

Engineering and Technology

- Develops bid packages and technical specifications needed to subcontract RI work

- Performs engineering studies in support of SAIC to evaluate data and assess remedial action alternatives

- Provides field engineering services to monitor onsite work and modify technical specifications as required

- Develops plans, objectives, and documentation; manages and evaluates chemical and radiological data obtained during RI activities

- Manages radiological and chemical analysis support subcontracts

- Provides technical group leader to support onsite RI efforts

Construction

- Reviews all site plans for constructibility
- Monitors subcontract status (cost, completion, etc.)
- Provides a site superintendent to administer subcontracts for onsite activities
- Performs site maintenance work
- Provides site security
- Manages local purchasing of equipment and supplies
- Provides year-round onsite support, including collection of environmental samples

Environment, Safety, Health, and Waste Management

- Coordinates and evaluates all health and safety matters
- Provides a site health and safety officer (SHSO)
- Plans, coordinates, and directs functions related to the generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities

Procurement

- Identifies bidders for subcontract work
- Coordinates subcontract bid and award process
- Manages revisions to subcontracts

Quality Assurance

- Reviews and approves BNI quality assurance project plan (QAPjP)
- Evaluates implementation of the QAPjP
- Audits systems and performance
- Conducts periodic reviews of program plans

Project Controls

- Provides cost and schedule support, including budgeting, monitoring, variance analysis, and trend analysis

Administrative Services

- Provides administrative services such as document control, mail distribution, and reproduction
- Provides document editing services

Community Relations

- Conducts community relations planning and prepares the community relations plan
- Coordinates community relations activities

Onsite management of RI activities is accomplished through the organizational structure shown in Figure 1-3. Responsibilities of each onsite position are described below.

Site superintendent

The site superintendent is responsible to the BNI project manager for day-to-day operations at the site. If no health and safety representative is onsite, the site superintendent may also serve as the SHSO.

Technical group leader

The technical group leader is responsible for accomplishing the goals of the RI. All BNI or subcontractor personnel providing training, radiological survey services, chemical sampling, and geological/hydrological support to the RI activities report to the technical group leader. The technical group leader works with the field engineer to ensure coordination of subcontractor and sampling activities.

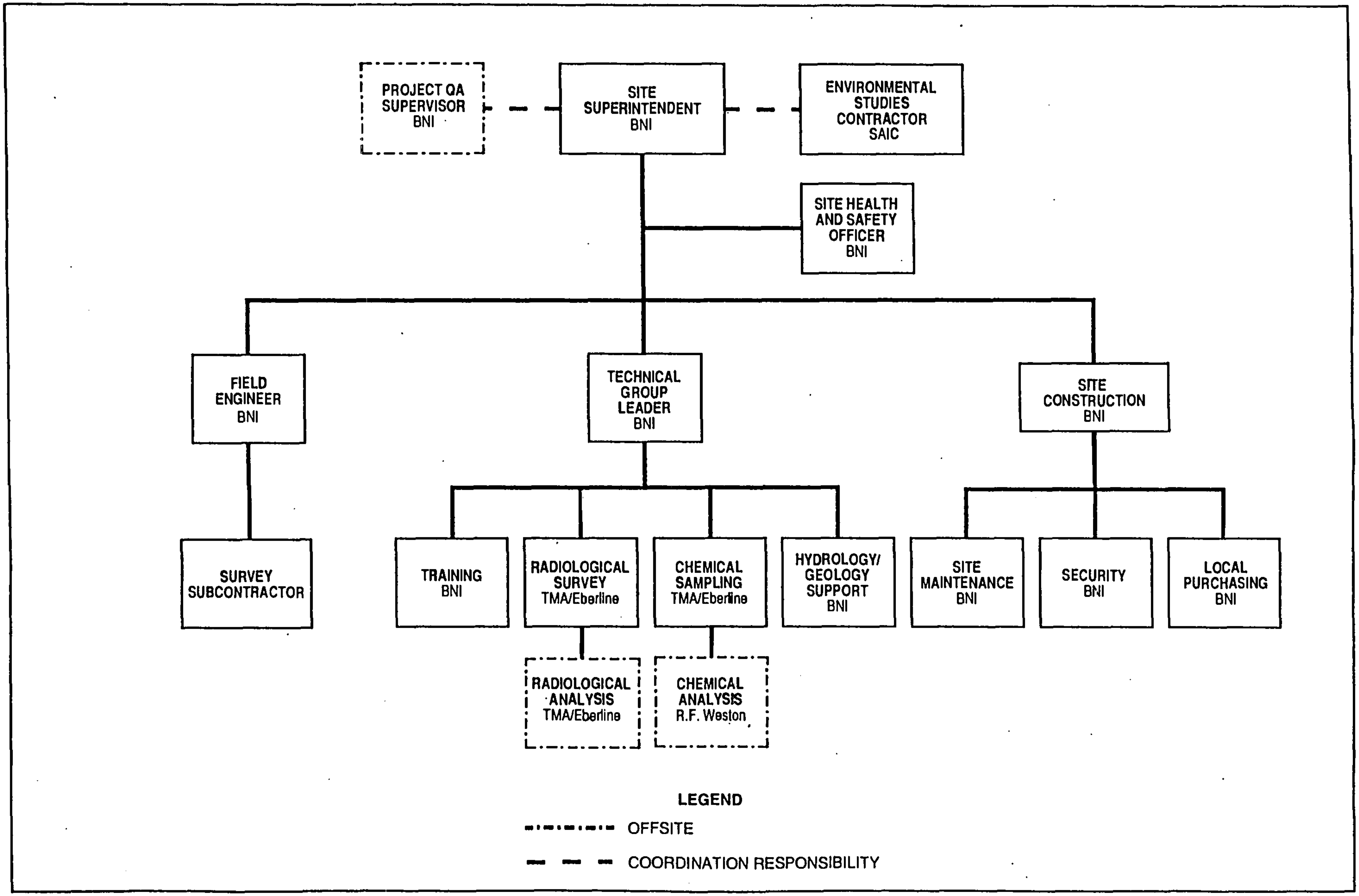

Figure 1-3
Onsite Organization

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Field engineer

The field engineer administers all subcontractor activities (excluding radiological and chemical support), including daily work assignments, completion of subcontract management documentation, QA/QC verification, and cost management.

Site construction personnel

Site construction personnel are responsible for maintenance and security and for purchasing local supplies and equipment. Site construction personnel coordinate purchases with both the technical group leader and the field engineer to ensure that the needs of the RI activities are met.

Site health and safety officer

The SHSO is responsible for the administration and implementation of all health and safety matters that may affect the health and well-being of the general public or site personnel. The SHSO works directly with the site superintendent or his designee to coordinate all matters related to health and safety. The SHSO has the authority to implement corrective measures or to stop work to ensure the health and safety of site personnel.

Project quality assurance supervisor

The project quality assurance supervisor (PQAS) conducts audits in the field to ensure implementation of the CERCLA process, the FSP, and the health and safety plan (HSP); compliance with applicable or relevant and appropriate requirements associated with interim measures and waste derived from investigation activities; and compliance with project documents (e.g., project instructions, project procedures, instruction guides, subcontract specifications). Audits and surveillances are also conducted of how the BNI environmental monitoring team handles and analyzes sample data after receipt of data from the laboratories. The PQAS reports to BNI management the results of audits, surveillances, and evaluations of the effectiveness of the QA/QC program. The PQAS also conducts audits of subcontractors who are involved in the implementation of the FSP and HSP with regard to compliance with environmental regulations. All QA/QC program procedures and instructions are submitted to the PQAS for review and sign-off before they are issued.

1.2.3 Summary

The onsite organization clearly defines the responsibilities of each group and allows the site superintendent to make decisions based on input from each group. However, depending on the level of effort at a particular site, individuals within the organization may be assigned multiple responsibilities. When activities are under way at a specific site, the names and telephone numbers of individuals in the positions shown in Figure 1-3 will be posted in a conspicuous location at the site.

1.3 SITE BACKGROUND AND DESCRIPTION

Subsections 1.1 and 2.1 of the WP-IP (BNI 1993a) provide general site information and a description of the site, respectively.

1.4 SITE HISTORY

Refer to Subsection 2.2 of the WP-IP (BNI 1993a) for a complete history of the St. Louis site.

1.5 SUMMARY OF EXISTING SITE CONDITIONS AND DATA

Existing site conditions and data are provided in both Section 2.0 of the WP-IP (BNI 1993a) and Section 3.0 of the RI report (BNI 1992).

1.6 DATA GAPS

Substantial information on the nature and extent of site contamination is used to support the decision-making process for the RI/FS-EIS being conducted for the St. Louis site. Some limited additional data will be required, however, to support the FS-EIS and remedial action. The additional sampling efforts described in Section 2.0 of this FSP are logical continuations of previous work described in Subsection 1.5 and are not significant enough to delay the RI/FS process. Information acquired as part of the ongoing DOE environmental monitoring program will be evaluated as it becomes available and used to support the RI/FS process.

Additional information to support the current understanding of hydrologic conditions at SLAPS may be required if the property is selected as a preferred permanent disposal site. Additional requirements may include collecting additional soil samples for geotechnical testing and possibly performing additional aquifer testing.

As previously stated, this FSP addresses only those data gaps identified during field investigations described in the WP-IP (BNI 1993a) and RI report (BNI 1992).

2.0 REMEDIAL INVESTIGATION APPROACH

The additional types of data that will be collected to fill data gaps have been identified through detailed study of data acquired during activities described in the WP-IP (BNI 1993a) and comments received from EPA during preparation of the RI report (BNI 1992). These data will supplement existing data to allow evaluation of remedial action alternatives.

The following subsections delineate the data gaps identified during review of existing field investigation data and describe the technical approach that will be used to obtain the needed data. All of the procedures used to collect samples will be consistent with EPA protocol for conducting field investigations (EPA 1987a).

2.1 DATA REQUIREMENTS

As stated in Subsection 1.5, substantial information on the nature and extent of site contamination is used to support the decision-making process for the RI/FS-EIS being conducted at the St. Louis site. To provide data required to more precisely define contaminant boundaries and to provide additional characterization data and background information, the following data objectives have been identified for this phase of the characterization of the St. Louis site:

- Objective 1: Refine horizontal and vertical boundaries of soil contamination at SLDS
- Objective 2: Determine the presence and extent of contamination in drains and process lines at SLDS
- Objective 3: Refine horizontal and vertical boundaries of soil contamination at SLDS vicinity properties

- Objective 4: Collect background soil and groundwater samples from the vicinity of SLDS and SLAPS for chemical analyses

- Objective 5: Collect and analyze sediment samples from the Mississippi River to determine concentrations of radioactive contaminants

- Objective 6: Collect and analyze soil samples to determine whether mixed waste is present

- Objective 7: Refine groundwater characterization at SLDS, SLAPS, and HISS

- Objective 8: Refine horizontal boundaries of soil contamination along haul roads and vicinity properties associated with SLAPS and HISS

- Objective 9: Conduct special studies at the St. Louis site

2.2 TECHNICAL APPROACH

2.2.1 Objective 1: Refine Horizontal and Vertical Boundaries of Soil Contamination at SLDS

Areas where boundaries of contamination were not established during the radiological characterization of SLDS include the northern, eastern, and southern edges of the City of St. Louis property, two locations on Angelrodt Street east of Plant 7E, and areas in Plants 1, 2, 5, 6E, and 7S (Figure 2-1).

A civil surveyor will establish soil sampling locations with a specified maximum tolerance of ±0.3 m (1 ft). Nineteen boreholes will be drilled on the northern, eastern, and southern edges of the City of St. Louis property to obtain data to define the boundaries of contamination in these areas (Figure 2-2). Coordinates of these borehole locations are provided in Table 2-1. Eight boreholes will be drilled to establish boundaries of contamination at the

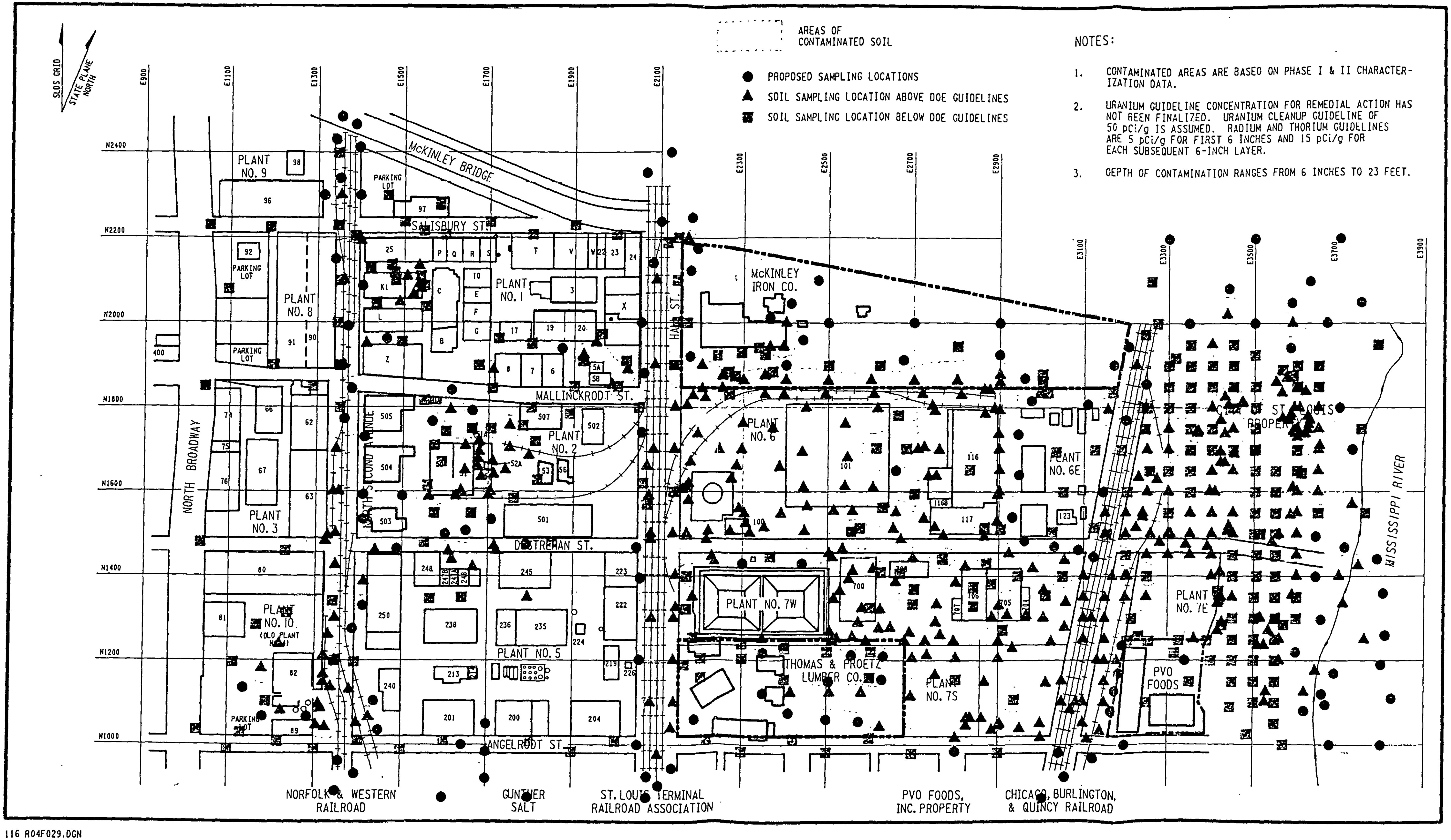

Figure 2-1
Areas of Radioactive Contamination at SLDS

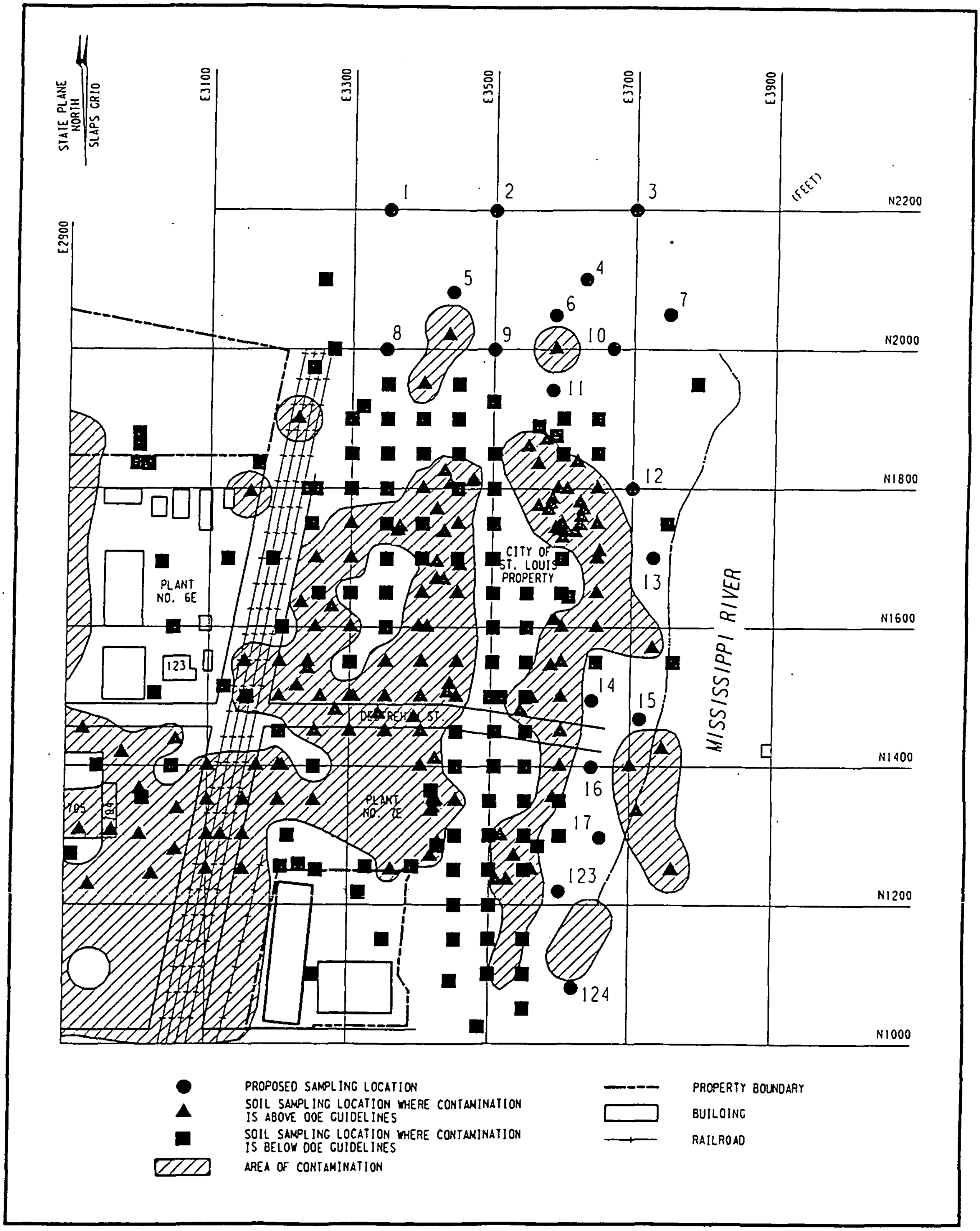

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Figure 2-2
Soil Sampling Locations at the City of St. Louis Property

Table 2-1
Proposed Borehole Locations at SLDS (Edges of City of St. Louis Property)

Location Identification[a]	Coordinate East	Coordinate North
1	3350	2200
2	3500	2200
3	3700	2200
4	3630	2100
5	3440	2082
6	3587	2049
7	3750	2050
8	3347	2000
9	3500	2000
10	3670	2000
11	3584	1942
12	3700	1800
13	3730	1700
14	3645	1495
15	3713	1469
16	3645	1400
17	3658	1297
123	3600	1220
124	3620	1080

[a]Proposed locations are shown in Figure 2-2.

NOTE: Maximum drilling depth for all boreholes will be 0.9 m (3 ft); samples collected from the surface interval [0 to 0.15 m (0 to 0.5 ft)] will be analyzed.

two locations on Angelrodt Street (Figure 2-3); coordinates are provided in Table 2-2. An additional 21 boreholes will be drilled at the locations in the vicinity of Plants 1, 2, 5, 6E, and 7S, shown in Figures 2-4 and 2-5; coordinates are provided in Table 2-3. These boreholes will be sampled to establish the boundaries of contamination in each of the plant areas.

All boreholes will be drilled with a subsurface tube sampler. Continuous soil sampling to a depth of 0.9 m (3 ft) will proceed at intervals of 0 to 0.15, 0.15 to 0.3, 0.3 to 0.6, and 0.6 to 0.9 m (0 to 0.5, 0.5 to 1, 1 to 2, and 2 to 3 ft). Analyses for uranium-238, radium-226, thorium-232, and thorium-230 will be conducted on surface samples [0 to 0.15 m (0 to 0.5 ft)] from all locations, except for locations 20 and 21, from which samples from the 0.15- to 0.3-m (0.5- to 1-ft) interval will be analyzed. If a sample from the first interval is analyzed and found to exceed DOE guidelines, the sample from the next consecutive depth interval will be analyzed for the same radiological parameters. This process will be continued until contaminant boundaries are established. All other samples will be archived in case they are needed for future analysis to determine the depth of contamination.

2.2.2 Objective 2: Determine the Presence and Extent of Contamination in Drains and Process Lines at SLDS

To supplement existing radiological survey results, sumps, drains, and process lines at SLDS will be scanned. Because Mallinckrodt is an operating facility, characterization immediately followed by remedial action would be the preferred approach to the remediation of these areas because it would minimize disruption of plant operations.

Based on past survey results, all accessible drains, sumps, manholes, and process lines in and around SLDS will be surveyed for direct alpha, beta-gamma, and removable contamination.

Two types of specially fabricated detectors will be used to survey interior areas of potentially contaminated drains and pipes.

Table 2-2

Proposed Borehole Locations at SLDS

(Vicinity of Angelrodt Street)

Location Identification[a]	Coordinate East	Coordinate North
18	1700	1050
19	1643	1000
20[b]	1700	990
21[b]	2800	990
22	1700	920
23	1600	875
24	1800	875
25	1700	800

[a]Proposed locations are shown in Figure 2-3.

[b]Samples collected from the 0.15- to 0.3-m (0.5- to 1-ft) interval will be analyzed.

NOTE: Except as noted, maximum drilling depth for all boreholes will be 0.9 m (3 ft); samples collected from the surface interval [0 t 0.15 m (0 to 0.5 ft)] will be analyzed.

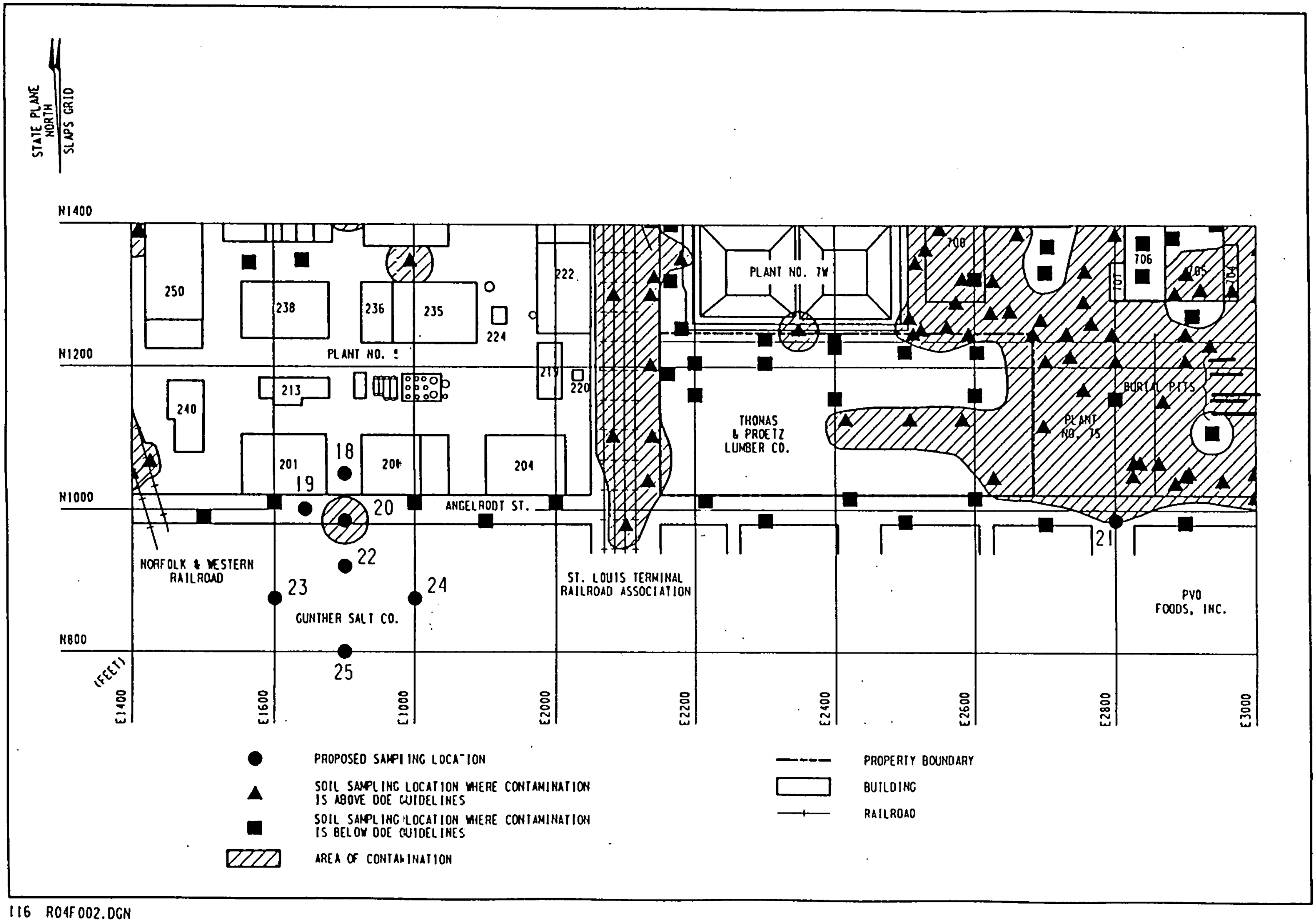

Figure 2-3

Soil Sampling Locations at Angelrodt Street

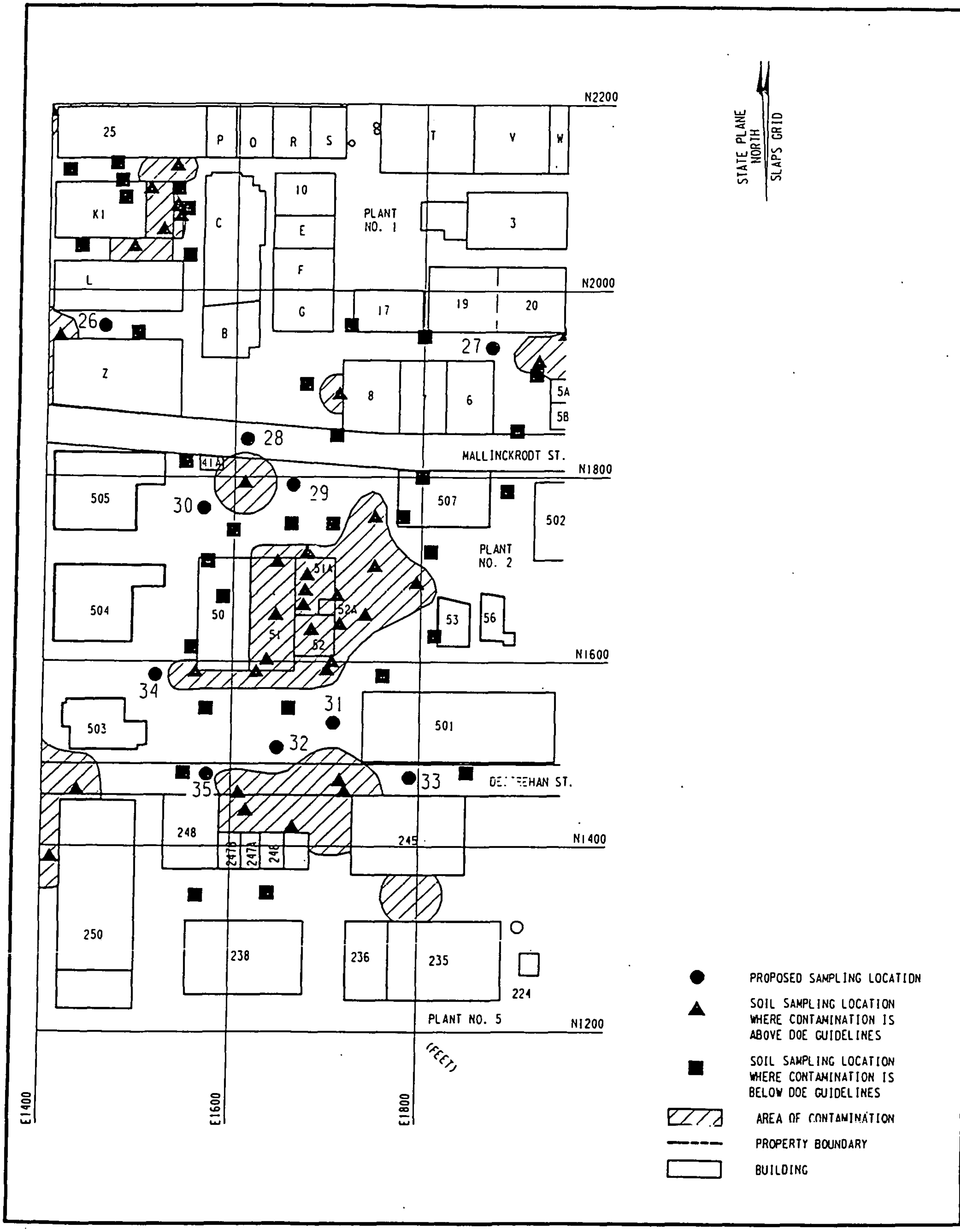

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Figure 2-4
Soil Sampling Locations at SLDS (Plants 1, 2, and 5)

