DOE/OR/20722-164

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

GEOLOGICAL AND HYDROGEOLOGICAL CHARACTERIZATION PLAN FOR THE ST. LOUIS AIRPORT SITE AND BALL FIELD AREA

St. Louis, Missouri

July 1987

Bechtel National, Inc.

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AUG 3 1987

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Attention: S. W. Ahrends, Director
Technical Services Division

Subject: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Publication of the Geological and Hydrogeological Characterization Plan for the St. Louis Airport Site and Ball Field Area
Code: 7310/WBS: 153

Dear Mr. Ahrends:

As requested by Steve McCracken in a telephone conversation on July 30, we are transmitting five copies of the referenced report to you with this letter. This published version of the report reflects the comments transmitted to us on July 1 (our CCN 045946) and the additional comments provided by Steve McCracken in a review meeting on July 29.

Please let us know if additional copies are required.

Very truly yours,

SD Liedle

S. D. Liedle
Assistant Project Manager -
FUSRAP

AMF/amf

Enclosures: As Stated

cc: J. D. Berger (ORAU) (w/a)
S. H. McCracken (w/o)
B. A. Hughlett (w/o)
J. F. Wing (w/o)

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GEOLOGICAL AND HYDROGEOLOGICAL CHARACTERIZATION PLAN FOR THE ST. LOUIS AIRPORT SITE AND BALL FIELD AREA

JULY 1987

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

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Oak Ridge, Tennessee

Bechtel Job No. 14501

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1.0 INTRODUCTION

Characterization of the St. Louis Airport Site (SLAPS) and the ball field area to the north of the SLAPS is necessary to determine the geological and hydrogeological properties of both areas, since these factors will affect actions to be taken for development of the property as a permanent disposal site for residual radioactive waste. Limited geological and hydrogeological characterization of the site was performed in January 1987 to provide the information required for development of this characterization plan (Ref. 1). This report is intended to document the scope of the geological and hydrogeological characterization effort and the procedures to be used.

1.1 HISTORICAL OVERVIEW

SLAPS 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). The site was acquired by the U.S. Atomic Energy Commission (AEC) in 1947; from then until approximately 1966, the site was used to store waste produced by a uranium feed materials plant in St. Louis. These waste 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 along with the rest of the site, were covered with 1 to 3 ft of clean fill material. It is believed that the rubble was buried primarily in the western portion of the site.

On the basis of a radiological investigation of the SLAPS performed from 1976 through 1978 by Oak Ridge National Laboratory (ORNL), it was determined that radioactive materials were present in the drainage ditches to the north and south of McDonnell Boulevard (Ref. 2). In 1981, the drainage ditches were designated for

