START

19

0038377

BHI-00045
Rev. 01

100 N Barrier Wall Design Drilling Program

Authors

K. R. Simpson
V. M. Johnson

Date Published
September 1994

Environmental Excellence
HANFORD

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

SEP 1994
RECEIVED
EDMC

Approved for Public Release

BHI-00045
REV: 01
OU: 100 N
TSD: N/A
ERA: 100 N

APPROVAL PAGE

Title of Document: 100 N BARRIER WALL DESIGN DRILLING PROGRAM

Author(s): K. R. Simpson
V. M. Johnson

Approval: M. J. Lauterbach, PRJ

Signature 9/15/94 Date

Joan Plastino, Quality Assurance

Signature 9/15/94 Date

Dave Herman, Safety

Signature 9/15/94 Date

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

In some cases, for documents in process or previously issued with a WHC document number before July 1, 1994, this page will appear in documents identified with WHC document numbers. No other forms are required for these documents.

~~BHI-DIS~~ 9-16-94

total pages 18

CONTENTS

1.0 INTRODUCTION 1
1.1 BACKGROUND 1
1.2 OBJECTIVES 1
1.3 GENERAL SUBSURFACE CONDITIONS 2

2.0 SCOPE OF WORK 2
2.1 STABILIZATION OF ACCESS ROAD 2
2.2 GEOTECHNICAL BORINGS 2
2.3 AQUIFER TESTING 3
2.4 INSTALLATION OF MONITORING WELLS 3

3.0 GENERAL REQUIREMENTS 4
3.1 HANFORD SITE GENERAL REQUIREMENTS 4

4.0 SAMPLING AND FIELD ACTIVITIES 4
4.1 GEOTECHNICAL BORINGS 4
4.2 MONITORING WELL COMPLETIONS 5
4.3 AQUIFER TESTING 6
4.4 SAMPLES FOR TOTAL STRONTIUM AND RETARDATION COEFFICIENT 7

5.0 LABORATORY ANALYSIS 7

6.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS 8

7.0 SCHEDULE 8

8.0 CHANGES TO DESCRIPTION OF WORK 8

9.0 REFERENCES 8

FIGURES:

1. Location Map of Geotechnical Borings and Monitoring Wells 10

2. Stratigraphic Cross Section Through the Barrier Wall 11

3. General Design of Washington Department of Ecology WAC 173-160 Compliant Wells 12

4. Field Change Form 13

CONTENTS (cont.)

TABLE:

1. Borehole Sampling and Testing Summary 14

1.0 INTRODUCTION

This report describes field activities associated with geotechnical characterization borings to be drilled in the 100-N Area of the Hanford Site in support of the N Springs Expedited Response Action (ERA). The purpose is to gather sufficient geologic, geotechnical, and geohydrological data to support design and construction of a barrier wall along the banks of the Columbia River in the 100-N Area. This work is being performed in accordance with the *N Springs Expedited Response Action Proposal* (DOE-RL 1993) and Tri-Party Agreement Milestone M-16-01N.

1.1 BACKGROUND

Past practices in the 100-N Area have resulted in contamination of soils and underlying groundwater. The release of large volumes of water to the 1301-N and 1325-N liquid waste disposal facilities (LWDF) have resulted in transport of contaminants, particularly strontium-90, to the Columbia River. Since the shutdown of N Reactor in 1987, the releases to the LWDF have been discontinued. However, the contamination, which is primarily located within the vadose zone, still leaches into the unconfined aquifer and is transported to the river by groundwater. N Springs consists of a series of seeps and springs along the river's edge where contaminated groundwater is discharged. Although the contamination is rapidly diluted to very low levels within the river, N Springs has been determined to represent a significant pathway for strontium-90 release into the river.

1.2 OBJECTIVES

A total of eight borings are to be drilled in the vicinity of the proposed barrier alignment as shown in Figure 1. Of these, three of the geotechnical boreholes, N-92A, N-94A, and N-96A, are to be completed as groundwater monitoring wells. A fourth borehole, N-99A, will be drilled for installation of a monitoring well.