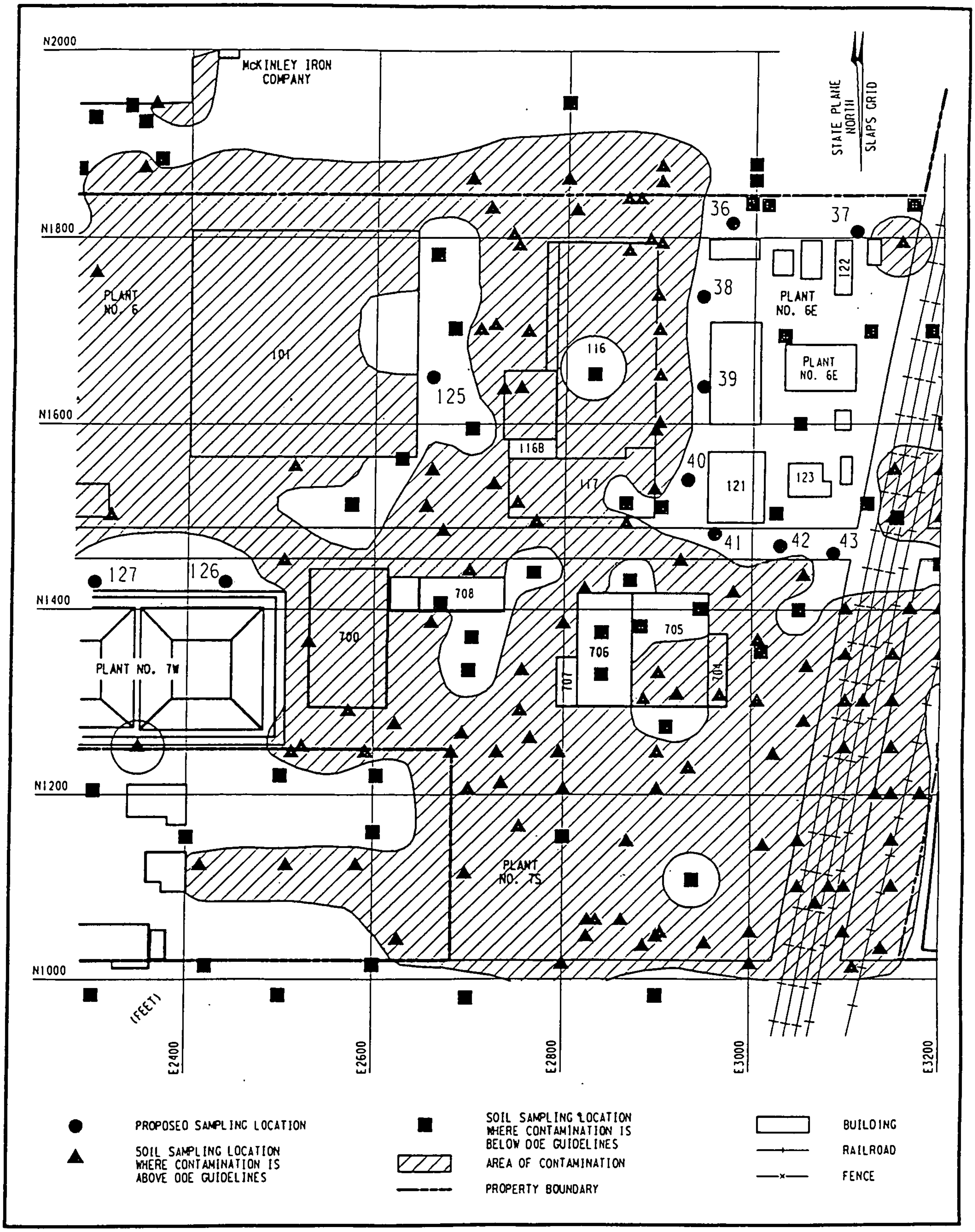

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Figure 2-5
Soil Sampling Locations at SLDS (Plants 6E and 7S)

Table 2-3

Proposed Borehole Locations at SLDS

(Plants 1, 2, 5, 6E, and 7S)

Location Identification[a]	Coordinate East	Coordinate North
26	1460	1962
27	1872	1939
28	1613	1841
29	1662	1792
30	1568	1767
31	1708	1534
32	1648	1507
33	1790	1475
34	1500	1590
35	1600	1500
36	2975	1816
37	3108	1807
38	2945	1737
39	2947	1640
40	2931	1540
41	2960	1483
42	3030	1470
43	3087	1462
125	2260	1650
126	2440	1430
127	2300	1430

[a]Proposed locations are shown in Figures 2-4 and 2-5.

NOTE: Maximum drilling depth for all boreholes will be 0.9 m (3 ft); samples collected from the surface interval [0 to 0.15 m (0 to 0.5 ft)] will be analyzed.

The first is a proportional detector designed to respond to low-energy gamma or X-ray and beta radiation. The assumption of normal uranium contamination requires that this detector be capable of responding to 2.3 MeV-Max beta and bremsstrahlung-produced secondary photons (i.e., X rays); it will also respond to higher-energy gamma photons. The proportional detector, which has a thin plastic wall lining, has demonstrated good response to strontium/yttrium-90 beta and americium-241 60-keV gamma emissions and will drive a signal to a normal scaler a distance of 76.2 m (250 ft). The detector will be attached to a sewer snake of electrical wire puller to assess how far contamination extends in the drains and pipes.

The second detector, which is constructed of a plastic scintillator and uses a photomultiplier tube, is small and can provide NaI(Tl) equivalent spectra using a portable multi-channel analyzer. This detector will be used to determine the type of contamination that may be present by careful analysis of the spectra within selected accessible drainpipes. Because alpha as well as gamma emitters could be present in the drain and process lines, samples of scale, dirt, sludge, and sediment will be collected where possible and analyzed.

2.2.3 Objective 3: Refine Horizontal and Vertical Boundaries of Soil Contamination at SLDS Vicinity Properties

Preliminary surveys conducted on the SLDS vicinity properties included the collection of surface and subsurface soil samples from the Norfolk and Western Railroad property; the St. Louis Terminal Railroad Association property; the Chicago, Burlington, and Quincy Railroad property; the Thomas and Proetz Lumber Company property; the McKinley Iron Company property; and the PVO Foods, Inc., property (Figure 2-1). Results of the radiological characterization of these properties indicate areas where the boundaries of contamination were not established.

A civil surveyor will establish soil sampling locations with a specified maximum tolerance of ±0.3 m (1 ft). A slide-hammer Shelby tube sampler will be used to sample 82 boreholes on the SLDS vicinity properties. Where rail ballast is present, a powered auger drill combined with a Shelby tube sampler may have to be used to collect samples from the railroad properties. Soil will be sampled continuously to a depth of 0.9 m (3 ft). Samples will be collected from the locations indicated in Figures 2-6 through 2-11 at depth intervals of 0 to 0.15, 0.15 to 0.3, 0.3 to 0.6, and 0.6 to 0.9 m (0 to 0.5, 0.5 to 1, 1 to 2, and 2 to 3 ft). Surface soil samples will be analyzed for uranium-238, radium-226, thorium-232, and thorium-230. All other samples will be archived in case they are needed for future analysis to determine the depth of contamination.

In the previous survey of the Norfolk and Western Railroad property, radionuclide concentrations exceed remedial action guidelines in 18 of 34 samples collected from 24 sampling locations and analyzed. These 18 samples were surface soil samples that were collected along the entire length of the property; archived soil samples collected at the same locations will be retrieved and analyzed to provide information on the depths of contamination. Twenty-five additional boreholes will be drilled to a depth of 0.9 m (3 ft) at locations shown in Figure 2-6.

At the St. Louis Terminal Railroad Association property, radionuclide concentrations exceed remedial action guidelines in 19 of 32 samples collected from 28 sampling locations along the entire length of the property and analyzed. Archived samples collected beneath the depth of known contamination from 9 of these locations will be retrieved for analysis, and 16 additional boreholes will be drilled to a depth of 0.9 m (3 ft) at locations shown in Figure 2-7.

At the Chicago, Burlington, and Quincy Railroad property, radionuclide concentrations exceed remedial action guidelines in 21 of 40 samples collected from 26 sampling locations and analyzed. The contamination was generally found on the southern two-thirds of the property. Archived soil samples collected beneath the depth of known contamination from 6 of these 21 locations will be retrieved for analysis, and 9 additional boreholes will be drilled to a depth of 0.9 m (3 ft) at locations shown in Figure 2-8.

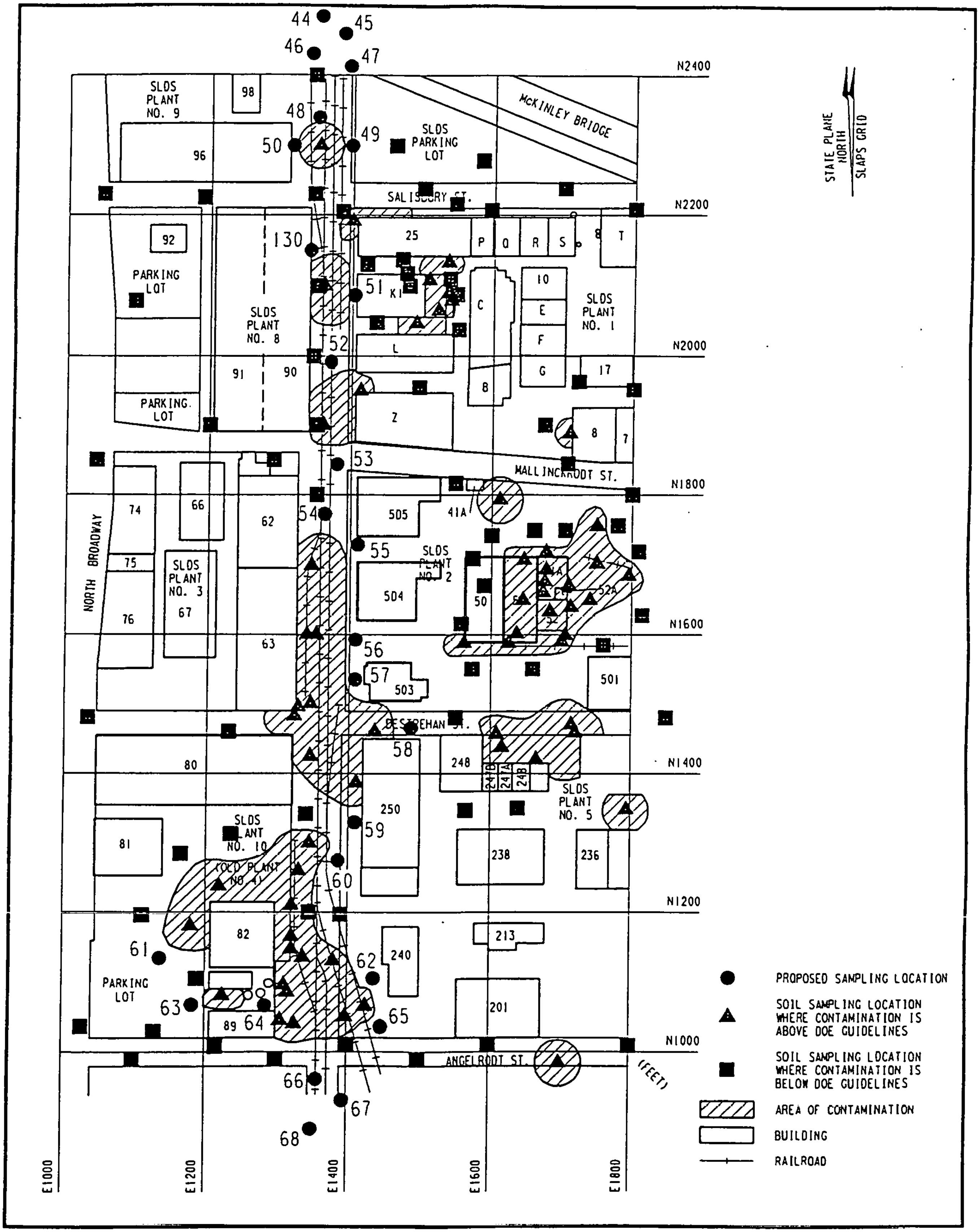

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Figure 2-6
Soil Sampling Locations at the
Norfolk and Western Railroad Property

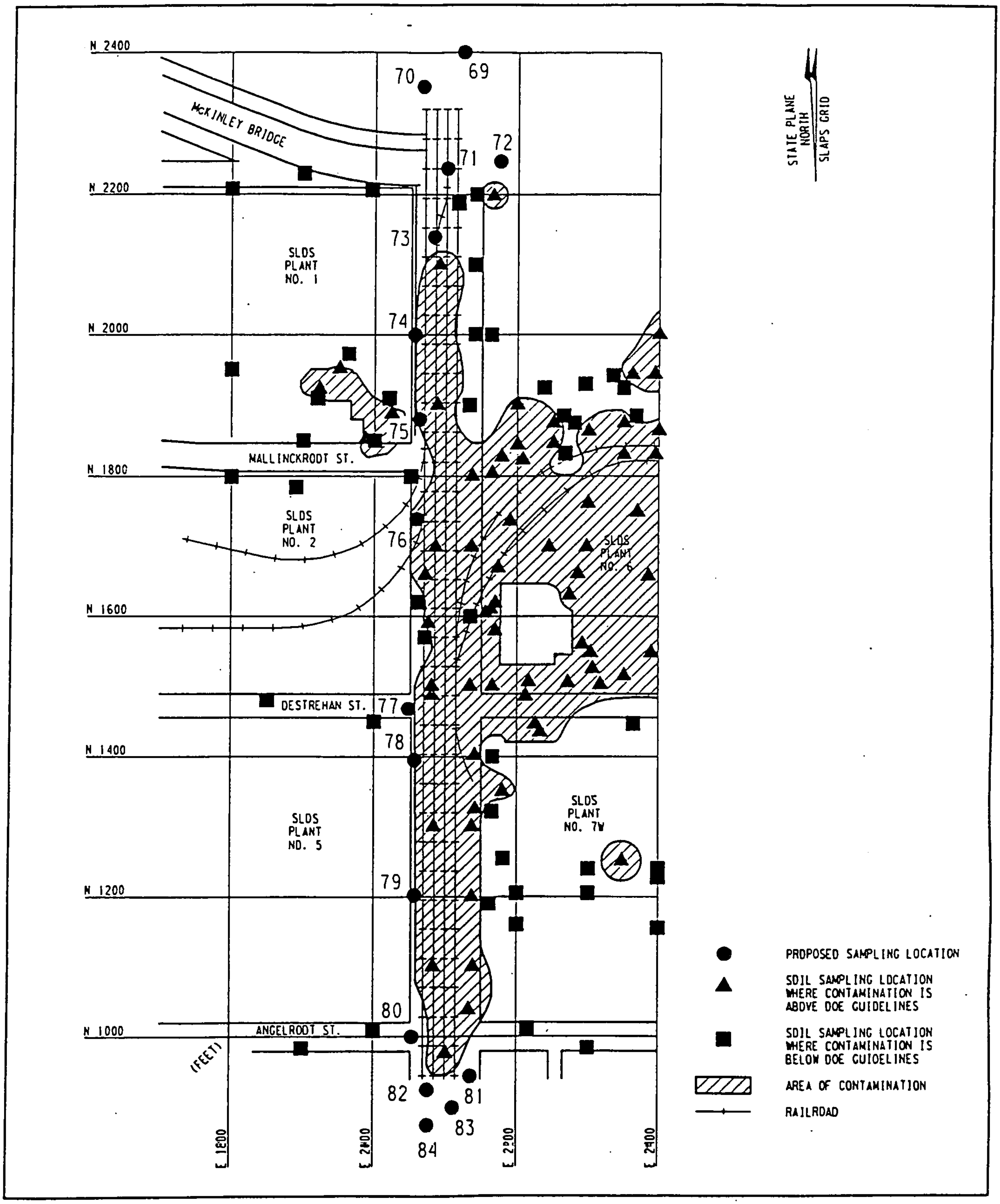

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Figure 2-7
Soil Sampling Locations at the St. Louis Terminal Railroad Association Property

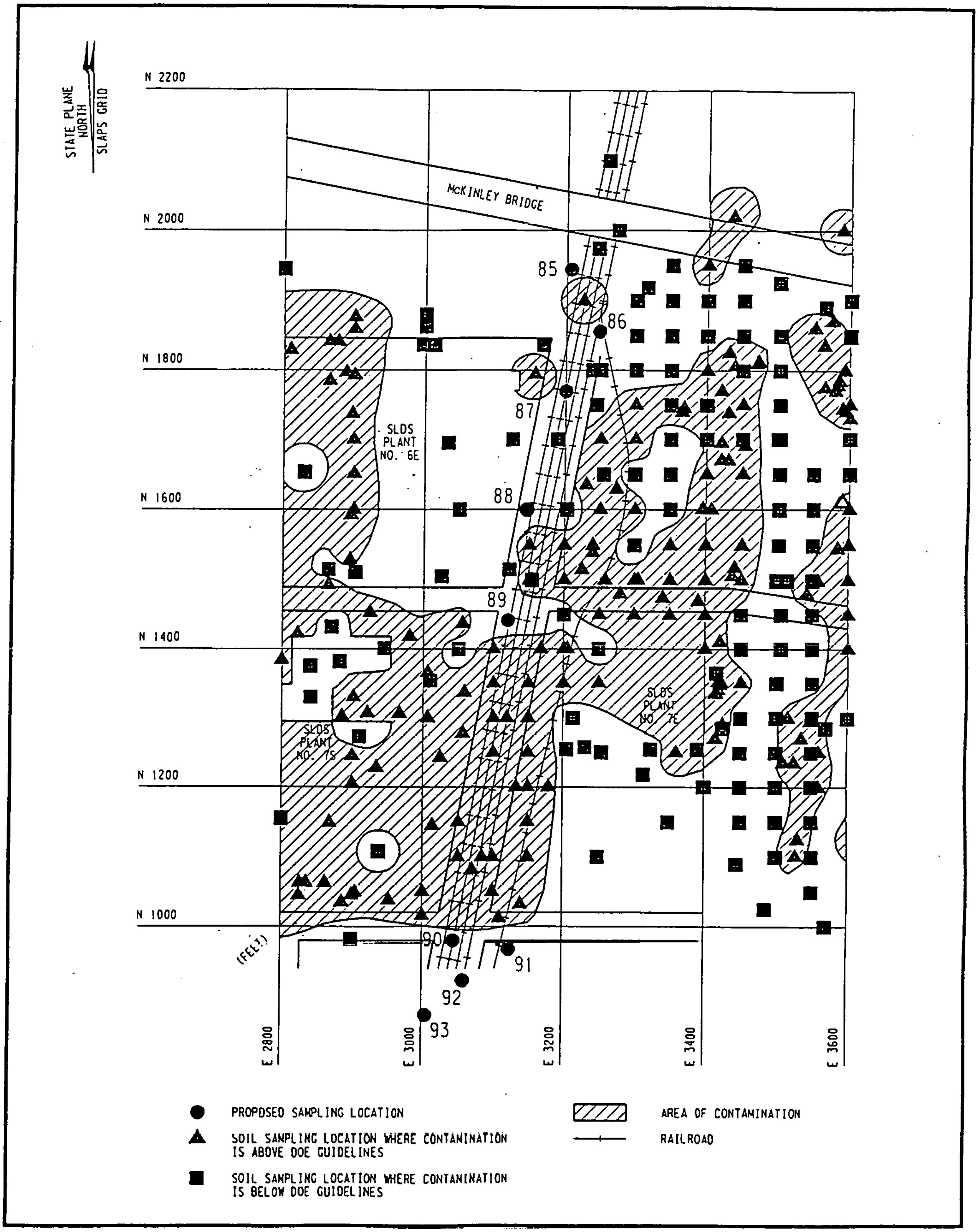

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Figure 2-8
Soil Sampling Locations at the
Chicago, Burlington, and Quincy Railroad Property

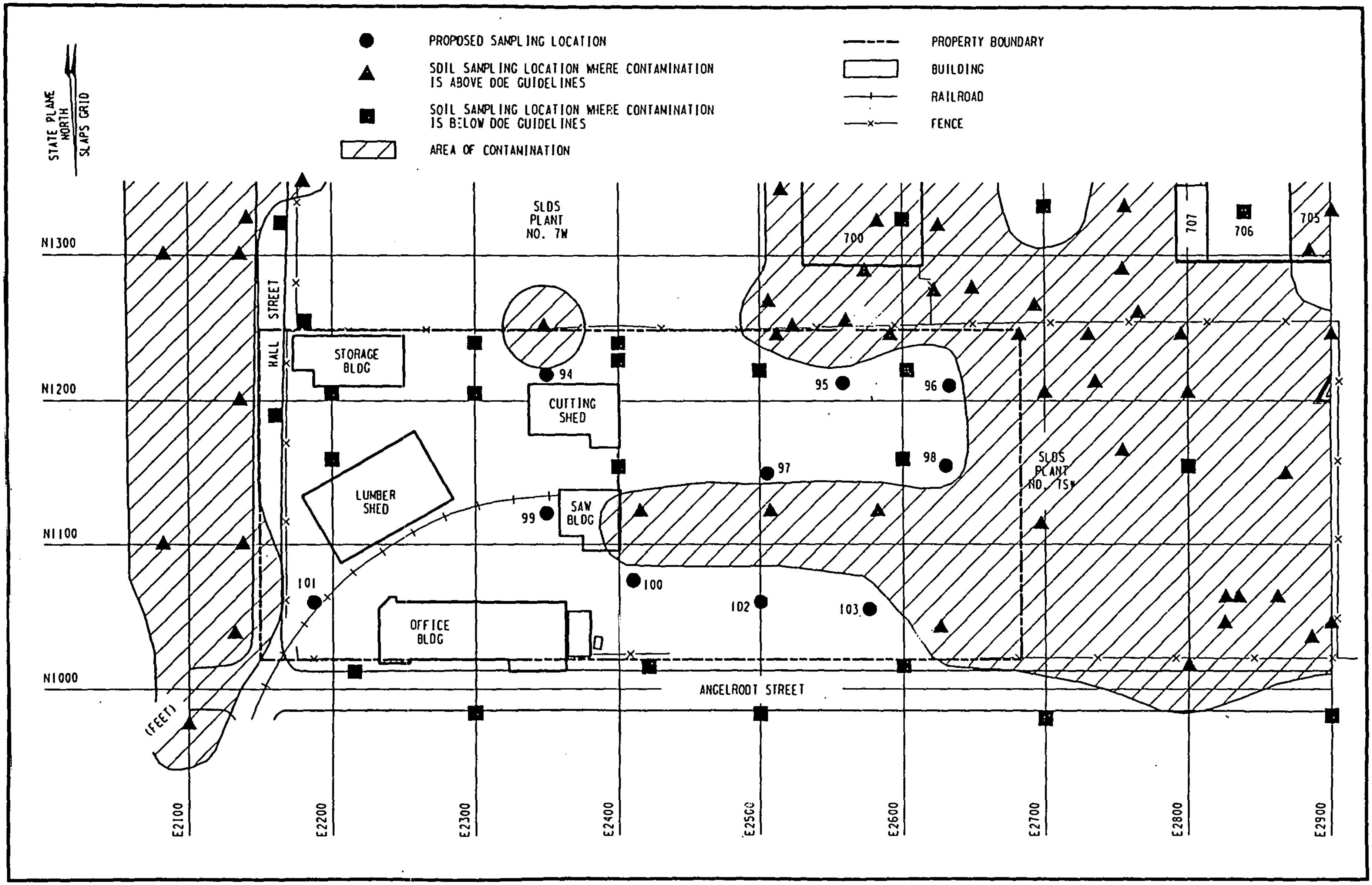

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Figure 2-9
Soil Sampling Locations at the Thomas & Proetz Lumber Co. Property