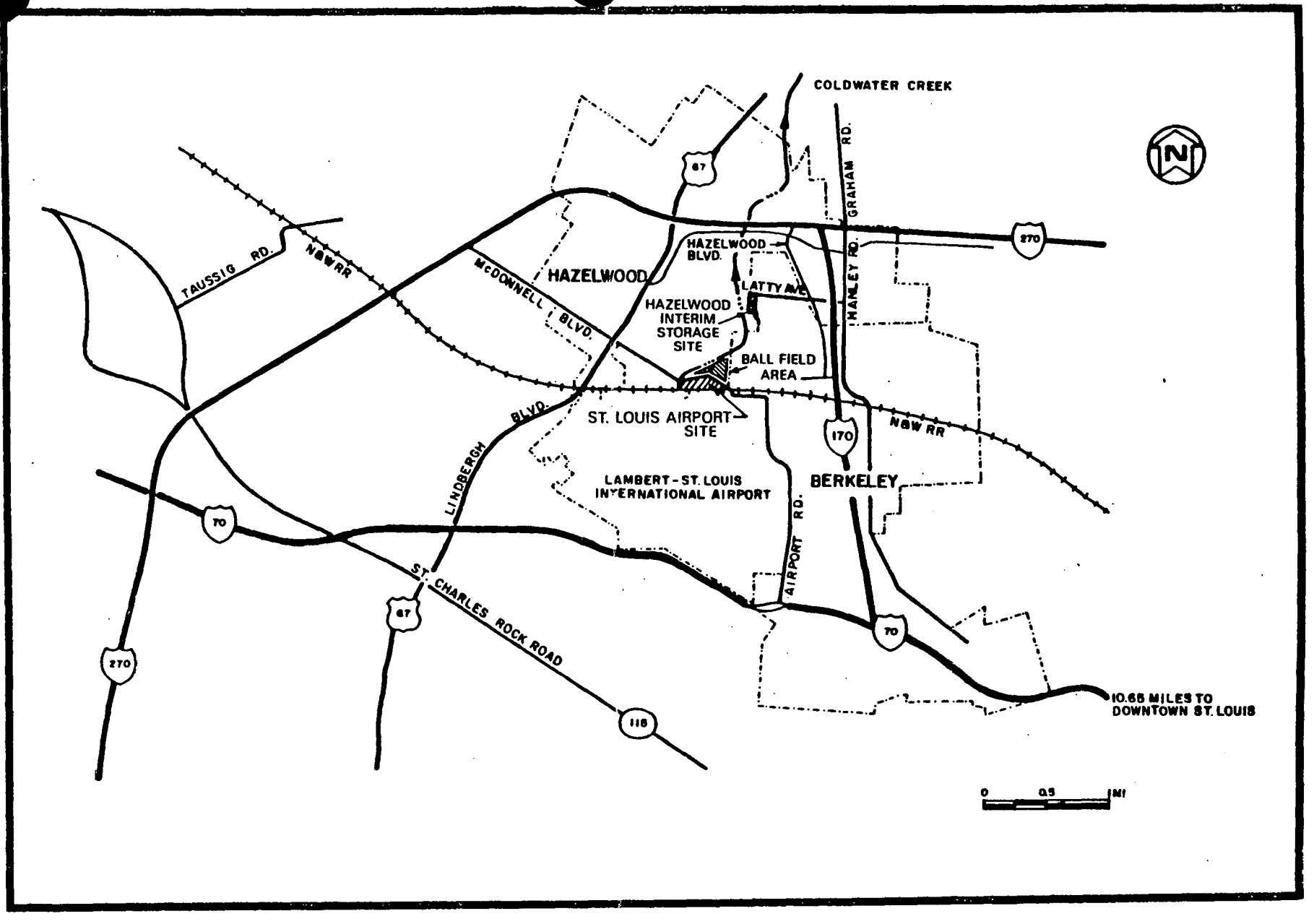

FIGURE 1-1 LOCATION OF THE SLAPS AND BALL FIELD AREA

remedial action under FUSRAP. In 1982, BNI performed a radiological survey of the drainage ditches to establish the vertical and horizontal limits of the uranium-238 and radium-226 contamination (Ref. 3). In 1982 Roy F. Weston, Inc. performed a limited radiological and geological investigation of the SLAPS (Ref. 4). In 1986, BNI performed a radiological and limited chemical survey of the SLAPS. An investigation to obtain preliminary information about the hydrogeological properties of the site was also conducted at that time. Results of the limited geological and hydrogeological investigation are the subject of a separate report (Ref. 1). Preparation of the characterization report on the radiological and limited chemical survey performed in 1986 is under way. The 1982 and 1986 radiological surveys performed by BNI were the only ones that extended beyond the site fence line to include the drainage ditches along McDonnell Boulevard.

In 1973, ownership of the site was transferred by quitclaim deed from the AEC to the City of St. Louis. The 1985 Energy and Water Development Appropriations Act (Public Law 98-360) authorized the U.S. Department of Energy (DOE) to reacquire the property from the city for use as a permanent disposal site for the waste already on the site, the material in the waste storage pile at the HISS, the material excavated during cleanup of the HISS vicinity properties, and the contaminated material to be removed from along McDonnell Boulevard immediately to the north and east of the SLAPS (Figure 1-1). Actions to transfer ownership of the property to DOE have been initiated.

1.2 SCHEDULE

The field activities for the geological and hydrogeological characterization of the SLAPS are scheduled to be performed during the fourth quarter of calendar year 1987.

1.3 SUPPORT SERVICES

The following support services will be required to perform this characterization:

- Drilling geologic boreholes
- Installing monitoring wells
- Geotechnical soil testing
- Geochemical water analysis
- Civil surveying

1.4 REVIEW OF EXISTING INFORMATION

Before field activities for this characterization commence, available geological and hydrogeological information pertaining to the site will be compiled by the University of Missouri. The types of documentation to be gathered will include, but will not be limited to, known previous geological/hydrogeological characterization reports by various organizations, map studies, topographic surveys, and aerial photographs. Information and data pertinent to the project will be sought from published and unpublished papers, reports, maps, records, and consultations with the United States Geological Survey and other federal, state, and local agencies. The information that is compiled will be reviewed by BNI and evaluated for validity and applicability to the project.