The objectives of the work are as follows:

1. Obtain geologic and geotechnical information regarding the fluvial gravel unit (unit E) of the upper Ringold Formation in the vicinity of the proposed barrier alignment. Specific areas of interest include penetration resistance, the presence of cobbles or boulders, and the degree of cementation.

2. Obtain information regarding the elevation and geologic and geohydrologic characteristics of the upper mud contact (paleosol/overbank unit) along the proposed barrier alignment. This unit is thought to occur approximately 50 to 60 ft below ground surface in the vicinity of the proposed barrier. Under the present concept, the barrier will penetrate approximately 5 ft into this unit to cut off flow in the upper unconfined aquifer.

1.3 GENERAL SUBSURFACE CONDITIONS

Hydrogeologic units that will be penetrated in the barrier wall project include a thin, approximate 5-ft vadose zone and an unconfined aquifer approximately 40 to 50 ft thick in the upper Ringold Formation. Character of the sediments expected to be encountered will consist of clast to matrix supported, pebble to cobble gravel with a sand matrix. Boulders may be encountered. Figure 2 shows a cross section normal to the path of the barrier wall and intersects two wells that penetrated to the lower mud unit.

The base of the aquifer consists of a paleosol/overbank deposit which is composed of a thick, fine-grained silt and sand otherwise known as the upper mud confining unit of the Ringold Formation. A more complete description of subsurface conditions can be found in Hartman (1993).

2.0 SCOPE OF WORK

The work addressed by this report includes stabilization of the access road, drilling and sampling of seven geotechnical borings, installation of groundwater monitoring wells, aquifer testing, abandonment of geotechnical borings, handling and disposal of all investigation derived waste, and decontamination of equipment. Specific tasks are discussed in detail below.

2.1 STABILIZATION OF ACCESS ROAD

The proposed barrier alignment is located along the south bank of the Columbia River, following a bench approximately 10 to 15 ft above river level. The access roads to the barrier alignment have been poorly maintained and the area is presently marked as a surface contamination area (SCA). The access roads will be stabilized by placing clean fill, as necessary, to ensure that heavy equipment may access the barrier alignment, and to control areas of radiological contamination. Every effort should be made to minimize disturbance of the ground surface during the stabilization effort and subsequent tasks.

2.2 GEOTECHNICAL BORINGS

Seven geotechnical borings shall be drilled at locations shown in Figure 1. Each boring will be drilled with a cable tool rig. At least two strings of casing (10 in. and 8 in.) will be used in each boring to minimize slough in the borehole. Blow count samples will be obtained at intervals of 5 ft, or at any change in strata, using a 6-in. drive barrel driven by the drilling jars. From this point on, the word "samples" includes the material returned by the drive barrel while obtaining blow counts. All samples will be placed in a 1-L or larger plastic

container for future consideration of strontium-90 and retardation coefficient (K_d) analysis. Samples will be chosen for analysis based on field screening for contamination.

Each geotechnical boring shall be drilled a minimum of 10 ft into the Ringold upper mud contact. This contact is expected to occur at an elevation of 349 to 359 ft above mean sea level, which corresponds to a depth of approximately 50 to 70 ft below ground surface.

Unless it is to be completed as a monitoring well, each geotechnical boring shall be abandoned in accordance with the requirements of WHC-S-0105.

2.3 AQUIFER TESTING

Aquifer testing will consist of constant head testing in the upper mud after total depth has been reached. A falling head test will be performed depending on results of the constant head test. Slug testing will be performed in the completed well at the water table. Section 4.3 has details of the testing requirements.

2.4 INSTALLATION OF MONITORING WELLS

Groundwater monitoring wells shall be installed in three of the geotechnical borings (N-92A, N-94A, and N-96A in Figure 1). General design of Washington Department of Ecology WAC 173-160 compliant wells is shown in Figure 3. Borehole-specific design requirements (Figure 2) will be dependent on conditions encountered. Variances may be required from the Washington Department of Ecology for the construction of the monitoring wells. Screen length will be 20 ft with 15 ± 2 ft set into the aquifer. The top of the aquifer will be considered as the highest recorded river stage based on historical high water. For the past year, the highest recorded elevation was 390 ft. Thus, the top of the screen will be set at approximately 392 ft elevation. However, final depth will be determined by the well site geologist.