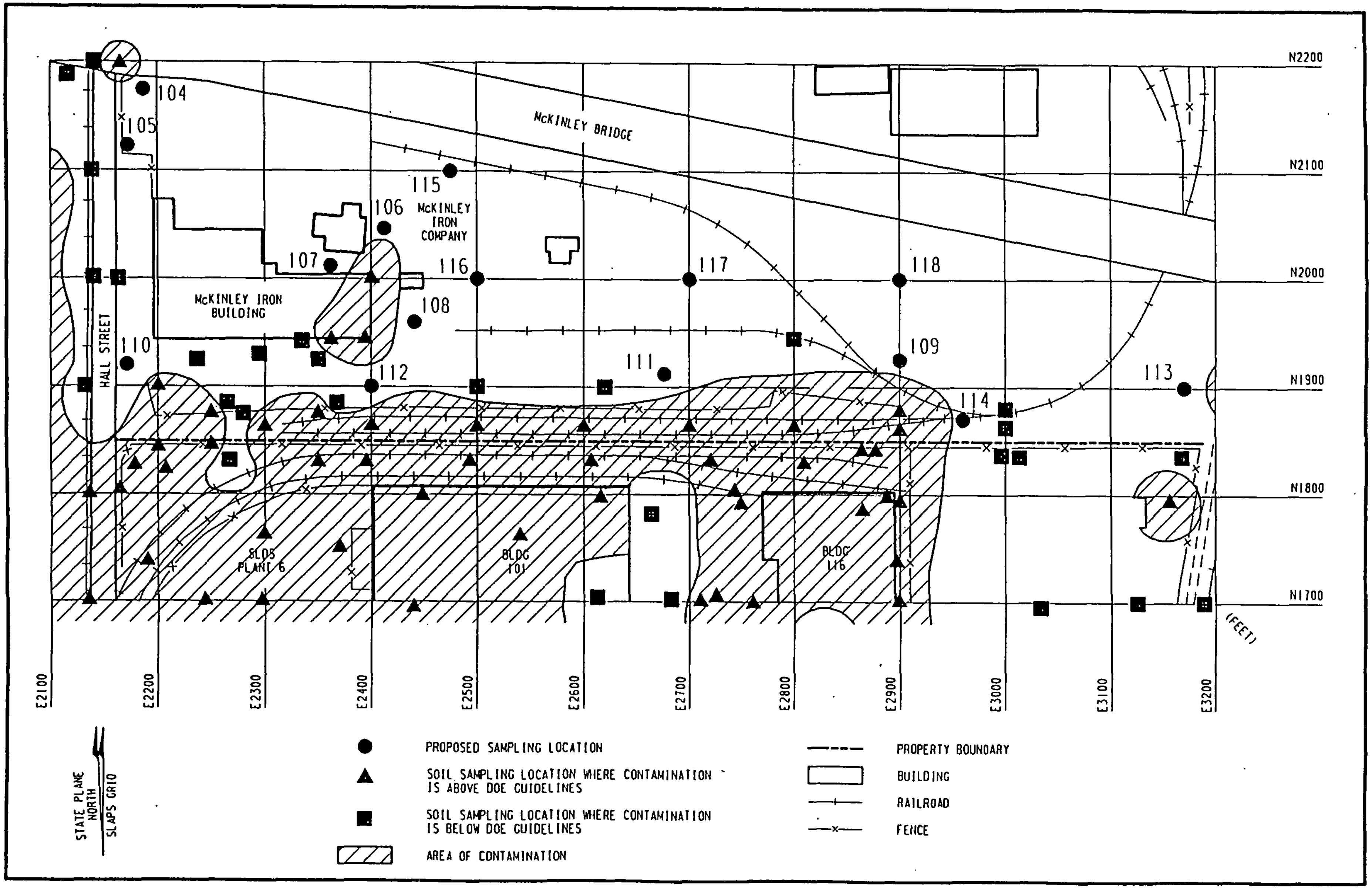

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Figure 2-10
Soil Sampling Locations at the McKinley Iron Company Property

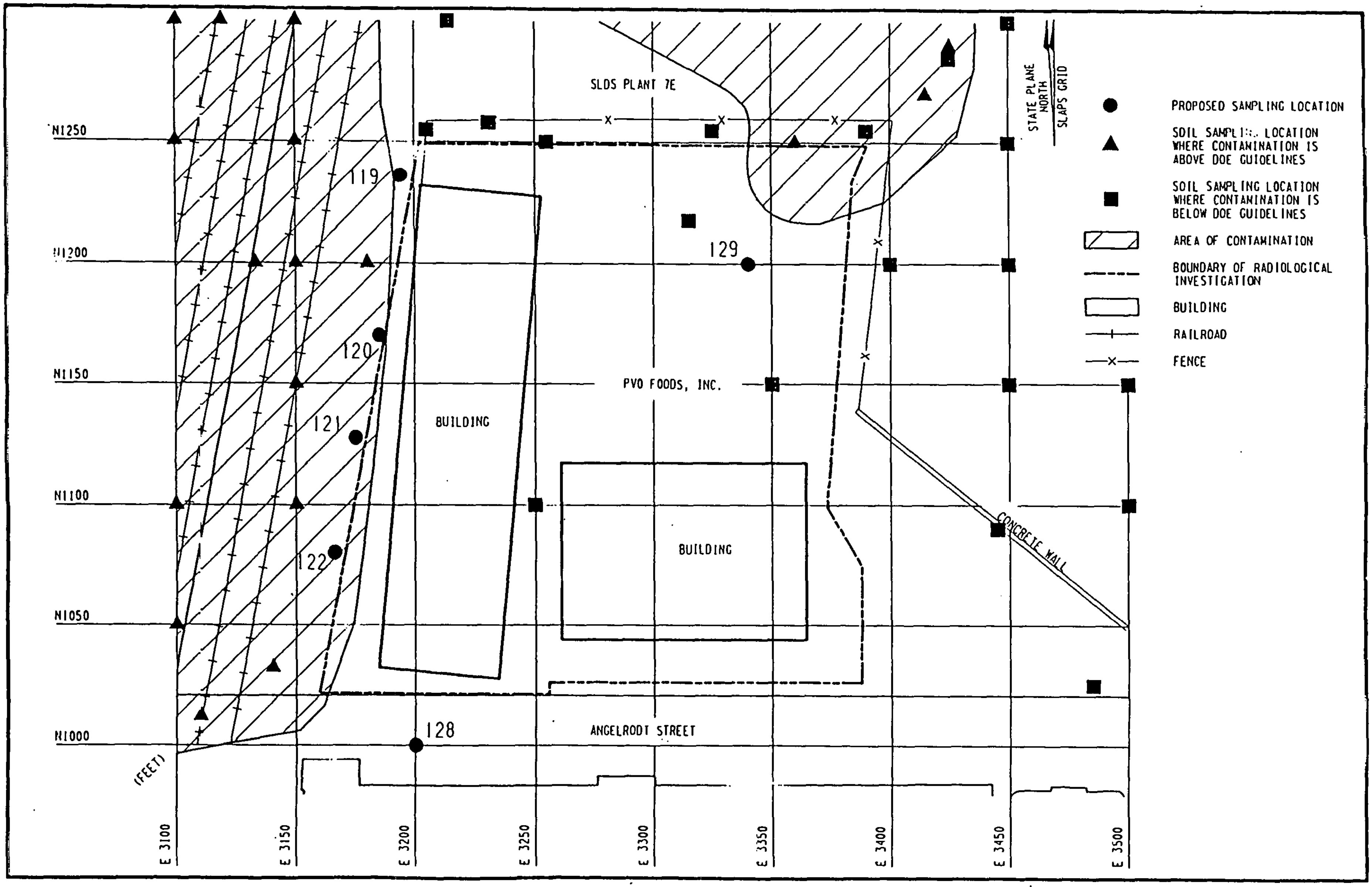

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Figure 2-11
Soil Sampling Locations at the PVO Foods, Inc., Property

Radionuclide concentrations exceed remedial action guidelines in 26 of 65 samples collected from 49 sampling locations at the Thomas and Proetz Lumber Company property. These 26 samples were collected near the fence at the northern and eastern property boundaries and across the entire width of the eastern two-thirds of the property. Archived soil samples collected beneath the depth of known contamination from 6 of these 26 locations will be retrieved for analysis, and 10 additional boreholes will be drilled to a depth of 0.9 m (3 ft) at locations shown in Figure 2-9.

At the McKinley Iron Company property, radionuclide concentrations exceed remedial action guidelines in 19 of 42 samples collected and analyzed from 39 sampling locations between the site fences and adjacent to the company building. Soil samples collected beneath the depth of known contamination from 14 of these 19 locations will be retrieved from archive for analysis. Fifteen additional boreholes will be drilled to a depth of 0.9 m (3 ft) at the locations shown in Figure 2-10.

None of the 13 samples collected and analyzed from 9 sampling locations at the PVO Foods, Inc., property exhibit radionuclide concentrations exceeding remedial action guidelines; however, contamination was found on the Chicago, Burlington, and Quincy Railroad west of PVO Foods. Six boreholes will be drilled to investigate the extent of contamination: four on the eastern edge of the railroad property at locations adjacent to the PVO Foods property, one on the property itself, and one near the southwestern corner of the property (see Figure 2-11).

Table 2-4 provides the coordinates of proposed borehole locations at the SLDS vicinity properties.

2.2.4 Objective 4: Collect Background Soil and Groundwater Samples from the Vicinity of SLDS and SLAPS for Chemical Analyses

Background samples will be collected near SLDS and SLAPS to determine the naturally occurring levels of chemical constituents in soil and groundwater in the vicinity of each site. A geologist will be present to determine appropriate sampling locations and

Table 2-4
Proposed Borehole Locations at SLDS Vicinity Properties

Location Identification[a]	Coordinate East	Coordinate North
Norfolk & Western Railroad Property		
44	1353	2485
45	1385	2460
46	1340	2431
47	1394	2413
48	1353	2350
49	1397	2300
50	1314	2300
51	1403	2087
52	1370	1992
53	1380	1844
54	1363	1773
55	1410	1720
56	1408	1593
57	1410	1535
58	1487	1465
59	1409	1330
60	1386	1275
61	1137	1134
62	1437	1105
63	1182	1067
64	1284	1066
65	1448	1035
66	1357	961
67	1394	931
68	1350	890
130	1340	2150

Table 2-4

(continued)

Location Identification[a]	Coordinate East	Coordinate North
St. Louis Terminal Railroad Association Property		
69	2123	2400
70	2066	2352
71	2090	2237
72	2180	2240
73	2082	2140
74	2055	2000
75	2062	1880
76	2058	1740
77	2047	1468
78	2056	1395
79	2056	1202
80	2053	1000
81	2135	944
82	2075	925
83	2110	900
84	2075	875
Chicago, Burlington, and Quincy Railroad Property		
85	3206	1944
86	3247	1856
87	3200	1770
88	3147	1600
89	3120	1442
90	3044	980
91	3124	967
92	3058	922
93	3005	872
Thomas & Proetz Lumber Co. Property		
94	2350	1218
95	2558	1212
96	2633	1210
97	2505	1150
98	2630	1155
99	2350	1122
100	2410	1075
101	2187	1060
102	2500	1060
103	2576	1055

Table 2-4

(continued)

Location Identification[a]	Coordinate East	Coordinate North
McKinley Iron Company Property		
104	2187	2175
105	2172	2123
106	2412	2047
107	2362	2012
108	2440	1960
109	2900	1925
110	2171	1920
111	2676	1912
112	2400	1900
113	3170	1900
114	2960	1870
115	2480	2100
116	2500	2000
117	2700	2000
118	2900	2000
PVO Foods, Inc., Property[b]		
119	3194	1236
120	3185	1170
121	3175	1128
122	3166	1080
128	3200	1000
129	3340	1200

[a]Proposed locations are shown in Figures 2-6 through 2-11.

[b]Locations 119-122 are along the PVO Foods property fenceline on the Chicago, Burlington, and Quincy Railroad property.

NOTE: Maximum drilling depth for all boreholes will be 0.9 m (3 ft); samples collected from the surface interval [0 to 0.15 m (0 to 0.5 ft)] will be analyzed.

depths to ensure that the background samples collected are representative of St. Louis site geology. Samples will be collected offsite to ensure that no onsite contamination contributes to background levels. Samples will be collected from undisturbed, nonindustrialized areas (such as parks and wooded areas) using the same protocols and procedures as those followed for the site field investigation. A minimum of 10 soil samples (total of 20 samples) will be collected from the areas surrounding SLAPS and SLDS (Figures 2-12 and 2-13) and analyzed to determine average background concentrations of the parameters of interest, including volatile organic compounds (VOCs), base/neutral and acid extractable (BNAE) organics, and metals. All samples will be collected using a stainless steel split spoon sampler.

A groundwater sample will be collected from upgradient wells at SLDS (well W01S) and SLAPS (well B53W20S) and analyzed for the above parameters.

2.2.5 Objective 5: Collect and Analyze Sediment Samples from the Mississippi River to Determine Concentrations of Radioactive Contaminants

As part of the radiological characterization at SLDS, sediment samples were collected along the western bank of the Mississippi River in an area east of the Mallinckrodt property (Figure 2-14). Two samples indicated elevated levels of radionuclides. To verify contamination in these areas and to determine the boundaries of contamination and whether the sediment has migrated downstream from the area, ten additional samples will be collected from the riverbed (Figure 2-14). Table 2-5 lists the sampling locations and coordinates. If possible, sampling will take place when the water level in the river is low and the suspect areas are not underwater; if the water level is high, a boat with a hull designed for stability will be used to collect samples as near the specified locations as possible. If water levels are low, sediments will be sampled to a depth of 0.9 m (3 ft) (where practicable) in a manner similar to that described in Subsection 2.2.1. In areas covered by water, sediment samples will be collected from the river bottom

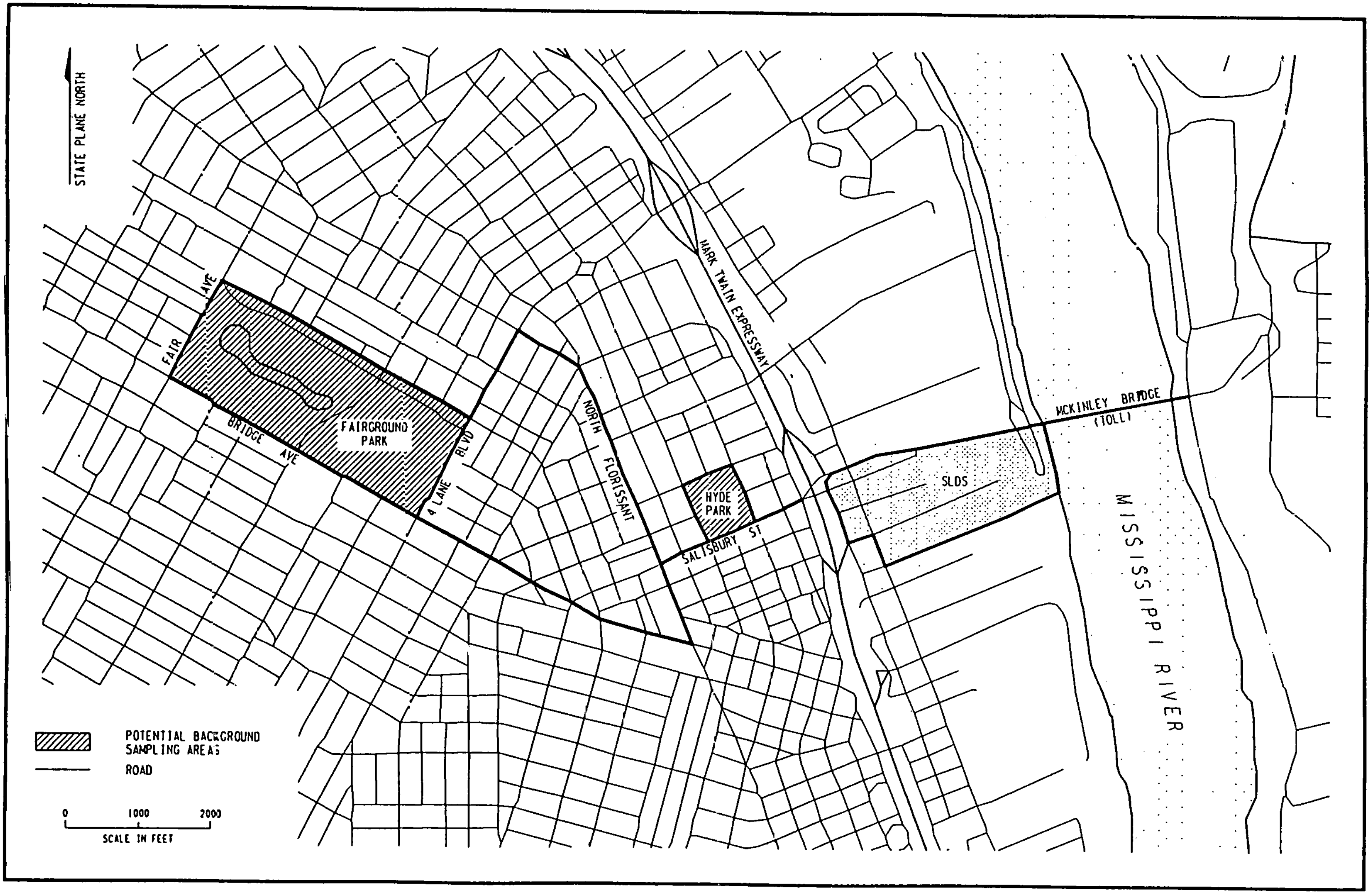

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Figure 2-12
Potential Areas for Background Sampling in the Vicinity of SLDS

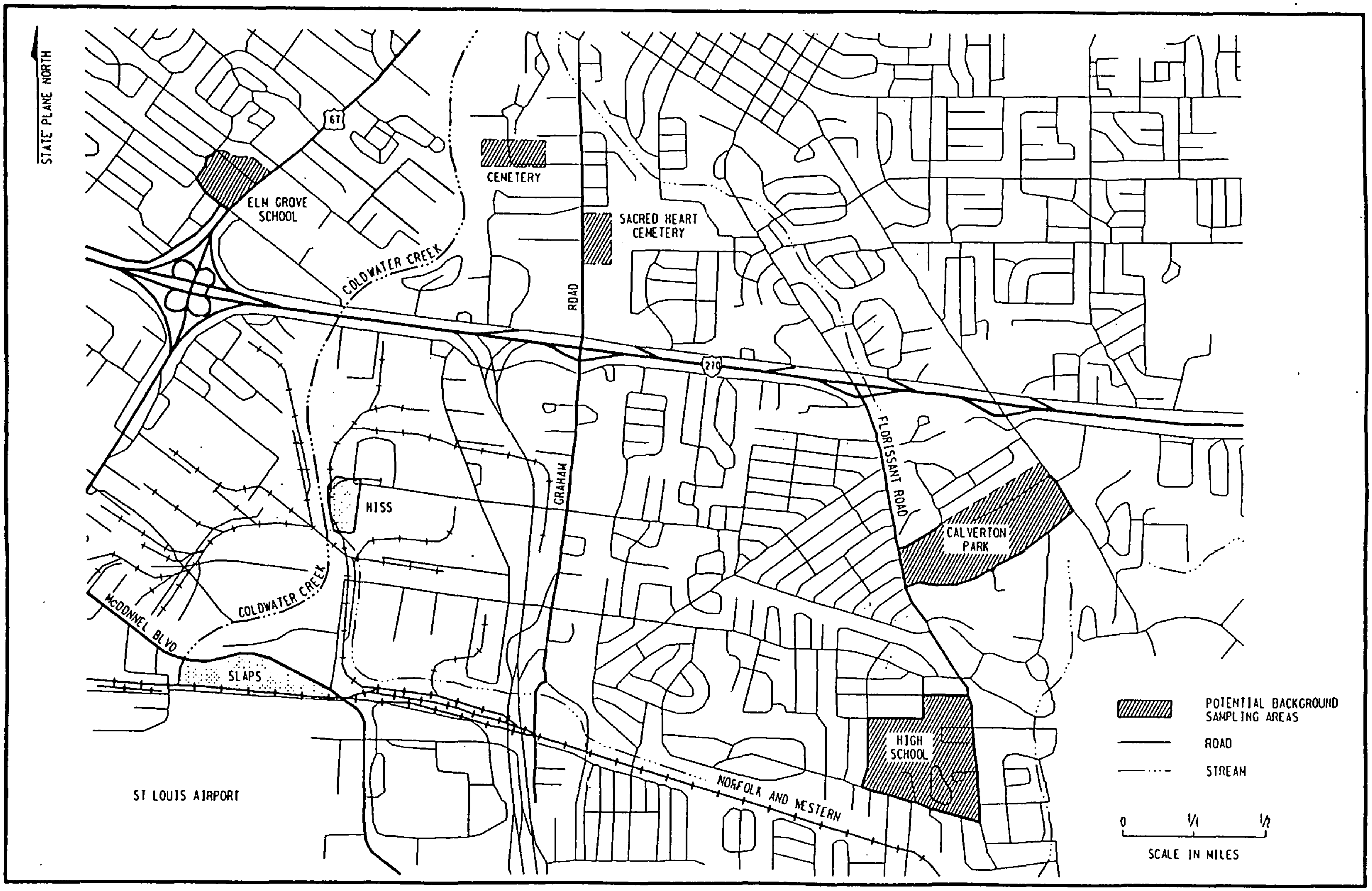

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Figure 2-13
Potential Areas for Background Sampling in the Vicinity of SLAPS

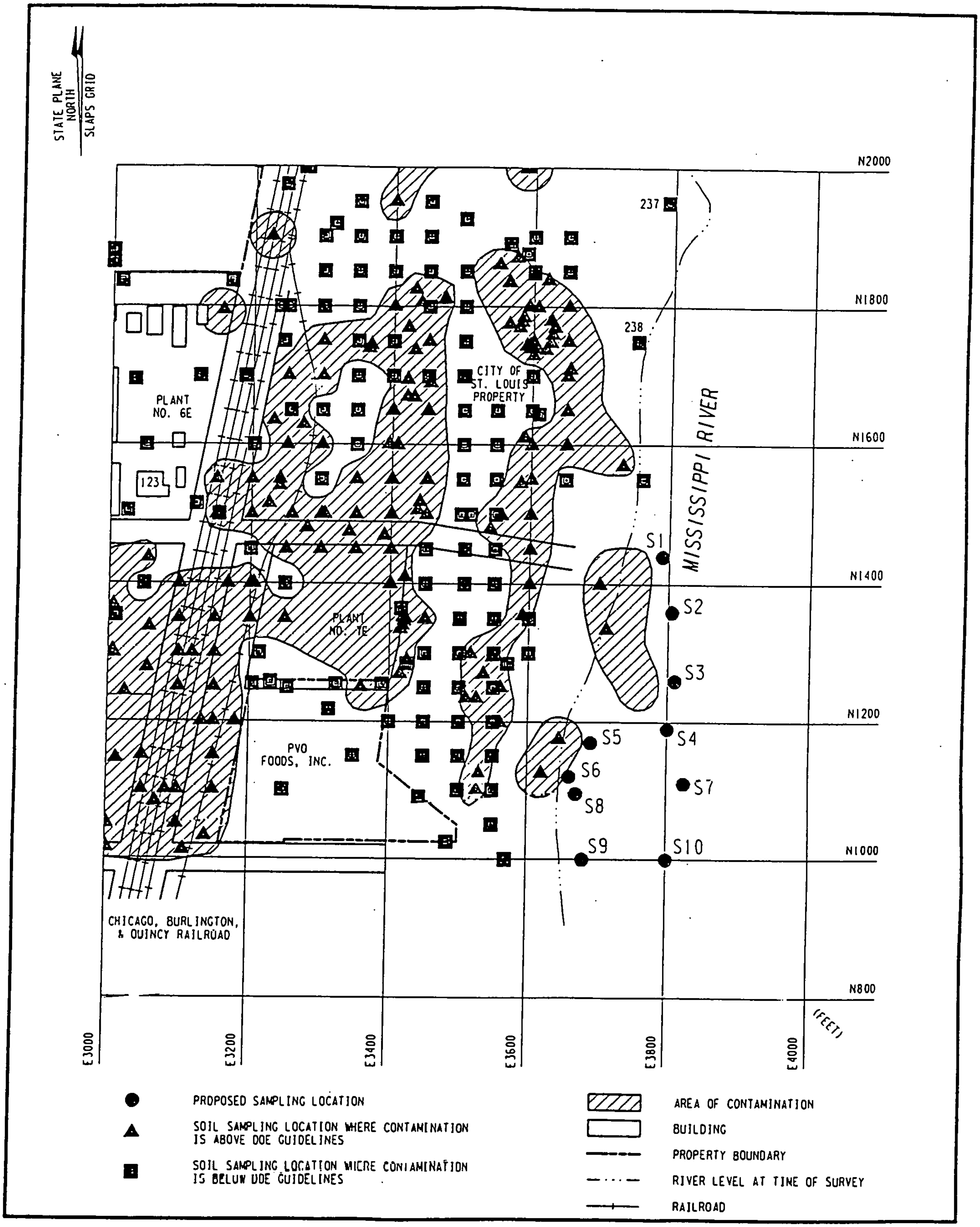

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Figure 2-14
Sediment Sampling Locations at the Mississippi River

Table 2-5

Proposed Sediment Sampling Locations at the Mississippi River

Location Identification[a]	Coordinate	
	East	North
S1	3790	1440
S2	3805	1360
S3	3810	1260
S4	3800	1190
S5	3690	1170
S6	3660	1120
S7	3825	1110
S8	3670	1095
S9	3680	1000
S10	3800	1000

[a]Proposed locations are shown in Figure 2-14.

with Peterson-type (clam-shell) grab samplers. All sediment samples will be analyzed for uranium-238, radium-226, thorium-232, and thorium-230.

2.2.6 Objective 6: Collect and Analyze Soil Samples to Determine Whether Mixed Waste is Present

To evaluate the potential presence of mixed waste at the St. Louis site, grab samples will be collected from within the zone of radioactive contamination at SLDS and SLAPS and submitted for toxicity characteristic leaching procedure (TCLP) total analysis (including both organic and inorganic parameters). All samples will be collected using stainless steel split spoon samplers.

At SLDS, 15 sampling locations (shown in Figure 2-15) were biased toward areas that were known to have failed the extraction procedure toxicity test for metals or have high levels of total metals and were selected to provide spatial coverage of the site. Table 2-6 lists proposed sampling locations and depths. Additionally, samples from some deep borehole intervals will be submitted for TCLP total analysis.

At SLAPS, 15 sampling locations (shown in Figure 2-16) were chosen to provide spatial coverage of the site. Table 2-7 lists proposed sampling locations and depths. Additionally, samples from some deep borehole intervals will be submitted for TCLP total analysis.

2.2.7 Objective 7: Complete Groundwater Characterization at SLDS, SLAPS, and HISS

Groundwater data collected previously at SLDS, SLAPS, and HISS do not completely define the boundaries of contamination. To complete the groundwater characterization at these locations, as many as 22 additional groundwater monitoring wells may be installed. (Four of these wells may not be necessary if deep groundwater is not found at HISS or if deep groundwater is not contaminated and is isolated from perched water.)

