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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

CHARACTERIZATION PLAN FOR THE ST. LOUIS AIRPORT SITE

St. Louis, Missouri

July 1986



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Attention: J. F. Wing
Technical Services Division

Subject: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Published Version of the Characterization
Plan for the St. Louis Airport Site
File 148, 153-K

Reference: Letter, B. G. Bowles to T. Baer, "Draft
Characterization Plan for SLAPS and Draft Remedial
Action Work Plan for SLAPS," June 26, 1986

Dear Mr. Wing:

Enclosed are five copies of the subject document, as requested
in the referenced letter.

Very truly yours,

Thomas S. Baer
Thomas S. Baer
Project Manager - FUSRAP

JMH/jmh

Enclosures: As Stated

cc: S.W. Ahrends
B.A. Hughlett
B.G. Bowles
J.P. Nemec

CONCURRENCE

JMH				
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CHARACTERIZATION PLAN FOR THE
ST. LOUIS AIRPORT SITE

JULY 1986

Prepared for

UNITED STATES DEPARTMENT OF ENERGY
OAK RIDGE OPERATIONS OFFICE
Under Contract No. DE-AC05-81OR20722

By

Bechtel National, Inc.
Advanced Technology Division
Oak Ridge, Tennessee

Bechtel Job No. 14501

TABLE OF CONTENTS

	<u>Page</u>
1.0 Introduction	1
1.1 Historical Overview	1
1.2 Review of Existing Information	3
1.3 Schedule	5
1.4 Supporting Services	5
2.0 Radiological Characterization	6
2.1 Scope/Purpose	6
2.2 Characterization Activities	6
2.2.1 Site Grid System	6
2.2.2 Surface Characterization	7
2.2.3 Subsurface Investigation	8
2.2.4 Data Review	9
2.3 Documentation	10
2.4 Reporting	11
3.0 Hydrogeological Characterization	12
3.1 Scope/Purpose	12
3.2 Characterization Activities	13
3.2.1 Geological Boreholes	13
3.2.2 Installation of Perimeter Groundwater Monitoring Wells	16
3.2.3 Installation of Interior Groundwater Monitoring Wells	16
3.2.4 Well Development	20
3.2.5 Logging of Radiological Characterization Boreholes	20
3.2.6 Hydrogeological Testing	20
3.2.7 Hydrogeochemical Testing	21
3.2.8 Soil Testing	21

	<u>Page</u>
3.3 Documentation	22
3.3.1 BNI Documentation	22
3.3.2 Subcontractor Documentation	23
3.4 Reporting	23
4.0 Chemical Characterization	24
4.1 Scope/Purpose	24
4.2 Characterization Activities	24
4.2.1 Number of Samples	24
4.2.2 Sampling Locations	25
4.2.3 Sampling Procedure	25
4.2.4 Required Analyses	27
4.2.5 Analysis of Groundwater Samples	27
4.2.6 Special Analyses	28
4.2.7 Shipping Requirements	28
4.3 Documentation	28
4.4 Reporting	28
5.0 Personnel Health and Safety	30
References	31
Appendix A Radiological Characterization Checklist for SLAPS	A-1
Appendix B Staffing/Budget for Bechtel National, Inc. and Thermo Analytical-Eberline for the SLAPS Characterization	B-1

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1-1	Location of the St. Louis Airport Site	2
3-1	Locations of Geological Boreholes and Monitoring Wells at the St. Louis Airport Site	14
3-2	Typical Geological Borehole	15
3-3	Typical Conductor Casing Installation	17
3-4	Typical Deep Monitoring Well	18
3-5	Typical Shallow Monitoring Well	19

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1-1	Summary of Residual Contamination Guidelines for the SLAPS	4
4-1	Borehole Locations for Chemical Sampling at the SLAPS	26

1.0 INTRODUCTION

Characterization of the St. Louis Airport Site (SLAPS) is necessary to determine the hydrogeologic properties of the site and to determine the magnitude and nature of the chemical and radioactive contamination there since these factors will affect actions taken to develop the property as a permanent disposal site for low-level radioactive waste. This report is intended to document the scope of the characterization effort and the procedures to be used.

1.1 HISTORICAL OVERVIEW

The site is a 21.7-acre area located in St. Louis County, Missouri, approximately 15 mi from downtown St. Louis and immediately north of the Lambert-St. Louis International Airport (Figure 1-1). It was acquired by the U.S. Atomic Energy Commission (AEC) in 1947; from then until approximately 1966, the site was used to store waste materials from a uranium feed materials plant in St. Louis. These materials included pitchblende raffinate residues, radium-bearing residues, barium sulfate cake, Colorado raffinate residues, and contaminated scrap.

In the mid 1960s, most of the residues were sold and removed from the site. The structures were demolished, buried on-site, and covered with 1 to 3 ft of clean fill. Burial of contaminated material and scrap is believed to have occurred predominantly in the western portion of the site.

Topographic and radiological surveys were conducted in 1965, 1969, and 1971 to document the surface elevations and radiological condition of the site (Ref. 1). There is no evidence that any of these surveys extended beyond the site fence line to include the drainage ditches along McDonnell Boulevard.