The well will be installed at the completion depth by grouting the bottom of the hole up to the test interval and then completing the monitoring well installation in accordance with the requirements of WHC-S-014, Generic Well Specification, Groundwater Monitoring Wells (Rev. 7).

An additional groundwater monitoring well, 99A (permanent well number N-99A in Figure 1), may be installed by drilling to total depth without sampling. Completion will be in accordance with WHC-S-014.

3.0 GENERAL REQUIREMENTS

3.1 HANFORD SITE GENERAL REQUIREMENTS

All personnel working to this description of work will have completed the 40-hour Hazardous Waste Site Worker Training Program and will perform all work in accordance with the following:

- WHC-EP-0383, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990)
- WHC-CM-1-6, *Radiological Control Manual* (WHC 1993)
- WHC-CM-4-3, *Industrial Safety Manual*, Vol. 1 through 4 (WHC 1987)
- WHC-CM-4-11, *ALARA Program* (WHC 1988a)
- WHC-CM-7-5, *Environmental Compliance Manual* (WHC 1988c)
- WHC-CM-7-7, *Environmental Investigations and Site Characterization Manual* (WHC 1988d)
- WHC-IP-0692, *Health Physics Procedures Manual* (WHC 1991)
- WHC-S-014, *Specification for Generic Well Specification, Groundwater Monitoring Wells*
- WHC-S-0105, *Specification for Geotechnical Test Borings*
- Site-specific health and safety plan/radiation work permits/job safety analysis.

The field team leader will be responsible for holding regular pre-job safety meetings in order to ensure that all site personnel have been briefed on all safety and health issues that may pose risks to site workers.

4.0 SAMPLING AND FIELD ACTIVITIES

4.1 GEOTECHNICAL BORINGS

Seven geotechnical borings are to be drilled as shown in Figure 1, using a cable tool rig. Table 1 shows the sample and testing requirements for each borehole.

Borehole cuttings will be screened for radioactivity by health physics technicians as deemed necessary. Samples of the cuttings may be collected and submitted to the 222-S Laboratory for total activity analysis or other appropriate radiological analyses. All contaminated cuttings collected during the drilling of the monitoring wells will be placed in a drum and disposed of in accordance with WHC-CM-7-7, Environmental Investigations Instruction (EII) 4.3 "Control of CERCLA and Other Past Practice Investigation Derived Waste" (WHC 1988d).

Field activity reports shall be prepared in accordance with EII 6.7, "Documentation of Well Drilling and Completion Operations" (WHC 1988d). A geologic log will be prepared for each geotechnical boring in accordance with EII 9.1, "Geologic Logging" (WHC 1988d). Note that the field activity report is intended to be a chronological record of drilling activities, whereas the geologic log is intended to be a description of the material encountered in the boring, listed in order of increasing depth.

Because the hole is being advanced by cable tool methods and much of the material to be encountered is anticipated to be gravel, the standard penetration test as described in American Society for Testing and Materials Standard D-1586 is not considered appropriate. Hence, samples will be collected using a 6-in. drive barrel, driven by the drilling jars. The weight of the jars and the drop distance will be recorded for each sample on the geologic log. Each sample will be driven a total of 18 in., with the number of blows required to drive each 6-in. increment recorded in the log. Refusal is defined as less than 6 in. penetration after 100 blows. In this case, the sample attempt will be discontinued and the length of penetration will be recorded after 100 blows.

It is recognized that the subsurface material may contain cobbles and boulders. Every effort will be made to determine the approximate proportion of cobbles and boulders, as well as the degree of cementation. Although sample descriptions are considered an important component of the geologic log, the difficulty of obtaining cobble or boulder samples is acknowledged. While every reasonable effort shall be made to obtain samples at 5-ft intervals, the well site geologist shall have the discretionary authority to skip individual sampling efforts where it appears likely that no sample will be obtained. However, each instance where no sample is attempted shall be individually documented in the geologic log.