As a result of this effort, a reasonable knowledge of site conditions will be obtained. This information will be used to aid in the geologic interpretation of data collected during the installation and monitoring of new wells. The review of existing information may also reveal gaps in information about the site; the methods to be used for obtaining the missing information will then be integrated into the plan for collection of detailed information needed for final design of a disposal facility.

Previous investigations have identified two groundwater systems at the site (Ref. 5). The upper zone is an eolian (wind deposit) and lacustrine (lake deposit) silt, and the lower zone is a lacustrine silt. The two identified systems are separated by a lacustrine, silty clay.

The geological and hydrogeological characterization will include an portion of the ball field to the north of McDonnell Boulevard. This area of the ball field is known to have been used previously for disposal of building debris and construction rubble. Characterization of the area will confirm whether the materials were placed on top of the existing ground surface as is suspected.

2.0 GEOLOGICAL AND HYDROGEOLOGICAL CHARACTERIZATION

2.1 SCOPE/PURPOSE

The main objective of this characterization effort is to determine the geological, hydrogeological, and engineering properties of the stratigraphic sequence that underlies the site. As an additional result of the characterization, information will be obtained as to the quality of the groundwater and soil at the site and vicinity. Data will be gathered to determine the thickness, areal extent, hydraulic conductivity, cation exchange capacity, and distribution coefficient of the clay, as well as any other soil characteristics to be considered in designing a waste containment structure.

Borings and groundwater monitoring well samples will be analyzed to provide the required characterization data; laboratory support will be provided through the support subcontracts for soil and water analysis. The results of this characterization will be reviewed along with the findings of previous investigations to provide a data base for evaluation of technical approaches to the development of a permanent waste disposal site.

2.2 CHARACTERIZATION ACTIVITIES

The characterization will include the following major work elements:

- Drilling of geologic boreholes
- Installation of groundwater monitoring wells around the ball field area (along Coldwater Creek, McDonnell Boulevard, and Eva Avenue)
- Development of wells
- Civil surveying
- Hydrogeological testing
- Chemical/Geochemical testing
- Soil testing (engineering/geochemical properties)

Other characterization activities will include:

- An investigation to confirm the presence of the two previously identified groundwater systems and to identify any additional groundwater systems
- Determination of the hydrogeological characteristics of the two previously identified groundwater systems, including hydraulic conductivity, groundwater flow direction and gradient, head relationships, and magnitude of seasonal fluctuations in groundwater level
- Acquisition of water quality and water level data from additional groundwater monitoring points

Future discussions between DOE and local government entities may result in a need to revise the specific locations that have been selected for the characterization activities. If such revisions do become necessary, additional locations will be selected by the project geologist and will be established in accordance with applicable specifications. In addition, these revisions will be coordinated with project environmental health and safety personnel in conjunction with the radiological and limited chemical characterization of the site.

Each of the major characterization activities is described in the subsections that follow.

2.2.1 Geologic Boreholes

Approximately 44 geologic boreholes will be drilled in the area adjacent to the site and in the ball field area (Figure 2-1) to provide data on the stratigraphic sequence above and below the lacustrine silty clay unit. It is planned that approximately 27 of these geologic boreholes will be completed as monitoring wells. A generalized sketch of a typical geologic borehole is shown in Figure 2-2.

To ensure that the underlying clay layer remains intact in an area that could potentially accommodate a waste containment structure, drilling performed within the area encompassed by Banshee Road, Eva Road, and Coldwater Creek will not penetrate the lacustrine clay