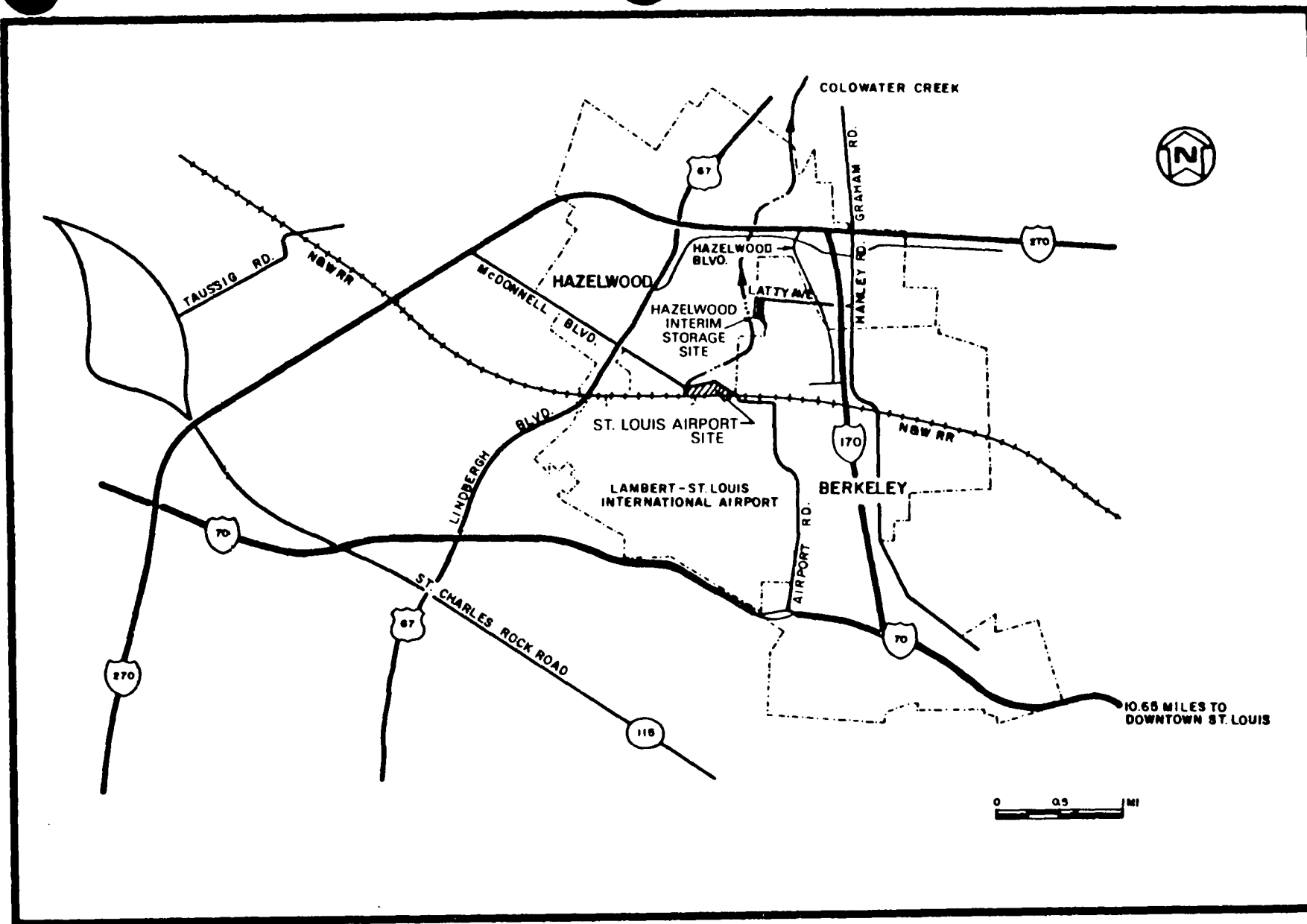


FIGURE 1-1 LOCATION OF THE ST. LOUIS AIRPORT SITE

In 1973, the 21.7-acre tract was transferred by quitclaim deed from the AEC to the City of St. Louis. The FY 1985 Energy and Water Development Appropriations Act (P.L. 98-360) authorized DOE to acquire the property from the city for use as a permanent disposal site for the waste already on-site, contaminated soil in the ditches surrounding the site, and the waste from the Hazelwood Interim Storage Site, approximately 1 mile to the north (Figure 1-1). To date, the property has not been transferred to DOE.

In 1976 and 1978, Oak Ridge National Laboratory performed radiological surveys of the property, including the ditches (Ref. 1). This survey determined that radioactive materials were present in the drainage ditches north and south of McDonnell Boulevard.

In 1981, the drainage ditches were designated for remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP), a U.S. Department of Energy (DOE) program to identify, clean up, or otherwise control sites where low-level radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program. Bechtel National, Inc. (BNI) was selected as Project Management Contractor for FUSRAP. In 1982, BNI performed a radiological survey of the drainage ditches (Ref. 2) because insufficient data on the extent of contamination were available from the earlier surveys. The DOE guidelines governing the remedial action at SLAPS are presented in Table 1-1.

1.2 REVIEW OF EXISTING INFORMATION

Before field activities for the characterization commence, available information on the site will be reviewed. These reviews will include, but will not be limited to, all known previous characterization reports by various organizations, documents describing AEC operations at SLAPS and at the uranium feed materials plant in St. Louis, topographic surveys, aerial photographs, and eyewitness accounts.

TABLE 1-1
SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES FOR THE SLAPS

SOIL (LAND) GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

<u>Radionuclide</u>	<u>Soil Concentration (pCi/g) above background^{a,b,c}</u>
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.
Other radionuclides	Soil guidelines will be calculated on a site-specific basis using the DOE manual developed for this use.

^aIn the event of occurrence of mixture of radionuclides, the fraction contributed by each radionuclide to its limit shall be determined, and the sum of these fractions shall not exceed 1.

^bThese guidelines represent unrestricted-use residual concentrations above background averaged across any 15-cm thick layer to any depth and over any contiguous 100-m² surface area.

^cLocalized concentrations in excess of these limits are allowable provided that the average over 100 m² is not exceeded.

As a result of this effort, a reasonable knowledge of expected site conditions and suspect areas will be obtained. This information will be used to help direct biased sampling activities and will result in a more accurate projection of site conditions while minimizing costs. Review of the information will be completed in time for findings to be made available to the field characterization team for use in performing the survey.

1.3 SCHEDULE

The radiological characterization of surface contamination will begin in late April with subsurface investigations following in mid-May. The base radiological, chemical, and hydrogeological subsurface characterizations will be accomplished simultaneously. Completion of field work is scheduled for mid-July 1986. Biased subsurface investigation may also be required to better estimate the volume of contaminated material to be removed. If needed, this work would follow base characterization activities, thereby delaying the completion date until mid-September. Additional biased sampling is not currently funded. Monitoring of newly installed wells will be a continuing activity.

1.4 SUPPORTING SERVICES

Accomplishment of this characterization will necessitate the following support subcontracts:

- o Surveying services will be required to reestablish the 50-ft grid system used in previous surveys at the site and to survey all the geological boreholes and monitoring wells installed during this investigation. The former will be required before the start of on-site characterization activities.
- o Subcontracts will be required for borehole drilling, geochemical analyses, and well installation.

2.0 RADIOLOGICAL CHARACTERIZATION

2.1 SCOPE/PURPOSE

Radiological characterization of the SLAPS will be conducted to determine approximate horizontal and vertical limits of contamination, to determine ranges of radionuclide concentrations, and to estimate the volume of contaminated material presently on-site. Individual activities designed to cost-effectively accomplish these goals are delineated in a checklist presented in Appendix A. The following subsections provide more detail associated with the checklist. The planned level of effort for field work by BNI and Thermo Analytical-Eberline (TMA-E) is documented in Appendix B.

2.2 CHARACTERIZATION ACTIVITIES

2.2.1 Site Grid System

A civil surveyor will reestablish the 50-ft grid used in previous site surveys over the entire site by staking the intersections of a series of mutually perpendicular lines. Reestablishment of the previous grid system will allow easy incorporation of existing data into the characterization database. A 2-in.-square wooden hub stake will also be installed at each alternate stake (every 100 ft) along each grid line. These stakes can be located to preserve the grid if the above-ground stakes are lost as a result of weathering or grass mowing. Each stake will be marked with grid coordinates. The grid origin will be located to the southwest of the property. The grid will be tied to the Missouri state grid system with sufficient detail to allow reestablishment of the grid at some future date. All property lines will be located and set. A drawing showing the property lines, fences, roads, gravel, asphalt, surface obstructions, landmarks, grid intersections, and other improvements will be provided by the surveyor. This drawing will help identify surface obstructions and ground elevations, as well as problem areas that will significantly affect the cost of remedial action.

2.2.2 Surface Characterization

Surface characterization will precede subsurface investigations so that an understanding of contamination patterns is gained before biased borehole locations are selected. This will ensure that the depth of all surface contamination is known.

Surface characterization will consist of the activities listed below.

- o Walkover surveys will be performed that consist of gamma radiation scans of individual 50-ft by 50-ft grid blocks. Areas in which readings exceed twice normal background levels will be marked on a site drawing. The walkover survey covers essentially 100 percent of the ground surface and ensures that hotspots between grid points are detected.
- o Cone-shielded gamma scintillometer measurements will be made at no greater than 12.5-ft intervals in areas of contamination identified during the walkover survey. These measurements will eliminate any discrepancy in the size of a given area that might have been created by lateral gamma flux (shine) from other contaminated areas nearby. This survey refines the size of the areas marked from the walkover scans.
- o Gamma exposure rate measurements will be made 3 ft above the surface at 50 selected grid points on the site using a pressurized ionization chamber (PIC). These measurements will be used to determine field calibration factors for the 2-in. by 2-in. sodium iodide (NaI) gamma scintillation detectors. The factors allow conversion of measured count rates to an exposure rate for direct comparison with DOE guidelines.
- o Surface radon emission rates will be measured at points selected in the field while conducting the survey. Emission rates will be measured by placing charcoal canisters in direct contact with the ground surface. This survey will help identify areas of radium contamination and will allow determination of a baseline radon emission rate. Radon emission rates are limited by DOE guidelines for disposal sites.
- o Surface soil samples (0-6 in.) will be collected from selected locations on biased spacing. Locations will be selected after review of the gamma scanning data. Samples will be analyzed for uranium-238, thorium-230, thorium-232, and radium-226. The samples will be selected to determine radionuclide concentrations in areas where the surface scan data are ambiguous. Since thorium-230 analyses are costly, the number of these samples will be minimized.