Each geotechnical boring shall be drilled a minimum of 10 ft beyond the Ringold upper mud contact, as determined by the well site geologist. Available data suggest that this contact will be encountered at depths of 50 to 60 ft. Permeability testing shall be performed in the Ringold upper mud unit as described in Section 4.3.

4.2 MONITORING WELL COMPLETIONS

All groundwater monitoring wells shall be installed in accordance with WHC-S-014, "Generic Well Specification - Groundwater Monitoring Wells." Documentation shall be prepared in accordance with EII 6.7, "Documentation of Well Drilling and Completion Operations" (WHC 1988d).

Groundwater monitoring wells will be installed at each end of the proposed barrier alignment, N-91A and N-97A. Two additional monitoring wells will be installed in a "matched pair" configuration on both sides of the proposed barrier and near the center of the alignment, N-94A and N-99A. The locations of all monitoring wells are shown in Figure 1.

To minimize drilling, the monitoring wells at each end of the barrier alignment and one of the center wells will be installed in the geotechnical borings. Each monitoring well will consist of 20 ft of 4-in.-diameter screen set at the top of the unconfined aquifer. To accomplish this, it will be necessary to grout the lower part of each geotechnical boring (approximately 30 ft) before installing the screen in accordance with well drilling specifications (WHC-S-014).

Monitoring well N-99A will be installed by drilling to the appropriate depth without sampling except for grain size analysis for the purpose of screen selection.

4.3 AQUIFER TESTING

Aquifer testing will be performed in order to determine the hydrologic properties of both the Ringold upper mud unit and the unconfined aquifer in the upper Ringold unit E gravel. Two types of permeability tests, a constant head and, if necessary, a falling head, will be carried out in all seven of the geotechnical borings to determine the hydraulic conductivity of the upper mud unit. For the upper gravel unit, hydrologic properties will be obtained through development and subsequent slug testing of the monitoring wells.

Both permeability tests will be run off the same initial configuration in each boring. The boring will start with 10-in. casing and downsize to 8 in. at the top of the lower mud unit. The 8-in. casing will then be driven into the mud to the point at which it is sealed off from the unconfined aquifer. Then the bottom of the hole will be cleaned out and some open hole drilled out. The boring should not advance more than 10 ft into the upper mud unit.

The constant head test will be run first. A constant head wellhead assembly will be affixed to the top of the casing. The wellhead will be connected to a water truck via hose and will have a clear tube (i.e., tygon) rising from the top. The casing will be filled with water, and a steady head of water will be maintained in the tube. The tubing will have an overflow port so that a slight amount of water will discharge from it. The flow rate will be determined by shutting off the water flow from the tanker truck, with a shutoff valve, and timing a 1-ft head change in the tubing. Using the inner diameter of the tubing and the time for the head change, the flow rate will be calculated. The flow will then be re-established and the process repeated until a steady-state flow is achieved.

Depending on the aquifer response during the constant head test, a falling head test may be performed that will require the wellhead assembly to be removed and a transducer lowered into the boring casing. The water level will then be topped off in the boring, and the transducer (with datalogger) will measure the drop in water level over time. It is anticipated that the falling head test will, at a logarithmic recording rate, be run overnight.

As part of the completion of the monitoring wells, well development shall be performed for each well (in accordance with EII 10.4, "Well Development" [WHC 1988d]). During well development, a pump test and slug test will be performed that will give data for establishing hydrologic properties of the upper gravel. The pump test consists of installation of a pump and purging the well until the NTUs are in an acceptable range (approximately 5 NTU). A transducer will be installed to record water level.

4.4 SAMPLES FOR TOTAL STRONTIUM AND RETARDATION COEFFICIENT

Total strontium will be analyzed to confirm vertical distribution of strontium. This is important for design of extraction and injection wells to better refine the groundwater model and to better understand the results of the retardation coefficient analysis. Total strontium analytical results are considered informational and are being analyzed to provide general information on distribution. Thus, no formal quality assurance/quality control sampling is required. Retardation coefficients are to better refine the conceptual model and provide inputs to the groundwater model.