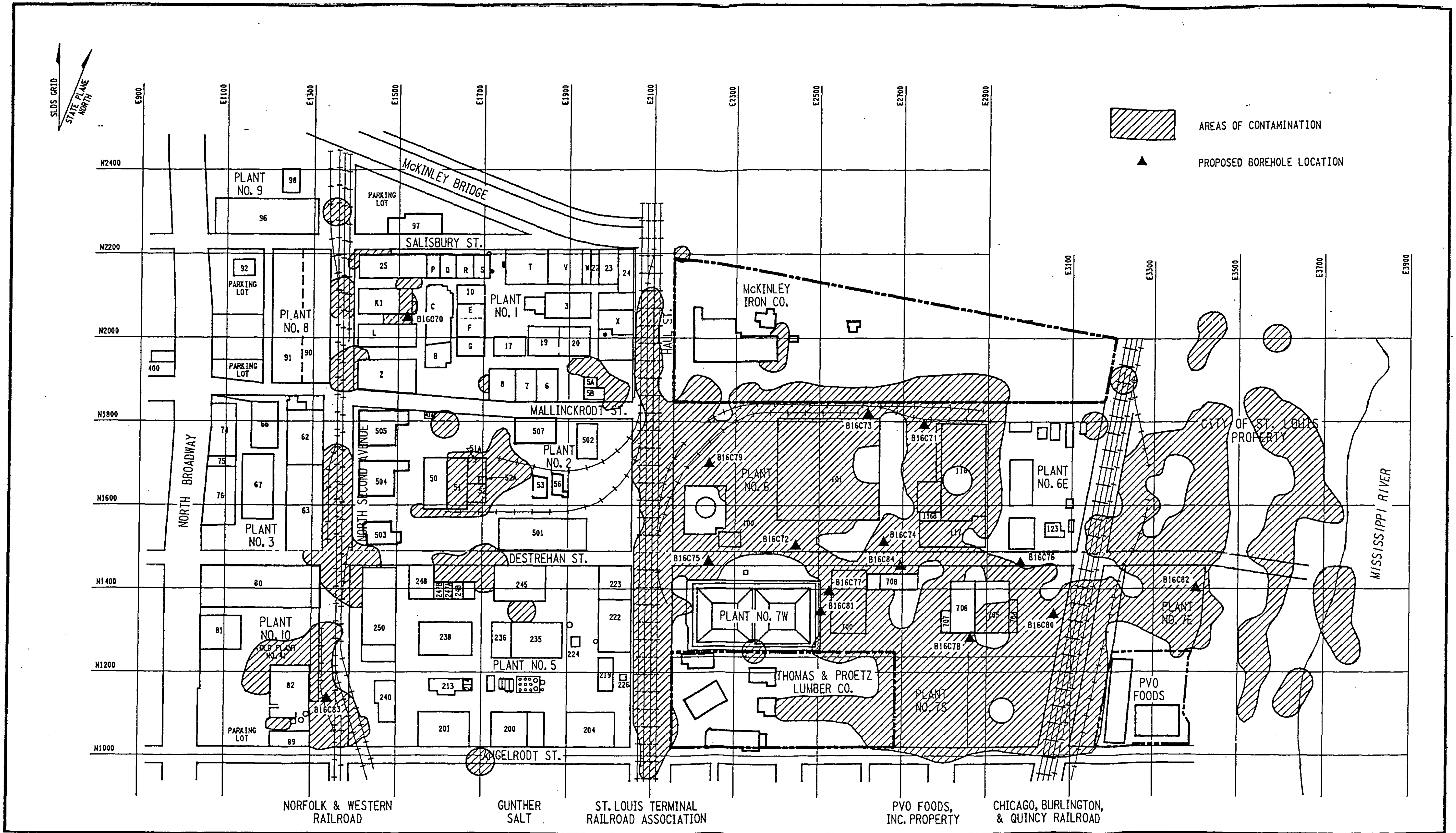

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Figure 2-15
Proposed Sampling Locations at SLDS for TCLP Total Analysis

Table 2-6

Proposed Borehole Locations and Sampling Depths for TCLP Analyses at SLDS

Location Identification[a]	Coordinate East	Coordinate North	Sampling Interval (ft)[b]	Maximum Depth (ft)[b]
B16C70	1521	2047	0-2, 8-10	10
B16C71	2749	1791	0-2, 2-4	4
B16C72	2445	1506	1-3, 3-5	5
B16C73	2616	1797	6-8, 8-10	10
B16C74	2654	1511	0-2, 8-10	10
B16C75	2225	1466	4-6, 6-8	8
B16C76	2960	1400	0-2, 6-8	8
B16C77	2514	1392	1-3, 5-7	7
B16C78	2860	1280	2-4, 11-13	13
B16C79	2244	1700	2-4, 6-8	8
B16C80	3058	1337	0-2, 2-4	4
B16C81	2515	1345	0-2, 12-14	14
B16C82	3400	1400	0-2, 2-4	4
B16C83	1337	1135	0-2, 5-7	7
B16C84	2700	1442	0-2, 5-7	7

[a]All locations and depths are approximate and are subject to change in the field. Proposed locations are shown in Figure 2-15.

[b]1 ft = 0.3048 m.

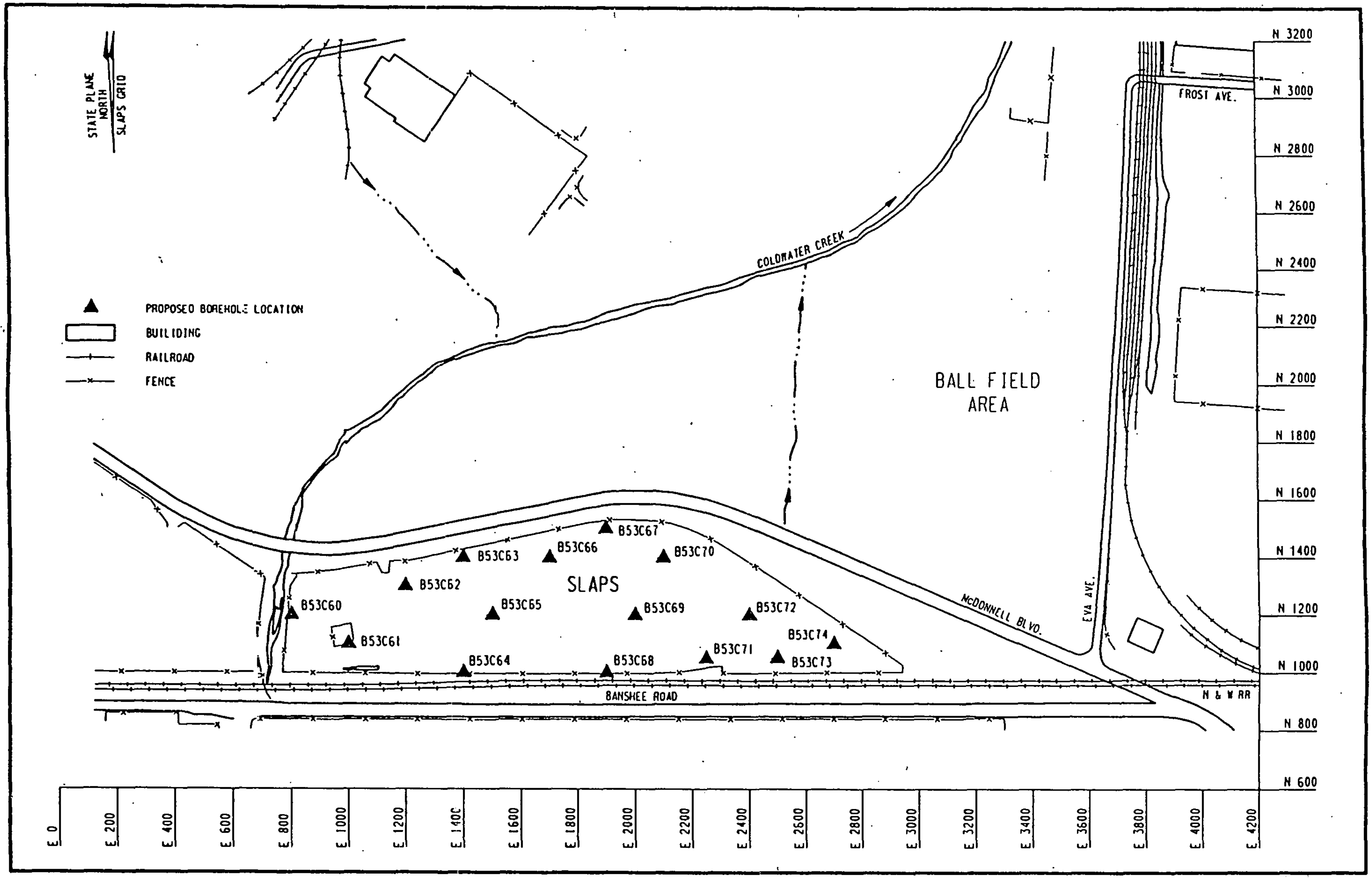

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Figure 2-16
Proposed Sampling Locations at SLAPS for TCLP Total Analysis

Table 2-7

Proposed Borehole Locations and Sampling Depths for TCLP Analyses at SLAPS

Location Identification[a]	Coordinate East	Coordinate North	Sampling Interval (ft)[b]	Maximum Depth (ft)[b]
B53C60	800	1200	2-4, 5-7	7
B53C61	1000	1100	6.5-8.5, 13-15	15
B53C62	1200	1300	4-6, 8-10	10
B53C63	1400	1400	0-2, 3-5	5
B53C64	1400	1000	7-9, 13-15	15
B53C65	1500	1200	4.5-6.5, 10-12	12
B53C66	1700	1400	2-4, 7-9	9
B53C67	1900	1500	0-2, 7-9	9
B53C68	1900	1000	2-4, 4-6	6
B53C69	2000	1200	1-3, 6-8	8
B53C70	2100	1400	0-2, 9.5-11.5	11.5
B53C71	2250	1050	0.5-2.5, 4-6	6
B53C72	2400	1200	2-4, 8-10	10
B53C73	2500	1050	1-3, 5-7	7
B53C74	2700	1100	1.5-3.5, 4-6	6

[a]Proposed locations are shown in Figure 2-16.

[b]1 ft = 0.3048 m.

Data obtained from this additional sampling are critical to the understanding of the nature of the contamination at the properties and the rate of contaminant migration.

SLDS

Eight additional groundwater monitoring wells will be installed at SLDS at locations shown in Figure 2-17. In addition, one borehole (B16C85) will be drilled in the center of Building 52 at SLDS. Table 2-8 lists locations, coordinates, and sampling intervals. The following is a detailed description of the sampling activities for each well location at SLDS.

Well B16W05S. During the drilling of well B16W05S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged well B16W05D. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.15- to 0.8-m and 4.3- to 5.2-m (0.5- to 2.5-ft and 14- to 16-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 4.6- to 5.2-m and 5.5- to 6.1-m (15- to 17-ft and 18- to 20-ft) intervals, which should be silty sand and clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at

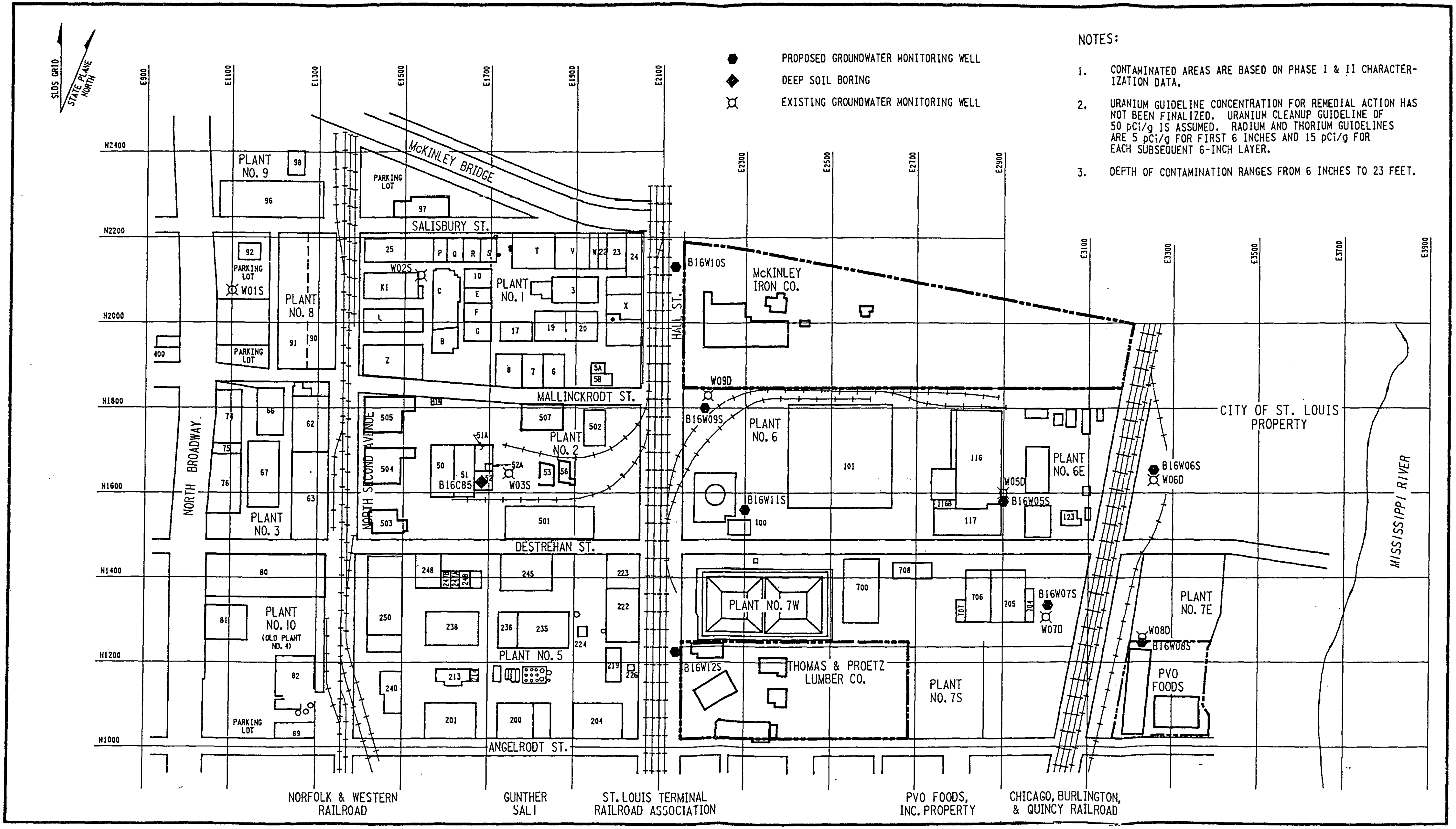

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Figure 2-17
Locations for Additional Borehole and Groundwater Monitoring Wells at SLDS

Table 2-8
Proposed Borehole Locations and Depths for Monitoring Wells at SLDS

Location Identification[a]	Coordinate East	Coordinate North	Maximum Depth (ft)	Sampling Interval (ft) TCLP Sample	Radiological Sample	Geotech Sample[b]
B16C85	1683	1634	35	8-10 23-25 25-27 27-29 29-31 31-33 33-35	8-10	None
B16W05S	2900	1579	--[c]	-- 0.5-2.5 14-16	0-0.5 0.5-2.5 14-16	15-17 18-20 --
B16W06S	3255	1685	--[c]	-- 1.5-3.5 9-11	0-0.5 1.5-3.5 9-11	15-17 17-19 --
B16W07S	3006	1335	--[c]	-- 5-7 11-13	0-0.5 5-7 11-13	15-17 17-19 --
B16W08S	3230	1245	--[c]	-- 1.5-3.5 13-15	0-0.5 1.5-3.5 13-15	12-14 19-21 --
B16W09S	2200	1800	--[c]	-- 6-8 10-12	0-0.5 6-8 10-12	12-14 14-16 --
B16W10S	2130	2130	--[c]	-- --[d]	0-0.5 --[d]	12-14 14.5-16.5
B16W11S	2300	1560	--[c]	-- 6-8 10-12	0-0.5 6-8 10-12	12-14 14-15.5 --
B16W12S	2136	1225	--[c]	-- --[d]	0-0.5 --[d]	10-12 12-14

[a]Proposed locations are shown in Figure 2-17.

[b]Geotech samples will be collected from first clay interval encountered and 0.9 m (3 ft) below static water level.

[c]Maximum depth will be determined by a geologist.

[d]Sampling intervals will be determined by gamma logging and will include the interval with the highest gamma activity and the first interval where gamma activity is below background.

the silty sand/clay interface [estimated to be at a depth of 7.9 m (17.5 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth 5.3 to 7.9 m (17.5 to 26 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 10.7 m (30 to 35 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W06S. During the drilling of well B16W06S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged well B16W06D. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.5- to 1.1-m and 2.7- to 3.4-m (1.5- to 3.5-ft and 9- to 11-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 4.6- to 5.2-m and 5.2- to 5.8-m (15- to 17-ft and 17- to 19-ft) intervals, which should be clayey silt and clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the clayey silt/clay interface [estimated to be at a depth of 5.2 m (17 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth 5.2 to 7.6 m (17 to 25 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 10.7 m (30 to 35 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W07S. During the drilling of well B16W07S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged well B16W07D. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 1.5- to 2.1-m and 3.4- to 4.0-m (5- to 7-ft and 11- to 13-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 4.6- to 5.2-m and 5.2- to 5.8-m (15- to 17-ft and 17- to 19-ft) intervals, which should be clayey silt and clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the clayey silt/clay interface [estimated to be at a depth of 5.2 m (17 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth of 5.2 to 7.6 m (17 to 25 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 10.7 m (30 to 35 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W08S. During the drilling of well B16W08S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged well B16W08D. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.5- to 1.1-m and 4- to 4.6-m (1.5- to 3.5-ft and 13- to 15-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 3.7- to 4.3-m and 5.8- to 6.4-m (12- to 14-ft and 19- to 21-ft) intervals, which should be silty sand and clayey silt, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the clay/clayey silt interface [estimated to be at a depth of 6.4 m (21 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth 6.5 to 6.7 m (21 to 22 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 10.7 m (30 to 35 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W09S. During the drilling of well B16W09S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged well B16W09D. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 1.8- to 2.4-m and 3.1- to 3.7-m (6- to 8-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 3.7- to 4.3-m and 4.3- to 4.9-m (12- to 14-ft and 14- to 16-ft) intervals, which should be very fine-grained sand and clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the very fine-grained sand/clay interface [estimated to be at a depth of 4.4 m (14.5 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth of 4.4 to 5.8 m (14.5 to 19 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 12.2 m (30 to 40 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W10S. During the drilling of well B16W10S, split-spoon samples will be collected continuously throughout the depth of the borehole, except for the intervals where Shelby tube samples are collected. Three samples will be collected for chemical and/or radiological analysis based on the results of a downhole gamma survey. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the interval showing the highest gamma activity and the first interval where the gamma activity drops to background levels and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Because the sampling intervals selected for the second and third samples are based on the results of gamma logging, which is performed after the total depth of the borehole has been reached, TCLP organic sample bottles must be filled with soil from each sampling interval. The remainder of the sample from each interval must be wrapped tightly in foil. Both portions of the sample must then be stored in a cooler until drilling is completed. After gamma logging is completed, the remaining two sampling intervals are selected, packaged, and labeled. Gamma logs must be run throughout the entire depth of the borehole.

Two Shelby tube samples will be collected from the 3.7- to 4.3-m and 4.4- to 5.0-m (12- to 14-ft and 14.5- to 16.5-ft) intervals, which should be very-fine grained sand and clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the very fine sand/clay interface [estimated to be at a depth of 4.6 m (15 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth of 4.6 to 5.8 m (15 to 19 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 12.2 m (30 to 40 ft)]. The well will be set so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W11S. During the drilling of well B16W11S, continuous split spoon sampling will not be performed because this well is being installed adjacent to a previously logged borehole (B16R18). Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 1.8- to 2.4-m and 3.1- to 3.7-m (6- to 8-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 3.7- to 4.3-m and 4.3- to 4.7-m (12- to 14-ft and 14- to 15.5-ft) intervals, which should be rubbley clay and undisturbed clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the rubbley clay/undisturbed clay interface [estimated to be at a depth of 4.7 m (15.5 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth of 4.7 to 5.0 m (15.5 to 16.5 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 12.2 m (30 to 40 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Well B16W12S. During the drilling of well B16W12S, split spoon samples will be collected continuously throughout the depth of the borehole, except for the intervals where Shelby tube samples are collected. Three samples will be collected for chemical and/or radiological analysis based on the results of a downhole gamma survey. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the interval showing the highest gamma activity and the first interval where the gamma activity drops to background levels and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Because the sampling intervals selected for the second and third samples are based on the results of gamma logging, which is performed after the total depth of the borehole has been reached, TCLP organic sample bottles must be filled with soil from each sampling interval. The remainder of the sample from each interval must be wrapped tightly in foil. Both portions of the sample must then be stored in a cooler until drilling is complete. After gamma logging is complete, the remaining two sampling intervals are selected, packaged, and labeled. Gamma logs must be run throughout the entire depth of the borehole.

Two Shelby tube samples will be collected from the 3.1- to 3.7-m and 3.7- to 4.3-m (10- to 12-ft and 12- to 14-ft) intervals, which should be sandy clay and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the sandy clay/silty clay interface [estimated to be at a depth of 3.7 m (12 ft)]. It is critical that drilling not penetrate the clay unit [estimated depth of 3.7 to 4.9 m (12 to 16 ft)].

If no perched groundwater is detected, drilling and sampling will continue until deeper groundwater is reached [estimated to be at a depth of 9.2 to 12.2 m (30 to 40 ft)]. The well will be built so that 2.4 m (8 ft) of screen is below the static water level.

Borehole B16C85. During the drilling of borehole B16C85, one split spoon sample will be collected from a depth of 2.4 to 3.1 m (8 to 10 ft); the borehole will then be continuously sampled from

7 to 10.7 m (23 to 35 ft). The 0- to 7-m (0- to 23-ft) interval is not being continuously sampled because an adjacent borehole is sampled at this interval. The 2.4- to 3.1-m (8- to 10-ft) soil sample will be analyzed for TCLP total (metals and organics). The soil collected from the 7- to 7.6-m, 7.6- to 8.2-m, 8.2- to 8.8-m, 8.8- to 9.4-m, 9.4- to 10-m, and 10- to 10.7-m (23- to 25-ft, 25- to 27-ft, 27- to 29-ft, 29- to 31-ft, 31- to 33-ft, and 33- to 35-ft) intervals will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. This borehole will be grouted up after the last sample is collected.

Drill cuttings. During the drilling of wells B16W10S, B16W12S, and B16W06S at SLDS, two soil samples will be collected from the drill cuttings generated from the drilling of each of these wells. For each well, a sample will be collected from the coarsest-grained and finest-grained (clay) soil. A sufficient volume of sample will be collected to fill a 7.5-L (2-gal) plastic bottle. These samples will be shipped to the EPA laboratory for analysis of grain-size distribution, Atterberg limits, soil classification, specific gravity, unit weight, and moisture content. This information will be useful in evaluating the effectiveness of volume reduction technologies on St. Louis site soils. These samples will be shipped to the attention of Mr. Scott Hay/Mr. Clinton Cox, USEPA NREL, 1504 Avenue A, Montgomery, AL 36115-2601. The same sample-handling practices will be used as for soil samples being collected for other analyses.

SLAPS

Five additional groundwater monitoring wells will be installed at SLAPS; locations are shown in Figure 2-18. Table 2-9 lists locations, coordinates, and sampling intervals. The following is a detailed description of the sampling activities for each sampling location at SLAPS.

Well B53W12D. During the drilling of well B53W12D, continuous split spoon sampling will not be performed because this well is being installed near previously logged geological boreholes B53G16 and B53G17 and well B53W09D. Because this is a deep well, a 41-cm

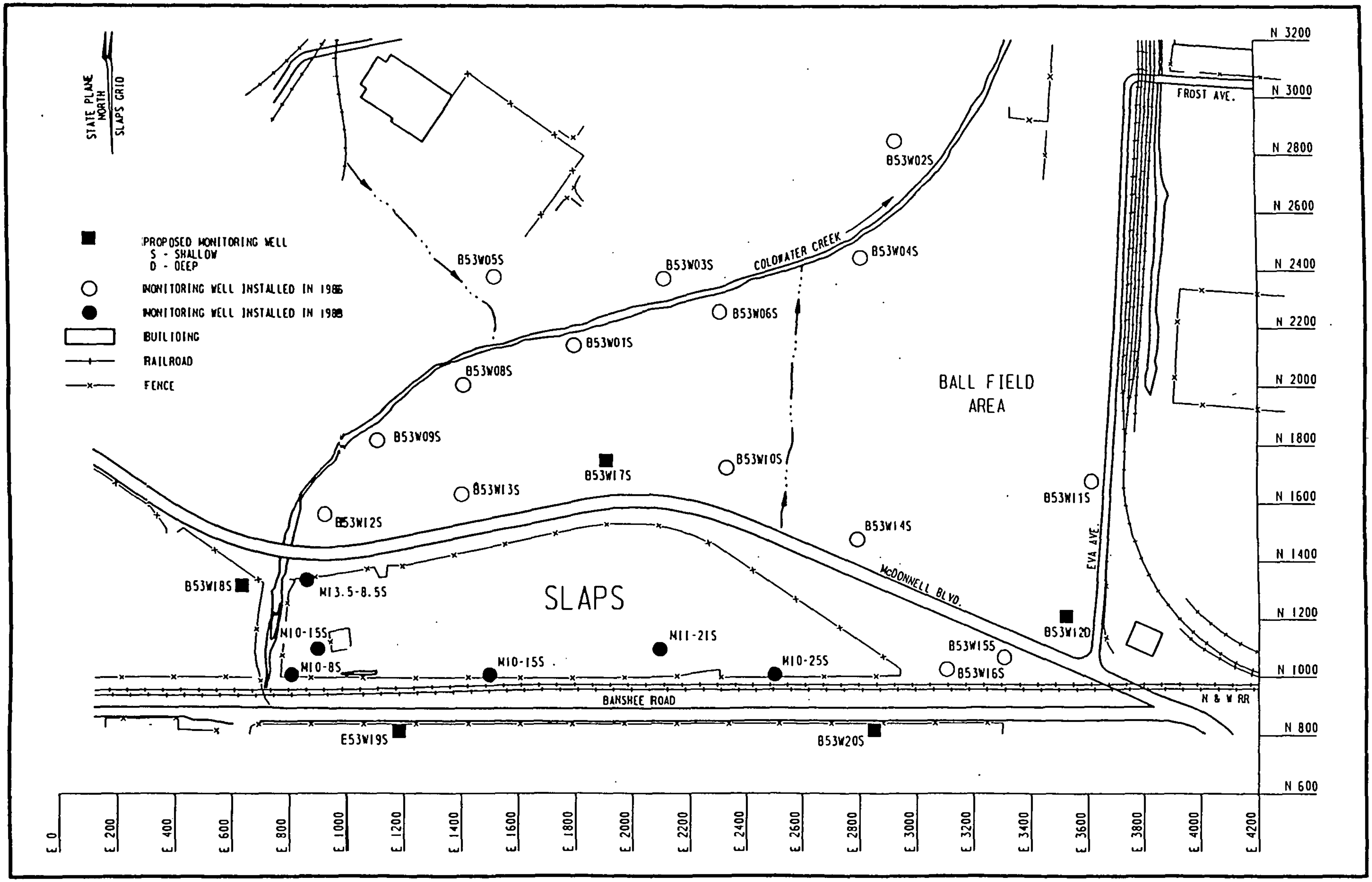

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Figure 2-18
Locations of Additional Shallow and Deep Groundwater Monitoring Wells at SLAPS

Table 2-9
Proposed Borehole Locations and Depths
for Monitoring Wells at SLAPS

Location Identification[a]	Coordinate East	Coordinate North	Maximum Depth (ft)	Sampling Interval (ft) TCLP Samples	Radiological Samples	Geotech Samples
B53W12D	3525	1210	--[b]	-- 2-4 10-12	0-0.5 2-4 10-12	25-27 45-47 --
B53W17S	1910	1750	--[b]	-- 2-4 10-12	0-0.5 2-4 10-12	22-24 29-31 --
B53W18S	675	1255	--[b]	-- 2-4 10-12	0-0.5 2-4 10-12	25-27 30-32 --
B53W19S	1180	815	--[b]	-- 2-4 10-12	0-0.5 2-4 10-12	6-8 12-14 --
B53W20S	2850	815	--[b]	-- 2-4 10-12	0-0.5 2-4 10-12	11-13 13-14.5 --

[a]Proposed locations are shown in Figure 2-18.