2.2.3 Subsurface Investigation

Systematic subsurface investigation will be conducted by drilling boreholes at most 100-ft grid intersections. Systematic subsurface investigation is necessary to 1) define vertical excavation limits, 2) estimate the volume of waste, and 3) provide assurance to the Independent Verification Contractor that major subsurface deposits have been identified. The grid interval of 100 ft has been selected on the basis of budgetary constraints. Each grid block could potentially contain 7400 yd³ of waste. Biased subsurface samples may be taken later (contingent on funding) to gain additional information from areas of suspected contamination and to reduce some uncertainties in the waste volume estimates. At least one borehole will be drilled in each area where elevated surface radioactive contamination is found so that the depth of the contamination can be determined. The depth to which each borehole is drilled will be determined in the field based on guidance from the geologist and radiological support representative. To the extent feasible, boreholes will at least reach natural soil.

Although gamma logging is typically used to determine subsurface contamination depths, thorium-230 (a principal contaminant) cannot be detected in situ; therefore, subsurface soil samples will be collected continuously by a split-spoon sampler driven in advance of the auger. Once drilled, each characterization hole will be temporarily lined with a closed-end, 4-in.-diameter PVC casing while it is gamma logged. All boreholes drilled for chemical sampling or hydrogeological investigation will also be gamma logged. Gamma logging will be conducted by lowering a gamma scintillometer into the borehole. This detector will be calibrated to allow correlation from counts per minute to picocuries per gram (pCi/g). Gamma radiation measurements will be made typically at 1-ft vertical intervals; however, the interval may be smaller near the boundaries of contamination to more accurately determine the boundary between clean and contaminated soil.

After each borehole is systematically logged, the depth of gamma-emitting radionuclide contamination in it will be compared with depths of contamination in other boreholes in the area. If a significant difference is noted, it may be necessary to drill additional boreholes at closer spacing to better define the areas of contamination (provided funding is available). If additional biased holes cannot be drilled, the entire 100-ft² grid block would be assumed to be contaminated, representing up to 7400 yd³ of assumed waste. These boreholes would be logged and sampled in the manner described above. Once sampled, all boreholes will be sealed as described in Subsection 3.2.1.

Although continuous samples will be taken from each borehole, the cost of analyzing all samples for thorium-230 is prohibitive (approximately \$90/sample). Previous experience has shown that the concentration of thorium-230 typically exceeds the concentration of radium-226 by a factor of at least 5 (in similar residues from a uranium feed materials plant in St. Louis). Therefore, as long as radium-226 is detectable using the gamma scintillometer, it is reasonable to assume that the thorium-230 concentration exceeds the guideline of 15 pCi/g. Based on this reasoning, soil samples collected from boreholes will not be analyzed for thorium-230 until the gamma readings drop below the level equivalent to 15 pCi/g. Analysis for the presence of thorium-230 will be performed on successively deeper samples until results indicate that its concentration is less than 15 pCi/g.

For boreholes where the gamma logs do not indicate any contamination, the surface soil sample will be analyzed. It is important to note that the budget for soil sample analysis for this characterization assumes an average of three samples per borehole.

2.2.4 Data Review

Meetings of the field characterization team will be held after each successive stage of the characterization to review and discuss the findings to date. At these meetings, problem areas and

inconsistencies with current and historical data will be identified, and a strategy for continued investigation will be developed. The meetings will serve to structure the characterization sequentially so that information collected in each phase is built upon and clarified throughout the course of the survey.

Field data will be submitted to the BNI Oak Ridge office on a daily basis for interpretation by the BNI health physics staff. This will allow monitoring of progress and real-time resolution of problems. Changes in methodology can be implemented to refine the characterization and gain better information in a cost-effective manner.

2.3 DOCUMENTATION

All data collected during the survey will be transmitted to the BNI Oak Ridge office via the TMA/E Oak Ridge office in an approved format (graphically whenever possible). Before the start of field activities, the field team will be provided with blank grid drawings on which to plot field measurements. The field team will assign a scale to the grid blocks, which will permit later interpretation of the drawings. These drawings will show:

- o Surface walkover scan findings in the form of grid blocks showing radiation levels greater than twice background
- o All cone-shield readings in counts per minute
- o Locations of all boreholes with identification numbers corresponding to gamma logs and soil samples
- o Sketches of surface obstructions, irregularities, drainage pathways, culverts, fences, roads, landmarks, (to rough scale)
- o Locations of PIC and radon emanation measurements

2.4 REPORTING

A formal radiological characterization report will be prepared to present the data collected and an interpretation of the results. The main objectives of the report will be to present the current radiological conditions at SLAPS and to provide an evaluation of these conditions relative to the design and construction of a waste containment facility.

3.0 HYDROGEOLOGICAL CHARACTERIZATION

Previous investigations have identified two groundwater systems at the site (Refs. 3 and 4). The upper zone is an eolian (wind deposit) and lacustrine (lake deposit) silt, and the lower zone is a lacustrine silt. The two systems are separated by a lacustrine silty clay.

3.1 SCOPE/PURPOSE

The objectives of this hydrogeologic characterization effort are threefold:

- o Determine the hydrogeologic characteristics of the two groundwater systems, including hydraulic conductivity, groundwater flow direction and gradient, head relationships between the two systems, and the magnitude of seasonal groundwater level fluctuations.
- o Determine the geologic and hydrogeologic characteristics of the lacustrine silty clay, including thickness, areal extent, hydraulic conductivity, cation exchange capacity, and distribution coefficient. Also determine soil characteristics that will affect the design of a groundwater cutoff wall and french drain.
- o Provide additional groundwater monitoring points for water quality and water level data acquisition.

Additional borings and groundwater monitoring well installations will be used to provide the hydrogeologic and geotechnical data. All monitoring well installations will be in accordance with the Environmental Protection Agency's draft Resource Conservation and Recovery Act groundwater monitoring technical enforcement guidance (Ref. 5). The boring and groundwater monitoring well program is designed to provide data on the upper and lower groundwater systems and the lacustrine silty clay, without compromising the integrity of the lacustrine silty clay beneath the stored wastes. The results of this characterization will be integrated with previous investigations to provide a database for evaluation of remedial action alternatives.

3.2 CHARACTERIZATION ACTIVITIES

The characterization investigation includes the following work:

- o Drilling of geological boreholes
- o Installation of groundwater monitoring wells along the perimeter of the site
- o Installation of groundwater monitoring wells inside the boundaries of the site
- o Well development
- o Hydrogeological testing
- o Hydrogeochemical testing
- o Soil testing

Each of these work elements is described in the following subsections.

3.2.1 Geological Boreholes

Seven geological boreholes will be drilled to depths ranging from approximately 40 to 70 ft around the perimeter of the site (Figure 3-1) to provide data on the upper and lower groundwater zones and the stratigraphic sequence above and below the lacustrine silty clay unit. A generalized sketch of a typical geological borehole is shown on Figure 3-2. The boreholes will be advanced using 8.5-in.-diameter hollow stem augers and taking split spoon or undisturbed samples in advance of the augers. Split-spoon samples will be taken at 5-ft intervals and at each change in materials. At one or more boreholes, however, samples will be taken continuously for the full depth of the borehole. The continuous samples will be examined and retained for inspection by others. Undisturbed samples for laboratory testing will be taken from the upper groundwater zone, the lacustrine silty clay, and the lower groundwater zone. A BNI geologist will log all samples and cuttings from the boreholes.