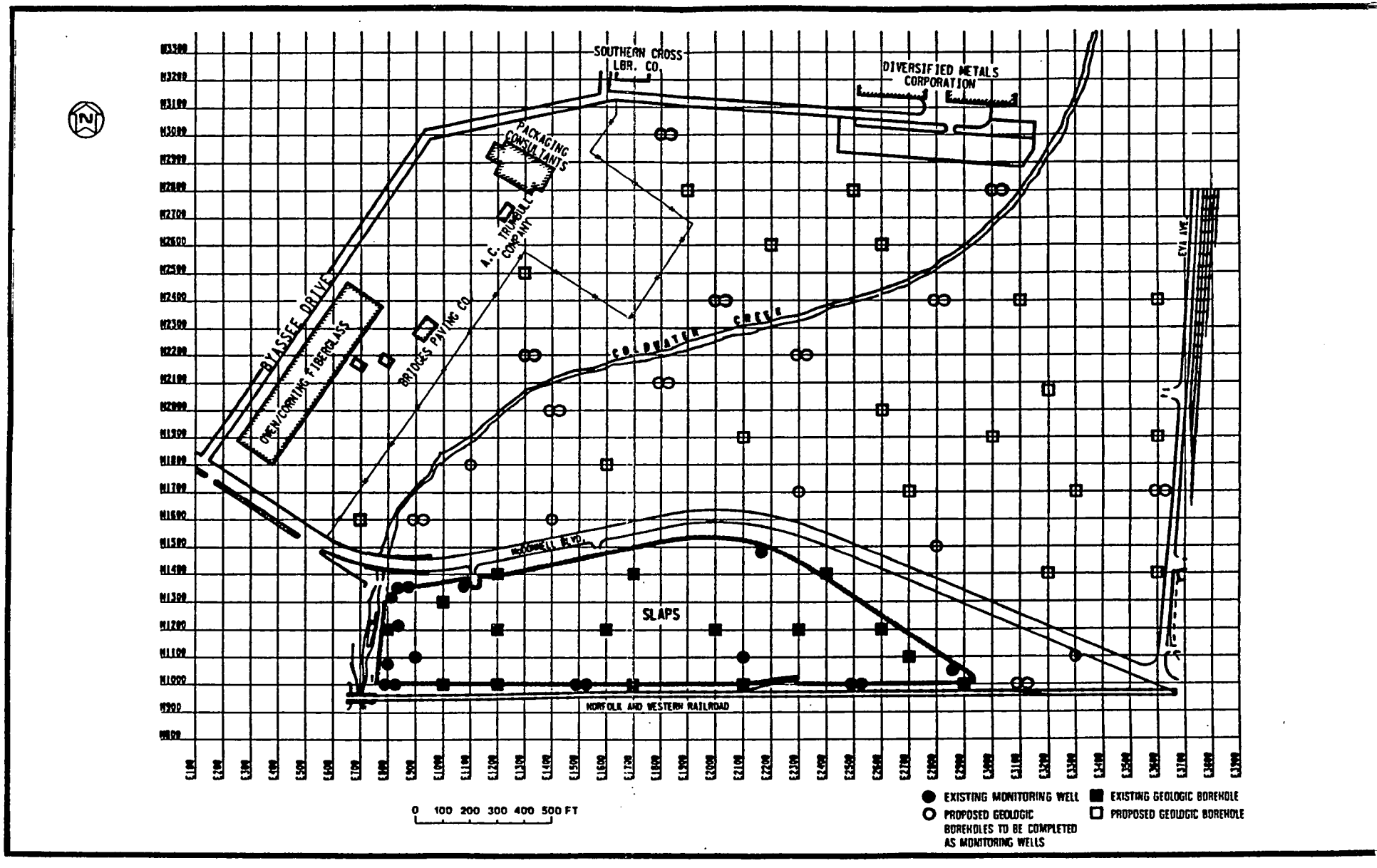

FIGURE 2-1 LOCATIONS OF GEOLOGIC BOREHOLES AND MONITORING WELLS AT THE SLAPS AND BALL FIELD AREA

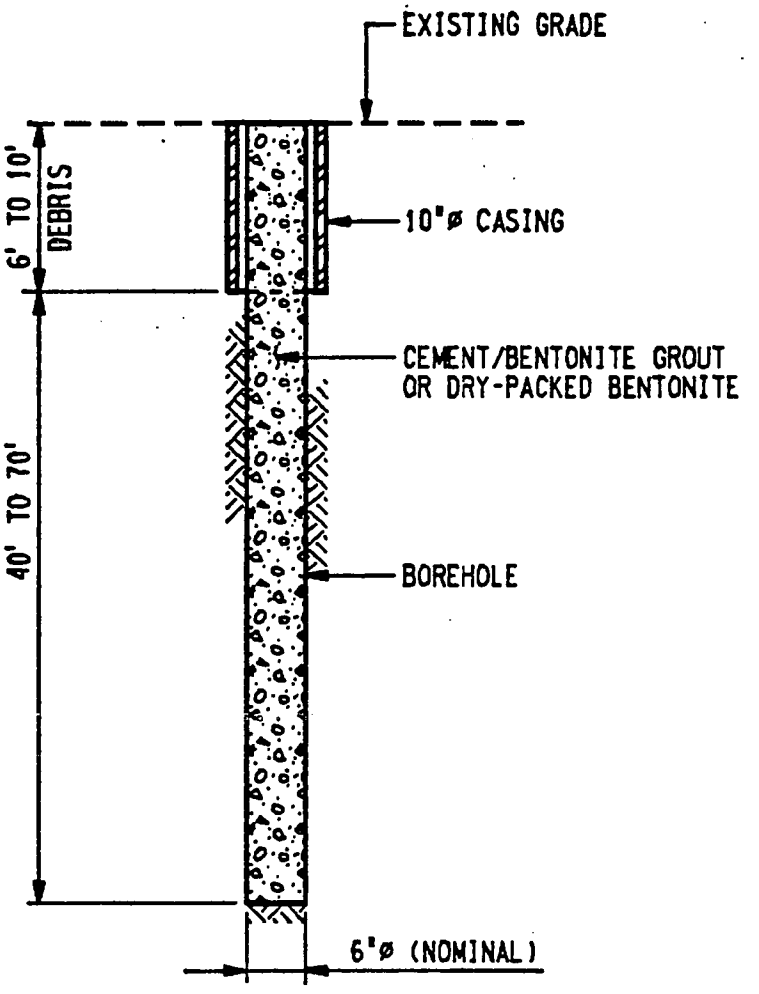

FIGURE 2-2 TYPICAL GEOLOGIC BOREHOLE

layer. The boreholes will be advanced using hollow-stem augers; split-spoon or undisturbed samples will be collected in advance of the augers. Beginning at the bottom of the fill material (debris), which is believed to overlie undisturbed soil, continuous split-spoon samples will be taken for the first 10 ft, at 5-ft intervals thereafter, and at each point where there is a change in the type of material encountered. Undisturbed soil samples will be taken from the eolian soil zone, 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.

Field permeability tests will be performed in selected boreholes (see Subsection 2.2.5). All geologic boreholes will be backfilled and sealed upon completion using dry-packed bentonite and/or cement/bentonite grout. All borehole cuttings will be collected and transported to the SLAPS for disposal.

2.2.2 Installation of Groundwater Monitoring Wells

Six pairs of groundwater monitoring wells and five individual shallow monitoring wells will be installed along the perimeter of the ball field area adjacent to Coldwater Creek to monitor the upper and lower groundwater systems. In addition, four shallow groundwater monitoring wells will be installed between the site and the ball field area to monitor the upper aquifer within the area under consideration. Eight pairs of monitoring wells will be installed in the ball field area to the north of Coldwater Creek to monitor the upper and lower groundwater systems there. The monitoring