[b]Maximum depth will be determined by a geologist.

(16-in.) diameter conductor casing will be installed to a depth of approximately 7 m (23 ft) below ground surface. This casing will prevent perched aquifer groundwater from entering the deep well. The conductor casing will be installed approximately 0.9 m (3 ft) below the clayey silt/silty clay interface [estimated depth of 6.1 m (20 ft) below ground surface] to ensure a good seal.

Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15- (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 7.6- to 8.2-m and 13.7- to 14.3-m (25- to 27-ft and 45- to 47-ft) intervals, which should be silty clay and clayey silt, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling will continue until the bedrock/unconsolidated sediment interface is encountered [estimated depth of 15.4 m (50.5 ft)]. At this time, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If groundwater is detected, even in trace amounts, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the bedrock/unconsolidated sediment interface. The remainder of the well will be constructed in a manner identical to that for a shallow well; a 0.6-m (2-ft) bentonite seal will be installed from 0.6 to 1.2 m (2 to 4 ft) above the top of the screen, and the borehole will then be grouted to a depth several feet below the ground surface.

Well B53W17S. During the drilling of well B53W17S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged chemical and geological boreholes B53C41, B53G10, and B53G13. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10-to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 6.7- to 7.3-m and 8.8- to 9.5-m (22- to 24-ft and 29- to 31-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Well B53W18S. During the drilling of well B53W18S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged geological borehole B53G06. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 7.6- to 8.2-m and 9.2- to 9.8-m (25- to 27-ft and 30- to 32-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

If an access agreement cannot be obtained from McDonnell Douglas to drill this well, it will be installed approximately 30.5 m (100 ft) north of McDonnell Boulevard and approximately 30.5 m (100 ft) west of Coldwater Creek.

Well B53W19S. During the drilling of well B53W19S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged geological borehole B53G10-10. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 1.8- to 2.4-m and 3.7- to 4.3-m (6- to 8-ft and 12- to 14-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Well B53W20S. During the drilling of well B53W20S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged geological borehole B53G10-29. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 3.4- to 4-m and 4- to 4.4-m (11- to 13-ft and 13- to 14.5-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Drill cuttings. During the drilling of wells B53W12D, B53W17S, and B53W18S at SLAPS, two soil samples will be collected from the drill cuttings generated from the drilling of each of these wells. For each well, a sample will be collected from the coarsest-grained and finest-grained (clay) soil. A sufficient volume of sample will be collected to fill a 7.5-L (2-gal) plastic bottle. These samples will be shipped to the EPA laboratory for analysis of grain-size distribution, Atterberg limits, soil classification, specific gravity, unit weight, and moisture content. This information will be useful in evaluating the effectiveness of volume reduction technologies on St. Louis site soils. These samples will be shipped to the attention of Mr. Scott Hay/Mr. Clinton Cox, USEPA NREL, 1504 Avenue A, Montgomery, AL 36115-2601. The same sample-handling practices will be used as for soil samples being collected for other analyses.

HISS

As many as nine additional groundwater wells (four shallow and five deep) may be installed at HISS, depending on whether contamination is identified in deep groundwater. The locations of these proposed wells are shown in Figure 2-19. Well HISS5D will be the first deep groundwater well to be installed, developed, and sampled. If deep groundwater is not found in this well or if deep groundwater is not contaminated and is isolated from perched water, the additional four perimeter deep wells (HISS17D, HISS18D, HISS19D, and HISS20D) will not be installed.

Table 2-10 lists locations, coordinates, and sampling intervals. The following is a detailed description of the sampling activities for each location.

Well HISS17S. During the drilling of well HISS17S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged monitoring wells HISS6 and HISS8. Three samples will be collected for chemical

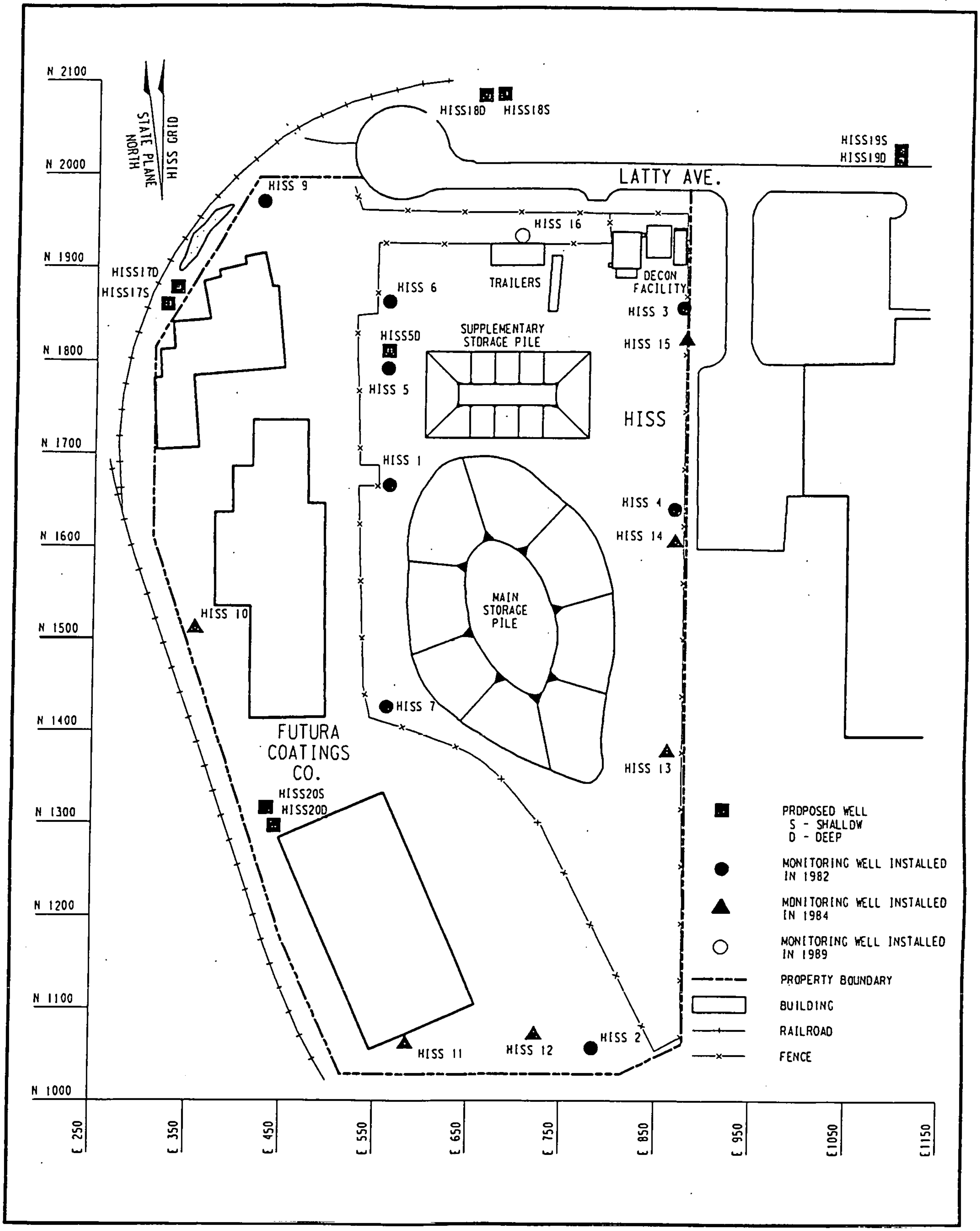

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Figure 2-19
Locations of Additional Shallow and Deep Groundwater Monitoring Wells at HISS

and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 4.3- to 4.9-m and 5.5- to 6.1-m (14- to 16-ft and 18- to 20-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Well HISS18S. During the drilling of well HISS18S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged boreholes HISS275 and HISS302. Three samples will be collected from this hole for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 4.3- to 4.9-m and 5.5- to 6.1-m (14- to 16-ft and 18- to 20-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Well HISS19S. During the drilling of well HISS19S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged borehole HISS274. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.15- to 0.8-m and 1.5- to 2.1-m (0.5- to 2.5-ft and 5- to 7-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 0.9- to 1.5-m and 2.1- to 2.7-m (3- to 5-ft and 7- to 9-ft) intervals, which should be silty clay and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Well HISS20S. During the drilling of well HISS20S, continuous split spoon sampling will not be performed because this well is being installed adjacent to previously logged borehole HISS45. Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 4.6- to 5.2-m and 5.8- to 6.4-m (15- to 17-ft and 19- to 21-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling operations will cease for a minimum of 1 h, and the borehole will be periodically monitored for groundwater. If perched groundwater is detected, the borehole will be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set 2.4 m (8 ft) below the static water level.

Well HISS5D. During the drilling of well HISS5D, continuous split spoon sampling will be performed from a depth of 18.3 m (60 ft) down to bedrock. The upper 18.3 m (60 ft) of the borehole does not need to be sampled because it is being drilled near previously logged well HISS5S. Because this is a deep well, a 41-cm (16-in.) diameter conductor casing will be installed to a depth approximately 9.5 m (31 ft) below ground surface. This casing will prevent perched aquifer groundwater from entering the deep well. The conductor casing will be installed approximately

0.9 m (3 ft) below the clayey silt/silty clay interface [estimated depth of 9.5 m (31 ft) below ground surface] to ensure a good seal.

Three samples will be collected for chemical and/or radiological analysis. The first sample will be collected from the 0- to 0.15-m (0- to 0.5-ft) interval and will be analyzed for uranium-238, radium-226, thorium-230, and thorium-232. The second and third samples will be collected from the 0.6- to 1.2-m and 3.1- to 3.7-m (2- to 4-ft and 10- to 12-ft) intervals, respectively, and will be analyzed for uranium-238, radium-226, thorium-230, thorium-232, and TCLP total (both metals and organics).

Two Shelby tube samples will be collected from the 7.6- to 8.2-m and 8.5- to 9.2-m (25- to 27-ft and 28- to 30-ft) intervals, which should be clayey silt and silty clay, respectively. These samples will be analyzed for hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, and cation exchange capacity.

After the second Shelby tube has been collected, drilling will continue [collecting samples continuously for logging purposes using a Central Mine Equipment (CME) screw-type sampler] until a water-bearing zone or bedrock is encountered. The CME screw-type sampler is a soil sampling tool composed of a 1.5-m (5-ft) split-core barrel that has a 7.6-cm (3-in.) inside diameter. During drilling, the barrel advances with the augers but does not rotate. This procedure provides an undisturbed soil sample for lithologic description.

If groundwater is detected, sampling will continue until the bottom of the permeable zone is reached. The borehole will then be secured and allowed to set overnight to allow the groundwater to equilibrate. The well should be built the following day and constructed so that the bottom of the 3-m (10-ft) screen is set at the bottom of the permeable zone. The remainder of the well will be constructed in a manner identical to that for a shallow well; a 0.6-m (2-ft) bentonite seal will be installed 1.8 m (6 ft) above the top of the screen, and the borehole will then be grouted to several feet below the ground surface.

If deep groundwater is not encountered before bedrock is encountered, this borehole will be grouted to the surface.

Wells HISS17D, HISS18D, HISS19D, and HISS20D. If contaminated or nonisolated deep groundwater is identified in well HISS5D, four additional wells (HISS17D, HISS18D, HISS19D, and HISS20D) will be installed to screen the identical water-bearing unit at the locations shown in Figure 2-19. No samples will be collected from these boreholes for chemical, radiological, or geotechnical analyses. Split-spoon samples, which will be used for lithologic description only, will be collected continuously.

If deep groundwater is not identified during the drilling of well HISS5D or if deep groundwater is not contaminated and is isolated from perched water, boreholes for wells HISS17D, HISS18D, HISS19D, and HISS20D will not be drilled.

During the drilling of wells HISS17S, HISS19S, and HISS20S, two soil samples will be collected from the drill cuttings generated from the drilling of each of these wells. For each well, a sample will be collected from the coarsest-grained and finest-grained (clay) soil. A sufficient volume of sample will be collected to fill a 7.5-L (2-gal) plastic bottle. These samples will be shipped to the EPA laboratory for analysis of grain-size distribution, Atterberg limits, soil classification, specific gravity, unit weight, and moisture content. This information will be useful in evaluating the effectiveness of volume reduction technologies on St. Louis site soils. These samples will be shipped to the attention of Mr. Scott Hay/Mr. Clinton Cox, USEPA NREL, 1504 Avenue A, Montgomery, AL 36115-2601. The same sample-handling practices will be used as for soil samples being collected for other analyses.

Drilling and well installation and development methodology

Drilling logs from previously installed wells will be used to help determine the proper setting of the new wells. Twenty-two groundwater wells and one borehole are proposed to be drilled at SLDS, SLAPS, and HISS, using augers with an inside diameter of 21 cm (8.25 in.). The augers will be advanced to the top of the sampling interval, and a sampler will be lowered through the augers. Split spoon samplers will be driven through the sampling interval with a 140-lb hammer; Shelby tube samplers will be pushed into the ground by use of hydraulics or the weight of the drill rig.

During previous drilling of boreholes in the vicinity of proposed SLDS wells B16W11S and B16W12S, concentrated methane gas pockets were encountered approximately 9 m (30 ft) below the ground surface. To avoid worker exposure to this gas, the two proposed boreholes may be drilled using water inside the augers. The water added to the augers should be from the same potable water source that is used for decontamination. Assuming that the methane gas is not under high pressure, the head of water should suppress the release of the gas.

For well HISS5D at HISS, a bucket auger will be used to drill and set a 41-cm- (16-in.-) diameter conductor casing several feet into the first clay layer underlying the first water-bearing zone. This casing will be grouted in place. After the grout has had time to set, the 21-cm- (6-in.-) inside-diameter augers can be used to drill the remainder of the hole. If deep groundwater is encountered, a well will be constructed as shown in Figure 2-20, except that the bottom of the 3-m (10-ft) screen will be set at the aquifer/aquitard interface. If deep groundwater is found to be contaminated or connected with perched groundwater in well HISS5D, the additional four deep wells will be installed in a similar manner. Otherwise, deep drilling should not be continued at HISS.

When deep well B53W12D is installed at SLAPS, a conductor casing should be used only if a confining clay unit is encountered. Based on existing maps, it appears that the clay unit, which separates the upper and lower water-bearing zones to the west, pinches out near the location proposed for installation of well B53W12D. If no confining bed is encountered, drilling should continue to bedrock. The bottom of the well screen should be set at the bedrock/unconsolidated sediment interface.

All wells will be installed as shown in Figure 2-20 except as noted for the deep wells. Each monitoring well will be constructed of 10-cm- (4-in.-) diameter stainless steel screen [3 m (10 ft) in

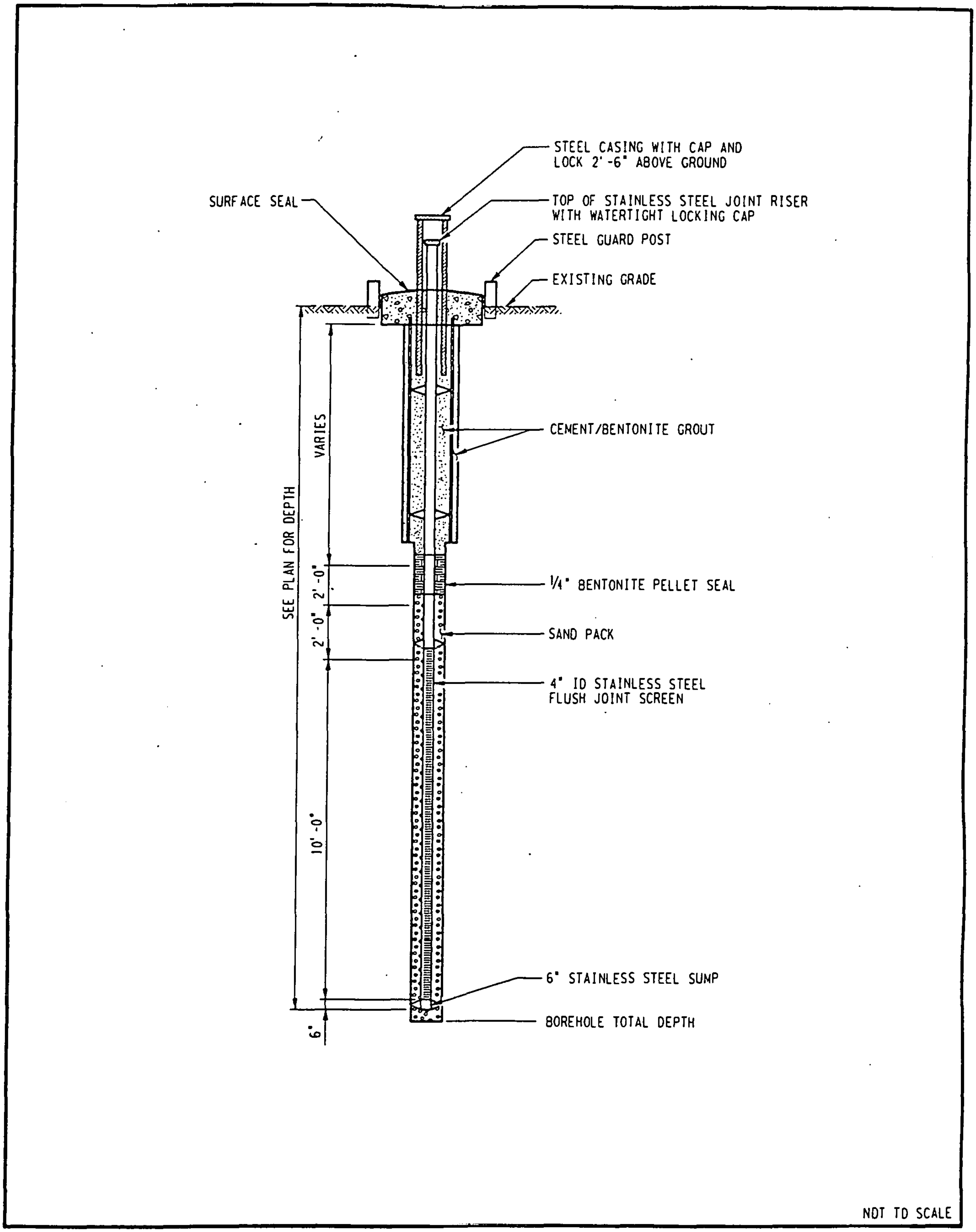

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Figure 2-20
Typical Above-Ground Well Completion

length] in combination with a stainless steel sump [10 cm (4 in.) in length] and a 10-cm- (4-in.-) diameter stainless steel riser pipe (Figure 2-20). Previous investigations at SLDS, SLAPS, and HISS indicate that 0.025-cm (0.01-in.) slotted screen is most appropriate.

A silica sand pack with a grain size distribution compatible with the slot size will be selected (Driscoll 1986). Based on previous knowledge of the site, a grain size of 30/40 is expected to be the most appropriate. A tremie pipe will be used to build the filter pack from the bottom of the hole to 0.6 m (2 ft) above the top of the well screen. A 0.6-m- (2-ft-) thick bentonite seal will be built above the sand pack using bentonite pellets, which will be allowed to hydrate for approximately 2 h. The remainder of the borehole will then be tremie-grouted with a Portland Type I/II cement/bentonite grout mixture (4 to 5 percent bentonite by weight) to a depth of approximately 1 m (3 ft) below ground surface. The wells at SLDS will be completed flush with existing grade; the wells at SLAPS and HISS will be of both flush and above-ground completion types (Figures 2-20 and 2-21). All wells will be sealed with watertight caps and will have locking protective steel casings.

To avoid possible damage to wells, a well will not be developed earlier than three days after installation. As part of the development process, each well will be thoroughly surged with a surge block before pumping. The surging action helps to clean the well screen and develop the sand pack. The well will then be pumped at multiple rates, with the pump intake at multiple levels in the well screen (this may not be possible for low-production wells). All development water will be containerized and analyzed to determine the proper disposal option. Each well will be developed until three well volumes are removed and the temperature (±0.5°C), pH (±0.1 units), conductivity (±10 percent), and turbidity (±5 NTUs) have stabilized. In poorly producing wells, obtaining three well volumes may not be possible. In this instance, wells will be pumped until these parameters stabilize.

A minimum of 24 h after well development, wells can be purged and sampled. In the purging process, as in the development

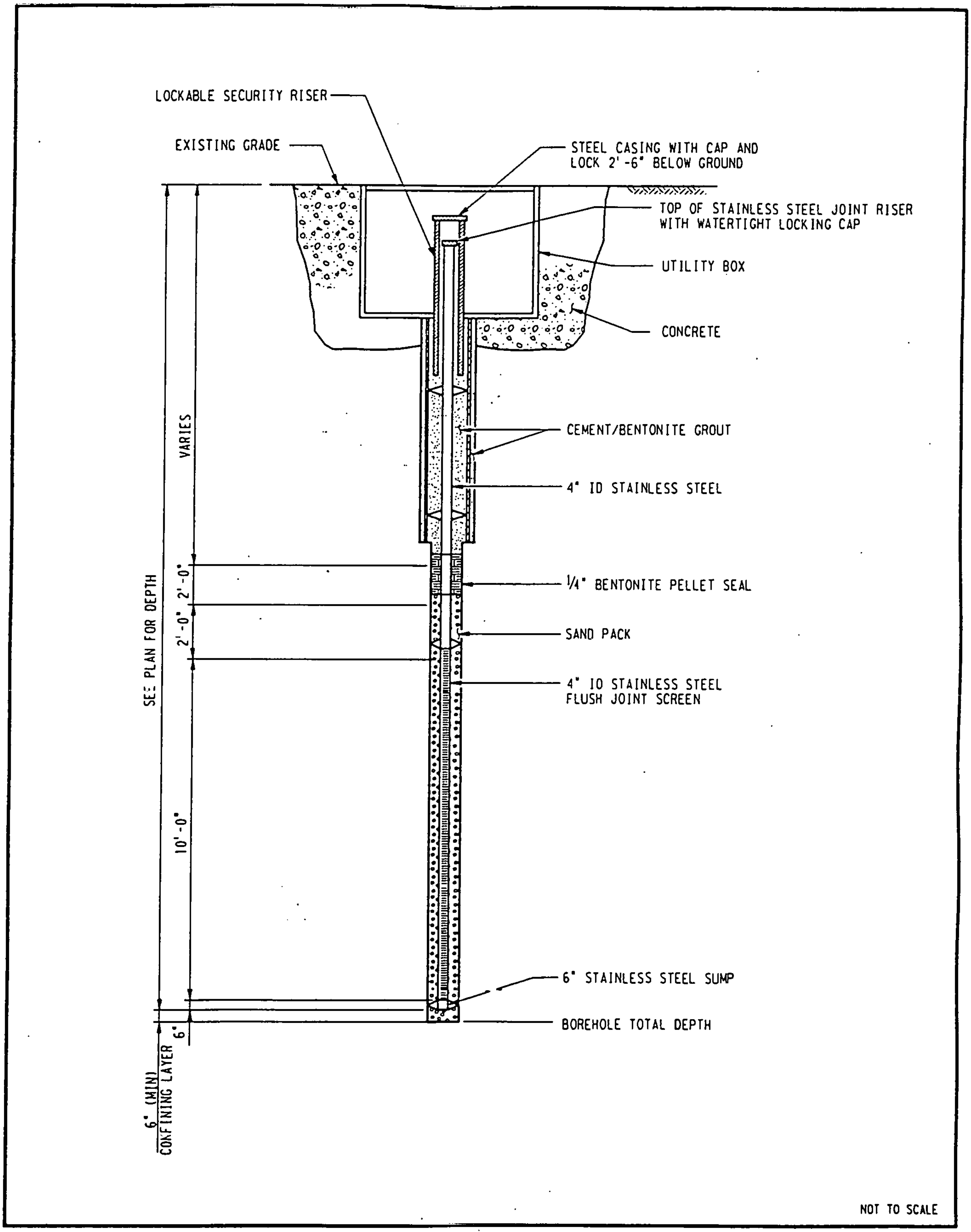

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Figure 2-21
Typical Below-Ground Well Completion

process, a well is pumped or bailed until three volumes of water have been removed, and the temperature (±0.5°C), pH (±0.1 units), conductivity (±10 percent), and turbidity (±5 NTUs) have stabilized. In poorly producing wells, obtaining three well volumes may not be possible. In this instance, wells will be pumped until these parameters stabilize. The groundwater in each of the newly installed wells will be sampled within 3 h after purging is complete. All samples will be collected using a Teflon bailer and monofilament line and will be analyzed for total uranium, radium-226, thorium-230, thorium-232, volatile organics, BNAEs, and metals. Because of potential transport of radionuclides via their adsorption onto mobile, colloidal-sized particles, samples collected for radiological analyses will not be field-filtered.

Aquifer tests will be performed in wells B16W06S, B16W10S, and B16W12S at SLDS; wells B53W17S, B53W19S, and B53W20S at SLAPS; and wells HISS17S, HISS19S, and HISS20S at HISS in an attempt to better characterize the hydrogeologic conditions at these properties. Because of the relatively low permeability of the formations at each of the properties, the slug test used will be consistent with American Society for Testing and Materials methods.

2.2.8 Objective 8: Refine Horizontal Boundaries of Soil Contamination along Haul Roads and Vicinity Properties Associated with SLAPS and HISS

Analytical results from the radiological characterization of the haul roads and vicinity properties associated with SLAPS and HISS indicate that the boundaries of contamination were not established in some of these areas (BNI 1990c). Additional sampling was conducted in 1990 at 23 properties: haul road properties 9, 12, 13, 14A, 27, 31A, 32, 46, 56, 57, 63, and 63A; Coldwater Creek properties 1, 2, 3, 5, 6, 7, 9, and 10; the Norfolk and Western Railroad property adjacent to Coldwater Creek; the Norfolk and Western Railroad property adjacent to Hazelwood Avenue and south of Latty Avenue; and the intersection of Hanley Road and Latty Avenue. Results for this sampling will be included in a report summarizing all data collected as part of the data gap sampling effort at the St. Louis site. These sampling activities established the boundaries of radioactive contamination at each of these properties.