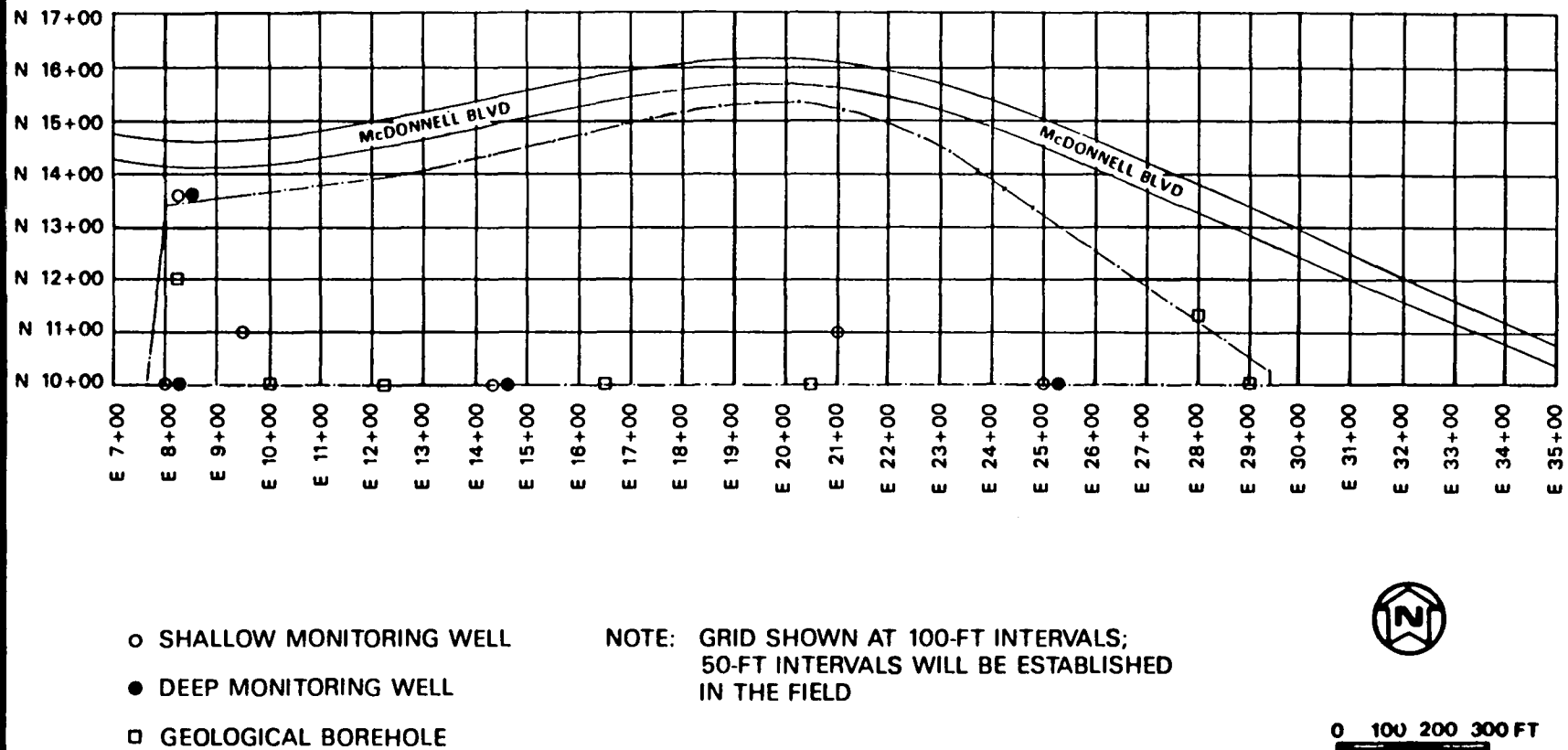


FIGURE 3-1 LOCATIONS OF GEOLOGICAL BOREHOLES AND MONITORING WELLS AT THE ST. LOUIS AIRPORT SITE

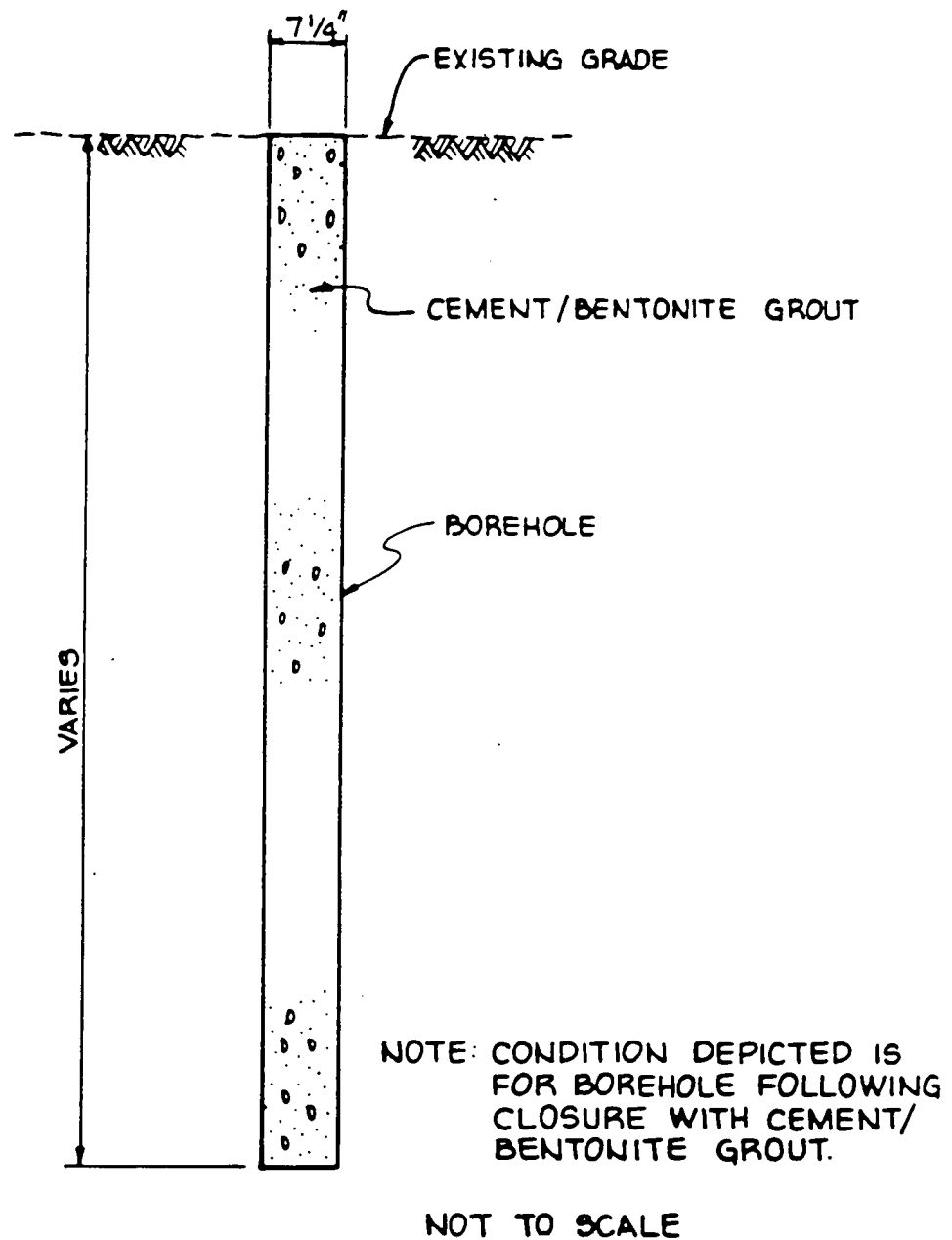


FIGURE 3-2 TYPICAL GEOLOGICAL BOREHOLE

Field permeability tests will be performed in selected boreholes as discussed in Subsection 3.2.6. All geological boreholes will be sealed upon completion using bentonite and/or cement/bentonite grout. All borehole cuttings will be collected and retained in barrels.