Drive barrel samples taken for blow count samples at 5-ft intervals will be containerized, if enough material is returned to the surface. Total strontium and retardation coefficient analysis will be run on selected samples. Table 1 gives the minimum locations for analysis. Each sample will be placed in a plastic 1-quart or larger water-tight container to preserve natural moisture.

5.0 LABORATORY ANALYSIS

The primary function of the characterization effort is to obtain a geologic and geotechnical profile along the proposed barrier alignment and to locate the Ringold upper mud contact. No laboratory analysis of soil samples is anticipated for characterization purposes. Samples of soil and water encountered in the borings may be submitted to the 222-S Laboratory as necessary to determine radiological conditions. Specific analyses may include the following:

- Total activity
- Gross alpha
- Gross beta
- Gamma energy
- Alpha energy
- Strontium retardation coefficient
- Total strontium-90.

Samples of cuttings will be collected and submitted for laboratory analysis in accordance with the Waste Designation Plan to support waste designation and ultimate disposal.

6.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Chemical or radiological samples will be taken for analytical analysis. However, none of the standard quality assurance verification sampling will be necessary because the chemical and radiological analyses are for informational purposes, i.e., trip blanks, duplicates, and splits.

7.0 SCHEDULE

TASK	START DATE	END DATE
Stabilize access road	8/08/94	8/31/94
Drill geotechnical borings and install monitoring wells	8/22/94	10/30/94
Generate Borehole Completion Report	9/1/94	11/15/94

8.0 CHANGES TO DESCRIPTION OF WORK

Field changes to this document, such as changing sampling methods, analyzing different parameters, using different analytical methods, or significantly changing the sampling interval, will be submitted on the attached form (Figure 4). All changes will be kept on file by the 100-N task leader and retained in the project file. Copies will also be provided to the appropriate field personnel by the field team leader within 10 working days of the occurrence.

9.0 REFERENCES

DOE-RL, 1993, *N Springs Expedited Response Action Proposal*, DOE/RL-93-23, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1986, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods,* SW-846, U.S. Environmental Protection Agency, Washington, D.C.

Hartman, M. J., 1993, *Hydrogeology of the 100-N Area*, WHC-SD-EN-EV-027, Westinghouse Hanford Company, Richland, Washington.

WHC, 1987, *Industrial Safety Manual,* Vol. 1-4, WHC-CM-4-3, Westinghouse Hanford Company. Richland, Washington.

WHC, 1988a, *ALARA Program*, WHC-CM-4-11, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, *Engineering and Geotechnology Functions and Procedures,* Vol. 2, WHC-CM-7-8, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988c, *Environmental Compliance Manual,* WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988d, *Environmental Investigations and Site Characterization Manual*, WHC-CM-07-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan,* WHC-EP-0383, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991, *Health Physics Procedures Manual,* WHC-IP-0692, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993, *Radiological Control Manual*, WHC-CM-1-6, Westinghouse Hanford Company, Richland, Washington.