In addition to the sampling conducted, 25 boreholes will be drilled on vicinity properties and along haul roads to refine the boundaries of contamination at other locations. A civil surveyor will establish soil sampling locations with a specified maximum tolerance of ±0.3 m (1 ft). Boreholes will be drilled using a hand-held sampling device and continuously sampled to a depth of 0.9 m (3 ft). Soil samples will be collected from the locations shown in Figures 2-22 through 2-27 at depth intervals of 0 to 0.15, 0.15 to 0.3, 0.3 to 0.6, and 0.6 to 0.9 m (0 to 0.5, 0.5 to 1, 1 to 2, and 2 to 3 ft). Table 2-11 summarizes the proposed sampling locations and coordinates. Surface soil samples will be analyzed for uranium-238, radium-226, thorium-232, and thorium-230. All other samples will be archived in case they are needed for future analysis to determine the depth of contamination.

2.2.9 Objective 9: Conduct Special Studies at the St. Louis Site

Three special studies are being conducted at the St. Louis site. The first study involves the differential migration of protactinium and actinium from the current contaminant sources. At both SLAPS and SLDS, five samples will be taken from archive and analyzed to determine whether protactinium and actinium are differentially migrating from the onsite radioactively contaminated soils. The archived samples will be selected from areas that are directly beneath contaminated soil but are considered radiologically "clean" per FUSRAP cleanup criteria. The second study involves the assimilation of thorium-230 into vegetation along the SLAPS ditches. Six vegetation samples will be collected from different species of flora growing along the contaminated ditches and analyzed for thorium-230. For the third study, surveys and measurements will be conducted at the Futura property. Limited surveys (i.e., alpha, beta-gamma, and count rate measurements) of interior walls, along with radon concentrations and exposure measurements (four per building), will be conducted in each of the

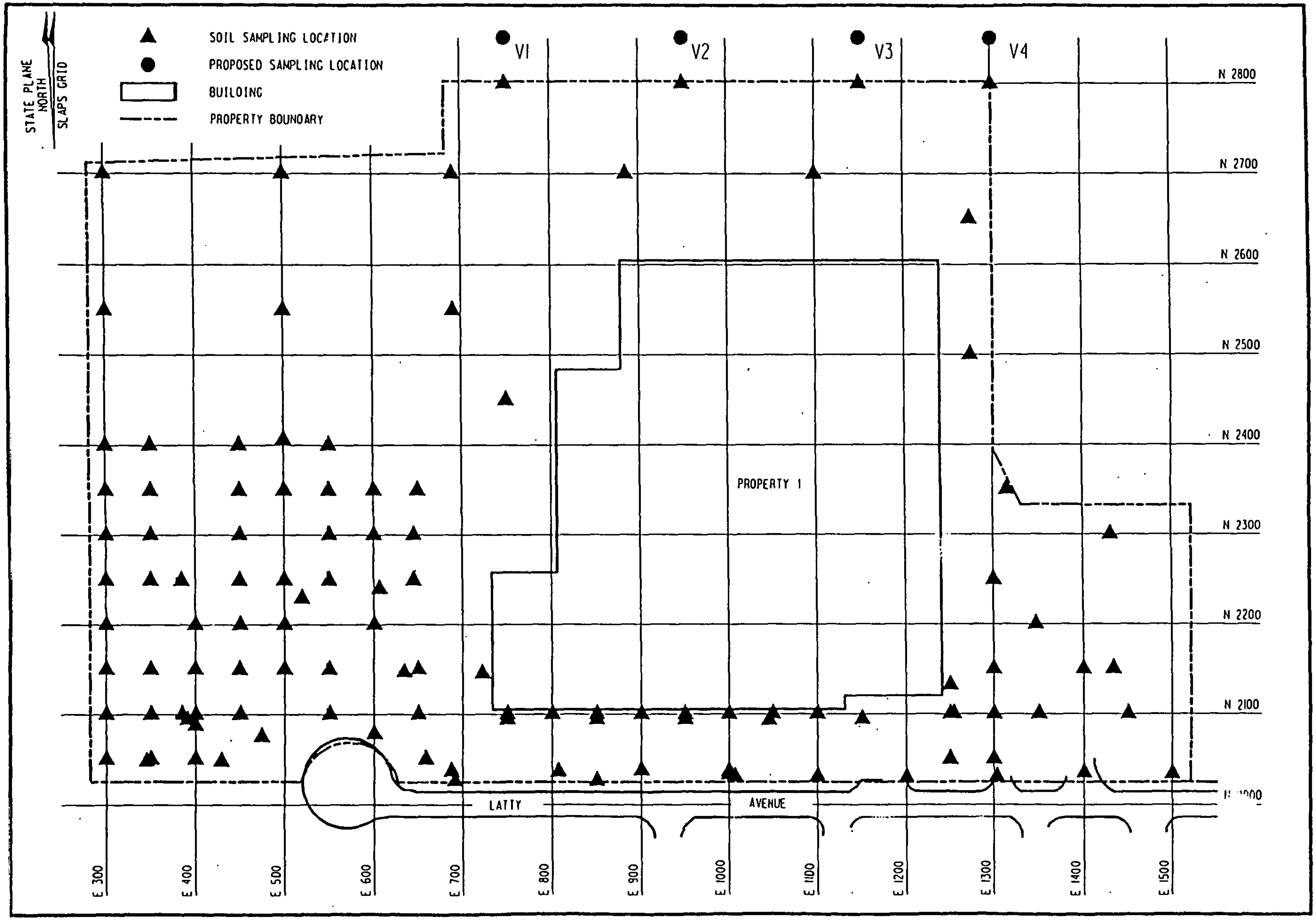

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Figure 2-22
Additional Sampling Locations Adjacent to Property 1 on Latty Avenue

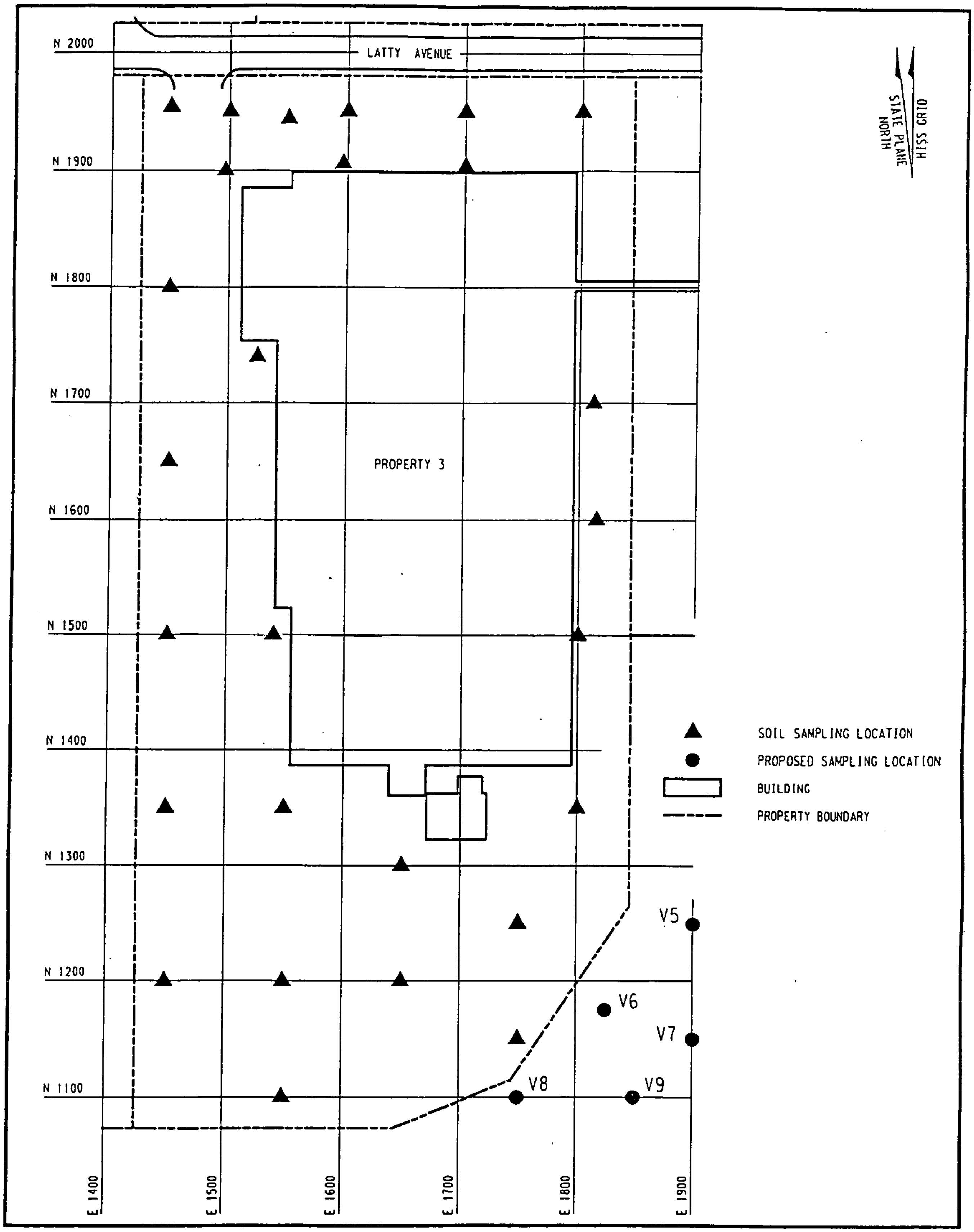

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Figure 2-23
Additional Sampling Locations
Adjacent to Property 3 Near Latty Avenue

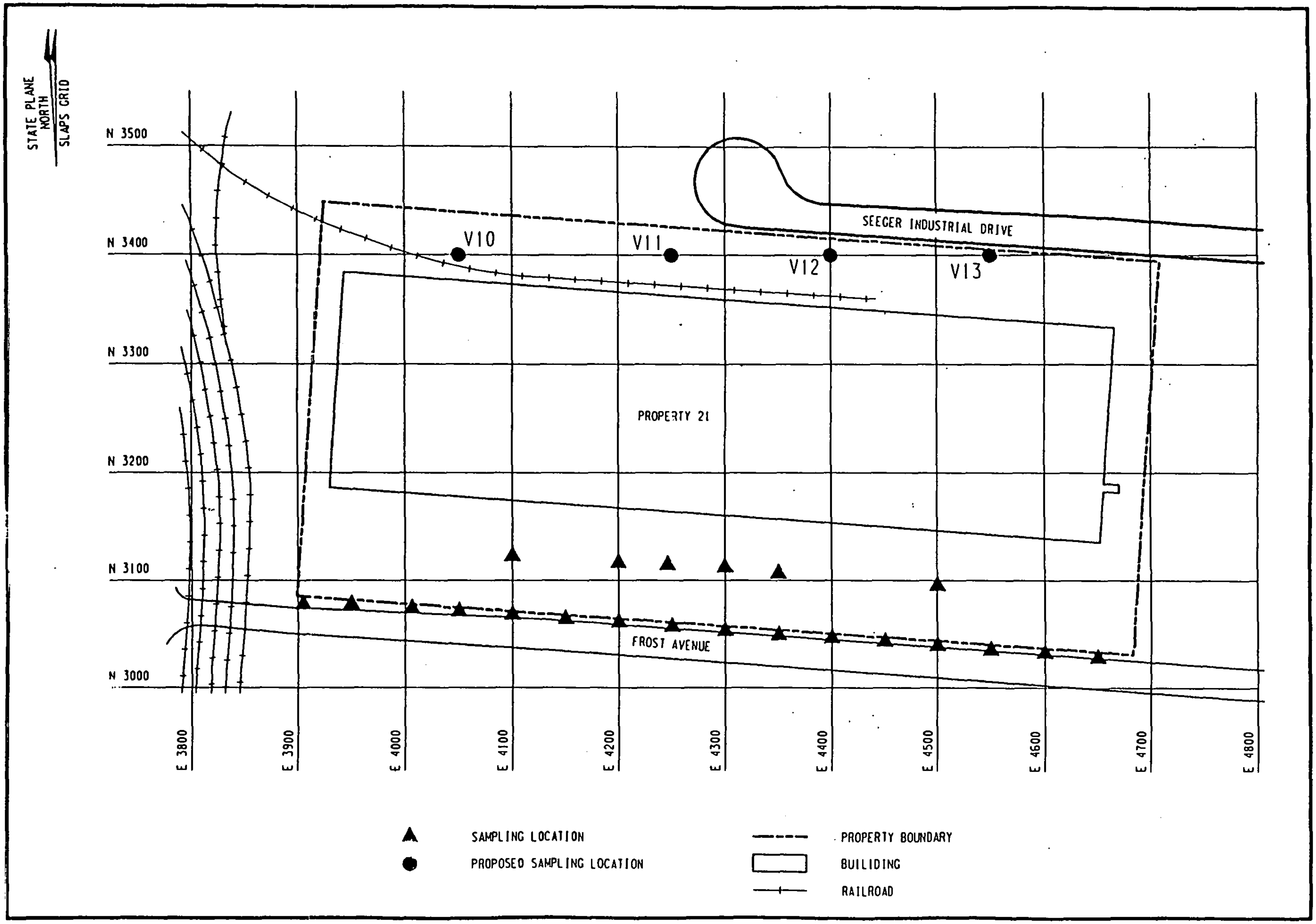

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Figure 2-24
Additional Sampling Locations for Haul Roads Vicinity Property 21

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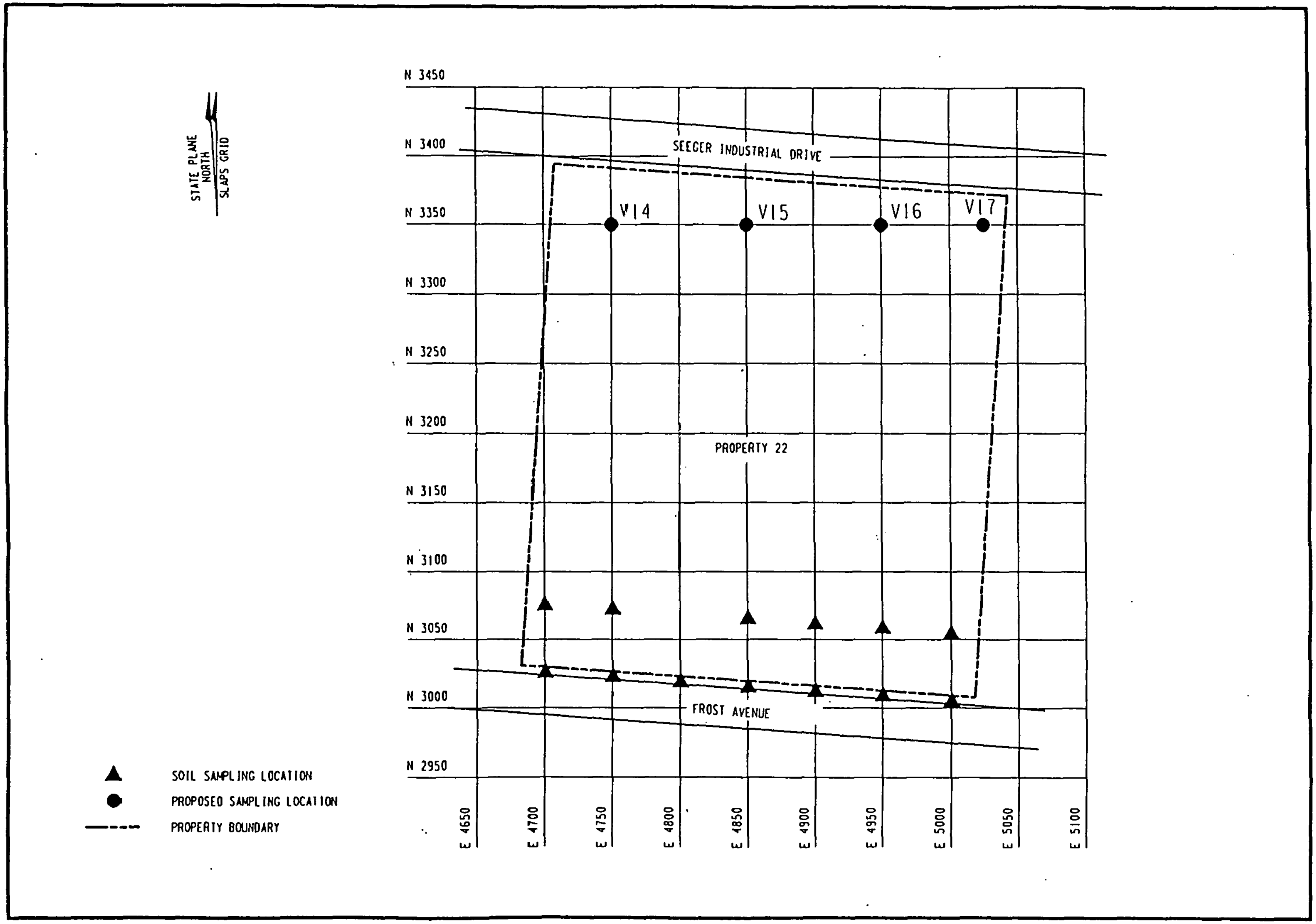

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Figure 2-25
Additional Sampling Locations for Haul Roads Vicinity Property 22

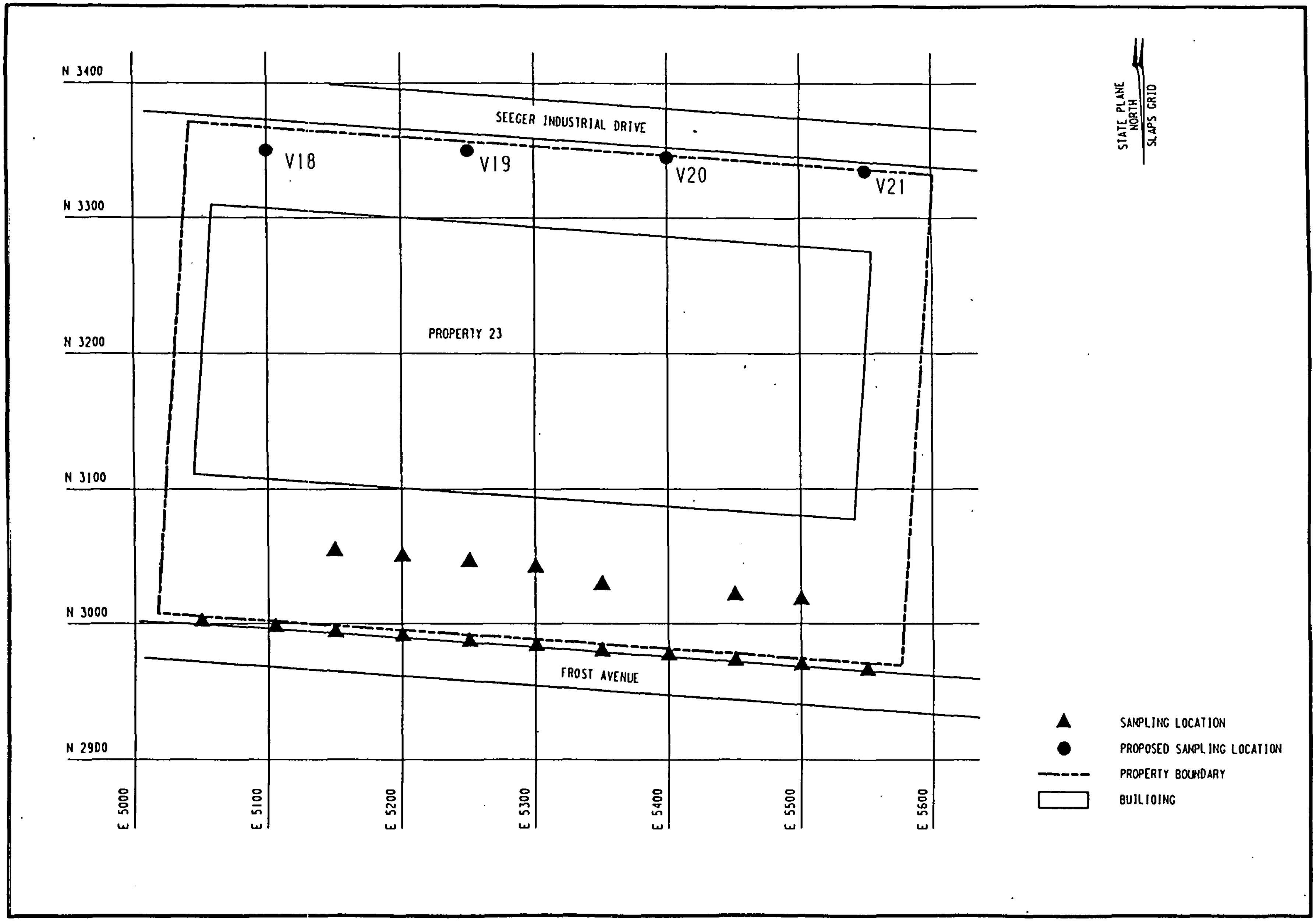

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Figure 2-26
Additional Sampling Locations for Haul Roads Vicinity Property 23

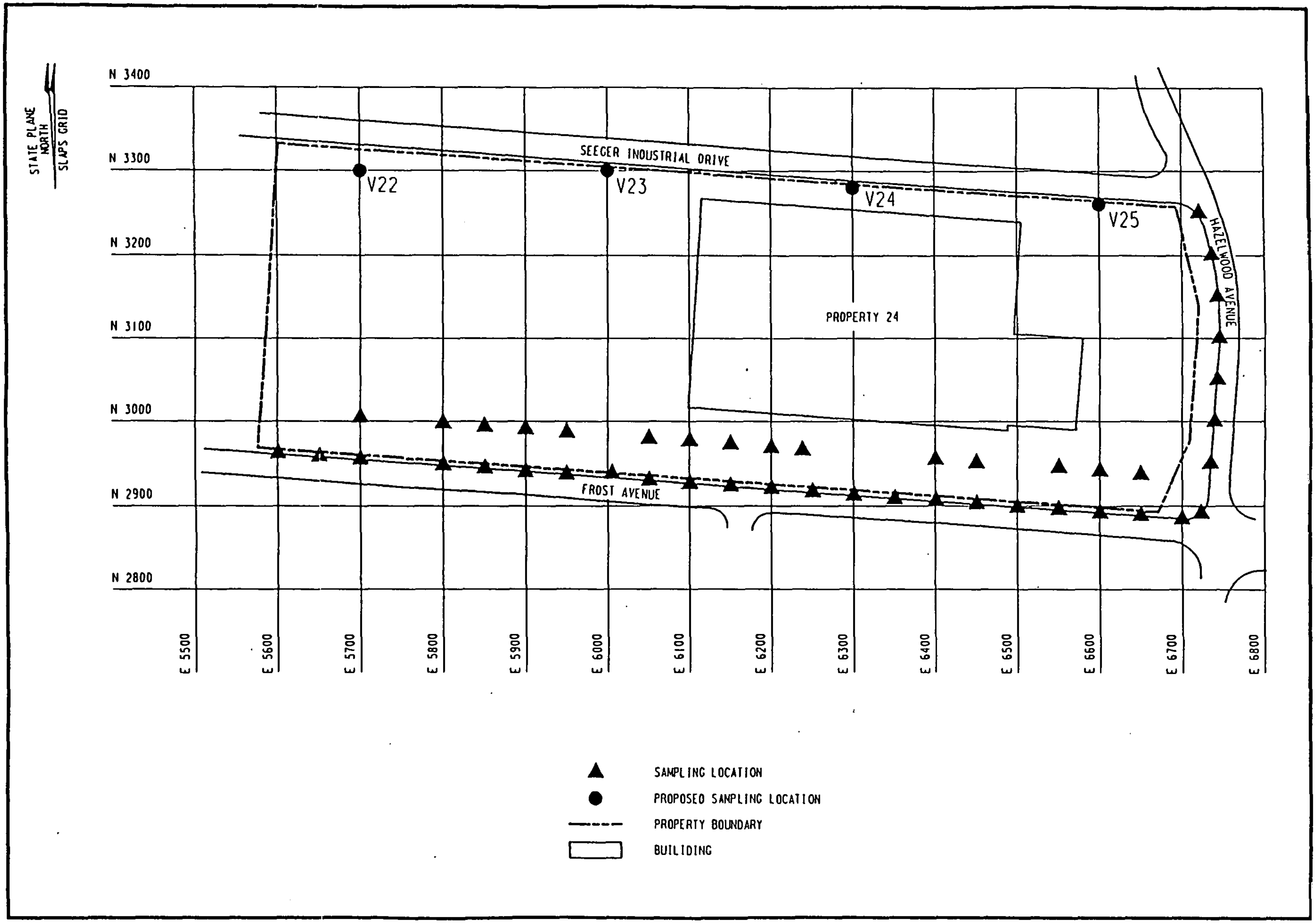

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Figure 2-27
Additional Sampling Locations for Haul Roads Vicinity Property 24

Table 2-11
Proposed Additional Sampling Locations at Haul Roads and Vicinity Properties Associated with SLAPS and HISS

Location Identification[a]	Coordinate East	Coordinate North
V1	750	2900
V2	950	2900
V3	1150	2900
V4	1300	2900
V5	1900	1250
V6	1825	1175
V7	1900	1150
V8	1750	1100
V9	1850	1100
V10	4050	3400
V11	4250	3400
V12	4400	3400
V13	4550	3400
V14	4750	3350
V15	4850	3350
V16	4950	3350
V17	5025	3350
V18	5100	3350
V19	5250	3350
V20	5450	3335
V21	5550	3330
V22	5700	3300
V23	6000	3300
V24	6300	3280
V25	6600	3260

[a]Proposed locations are shown in Figures 2-22 through 2-27.

three buildings on surfaces that are readily accessible to individuals working in the buildings. The data from these surveys will be used to refine determinations of exposure rates to workers within the buildings.

3.0 SAMPLE TYPES AND MEASUREMENTS

This section identifies the types of samples that will be collected and analyzed. Analytical parameters for each medium that will be sampled are listed in Table 3-1. Table 3-2 indicates the sample volumes and weights required for laboratory analyses.

In general, three media will be sampled during the data gap sampling effort: soil, groundwater, and sediment. All samples will be collected using methodologies compatible with those described in A Compendium of Superfund Field Operations Methods (EPA 1987a). Analyses to be performed on each type of sample vary for different portions of the site because of differing data needs.

Table 3-1

Analytical Parameters for Various Media

Parameter	Soil	Groundwater	Sediment
Radiological[a]			
Thorium-230	O	O	O
Thorium-232	O	O	O
Radium-226	O	O	O
Uranium-238	O	---	O
Total uranium	---	O	---
Metals			
ICPAES[b,c]	O	O	---
Organics			
Volatile organics	O	O	---
BNAE[d] organics	O	O	---
Hazardous Waste			
TCLP[e] total	O	---	---
Miscellaneous Indicators			
Temperature	---	O	---
pH	---	O	---
Specific conductivity	---	O	---

O - Analysis required.
--- - Analysis not required.