Where deep holes will be drilled through contaminated materials, a conductor casing or other means will be used to isolate the contaminants from the deeper uncontaminated section of the drill hole. A generalized sketch of a typical conductor casing installation is shown on Figure 3-3.

3.2.2 Installation of Perimeter Groundwater Monitoring Wells

Four pairs of groundwater monitoring wells will be drilled around the perimeter of the site (Figure 3-1) to monitor the upper and lower groundwater systems. A BNI geologist will log all samples and cuttings from the boreholes. All samples will be scanned to detect radioactive contamination. The deeper monitoring well in each pair will be drilled using an 8.5-in.-diameter hollow stem auger with split-spoon samples being taken at 5-ft intervals and at every change in materials. The deep monitoring wells will range from 40 to 80 ft in depth. A generalized sketch of a deep monitoring well installation is shown on Figure 3-4. The shallow monitoring well in each pair will be drilled using an 8.5-in.-diameter hollow stem auger. The shallow monitoring wells will range in depth from 25 to 45 ft. A generalized sketch of a shallow monitoring well installation is shown on Figure 3-5.

3.2.3 Installation of Interior Groundwater Monitoring Wells

Two shallow groundwater monitoring wells will be installed inside the property boundaries (Figure 3-1) to monitor the upper aquifer within the site proper. The wells will be drilled using 8.5-in.-diameter hollow stem augers with split-spoon samples being taken at 5-ft intervals and at every change in materials. A BNI geologist will log all samples and cuttings from the boreholes. All

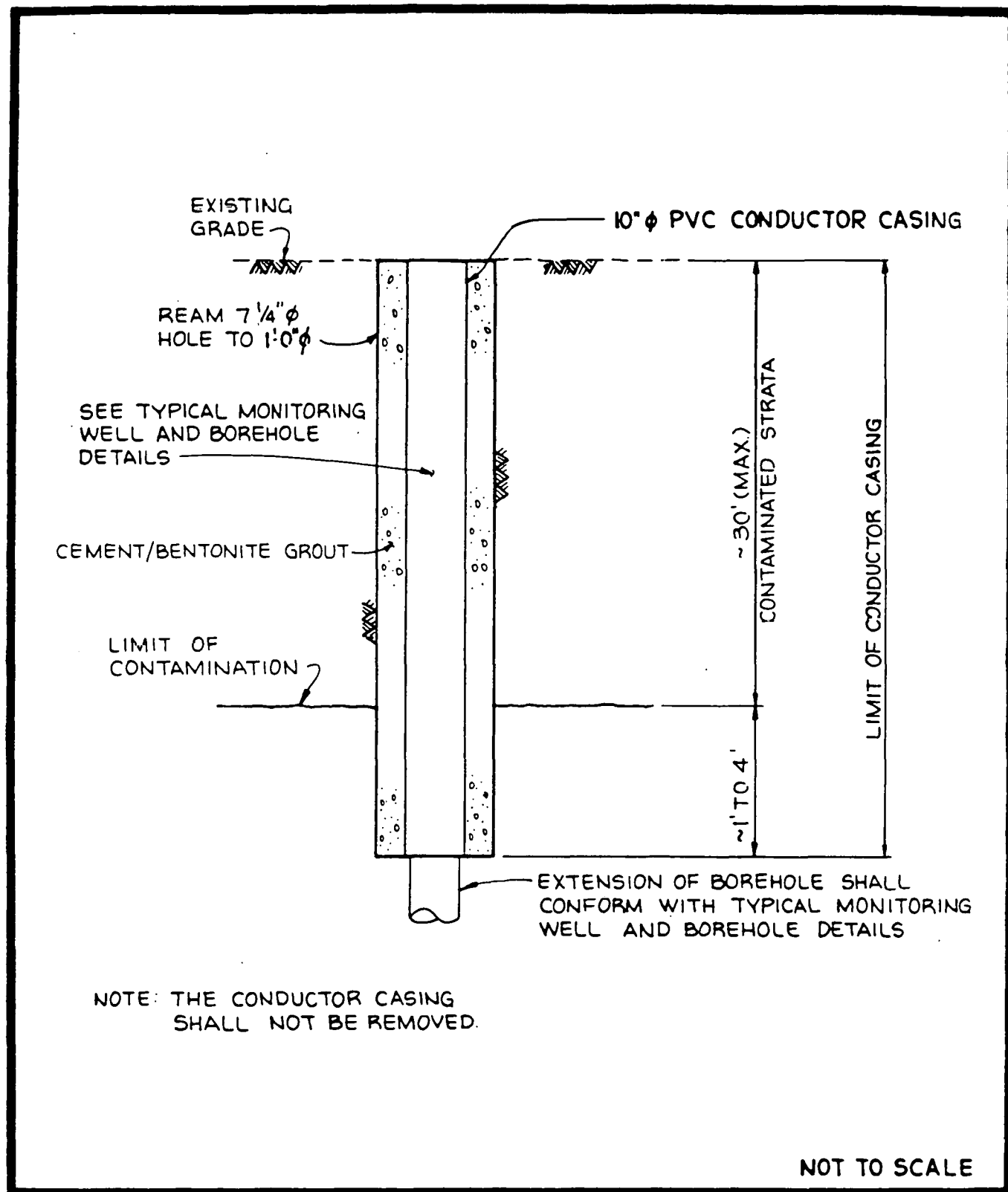
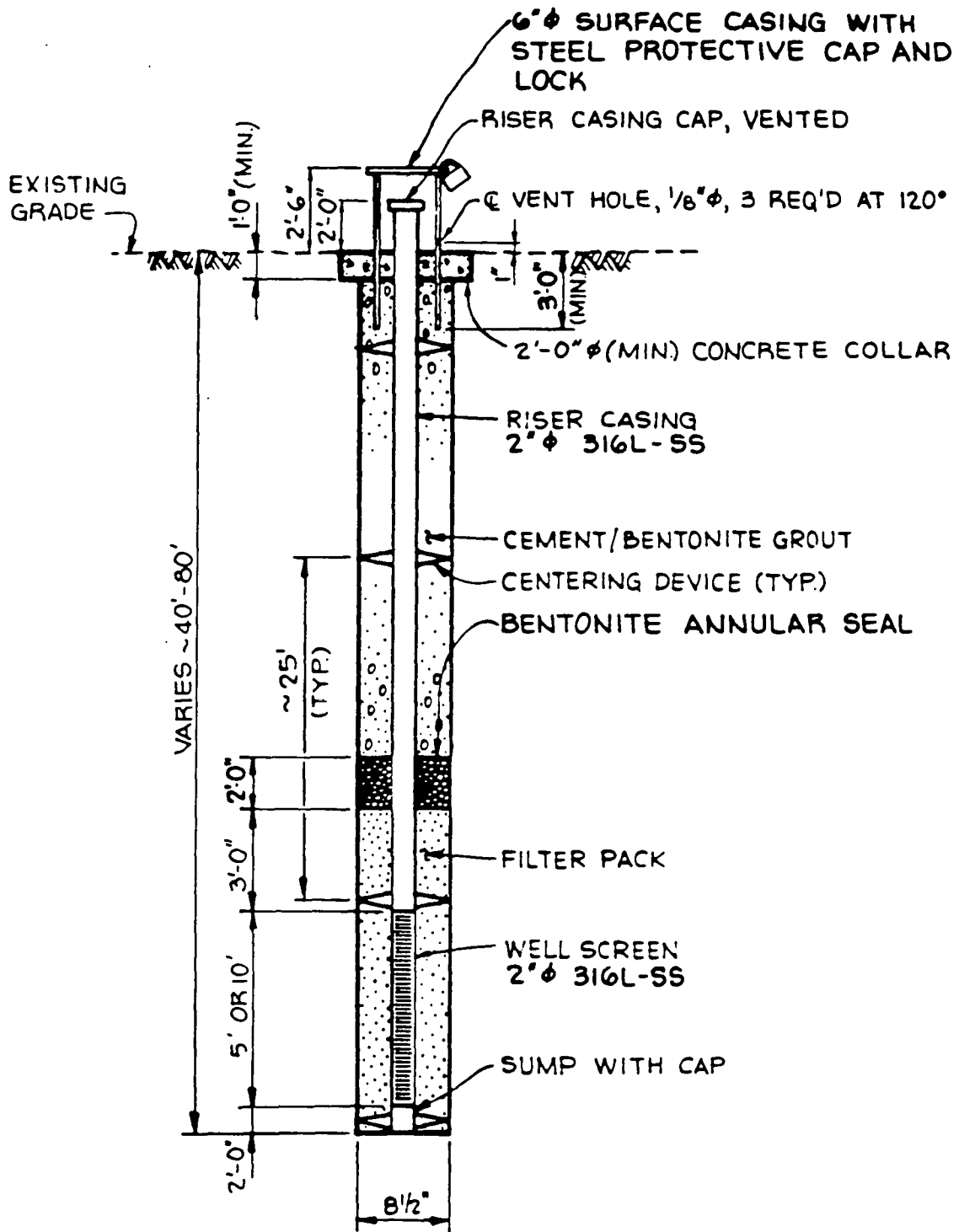
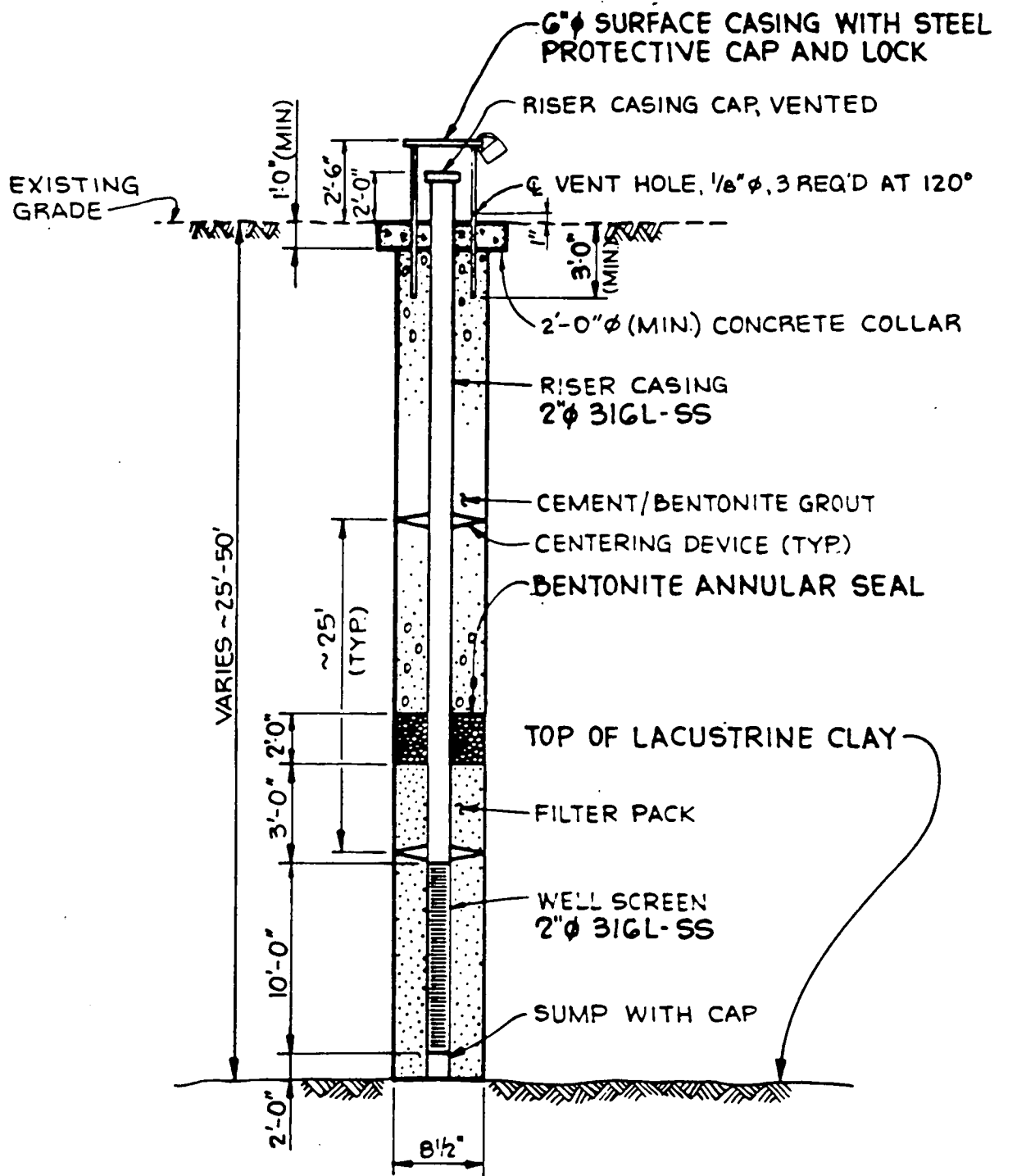