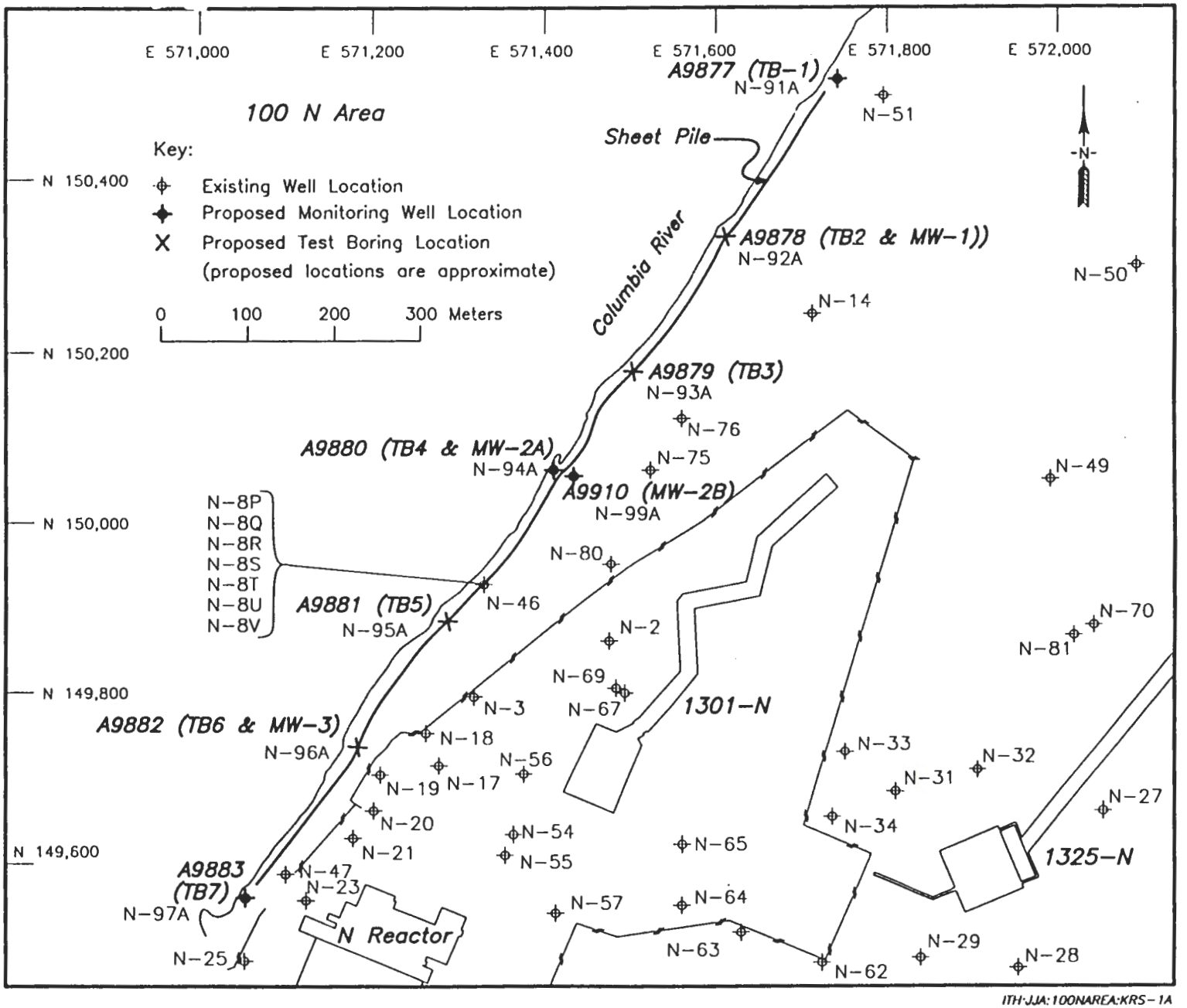

Figure 1. Location Map of Geotechnical Borings and Monitoring Wells.