wells will be installed in geologic boreholes as noted in Subsection 2.2.1. Based on the groundwater monitoring data obtained from these wells, a determination may be made that it is appropriate to install an additional well at the airport upgradient of the groundwater system.

Samples will not be collected from the boreholes in which the shallow monitoring wells are installed because of their proximity to the deep wells. A BNI geologist will log all samples and cuttings

from the boreholes. The wells will be drilled using hollow-stem augers. Beginning at the bottom of the debris, continuous split-spoon samples will be taken for the first 10 ft, at 5-ft intervals thereafter, and whenever there is a change in the type of material encountered. Figure 2-3 shows a typical groundwater monitoring well.

2.2.3 Well Development

The wells will be developed by means of pumping, bailing, or air lift pumping. All groundwater monitoring wells will be developed in a manner that will produce sand-free, low-turbidity water samples.

2.2.4 Civil Survey

A civil survey will be performed to determine as-built locations and elevations of all boreholes and groundwater monitoring wells.

2.2.5 Hydrogeological Testing

Information about the hydrogeological properties of the site will be obtained by conducting field permeability tests and measuring groundwater levels.

Field Permeability Tests

The field permeability tests may be any of four types: constant head, falling head, rising head, and/or well response tests. The specific method to be used will be determined by the BNI geologist on a case-by-case basis after a field evaluation of the materials to be tested has been conducted.