FIGURE 3-3 TYPICAL CONDUCTOR CASING INSTALLATION



NOT TO SCALE

FIGURE 3-4 TYPICAL DEEP MONITORING WELL



NOT TO SCALE

FIGURE 3-5 TYPICAL SHALLOW MONITORING WELL

samples will be scanned to detect radioactive contamination. The on-site shallow monitoring wells will be installed in the same manner as the shallow perimeter wells (Figure 3-5).

3.2.4 Well Development

Well development will be accomplished by pumping or air lifting. All groundwater monitoring wells will be developed to produce sand-free, low turbidity water samples.

3.2.5 Logging of Radiological Characterization Boreholes

All radiological characterization boreholes will be logged by a BNI geologist. Logging will include recording all pertinent drilling information and a visual description of materials encountered.

3.2.6 Hydrogeological Testing

Two types of hydrogeologic testing are to be used: field permeability tests and groundwater level measurements.

Field Permeability Tests

The field permeability tests will consist of four types: constant head, falling head, rising head, and well response tests. The method chosen for each test will be based upon field evaluation of the materials to be tested by the BNI geologist.

Groundwater Level Measurements

A groundwater level measurement program will be initiated at the site. Weekly readings will be taken by field representatives in designated monitoring wells for a minimum of one calendar year. The data will be used to evaluate the magnitude of seasonal groundwater level fluctuations and changes in horizontal and vertical hydraulic gradients.

3.2.7 Hydrogeochemical Testing

A variety of hydrogeochemical tests will be performed to aid in the evaluation of the suitability of the site for storage of waste materials. These tests can be divided into two categories: field tests and laboratory tests.

Field Tests

The field testing program will consist of measurement of oxidation-reduction potential (ORP), pH, temperature, conductivity, dissolved oxygen, and bicarbonate and carbonate in the groundwater. Temperature, pH, conductivity, and dissolved oxygen will be measured in situ by using a Martek Mark XIV digital borehole water quality analyzer. The ORP measurements will be made using a peristaltic pump and a flow-through-cell to allow well head measurement. Bicarbonate and carbonate will be measured from a bailer sample, immediately after sampling, using the electrometric titration method.

Laboratory Tests

Eight groundwater samples, two surface water samples, and two duplicate quality control samples will be collected and the concentrations of the following ions and radionuclides determined:

<u>Cations</u>	<u>Anions</u>	<u>Radionuclides</u>
Calcium	Sulfate	Radium-226
Magnesium	Nitrate	Thorium-230
Sodium	Chloride	Thorium-232
Potassium	Phosphate	Uranium-238
Iron (Total)		

3.2.8 Soil Testing

Standard soil tests will be performed on selected samples of the subsurface materials. Only uncontaminated samples will be submitted

for these tests. Radiological analyses on radioactively contaminated soil samples will be performed as part of the radiological characterization activities. The tests to be conducted on uncontaminated samples are:

- o Gradation/hydrometer tests
- o Atterberg limits
- o Water content
- o Specific gravity
- o Density
- o Effective porosity
- o Cation exchange capacity
- o Distribution coefficient

Representative undisturbed samples of the lacustrine clay will be tested for moisture content, cation exchange capacity, and distribution coefficient. Representative undisturbed samples of the upper and lower groundwater zones will be tested for density and porosity. Representative disturbed samples of all materials will be tested for gradation, specific gravity, and Atterberg limits.