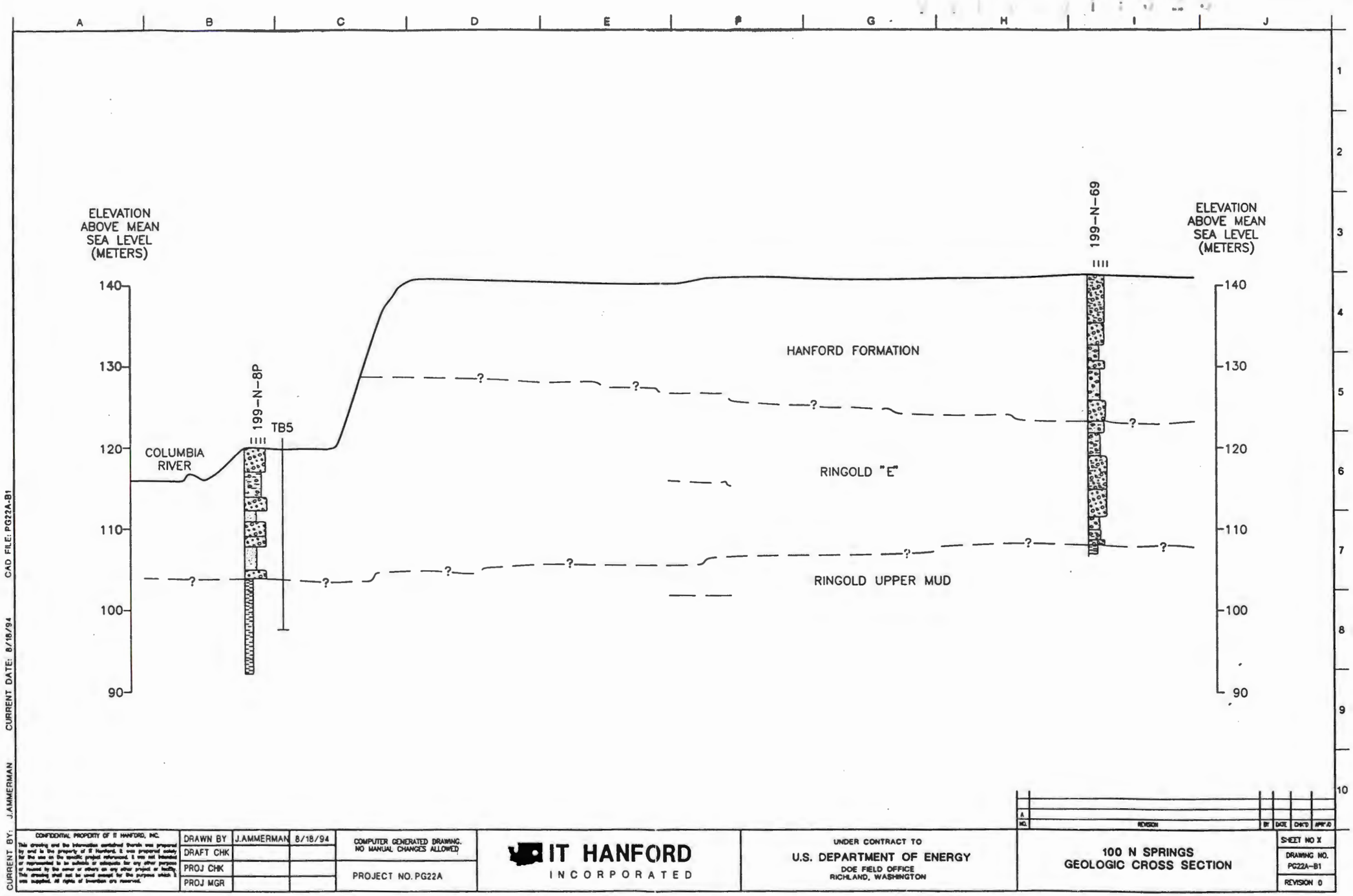

Figure 2. Stratigraphic Cross Section Through the Barrier Wall.

Figure 3. General Design of Washington Department of Ecology WAC 173-160 Compliant Wells.