[a]Includes parameters analyzed for in the environmental monitoring program.
[b]ICPAES - inductively coupled plasma atomic emission spectrophotometry.
[c]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, and zinc. Analyses for arsenic, selenium, thallium, and lead are by furnace atomic absorption.
[d]BNAE - base/neutral and acid extractable.
[e]TCLP - toxicity characteristic leaching procedure.

Table 3-2

Sample Volume and Weight

Parameter	Soil/ Sediment (g)	Water (ml)
Radiological[a]	500	1,000
Metals[a]	200	200
Organics[b]		
VOCs[c]	50	40
BNAEs[d]	100	1,000
Hazardous waste characteristics[e]	200	4,000

[a]Water samples will be acidified to pH <2. Metals analyses will be conducted by inductively coupled plasma atomic emission spectrophotometry.

[b]Soil and water samples will be cooled to 4°C.

[c]VOCs - volatile organic compounds.

[d]BNAEs - base/neutral and acid extractable organics.

[e]Include toxicity characteristic leaching procedure (TCLP) metals, TCLP organics, reactivity, and corrosivity.

4.0 SAMPLING FREQUENCY

This sampling plan is designed for a one-time field sampling effort to close data gaps identified during previous field investigations. However, depending on analytical results, additional field work may be necessary to further define site conditions. Table 4-1 summarizes the sampling activities and frequencies for each area.

Table 4-1

Sampling Activities and Frequencies

Property/Medium[a]	Planned Activity[b]	Approximate Number of Samples/Measurements	Analyses[c]	Analytical Support Level[d]
SLDS				
Soil	Drill boreholes to define horizontal and vertical boundaries of contamination	43	U-238, Ra-226, Th-232, Th-230	III
	Collect background samples in the vicinity of SLDS for chemical analyses	10	VOA, BNAE, metals	IV
	Analyze archived samples to determine if differential migration of actinium and protactinium is occurring	5	U-235, Th-231, Pa-231, Ac-227, Th-227	III
	Collect samples to determine presence of mixed waste	30	TCLP total	III
	Collect samples from specific intervals in well borings and deep boring for radiological analyses	31	U-238, Ra-226, Th-230, Th-232	III
	Collect samples from specific intervals in well borings and deep boring for chemical analyses	17	TCLP total	III
	Collect samples from specific intervals in well borings for geotechnical analyses	16	Hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, cation exchange capacity	N/A[e]
	Collect samples from specific intervals in 3 well borings (W06S, W10S, W12S) for suitability testing	6	Suitability testing	N/A
Sediment	Collect sediment samples to determine extent of radioactive contamination in Mississippi River	10	U-238, Ra-226, Th-230, Th-232	III
Drains and process lines	Collect debris, sediment, and scale from process lines and drains	1[illegible]	U-238, Ra-226, Th-232, Th-230	III

Table 4-1

continued

Property/Medium[a]	Planned Activity[b]	Approximate Number of Samples/Measurements	Analyses[c]	Analytical Support Level[d]
Groundwater	Collect background samples in vicinity of SLDS from upgradient well (W01S) for chemical analyses	1	VOA, BNAE, metals	IV
	Collect samples from newly installed wells for chemical analyses	8	VOA, BNAE, metals	IV
	Collect samples from newly installed wells for radiological analyses	8	Total U, Ra-226, Th-230, Th-232	III
<u>SLDS Vicinity Properties</u>				
Norfolk & Western Railroad/soil	Drill boreholes to define horizontal boundaries of contamination	25	U-238, Ra-226, Th-232, Th-230	III
	Analyze archived samples to determine vertical boundaries of contamination	18	U-238, Ra-226, Th-232, Th-230	III
St. Louis Terminal Railroad Association/soil	Drill boreholes to define horizontal boundaries of contamination	16	U-238, Ra-226, Th-232, Th-230	III
	Analyze archived samples to determine vertical boundaries of contamination	9	U-238, Ra-226, Th-232, Th-230	III
Chicago, Burlington, and Quincy Railroad/soil	Drill boreholes to define horizontal boundaries of contamination	9	U-238, Ra-226, Th-232, Th-230	III
	Analyze archived samples to determine vertical boundaries of contamination	16	U-238, Ra-226, Th-232, Th-230	III
Thomas & Proetz Lumber Company/soil	Drill boreholes to define horizontal boundaries of contamination	10	U-238, Ra-226, Th-232, Th-230	III
	Analyze archived samples to determine vertical boundaries of contamination	6	U-238, Ra-226, Th-232, Th-230	III
McKinley Iron/soil	Drill boreholes to define horizontal boundaries of contamination	15	U-238, Ra-226, Th-232, Th-230	III

Table 4-1

continued

Property/Medium[a]	Planned Activity[b]	Approximate Number of Samples/Measurements	Analyses[c]	Analytical Support Level[d]
	Analyze archived samples to determine vertical boundaries of contamination	14	U-238, Ra-226, Th-232, Th-230	III
PVO Foods/soil	Drill boreholes adjacent to PVO to determine presence of contamination	4	U-238, Ra-226, Th-232, Th-230	III
SLAPS				
Soil	Collect background samples in the vicinity SLAPS for chemical analyses	10	VOA, BNAE, metals	IV
	Analyze archived samples to determine if differential migration of actinium and protactinium is occurring	5	U-235, Th-231, Pa-231, Ac-227, Th-227	III
	Collect samples to determine presence of mixed waste	30	TCLP total	III
	Collect samples from specific intervals in well borings for radiological analyses	15	U-235, Ra-226, Th-230, Th-232	III
	Collect samples from specific intervals in well borings for chemical analyses	10	TCLP total	III
	Collect samples from specific intervals in well borings for geotechnical analyses	~10	Hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, cation exchange capacity	N/A
	Collect samples from specific intervals in 3 well borings (B53W12D, B53W17S, B53W18S) for suitability testing	6	Suitability testing	N/A
Groundwater	Collect background samples in vicinity of SLAPS from upgradient well (B53W20S) for chemical analyses	1	VOA, BNAE, metals	IV
	Collect samples from newly installed wells for chemical analyses	5	VOA, BNAE, metals	IV
	Collect samples from newly installed wells for radiological analyses	5	Total U, Ra-226, Th-230, Th-232	III

[illegible]e 4-1

continued

Property/Medium[a]	Planned Activity[b]	Approximate Number of Samples/Measurements	Analyses[c]	Analytical Support Level[d]
Vegetation	Collect samples for data on assimilation of thorium	5	Th-230	III
HISS and SLAPS Associated Haul Roads and Vicinity Properties				
	Drill boreholes to refine horizontal boundaries of contamination	25	U-238, Ra-226, Th-232, Th-230	III
	Collect samples from specific intervals in borings for radiological analyses	15	U-238, Ra-226, Th-232, Th-230	III
	Collect samples from specific intervals in borings for chemical analyses	10	TCLP total	III
	Collect samples from specific intervals in well borings for geotechnical analyses	10	Hydraulic conductivity, unit weight, specific gravity, grain-size distribution, moisture content, Atterberg limits, soil classification, cation exchange capacity	N/A
	Collect samples from specific intervals in 3 well borings (HISS17S, HISS19S, HISS20S) for suitability testing	6	Suitability testing	N/A
Groundwater	Collect samples from newly installed wells for chemical analyses	9	VOA, BNAE, metals	IV
	Collect samples from newly installed wells for radiological analyses	9	Total U, Ra-226, Th-230, Th-232	III
Surveys	Conduct limited surveys; take radon and exposure rate measurements	12	Radon-222, PIC exposure measurement, alpha, beta-gamma, smears, and count rate measurements	N/A

[a]SLDS - St. Louis Downtown Site; SLAPS - St. Louis Airport Site; HISS - Hazelwood Interim Storage Site.

[b]RCRA - Resource Conservation and Recovery Act.

[c]VOA - volatile organic analysis; BNAE - base/neutral and acid extractable; TCLP - toxicity characteristic leaching procedure; PIC - pressurized ionization chamber.

[d]These levels are based on EPA 1987b.

[e]N/A = not applicable.

5.0 ANALYTICAL PROCEDURES

This section describes acceptable analytical methods and protocols and QA/QC requirements for this FSP. The requirements are stated to ensure defensibility and integrity of the analytical data to DOE, peer reviewers, and regulatory agencies. These methods were selected for their ability to detect the maximum number of parameters and to meet the required detection limits. The QAPjP for the St. Louis site (BNI 1993b) contains greater detail on QA/QC requirements and checks.

5.1 ANALYTICAL METHODS

Procedures for analyzing chemical, radiological, and engineering/geotechnical parameters are shown in Tables 5-1, 5-2, and 5-3. The published detection limits for each method (where appropriate) and method reference numbers are also included. The technical requirements for analyses are based on guidelines and standards developed by EPA and other sources. The radiological laboratory adheres to laboratory procedures developed by Environmental Measurements Laboratory-300 (EML-300) (DOE 1990) and to EPA methods, and QA/QC checks are used to monitor performance as appropriate.

5.2 SAMPLE PRESERVATION

Tables 5-4 and 5-5 provide information on preservation methods, holding times, and types of containers needed for samples to be analyzed for chemical and radiological parameters. All samples collected for chemical analyses are stored at 4°C after collection and during transport to the laboratory. Soil samples collected for radiological analyses have no specific preservation requirements; water samples collected for analyses of radiological parameters are preserved by adjusting the pH to less than 2.

Table 5-1

Analytical Methods for Water

Parameter	Analytical Technique	EPA Method No. Sample Preparation	EPA Method No. Sample Analysis	Sample Size for Analysis	Regulatory/Published Method* Detection Limit
Radiological					
Thorium-230	Alpha spectroscopy	--	Th-01[a]	1 L	0.5 pCi/L*
Thorium-232	Alpha spectroscopy	--	Th-01[a]	1 L	0.5 pCi/L*
Radium-226	Emanation/ scintillation	--	Ra-05[a]	1 L	0.5 pCi/L*
Total uranium	Kinetic phosphorescence analysis	--	--[a]	50 ml	0.03 µg/L*
Metals					
ICPAES metals[b,c]	ICPAES	3010	6010	100 ml	2 - 5000 µg/L[d]
Arsenic	Furnace atomic absorption	7060	7060	100 ml	10 µg/L
Lead	Furnace atomic absorption	3020	7421	100 ml	5 µg/L
Selenium	Furnace atomic absorption	7740	7841	100 ml	5 µg/L
Thallium	Furnace atomic absorption	3020	3020	100 ml	10 µg/L
Mercury	Cold vapor	7470	7470	100 ml	0.2 µg/L
Organics					
Volatile organics	GC/MS[e]	5030	8240	5 ml	10 µg/L analyte
BNAE[f] organics	GC/MS	3520	8270	1 L	10 µg/L analyte
Miscellaneous Indicators					
Temperature	Thermometric	--	120.1	--	--
pH	Electrometric	--	150.1	--	--
Specific conductivity	Electrometric	--	120.1	--	0.5 µmhos/cm*

Table 5-1

(continued)

Parameter	Analytical Technique	EPA Method No. Sample Preparation	EPA Method No. Sample Analysis	Sample Size for Analysis	Regulatory/Published Method* Detection Limit
Level IV (Statement of Work) Parameters					
Organics					
Volatile organics	GC/MS	624CLP-M	624CLP-M	5 ml	10 µg/L
BNAE organics	GC/MS	625CLP-M	625CLP-M	1 L	10 µg/L
Metals					
ICPAES metals	IPCAES	[g]	200.7CLP-M	100 ml	5-5000 µg/L
Arsenic	Furnace atomic absorption	[g]	206.2CLP-M	100 ml	10 µg/L
Lead	Furnace atomic absorption	[g]	239.2CLP-M	100 ml	3 µg/L
Selenium	Furnace atomic absorption	[g]	270.2CLP-M	100 ml	5 µg/L
Thallium	Furnace atomic adsorption	[g]	279.2CLP-M	100 ml	10 µg/L
Mercury	Cold vapor	245.1CLP-M	245.1CLP-M	100 ml	0.2 µg/L

[a]TMA/E uses laboratory procedures developed by Environmental Measurements Laboratory-300 (EML-300)(DOE 1990). EML is currently developing a procedure for kinetic phosphorescence analysis of total uranium.

[b]ICPAES - Inductively coupled plasma atomic emission spectrophotometry.

[c]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, and zinc.

[d]Range of detection limits.

[e]GC/MS - Gas chromatography/mass spectrometry.

[f]BNAE - base/neutral and acid extractable.

[g]Sample prepared according to methods described in the EPA Statement of Work for Inorganics, Multi-media, Multi-concentration, Document Number ILMO 2.0, Exhibit D, Section III (1988).

Table 5-2

Analytical Methods for Soil, Sediment, and Vegetation

Parameter	Analytical Technique	EPA Method No. Sample Preparation	EPA Method No. Sample Analysis	Sample Size for Analysis	Regulatory/Published Method* Relative Detection Limit
Radiological					
Thorium-227	Alpha spectrometry	QAP-001[a]	Th-01[a]	1.0 g	0.5 pCi/g*
Thorium-230	Alpha spectrometry	QAP-001[a]	Th-01[a]	1.0 g	0.5 pCi/g*
Thorium-231[b]					
Thorium-232	Gamma spectrometry	QAP-001[a]	C-02[a]	500 g	0.5 pCi/g*
Radium-226	Gamma spectrometry	QAP-001[a]	C-02[a]	500 g	0.5 pCi/g*
Uranium-235	Alpha spectrometry	QAP-001[a]	U-02[a]	1.0 g	0.5 pCi/g*
Uranium-238	Gamma spectrometry	QAP-001[a]	C-02[a]	500 g	5.0 pCi/g*
Actinium-227	Gamma spectrometry	QAP-001[a]	C-02[a]	500 g	5.0 pCi/g*
Protactinium-231[c]					
Metals					
ICPAES metals[d,e]	ICPAES	3050	6010	1-2 g	1-1000 mg/kg
Arsenic	Furnace atomic absorption	3050	7060	1-2 g	2 mg/kg
Lead	Furnace atomic absorption	3050	7421	1-2 g	1 mg/kg
Selenium	Furnace atomic absorption	3050	7740	1-2 g	1 mg/kg
Thallium	Furnace atomic absorption	3050	7841	1-2 g	2 mg/kg
Organics					
Volatile organics	GC/MS[f]	5030	8240	Varies depending on level	10 µg/kg
BNAE[g] organics	GC/MS	3550	8270	2-30 g	330 µg/kg
TCLP[h]	Various	In accordance with 40 CFR 261	1311	100 g + 2 L extraction solution	Less than maximum contaminant level

Table 5-2

(continued)

Parameter	Analytical Technique	EPA Method No. Sample Preparation	EPA Method No. Sample Analysis	Sample Size for Analysis	Regulatory/Published Method* Relative Detection Limit
Level IV (Statement of Work) Parameters					
Organics					
Volatile organics	GC/MS	624CLP-M	624CLP-M	Varies depending on level	10 µg/kg
BNAE organics	GC/MS	624CLP-M	624CLP-M	2-30 g	330 µg/kg
Metals					
ICPAES metals	ICPAES	[i]	200.7CLP-M		1-1000 mg/kg
Arsenic	Furnace atomic absorption	[i]	206.2CLP-M		2 mg/kg
Lead	Furnace atomic absorption	[i]	239.2CLP-M		1 mg/kg
Selenium	Furnace atomic absorption	[i]	270.2CLP-M		1 mg/kg
Thallium	Furnace atomic absorption	[i]	279.2CLP-M		2 mg/kg

[a]QAP - TMA/Eberline Corporate Quality Assurance Procedure; modified EML (DOE 1990) procedure to accommodate the matrix.

[b]Because of the short half-life of thorium-231, thorium-231 is assumed to be in equilibrium with uranium-235.

[c]Protactinum-231 activity is based on equilibrium of uranium-235 and actinium-227. Based on the equilibrium of these isotopes, either the actinium-227 number is used or an ingrowth calculation is performed to determine the protactinum-231 activity.

[d]ICPAES - Inductively coupled plasma atomic emission spectrophotometry.

[e]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, and zinc. Arsenic, selenium, thallium, and lead analyses are by furnace atomic absorption.

[f]GC/MS - Gas chromatography/mass spectrometry.

[g]BNAE - Base/neutral and acid extractable.

[h]TCLP - toxicity characteristic leaching procedure.

[i]Sample prepared according to methods described in the EPA Statement of Work for Inorganics, Multi-media, Multi-concentration, Document Number ILMO2.0, Exhibit D, Section III (1988).

Table 5-3

Engineering/Geotechnical Test Methods[a]

Test	Method[b,c]
Gradation/hydrometer	ASTM D422
Cation exchange capacity	ASTM STP-805
Distribution coefficient	ASTM D4319
Atterberg limits	ASTM D4318
Unit weight (wet/dry)	DOA EM 1110-2-1906
Moisture content	ASTM D2216
Centrifuge moisture equivalent	ASTM D425
Specific gravity	ASTM D854

[a]All analyses will meet industry standard detection limits.

[b]ASTM - American Society for Testing and Materials.

[c]DOA EM - Department of Army Engineer Manual.

Table 5-4

Preservatives, Containers, and Maximum Holding Times[a]

Parameter/Test	Matrix	Container	Quantity/Size of Bottles	Storage/ Preservation	Maximum Holding Time[b]
Radiological					
U-238, Ra-226,	Soil and sediment	Polyethylene	1/500-ml wide-mouth jar	--	None
Th-232, Th-230	Water	Polyethylene	1/gal cubitainer	HNO_3 to pH<2	6 months
Metals					
ICPAES[c]	Soil and sediment	Glass, amber	1/250-ml wide-mouth jar	4°C	180 days
AA[d]	Soil and sediment	Glass, amber	1/250-ml wide-mouth jar	4°C	180 days
ICPAES	Water	Polyethylene	1/100-ml jar	HNO_3 to pH<2, 4°C	180 days
AA	Water	Polyethylene	1/100-ml jar	HNO_3 to pH<2, 4°C	180 days
Mercury-cold vapor	Water	Polyethylene	1/100-ml jar	HNO_3 to pH<2, 4°C	28 days
Organics					
Volatile organics	Soil	Glass vial with Teflon septum, sealed caps	2/120-ml wide-mouth vials	4°C	14 days
	Water	Glass vial with Teflon septum, sealed caps	2/40-ml jar vials	HCl to pH<2, 4°C	14 days
BNAE organics	Soil	Glass, amber	1/500-ml wide-mouth jar	4°C	7 days for extractions/ 40 days after extraction
	Water	Glass, amber	1000-ml jar	4°C	7 days for extractions/ 40 days after extraction
TCLP[e] (metals, organics, corrosivity, reactivity (sulfide/cyanide)	Soil	Glass, amber	1/500-ml wide-mouth jar	4°C	See Table 5-5
Miscellaneous Indicators					
pH and temperature	Water	Polyethylene or glass	1/500-ml wide-mouth jar	--	Onsite analysis
Specific conductivity	Water	Polyethylene or glass	1/500-ml jar	--	Onsite analysis
	Soil and sediment	Glass	1/250-ml jar	--	None
Geotechnical (Gradation/hydrometer, cation exchange capacity, distribution coefficient, Atterberg units, unit weight, moisture content, centrifuge moisture equivalent, specific gravity)	Soil	Shelby tube	1	Ends sealed with paraffin; tube stood upright	None

Table 5-4

(continued)

Sources: APHA 1989; ASTM 1985; EPA 1986, 1990.

[a]All bottles shipped to the site by Weston for chemical sample collection will be new, certified precleaned bottles. Analytical results for each bottle shipment are available upon request.

[b]Although EPA has not promulgated holding times for soil samples, all soils shall be assessed against the holding time criteria for water samples.

[c]Inductively coupled plasma atomic emission spectrophotometry; includes analysis for aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, and zinc.

[d]Atomic absorption (furnace) for arsenic, selenium, thallium, and lead.

[e]TCLP - toxicity characteristic leaching procedure.

Table 5-5

Maximum Holding Times for Toxicity Characteristic Leaching Procedure Samples

Parameter	Maximum Holding Times (days): Field Collection to TCLP Extraction	TCLP Extraction to Preparative Extraction	Preparative Extraction to Determinative Analysis	Total Elapsed Time (days)
Volatile organics	14	N/A[a]	14	28
BNAE[b] organics/ Pesticides/ Herbicides	14	7	40	61
Mercury	28	N/A	28	56
Metals, except mercury	180	N/A	180	360

[a]N/A - Not applicable.

[b]BNAE - base/neutral and acid extractable.

5.3 QUALITY CONTROL

QA/QC activities are described in detail in the QAPjP (BNI 1993b), which describes the blanks, splits, duplicates, and other QC samples required to measure field and laboratory performance for chemical samples. QA/QC activities for radiological field measurements and sampling procedures are described in detail in the procedures manual used by Thermo Analytical/Eberline (TMA/E) personnel, which includes procedures on instrument response checks, calibration configuration, duplicate sampling/surveys, and data review required to measure field and laboratory performance.

5.4 REPORTING

All data from each sample batch are reported. Analytes are reported using the International Union of Pure and Applied Chemistry system of chemical nomenclature (and if different, the applicable Federal Register nomenclature for CERCLA) and the Chemical Abstract Number. Analytical results for aqueous samples are reported in milligrams/liter (mg/L), micrograms/liter (µg/L), or microcuries/milliliter (µCi/ml); analytical results for solid samples are reported in milligrams/gram (mg/g), micrograms/kilogram (µg/kg), micrograms/gram (µg/g), or picocuries/gram (pCi/g). Ambient radon data are in picocuries/liter (pCi/L). Data for smear samples analyzed by gross alpha/beta techniques are reported in disintegrations per minute/100 square centimeters (dpm/100 cm^2) or total dpm, whichever is applicable.

5.5 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Samples are packed in vermiculite to guard against breakage during shipment to the laboratory for analysis. Chemical samples are cooled to 4°C and shipped (on ice if necessary) by priority mail to the laboratory on the same day they are collected. Chain of custody and sample handling are conducted in accordance with the QAPjP (BNI 1993b).

Because only low-level radioactivity is present at the St. Louis site, no radiological controls or labeling are necessary for packaging and shipping samples from the site.

6.0 OPERATING PLAN

The scope of the operating plan includes the field activities that will be performed to fulfill the data requirements. Because of the size and complex nature of FUSRAP, the elements of a typical operating plan are contained in project-specific guidance such as instruction guides, project procedures, and technical specifications. The following subsections address the major elements of the operating plan for the St. Louis site.

6.1 SAMPLING

All sampling performed as part of this RI will be conducted in accordance with guidance provided in A Compendium of Superfund Field Operations Methods (EPA 1987a). General practices are outlined below.

6.1.1 Presampling Activities

Before any field activities begin, the BNI Oak Ridge office will select and train field personnel and procure any subcontracted services. TMA/E and Weston analytical laboratories are subcontractors for FUSRAP. Civil surveying will be provided by St. Charles Consulting Engineers and Land Surveyors.

Before data gap sampling starts, access agreements will be negotiated with the owners of vicinity properties to grant project personnel permission to enter the property and to protect the interests of the property owner. The civil surveyor will perform a survey of each area to be investigated; property boundaries will be determined and staked, and drawings will be prepared showing legal boundaries, buildings, and significant surface features such as concrete and gravel. These drawings will be submitted to BNI as early as practicable to allow their use in preplanning for sampling activities. Just before field work begins, the civil surveyor will establish the grid system by staking and marking intersections of perpendicular grid lines. The surveyor may also spot precise locations of boreholes.

Mobilization will involve the arrival of all necessary personnel, receiving all equipment and instruments, ordering sampling containers, stocking personal protective equipment, performing initial instrument checkouts and calibrations, and demonstrating that personnel are medically qualified to work at a hazardous waste site. Forty hours of health and safety training will be given to members of any crew not previously trained (details are provided in the St. Louis site HSPs) (BNI 1989a, 1990b). Following site-specific training, field sampling may begin.

Before field work begins each day, the technical group leader will review the characterization plans for the day and coordinate activities with the field personnel. The technical group leader will identify the samples to be collected by referring to Section 2.0 of this plan.

Sample bottles ordered for the planned activities will be selected and provided to the sampling team with chain-of-custody forms. Proper sampling and decontamination procedures for the required analyses will be reviewed with sampling personnel. Decontamination techniques are included in Appendix A of this FSP.

All field instrumentation will be source-checked and calibrated daily to ensure its accurate operation in the field.

6.1.2 Sampling Activities

Slide-hammer and auger sampling equipment provide sufficient sampling volume and vertical distribution to ensure collection of representative samples for radiological analysis. Most of the site is covered with asphalt, concrete, and cobblestone, which will be bored through or removed before sampling takes place. After this material is removed, a slide-hammer Shelby tube [2.5 cm (1 in.) in diameter] will be driven into the ground through the sampling intervals indicated in Section 2.0. After the probe has advanced through a sampling interval, a measuring tape will be used to determine the amount of soil recovered within the sampling tube, soil recovery will be recorded in a logbook, and the tube will be advanced through the next sampling interval. This method will be repeated until the maximum sampling depth specified for each borehole is reached. The tube will then be marked to differentiate sampling intervals and shipped to the laboratory for appropriate analyses. Percent recovery records will accompany the tubes to ensure that the appropriate sampling intervals are analyzed.

In areas where conditions prohibit the use of tube samplers, auger sampling will be conducted. The auger will be advanced to the proper depth, and samples of the flights will be collected in polyethylene sampling containers and appropriately labeled as described in the QAPjP (BNI 1993b).

Levels of fixed and removable radioactive contamination will be determined for drains, sumps, and process lines; measurements of surface contamination will be made at specified intervals as required for adequate characterization or release of the area for use with no radiological restrictions. Fixed contamination will be measured using hand-held detectors (thin-window Geiger-Mueller detectors for beta-gamma activity and scintillation detectors for alpha activity) at contact as required. Measurements will be converted to dpm/100 cm^2 and documented on appropriate survey forms.

Soil samples for chemical analysis will be collected using a stainless steel split-spoon sampler. After the split spoon is withdrawn from the ground, the barrel will be opened and the sample collected. Samples for volatile organics analysis will be collected by pulling subsamples of the core with a stainless steel spoon the entire length of the interval and filling two 120-ml vials immediately upon retrieval of the split spoon. Per the coring and quartering method, the remaining contents will be mixed in a stainless steel pan with a stainless steel spoon to homogenize them. Samples will be placed in coolers and cooled to 4°C for shipment to the Weston laboratory. Sediment samples will be collected with a Peterson-type clam-shell sampler.

Before background samples of groundwater are collected for chemical analyses, a submersible pump or a Teflon bailer will be used to purge each well of three well casing volumes of water. The polyethylene pump suction line will be cleaned by being scrubbed with an Alconox™ solution, rinsed three times with deionized (DI) water, and inserted into the well. The bailers will be decontaminated in accordance with project procedures and instructions. These decontamination procedures have been proven adequate by a history of clean rinse blanks. A Teflon bailer will be used to obtain groundwater samples. Samples for radiological and metals analyses are preserved by lowering the pH to less than 2 with reagent-grade nitric acid. Samples for all chemical analyses are stored at 4°C until they are analyzed.