3.3 DOCUMENTATION

3.3.1 BNI Documentation

A geologic log will be prepared for each borehole drilled and will include the following information: hole number, location, descriptions and depths of materials encountered, location and types of samples taken, any unusual or significant observations during drilling, total depth, and final disposition of borehole (e.g., grouted to surface or groundwater monitoring well installed). In addition to the geologic log, all groundwater monitoring well installations will be documented on an "as-built" well installation diagram, and well development activities will be documented on a well development data form. All field permeability test

measurements will be recorded on appropriate data forms. A daily record of work activities by each geologist will be recorded on Daily Field Report forms.

3.3.2 Subcontractor Documentation

The drilling subcontractor will be required to submit driller's logs for each hole, which include: hole number, descriptions and depths of materials encountered, number and type of samples collected, and total depth of borehole. The analytical laboratory will be required to submit a report documenting sample number, concentration data, analytical methods, and precision of each method used. The soil testing laboratory will be required to submit a report documenting testing results and test methods used. A site plan certified by a registered professional land surveyor will be prepared to show the locations of all investigative activities and wells.

3.4 REPORTING

A formal hydrogeological characterization report will be prepared to present the data collected and an interpretation of the results. The main objectives of the report will be to present the current hydrogeologic conditions at SLAPS and to provide an evaluation of the hydrogeology of the site relative to the design and construction of a waste containment facility. It is possible that this report will be combined with the radiological and chemical reports into a single document.

4.0 CHEMICAL CHARACTERIZATION

4.1 SCOPE/PURPOSE

Chemical characterization of selected boreholes will be undertaken to determine the condition of the site with respect to regulations established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Chemical characterization will be conducted in accordance with guidelines presented in Guidance on Remedial Investigations Under CERCLA (Ref. 6), and chemical analyses will be performed in accordance with SW-846, Test Methods for Evaluating Solid Waste, second edition, published by the Environmental Protection Agency (EPA) (Ref. 7).

4.2 CHARACTERIZATION ACTIVITIES

4.2.1 Number of Samples

A methodology is presented in SW-846 for calculating the number of samples required to characterize a site. This technique assumes that previous sampling has resulted in some familiarity with the variance of the parameters to be measured. No previous measurements have been made at SLAPS. However, the guidance document for remedial investigations under CERCLA recognizes the need for using indicator parameters to avoid the expense of analyzing for all priority pollutants in each sample. The guidance states: "The goal of chemical (analysis) selection is to choose species or families present at the site, in terms of prevalence, toxicity, and mobility." Previous investigations have established that the soil is contaminated by members of the uranium-238 decay chain. These radionuclides were prevalent in the waste stored on this site, have environmental mobility, and may represent the largest potential health hazard of all hazardous materials present. In addition, their presence is easily detected and measured.

Normally, residues from uranium ore processing, such as were stored at the site, would be expected to produce only minor amounts of hazardous waste in comparison to the large volumes of radioactive waste. However, residues from chemical processes other than uranium refining may have inadvertently been mixed with the uranium residues. Hence, the presence or absence of chemically hazardous materials will be determined and the consequences estimated by means of a limited random sampling program.

The number of individual samples to be taken has been limited to 30 solely by budgetary constraints. Nevertheless, it is expected that 30 samples will be adequate to satisfy the intent of EPA CERCLA guidance and SW-846. Results of the chemical analyses on these samples will be compared with values obtained from background soil samples. If appreciably elevated concentrations of priority pollutants are found, further investigation may be required.

4.2.2 Sampling Locations

Based on the guidance of SW-846, a simple random sampling strategy was used to select sampling locations. To implement this approach, the area was subdivided into numbered, 100-ft grid blocks. A random number generator was then used to select the grid blocks for sampling. Sampling coordinates are shown in Table 4-1. Actual drilling locations may be selected within approximately 10 ft of the stated location. Inability to collect a sample within this range will necessitate choosing another location from the alternatives listed in Table 4-1. A background borehole will be drilled at a location determined by the geologist to represent natural background conditions.

4.2.3 Sampling Procedure

Sampling containers will be supplied by the Environmental Analysis Laboratory (EAL). Samples will be collected continuously from the surface to a depth agreed upon by the geologist as representing undisturbed, natural material. Sampling will be performed using

TABLE 4-1
BOREHOLE LOCATIONS FOR CHEMICAL SAMPLING
AT THE SLAPS

Borehole	Primary Grid Coordinates*	Alternative Coordinates
1	N11 + 00, E28 + 00	N13 + 00, E21 + 00
2	N11 + 00, E25 + 00	N11 + 00, E14 + 00
3	N13 + 00, E25 + 00	N11 + 00, E8 + 00
4	N14 + 00, E22 + 00	N13 + 00, E15 + 00
5	N11 + 00, E20 + 00	N11 + 00, E22 + 00
6	N13 + 00, E17 + 00	N14 + 00, E18 + 00
7	N11 + 00, E15 + 00	N11 + 00, E17 + 00
8	N11 + 00, E15 + 00	N12 + 00, E12 + 00
9	N13 + 00, E12 + 00	N12 + 00, E22 + 00
10	N13 + 00, E9 + 00	N13 + 00, E18 + 00
11	Background Location**	

*Grid shown in Figure 3-1.

**Selected in field by geologist.

split-spoon samplers. The sample will be split with one fraction being retained for radiological analysis by TMA-E and the other for chemical analysis by EAL. All samples taken from a single borehole will be composited into three samples to obtain a limited profile of the subsurface materials.

Composite sampling for volatile materials may produce results with little meaning because of the possible loss of volatiles from the samples during the compositing process. Hence, discrete samples for volatile organics will be taken from the third, sixth, and eighth spoons taken from each hole.

4.2.4 Required Analyses

All composite samples will be subject to a multi-element analysis by the Inductively Coupled Plasma Arc Emission (ICPAE) analytical method and a total organic carbon (TOC) analysis. Results of these analyses will be compared with those made on background soil samples. Results of the ICPAE test will indicate the concentrations of materials such as arsenic, lead, and mercury. Results of the TOC analysis will reveal the presence of organic contaminants. Since the TOC analysis may not detect the presence of highly volatile chlorinated organics these would be detected by performing total organic halides (TOX) analyses on the three discrete volatile organic samples taken from each hole.

4.2.5 Analysis of Groundwater Samples

The ten groundwater samples identified in Subsection 3.2 will also be subject to hazardous chemical analyses to determine whether or not any of these materials are migrating in the groundwater. Again, indicator analyses of ICPAE, TOC, and TOX will be performed on these samples.

4.2.6 Special Analyses

If material is encountered during drilling that appears to the geologist to have the appearance and other properties of organic sludge or residue, special analyses will be performed on this material. Samples will be taken for volatile organics analysis, base/neutral-acid extraction analysis, and polychlorinated biphenyl-pesticide analyses.

4.2.7 Shipping Requirements

Samples will be packaged and shipped in conformance with Department of Transportation, EPA, and applicable state and local regulations pertaining to hazardous and radioactive materials.

4.3 DOCUMENTATION

Chain of custody records will be maintained for each sample from the time it is collected until it is received by the laboratory. EAL will supply chain of custody forms.