Groundwater Level Measurements

A groundwater level measurement program is in place at the site. Groundwater levels will be monitored at all new wells as part of

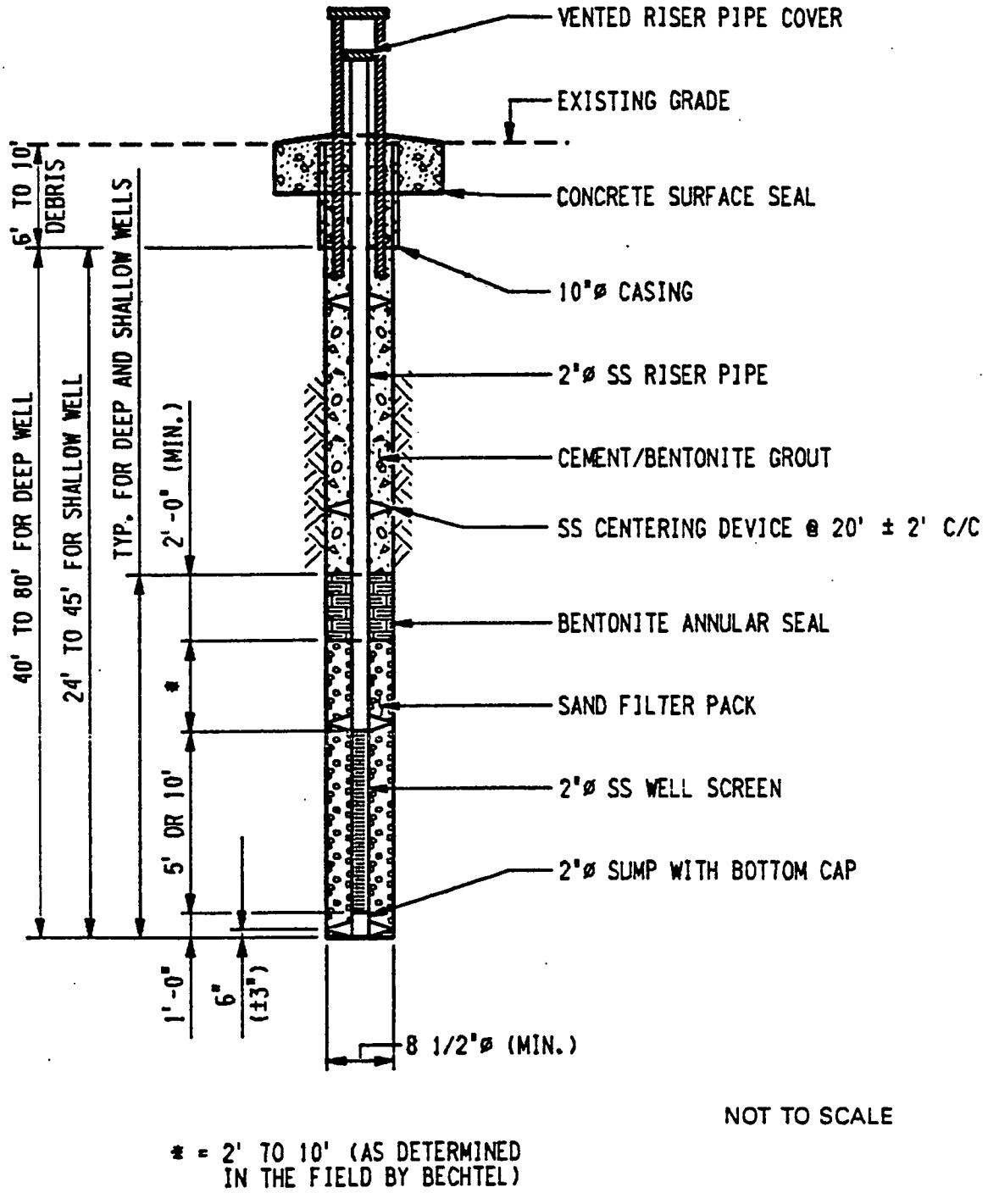

FIGURE 2-3 TYPICAL GROUNDWATER MONITORING WELL

this program. Data from the wells will be used to evaluate the magnitude of seasonal groundwater level fluctuations and changes in horizontal and vertical hydraulic gradients.

2.2.6 Chemical/Geochemical Testing

A variety of chemical and geochemical tests will be performed on water and soil samples as appropriate so that existing conditions can be determined and the suitability of the site for retention of waste materials can be evaluated. The water samples will be subjected to both field tests and laboratory tests. The soil samples will be analyzed for various chemical parameters.