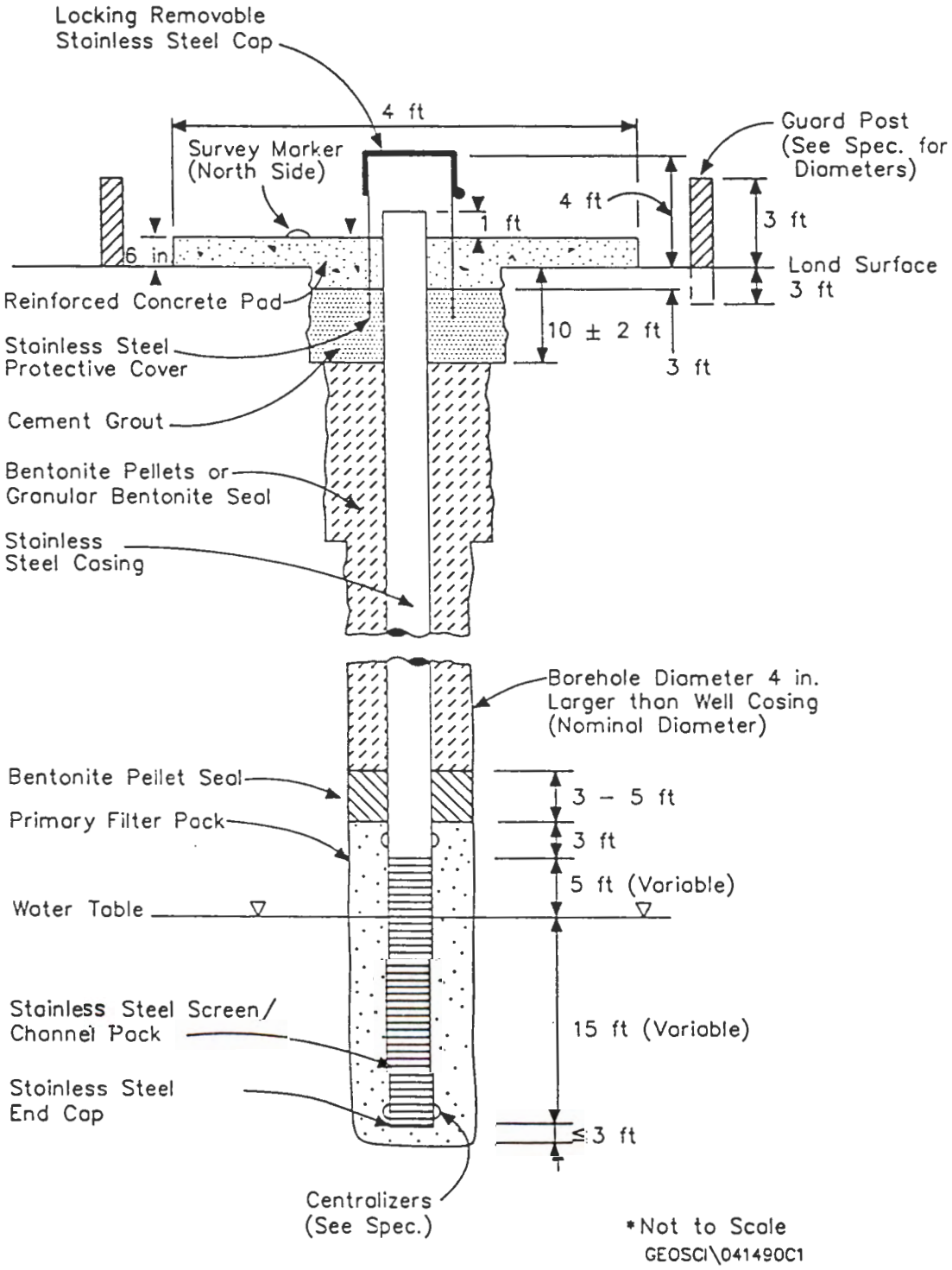

Figure 4. Field Change Form.

100 N Barrier Wall Design
Drilling Program Change Form
Document Number: BHI-00045

Date: _____

Person Initiating Change: _____

Change: _____

_____
_____
_____
_____

_____

Reason for Change: _____

_____
_____
_____
_____

_____
_____

APPROVAL: _____

Field Team Leader: _____

Task Leader: _____

Quality Assurance: _____

Table 1. Borehole Sampling and Testing Summary.

Geotechnical Borings (TB) and Monitoring Wells (MW)								
	N-91A	N-92A	N-93A	N-94A	N-99A	N-95A	N-96A	N-97A
Sample/Analysis	TB-1 MW-1	TB-2	TB-3	TB-4 MW-2A	MW-2B	TB-5	TB-6	TB-7 MW-3
Blow Count Sample								
5-ft intervals, or change in lithology	X	X	X	X	na	X	X	X
Strontium Retardation Coefficient[a]/Total Strontium-90								
Vadose		X		X			X	
At water table		X		X			X	
Mid-aquifer		X		X			X	
Lower Ringold gravel unit E		X		X			X	
Upper mud		X		X			X	
Grain Size								
Screen Interval		X		X	X		X	
Slug Test								
Water table		X		X			X	
Constant Head								
Upper Mud	X	X	X	X		X	X	X
Falling Head[b]								
Upper Mud	X	X	X	X		X	X	X

na = not applicable

[a]Analysis of strontium retardation coefficient samples will be determined from results of the total strontium analysis. Up to 12 K_ds will be analyzed.

[b]May be necessary, depending on results of constant head test.