All quality assurance/quality control (QA/QC) data will be reported with the analytical results for the samples. The QA/QC report will include blind splits, process blanks, standard reference materials, and spikes. The report is due 30 days after the laboratory receives the last sample. The report will also include a signed chain of custody record for all samples. This record will indicate the date on which samples were received, and the name of the receiving individual. Chain of custody records for individual laboratory analyses will not be required. Analytical methods used will be documented.

4.4 REPORTING

The data collected and an interpretation of the results will be reported following the characterization. These data will be

incorporated into the radiological characterization report for the site.

5.0 PERSONNEL HEALTH AND SAFETY

The health and safety of site personnel performing characterization activities will be protected through the implementation of the FUSRAP Occupational Health/Industrial Hygiene Plan (PI 26.0) (Ref. 8). This plan is based on prudent practices that are designed to minimize the chemical hazards posed by toxic substances that may be present on-site.

A brief description of the FUSRAP Occupational Health/Industrial Hygiene Plan follows.

- o General Policy, Organization, and Responsibility: Delineates the responsibilities of key FUSRAP personnel for implementing the plan, including coordinator and management review of the overall health protection system.
- o Medical Screening: Establishes scope of and criteria for pre-work, periodic, and follow-up medical assessment to ensure the evaluation of site personnel health status during performance of project work.
- o Personnel Protective Apparel and Equipment: Discusses specific health protection systems, including personnel protective apparel and equipment requirements; environmental hygiene monitoring equipment; equipment/ personnel decontamination procedures; radiological health protection systems; availability of first-aid, safety, and fire protection equipment on an emergency basis; and rationale for identification of certain on-site conditions as health hazards.
- o Conduct of On-site Workers and Visitors: Itemizes general health and safety procedures as well as prohibited practices for performing work on-site.
- o Field Personnel Health and Safety Training: Sets forth training objectives and proposed instructional outline to ensure comprehensive health and safety training of site personnel; reviews the personnel protection program in detail; and delineates emergency procedures, prohibited procedures, and general safety requirements for conducting site work.
- o Special Conditions for Specific Operations: Details the potential health hazards present during drilling and excavation operations (i.e., gases, volatile organics, and hydrogen sulfide).

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APPENDIX A
RADIOLOGICAL CHARACTERIZATION CHECKLIST
FOR SLAPS

APPENDIX A
RADIOLOGICAL CHARACTERIZATION CHECKLIST FOR SLAPS

Action	Completed	
	Initials	Date
1. Review of Historical Information		
a. previous radiation surveys	_____	_____
b. operations descriptions	_____	_____
c. photos	_____	_____
d. interviews		
1) operations personnel (hire as consultants?)	_____	_____
2) neighbors	_____	_____
3) others	_____	_____
e. Aero Space Research resources	_____	_____
f. others	_____	_____
2. Property Surveys		
a. obtain blank grid drawings	_____	_____
b. obtain old and new topographical drawings	_____	_____
c. confirm that the property is staked at 50-ft intervals	_____	_____
3. Walkover Tour of Site (note on drawings)		
a. rubble	_____	_____
b. surface obstructions	_____	_____
c. buried utility lines	_____	_____
d. utility poles	_____	_____
e. culverts	_____	_____
f. stockpiles	_____	_____
g. grates, drains	_____	_____
h. others (wells, etc.)	_____	_____

4. Characterization Team Review of Preliminary Information

- a. compare old and new topographic maps for changes
- b. develop sketch of site from historical information

_____	_____
_____	_____

5. Surface Gamma Surveys

- a. walkover with unshielded gamma scintillometer
- b. cone-shielded gamma survey at grid subdivisions

_____	_____
_____	_____

6. Team Meeting to Review Gamma Scans

- a. map areas exceeding preselected limits with unshielded scan
- b. map areas exceeding preselected limits with cone-shield results
- c. check consistency of surface scans with historical information
- d. plan locations for biased surface soil samples
- e. plan locations for systematic boreholes
- f. plan locations for sampling around Item 3 problem areas
- g. plan sediment sampling locations
 - 1) culverts
 - 2) drainage ways
 - 3) inside storm sewers
 - 4) outfalls
 - 5) others

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

7. Biased Surface Soil Sampling (as planned in 6d)

8. Subsurface Investigations (as planned in 6e)

- a. drill systematic boreholes to depth of undisturbed soil
- b. obtain surface elevation of boreholes

_____	_____
_____	_____

- c. gamma log boreholes
- d. sample as required from boreholes
- e. review gamma logs for uniformity of contamination layers
- f. plan biased borehole locations to resolve inconsistencies between systematic holes
- g. repeat steps a. through d. for biased boreholes (as funding allows)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

9. Team Meeting to Review Sampling

- a. were all planned samples collected?
- b. were sufficient samples collected to
 - 1) establish background?
 - 2) calibrate cone shield?
 - 3) calibrate unshielded gamma walkover survey?
 - 4) calibrate borehole gamma logs?
- c. were problem areas from Item 3 characterized?
 - 1) sides?
 - 2) bottoms?
 - 3) top?
- d. was a borehole drilled in each area of surface contamination?
- e. identify all areas that are unmeasurable
- f. graphically review data to ensure that all areas have been characterized

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

10. Review of Data for Consistency with Historical Information

_____	_____
-------	-------

11. Field Sample Collection Forms

- a. do coordinates on samples match those on forms?
- b. are all samples on collection forms?
- c. were all logged samples shipped?
- d. was copy of field sample collection sent to TMA/E Oak Ridge office?

_____	_____
_____	_____
_____	_____
_____	_____

- | | | |
|--|-------|-------|
| e. was copy of collection form sent with samples to laboratory? | _____ | _____ |
| 12. Transmit all Field Notes, Data, and Drawings to TMA/E Oak Ridge Office | _____ | _____ |
| 13. BNI/EH&S Interpretation of Characterization Data | | |
| a. Surface | | |
| 1) Develop surface contamination isopleths | _____ | _____ |
| 2) Compare BNI and characterization team isopleths | _____ | _____ |
| b. Subsurface | | |
| 1) correlate soil samples and borehole gamma logs to determine cpm/pCi/g | _____ | _____ |
| 2) develop contamination isopleths at various depths | _____ | _____ |
| a) map all borehole logs that exceed criteria | _____ | _____ |
| b) map all borehole logs with increasing trends regardless of magnitude | _____ | _____ |
| 14. Comparison of Contamination Limits and Historical Information for Consistency | _____ | _____ |
| 15. Transmittal of Data for Review to BNI Engineering Department with Copies to Construction and the Characterization Team | _____ | _____ |
| 16. Site Tour to Review Characterization Findings with | | |
| a. lead health physicist | _____ | _____ |
| b. lead engineer | _____ | _____ |
| c. lead construction representative | _____ | _____ |
| d. lead member of characterization team | _____ | _____ |

APPENDIX B
STAFFING/BUDGET FOR BECHTEL NATIONAL, INC. AND
THERMO ANALYTICAL/EBERLINE FOR
SLAPS CHARACTERIZATION

APPENDIX B
STAFFING/BUDGET FOR BECHTEL NATIONAL, INC. AND
THERMO ANALYTICAL/EBERLINE
FOR SLAPS CHARACTERIZATION
(BASE WORK ONLY)

Bechtel National, Inc. will support the field characterization work with two full-time geologists, one part-time industrial hygienist, and one part-time health physicist.

The following budgetary constraints are applicable to the Thermo Analytical/Eberline support:

- o Manpower in the Oak Ridge office will be limited to no more than 80 hours for the technical director for characterizations and 40 hours for the project manager.
- o The field characterization team is currently funded for approximately 6 people for 8 weeks.
- o Budgetary support is currently limited to analysis of:
 - 400 soil samples (radiological)
 - 30 soil samples (chemical)
 - 10 groundwater samples
 - 2 surface water samples
 - 30 urine samples

All samples shall be analyzed for thorium-230, thorium-232, radium-226, and uranium-238.