To prevent the compromising of sample integrity, TMA/E sampling personnel have been trained to properly decontaminate sampling equipment and to properly handle, package, preserve, and ship samples. Chain of custody from collection through shipment will be maintained by the sampling team; custody from shipment through analysis will be maintained by the analytical laboratory.

6.1.3 Postsampling Activities

Boreholes will be backfilled and closed (as described in Appendix A) as soon as possible after drilling is completed. Care will be taken to avoid creating a preferential pathway through which surface water may infiltrate the waste and reach groundwater. All disturbed areas will be restored to their original conditions.

All equipment and personnel entering a controlled area will be radiologically surveyed and decontaminated (as necessary) before leaving the area. Release limits will be the same as FUSRAP surface contamination guidelines for release of property with no radiological restrictions.

All field notes, chain-of-custody records, drawings, and files created during field activities will be forwarded to the BNI Oak Ridge office and entered into the Project Document Control Center (PDCC). PDCC will retain the records in a computerized database system until the end of FUSRAP, when they will be transferred to DOE.

Analytical results returned from the radiological and chemical laboratories will also be submitted to PDCC. PDCC will retain the originals and submit copies of the data to the Engineering and Technology department for verification and evaluation.

Data verification activities conducted by BNI personnel are described in the QAPjP (BNI 1993b). These activities include checking data completeness and analytical results for QA/QC samples. When these checks are completed and the validity of the results has been verified, the data will be released for interpretation and use.

6.2 SITE-SPECIFIC FEATURES

Utilities and other features of the property that will affect the field program will be drawn on a plot plan that is issued with all subcontract packages. Locations of underground utilities will be identified by the local utility companies and property owners.

6.3 HEALTH AND SAFETY

The St. Louis site HSPs (BNI 1989a, 1990b) will be in effect during all field activities.

6.4 LABORATORY PHASING

Because holding times for radiological analyses are long, laboratory phasing of samples at the TMA/E laboratory will not be necessary. Advance notification of when samples are to be shipped to the Weston laboratory will allow adequate time to phase samples so that holding times will not be exceeded (see Table 5-3). The mechanism for ensuring early notification of Weston is described in the QAPjP (BNI 1993b).

6.5 FIELD NOTES AND DOCUMENTATION

All sampling personnel will keep indelible ink records of field activities daily in bound field notebooks, on appropriate forms, and in a TMA/E field sampling log. Samplers will record weather conditions, sampling locations and depths, types of samples collected, analyses required, date and time of sampling, chain-of-custody identification numbers and procedures, field measurements, and names of sampling personnel. Examples of this documentation are included in Section 5.0 of the QAPjP (BNI 1993b).

Documentation of chemical and radiological sampling and measurement activities is specified by internal procedures, including procedures that detail documentation required for all sampling and survey activities (e.g., field sampling collection forms, near-surface gamma survey data sheets, subsurface gamma radiation logs, and geological logs).

6.6 FIELD TEAM ORGANIZATION

The field team will be organized as described in Subsection 1.2.

6.7 DECONTAMINATION

Decontamination will be conducted as necessary to ensure that personnel and equipment leaving a controlled area meet DOE guidelines for release.

After a sample is collected, equipment will be decontaminated in accordance with technical specifications in the drilling subcontract consistent with EPA protocols for equipment decontamination. Appendix A of this document describes decontamination procedures and technical specifications to be used for radiological and chemical sampling activities. Appendix A of the WP-IP (BNI 1993a) provides the DOE guidelines to be used.

6.8 EXPENDABLE SUPPLIES

Expendable supplies to accommodate sampling, decontamination, and health and safety activities will be identified before sampling begins. Supplies not already in inventory at the FUSRAP central stock point in Hazelwood, Missouri, will be purchased and delivered to the site before field activities begin. Purchase and delivery of supplies identified before the start of drilling are the responsibility of the BNI construction superintendent. Any supplies not identified in advance can be purchased locally by the

BNI construction superintendent. If the superintendent is unavailable, TMA/E may also purchase or rent small items such as coveralls, shoe covers, and gloves.

6.9 EQUIPMENT

Equipment for sampling, decontamination, and personal protection (as appropriate) will be identified and made available onsite before field activities begin.

Major equipment such as drill rigs, split spoon samplers, and radiation-measuring instruments will be supplied by subcontractors as specified in the technical specifications included in the subcontract packages.

7.0 A[illegible]TIONAL PHASES OF REMEDIA[illegible] INVESTIGATION WORK

The activities described in this plan are intended to meet all known data requirements resulting from evaluation of previous characterization data. However, depending on the results of some of these efforts, additional characterization may be necessary. Planning for such activities will begin as data are generated during the initial investigation, and any additional work will be conducted as soon as possible after the need has been identified. The objectives of any additional work would be to augment data collected in the previous investigations and to further define conditions at the St. Louis site; any data collected would be used to:

- Refine estimates of contaminant source volumes
- Further evaluate potential impacts on human health and the environment
- Further evaluate remedial action alternatives for the properties

Specific follow-up activities may include:

- Completion of additional soil borings and analyses for chemical and radioactive constituents

- Collection and analyses of additional groundwater and surface water samples (including groundwater elevation measurements)

- Site-specific testing of remedial action alternatives such as treatment of hazardous constituents

The approach for completion of additional characterization activities will be based, in part, on information collected during this characterization effort.

Procedures and specifications for collecting and analyzing samples (including QC samples), completing field measurements, installing boreholes, handling and preserving samples, and decontaminating equipment will be consistent with those described in Sections 2.0, 3.0, and 5.0 and Appendix A of this FSP.

REFERENCES AND BIBLIOGRAPHY

American Public Health Association (APHA), 1989. Standard Methods for the Examination of Water and Wastewater, 17th Edition, Washington, D.C.

American Society for Testing and Materials (ASTM), 1985. "Water and Environmental Technology," 1985 Annual Book of ASTM Standards, Section II, Volume 11.02, Philadelphia.

Bechtel National, Inc. (BNI), 1987a. Radiological and Limited Chemical Characterization Report for the St. Louis Airport Site, DOE/OR/20722-163, Oak Ridge, Tenn. (August).

BNI, 1987b. Characterization Report for the Hazelwood Interim Storage Site, DOE/OR/20722-141, Oak Ridge, Tenn. (June).

BNI, 1987c. Radiological Characterization Report for the Futura Coatings Site, DOE/OR/20722-158, Oak Ridge, Tenn. (July)

BNI, 1989a. Health and Safety Plan for the St. Louis Airport Site and Vicinity Properties and the Latty Avenue Properties and Vicinity Properties, DOE/OR/20722-223, Oak Ridge, Tenn. (February).

BNI, 1989b. Preliminary Geological, Hydrogeological, and Chemical Characterization Report for the Ball Field Area, Hazelwood and Berkeley, Missouri, DOE/OR/20722-211, Oak Ridge, Tenn. (February).

BNI, 1990a. Radiological, Chemical, and Hydrogeological Characterization Report for the St. Louis Downtown Site in St. Louis, Missouri, DOE/OR/20722-258, Rev. 1, Oak Ridge, Tenn. (September).

BNI, 1990b. Health and Safety Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement at the St. Louis Downtown Site (Draft), DOE/OR/20722-190.6, Oak Ridge, Tenn. (November).

BNI, 1990c. Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri, Area, DOE/OR/20722-203, Oak Ridge, Tenn. (August).

BNI, 1992. Remedial Investigation Report for the St. Louis Site (Draft), DOE/OR/21949-280, Oak Ridge, Tenn. (January).

BNI, 1993a. Work Plan-Implementation Plan for the Remedial Investigation/Feasibility Study - Environmental Impact Statement for the St. Louis Site, St. Louis, Missouri, DOE/OR/21949-271.1, Oak Ridge, Tenn.

BNI, 1993b. Quality Assurance Project Plan for the Remedial Investigation/Feasibility Study - Environmental Impact Statement for the St. Louis Site, St. Louis, Missouri, DOE/OR/21949-271.3, Oak Ridge, Tenn.

Department of Energy (DOE), 1990. EML Procedures Manual, HASL-300-Ed. 27, Environmental Measurements Laboratory, New York.

Driscoll, F. G., 1986. Groundwater and Wells, Johnson Division, St. Paul, Minn.

Environmental Protection Agency (EPA), 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd ed., Rev. 0 (September).

EPA, 1987a. A Compendium of Superfund Field Operations Methods, Volumes 1 and 2, EPA/540/P-87/001a and 001b, Washington, D.C. (August).

EPA, 1987b. EPA Data Quality Objectives for Remedial Response Activities/Development Process, EPA 540/G-87/003, Washington, D.C. (March).

EPA, 1988. EPA User's Guide to the Contract Laboratory Program, Washington, D.C. (December).

EPA, 1990. "Method 1311, Toxicity Characteristic Leaching Procedure," Appendix II, 40 CFR 261, Part II, Vol. 55, No. 61 (March).

Mason, M.G., 1977. History and Background Relative to the Radiological Re-monitoring of Mallinckrodt by the Energy Research and Development Administration, prepared for Mallinckrodt, Inc., St. Louis, Mo. (August).

Oak Ridge Associated Universities (ORAU), 1981. Radiological Evaluation of Decontamination Debris Located at the Futura Chemical Company Facility, 9200 Latty Avenue, Hazelwood, Missouri, Oak Ridge, Tenn. (September).

Oak Ridge National Laboratory (ORNL), 1977. Radiological Survey of the Property at 9200 Latty Avenue, Hazelwood, Missouri, Oak Ridge, Tenn. (September).

ORNL, 1979. Formerly Utilized MED/AEC Sites Remedial Action Program: Radiological Survey of the St. Louis Airport Storage Site, DOE/EV-0005/16, Oak Ridge, Tenn. (September).

ORNL, 1981. Radiological Survey of the Mallinckrodt Chemical Works, St. Louis, Missouri, DOE/EV-0005/27, ORNL-5715, Oak Ridge, Tenn. (December).

ORNL, 1986a. Results of Radiation Measurements Taken at Transportation Routes (LM004) in Hazelwood, Missouri, ORNL/RASA-86/31, Oak Ridge, Tenn. (December).

ORNL, 1986b. Radiological Survey of Latty Avenue in the Vicinity of the Former Cotter Site, Hazelwood/Berkeley, Missouri (LM001), ORNL/TM-10006, Oak Ridge, Tenn. (May).

ORNL, 1986c. Radiological Survey of Latty Avenue in the Vicinity of the Former Cotter Site, Hazelwood, Berkeley, Missouri (LM003), ORNL/TM-10008, Oak Ridge, Tenn. (May).

APPENDIX A

OVERVIEW OF TECHNICAL SPECIFICATIONS FOR BOREHOLES AND MONITORING WELL INSTALLATION

APPENDIX A

OVERVIEW OF TECHNICAL SPECIFICATIONS FOR BOREHOLES AND MONITORING WELL INSTALLATION

Characterization of FUSRAP sites typically includes a site geologic investigation and collection of various environmental samples for laboratory analysis. The principal activities supporting a site characterization include drilling radiological/chemical and geologic boreholes and installing groundwater monitoring wells.

Because all specialized support activities are typically conducted by subcontractors, the primary source of details will be contained in the scope of work, drawings, and technical specifications developed for a subcontract. The scope of work and drawings specifically define the tasks that will be done, and the technical specifications identify how the tasks are to be done. This appendix summarizes the requirements typically delineated in the subcontract document.

A.1 RADIOLOGICAL AND CHEMICAL BOREHOLES

The specifications include a discussion of general requirements related to any subcontracted activity. These requirements include quality standards that address quality control of the materials used for the activity and any standards specific to the activity. For radiological and chemical boreholes, all work is conducted in compliance with Occupational Safety and Health Administration (OSHA) standards (29 CFR 1926/1910). Specific requirements are summarized in detail in the following sections.

A.1.1 Documentation

To drill radiological and chemical boreholes, field logs recording specific information are required. All logs show the borehole number, the dates and locations (i.e., site coordinates) of drilling, ground surface elevation, a description of the material encountered by the boring, the depth at which each change in material occurs, the depth at which samples were obtained and the type of sample in each instance, the percentage of sample recovery, the depth to the water table, the depth to the undisturbed soil, and any other data pertinent to the identification of subsurface materials.

A.1.2 Equipment and Materials

Specific requirements are developed for the following equipment and materials:

- Drill rig and support equipment
- Cement-and-bentonite grout
- Granular bentonite
- Cleaning materials (DI water, hydrochloric acid, soap, and solvents)
- Temporary casing
- Surface protection materials (plastic sheeting, plywood)
- Perimeter barricade
- Borehole cover and markers
- Sediment barriers
- Sampling equipment
- Stainless steel (316) well screen (0.010-in. slot size)
- Stainless steel (316) casing
- Carbon steel surface casing with locking cap
- Lock
- Graded sand-gravel pack

A.1.3 Field Operations

Predrilling

- Underground utilities in the work area are evaluated. For example, before drilling operations begin, all local utility companies (e.g., gas, water, sewer, electric, and telephone) are contacted to determine and confirm locations of underground utilities in the work areas. All utility locations in the work areas are identified and visibly marked.

- A water-handling procedure is developed. For example, all water discharged from the boreholes during drilling operations is collected in a mud tub. (A mud pit will not be excavated.) Contents of the mud tub are transferred to drums and disposed of or stored onsite as indicated on the design drawings. Analytical results for boreholes where mud tub wastes originate will be used to determine contaminant status of the waste before final disposition.

- Safety and security measures are evaluated. For example, perimeter barricades are provided around work areas as required. Barricades are placed so that they do not interfere with work and remain in place until all work within the area is completed.

Drilling

- Drilling operations are managed from the field site. Boreholes are drilled at locations shown on the design drawings and in the sequence determined at the site. Some adjustment of locations may be required at the site because of interferences.

- Before drilling begins, surface protection material is placed over and around the borehole location to prevent the drill spoils from contacting the surrounding surfaces. Drill spoils are then collected and transported to and stored in the spoils area shown on the design drawing. Drill spoils not used for backfilling will be placed in drums and stored onsite until the site is remediated. At that time, the drill spoils will be disposed of with wastes from the site.

- All boreholes are drilled straight and free of obstructions to permit free and easy installation of temporary casings for downhole radiological logging.

- When obstructions or unstable materials are encountered in boreholes, suitable methods are used to drill through such obstructions. If necessary, temporary casings may be used to keep the holes open and able to be advanced.

- Prior approval from the BNI Engineering and Technology team leader or designee is necessary for permanent interruption of drilling before the required depth is reached.

- If a borehole is abandoned before the required depth is reached because of equipment failure, negligence, or other such causes, the hole is subject to rejection and replacement with a supplementary hole adjacent to it. Abandoned holes are backfilled as specified.

- Until completed boreholes are backfilled, borehole covers and appropriate markers are used to minimize the hazardous condition created by an open borehole.

- Drilling is performed in a manner that permits continuous soil sampling.

- For drilling and sampling activities associated with chemical boreholes, the tool joint lubricant for assembly of drill rods, auger flights, sampling apparatus, and other downhole items is Teflon tape, graphite powder, Dow Corning High Vacuum Grease, or equivalent material. Neither oil nor petroleum-based grease is used on downhole items for chemical boreholes.

General

- All downhole items such as augers and temporary casings are cleaned with brushes, scrapers, rags, and other items to remove surface contamination and then are radiologically surveyed before work commences at the next borehole. Materials are kept damp during brushing and scraping operations to guard against inhalation of contaminants.

- The DI water and soap used for cleaning are handled and disposed of with the water from the decontamination operations.

Cleaning Downhole Equipment for Radiological Boreholes

The sampling apparatus and other downhole items used in radiological boreholes are cleaned before each use so that they are free of visible soil, debris, and other foreign matter.

Cleaning Downhole Equipment for Chemical Boreholes

The drill rod assemblies, lead auger flights, center plugs, sampling apparatus, and other downhole items that could affect sample integrity are cleaned, in accordance with the applicable method set forth below, before they are used in a chemical borehole.

Method I: When not analyzing for metals

(1) Clean with one or both of the following:
- Steam with soap
- High-pressure water with soap

(2) Rinse with DI water
(3) Rinse with isopropyl alcohol
(4) Rinse thoroughly with DI water
(5) Air-dry before use

Method II: When analyzing for metals

(1) Clean with one or both of the following:
- Steam with soap
- High-pressure water with soap

(2) Rinse with tap water
(3) Rinse with nitric acid (10 percent)
(4) Rinse with tap water
(5) Rinse with isopropyl alcohol
(6) Rinse thoroughly with DI water
(7) Air-dry before use

Sampling

- Soil samples are obtained by a recognized sampling technique using a stainless steel split-barrel sampler, thin-walled tube sampler, CME sampler, or other device as approved by BNI before sampling begins.

- Samples are transferred to BNI (or the radiological analysis subcontractor for radiological samples) at the time of recovery. The person who actually collects a sample is personally responsible for that sample until it is properly transferred and documented. Chain-of-custody procedures are described in detail in Subsection 5.3 of the QAPjP (BNI 1993b). BNI (or the radiological subcontractor) is responsible for furnishing containers, placing samples into containers, and labeling containers as appropriate.

Backfilling Boreholes

All boreholes are backfilled as directed by BNI unless noted otherwise. Boreholes drilled through surface asphalt or concrete are backfilled with cement-and-bentonite grout using the tremie method and allowing for emplacement of an asphalt or concrete patch. Boreholes not drilled through surface asphalt or concrete are backfilled using either the dry pack method or the tremie method.

Dry pack method. The dry pack method is performed using granular bentonite emplaced in maximum 0.3-m (1-ft) lifts that are thoroughly rodded with a solid bar or suspended weight to preclude voids in the filled borehole. The dry pack method is not used when the borehole contains water unless approved in advance by BNI.

Tremie method. The tremie method uses cement-and-bentonite grout, which is emplaced in a single continuous operation starting at the bottom of the borehole. The tremie pipe is withdrawn as grout is emplaced but is kept below the grout surface at all times. If the grout shrinks or is lost, holes are refilled until the grout is within 1.3 cm (0.5 in.) of the required elevation shown on the design drawings.

A.2 GEOLOGIC BOREHOLES

The specifications include a discussion of general requirements related to any subcontracted activity. These requirements include quality standards that address quality control of the materials used for the activity and any standard specific to the activity. For geologic boreholes, all work will be conducted in accordance with the following standards and using the specific requirements summarized in the following sections.

- OSHA 29 CFR — Occupational Safety and Health Administration Standards (Part 1910 and Part 1926)
- ASTM D 1586 — Penetration Test and Split-Barrel Sampling of Soils
- ASTM D 1587 — Standard Method for Thin-Walled Tube Sampling of Soils

- ASTM D 2113 — Standard Practice for Diamond Core Drilling for Site Investigation
- USBR E-18 — Field Permeability Tests in Boreholes (Earth Manual)

A.2.1 Documentation

The documentation required when drilling geologic boreholes is the same as that for radiological and chemical boreholes (see Subsection A.1.1).

A.2.2 Equipment and Materials

Specific requirements for equipment and materials will be developed for the following:

- Drill rig and support equipment
- Permeability testing equipment
- Cement-and-bentonite grout
- Granular bentonite
- Hole support and conductor casings
- Surface protection materials (plastic sheeting, plywood)
- Protective barriers
- Sampling equipment

A.2.3 Field Operations

Predrilling

Predrilling procedures (i.e., evaluation of underground utilities, water-handling procedure development, and safety/security measures) are the same for geologic boreholes as for radiological and chemical boreholes (see Subsection A.1.3).

Drilling

Drilling activities and procedures for geologic boreholes are the same as those for radiological and chemical boreholes, with the following exceptions and additions (see Subsection A.1.3).

- Drilling is performed in a manner that permits disturbed and undisturbed sampling of the overburden and core sampling of rock as required.

- Core drilling begins at the top of rock, and all intervals in rock are advanced by diamond core drilling methods (ASTM D 2113). All drilling is done in a manner that allows for maximum core recovery.

- No drilling additives, drilling mud, organic solvents, or cleaning solutions may be introduced into boreholes without prior approval by BNI.

Sampling

Geologic samples are handled in the same manner as radiological and chemical samples (see Subsection A.1.3), with the following addition.

- Core sampling is conducted in accordance with ASTM D 2113 unless BNI directs otherwise. Sampling is continuous, and all core samples are preserved in labeled core boxes.

Conductor Casing

Conductor casings are installed through contaminated strata, as determined by BNI, as shown on the design drawings. Boreholes that require conductor casings are reamed to the diameter and length shown on the design drawings, and the conductor casing is installed in accordance with the technical specifications.

Conductor casings remain in place following installation. Specific wells and borings using conductor casing are those drilled in suspected or known areas of contamination. Details of monitoring well construction using conductor casing are shown in Figure A-1.

A.3 INSTALLATION OF MONITORING WELLS

The specifications include a discussion of general requirements related to any contract activity. These requirements include standards that address quality control materials and any applicable standards specific to the activity. For the installation of monitoring wells, all work will be conducted using the standards and codes listed below. Specific requirements are summarized in detail in the following sections.

- OSHA 29 CFR — Occupational Safety and Health Administration Standards (Part 1910 and Part 1926)

- ASTM A 312 — Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe

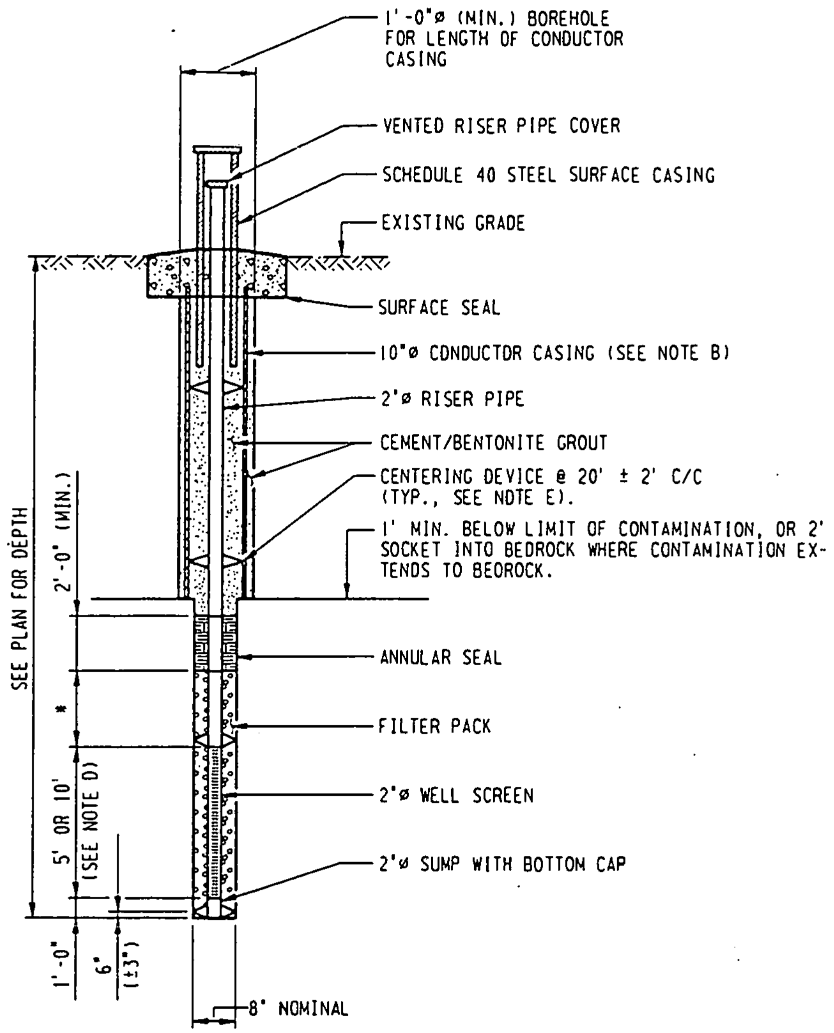
- ASTM C 136 — Standard Method for Sieve Analysis of Fine and Coarse Aggregates

A.3.1 Documentation

With the installation of monitoring wells, documentation required from the subcontractor will include the following items:

- Catalog cuts
- Samples of materials
- Certified sieve analyses
- Detail or shop drawings

All documentation will be transmitted to BNI at least two weeks before use, fabrication, or implementation of the wells.



* = 2' TO 10' (AS DETERMINED IN THE FIELD BY BECHTEL)

TYPE III WELL INSTALLATION (SEE NOTES A & C)

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NOTES:

A. TYPE III BOREHOLE IS FOR OUTDOOR LOCATIONS WHERE: A MONITORING WELL IS TO BE INSTALLED THROUGH A POTENTIALLY CONTAMINATED STRATUM INTO AN UNCONTAMINATED STRATUM; OR OVERBURDEN COLLAPSES UPON REMOVAL OF AUGER.

B. CONDUCTOR CASING SHALL BE INSTALLED TO THE REQUIRED DEPTH PRIOR TO DRILLING BELOW THE BOTTOM OF THE CONDUCTOR CASING. CONDUCTOR CASING SHALL BE EMBEDDED 1" TO 3" IN THE CONCRETE SURFACE SEAL (EXCEPT FLUSH MOUNT SEAL).

C. LIMIT OF CONTAMINATION WILL BE ESTABLISHED IN THE FIELD BY BECHTEL.

D. THE LENGTH OF THE WELL SCREEN WILL BE ESTABLISHED IN THE FIELD BY BECHTEL.

E. IN LIEU OF CENTERING DEVICES, INSTALLATION OF CASING, SCREEN AND FILTER PACK MAY BE MADE THROUGH HOLLOW STEM AUGER PROVIDED THAT RISER CASING AND SCREEN ARE LOCATED IN THE CENTER OF THE HOLE UPON COMPLETION.

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Figure A-1
Standard Well Installation

A.3.2 Equipment and Materials

Specific requirements for equipment and materials will be developed for the following:

- Drill rig and support equipment
- Conductor casing (polyvinyl chloride or carbon steel)
- Riser pipe (316 stainless steel schedule 55)
- Screen (slot size 0.010 in., 316 stainless steel)
- Filter pack
- Annular seal
- Cement-and-bentonite grout
- Surface casing and protective cap (schedule 40, carbon steel)
- Well cap
- Surface seal
- Centering device

A.3.3 Monitoring Well Installation

- Monitoring wells are installed in previously drilled boreholes at specified locations. If necessary, the boreholes are reamed to the size shown on the design drawings.

- The final depth of the hole is measured, and the stainless steel riser pipe assembly (i.e., riser pipe screen, sump, and bottom cap) is constructed and installed in the borehole. Installation is conducted in accordance with technical specifications.

- After the riser pipe assembly is installed, the hole is cleaned by water pumped into the riser pipe and allowed to flow to the surface through the annulus. The filter pack is installed during cleaning as specified in the technical specifications.

- After installation of the filter pack, the annular seal is installed and the remainder of the annular space is filled with grout. If grout shrinks or is lost, the holes are refilled.

- Each monitoring well is tested after the grout has set to confirm that the well is operative.

- The surface casing, cap, and seal are installed at each monitoring well, as shown on the design drawings.

A.3.4 Well Development

Installed wells are developed to maximize the yield of water per foot of drawdown and to extract from the water-bearing formation the maximum practical quantity of fines that can be drawn through the screen when the well is pumped under maximum conditions of drawdown. The subcontractor shall submit the well development procedures to BNI for review.