Field Tests

Field testing of the water will comprise measurement of oxidation-reduction potential (ORP), pH, temperature, and conductivity. In addition, concentrations of dissolved oxygen, bicarbonate, and carbonate in the groundwater will be measured.

Laboratory Tests

Ten groundwater samples and two surface water samples will be collected. At least one of these samples will be taken from a well that is considered to be in a background location. The concentrations of the following parameters will be determined:

CATIONS	ANIONS	RADIONUCLIDES	CHEMICALS
Calcium	Sulfate	Radium-226	Volatiles
Magnesium	Nitrate	Thorium-230	Heavy Metals
Sodium	Chloride	Thorium-232	Base-Neutral-Acid
Potassium	Phosphate	Uranium-238	Extractables
Iron (Total)			

Baseline chemical sampling to determine current conditions at the site will continue on a quarterly basis for a period of one year at selected locations.

Approximately 40 soil samples will be collected from geologic boreholes and analyzed for the following chemical parameters: volatiles, heavy metals, and base-neutral-acid extractables. Various soil tests will also be conducted to determine the geotechnical properties of the soil; these tests are discussed below.

2.2.7 Geotechnical Testing

In addition to providing data for use in site evaluation, soil samples obtained during the drilling of the geologic boreholes will be tested to gather data regarding load-bearing capacity, slope stability (temporary and final slopes), sorbtion, and other design features pertinent to the development of disposal facilities.

The following list shows geotechnical parameters to be considered in developing design features for disposal facilities:

- Descriptive Parameters
  - Grain size
  - Liquid and plastic limits
  - Centrifuge moisture equivalent
  - Specific gravity
  - Moisture content
  - Density (total and dry)
- Geochemical Parameters
  - Cation exchange capacity
  - Distribution coefficient
  - Soil pH

- o Strength Parameters

  - Cohesion
  - Friction angle
  - Unconfined compressive strength

- o Compressibility Parameters

  - Compression index
  - Preconsolidation pressure
  - Consolidation coefficient
  - Modulus
  - Compaction relationship
  - Rebound
  - Volume stability

- o Permeability

The specific tests to be performed will be selected based on the the above parameters as applicable given the characteristics of each geologic unit. As is appropriate, empirical correlations and other field data obtained during the characterization will be used to supplement the laboratory test results. If unexpected geologic conditions are encountered such that a modification to this characterization plan is required, both the Missouri Department of Natural Resources and the Environmental Protection Agency will be apprised of any changes in the characterization plan.

All tests will be assigned by a BNI geotechnical engineer or geologist. Testing will be performed in accordance with the standards established by the American Society for Testing and Materials or other published laboratory procedures where appropriate. All samples will be examined before they are tested to ensure that they are representative of the appropriate geologic unit and that they are suitable for testing.

2.3 DOCUMENTATION

2.3.1 BNI Documentation

A geologic log will be prepared for each borehole and will include the following information: hole number, location, descriptions and depths of materials encountered, locations and types of samples taken, any unusual or significant observations noted during drilling, total depth, and final disposition of the borehole (e.g., grouted to surface, groundwater monitoring well installed, etc.). In addition to the geologic log, an "as-built" well installation diagram will be prepared for each groundwater monitoring well. Well development activities will be documented on well development data forms. All field permeability test measurements will be recorded on appropriate data forms. Each geologist will record daily work activities on the appropriate forms.

2.3.2 Subcontractor Documentation

The drilling subcontractor will be required to submit driller's logs for each hole. These logs will include the following information: hole number, descriptions and depths of materials encountered, number and type of samples collected, and the total depth of the borehole.

The analytical laboratory for geochemical water analysis will be required to submit a report on analysis results. For each sample analyzed, the report will include the sample number, test results, concentration data, analytical methods, degree of precision for each method used, and quality control results.

The soil testing laboratory will be required to submit a report documenting testing methods and results and to make recommendations where appropriate. In addition, to ensure that appropriate changes in the foundation design are made as changes in foundation loading

occur, a Bechtel soils engineer will be routinely available for consultation with the design team.

A site plan certified by a registered professional land surveyor will be prepared to show the as-built locations for all investigative activities and wells.

2.4 REPORTING

A characterization report will be prepared to present findings of the characterization, including the current hydrogeological conditions at the site and ball field area. The characterization report will also include an evaluation of the hydrogeology of the site relative to its suitability as a permanent disposal site.

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