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7. Abstract

This test plan describes the field demonstration of the sonic drilling system being conducted as a coordinated effort between the VOC-Arid ID and the 200 West Area Carbon Tetrachloride ERA programs at Hanford. The purpose of this test is to evaluate the Water Development Corporation's drilling system, modify components as necessary and determine compatible drilling applications for the sonic drilling method for use at facilities in the DOE complex. The sonic demonstration is being conducted as the first field test under the Cooperative Research and Development Agreement (CRADA) which involves the U.S. Department of Energy, Pacific Northwest Laboratory, Westinghouse Hanford Company and Water Development Corporation.

The sonic drilling system will be used to drill a 45 degree vadose zone well, two vertical wells at the VOC-Arid ID site, and several test holes at the Drilling Technology Test Site north of the 200 Area fire station. Testing at other locations will depend on the performance of the drilling method. Performance of this technology will be compared to the baseline drilling method (cable-tool).

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1.0 INTRODUCTION

1.1 SCOPE

This test plan describes demonstration of the Sonic Drilling Method as part of the Volatile Organic Compound Arid Integrated Demonstration VOC-Arid ID). This demonstration will focus on assessing the need and type of improvements to various sonic drilling components, including drill rods, sampling equipment and the sonic drill head based on performance during various field tests. Operational parameters will be recorded using an instrumentation system which has been specially designed for this test.

Activities will involve the installation of a 45 degree angle vapor extraction well and two vertical vapor extraction wells. Other tests will be conducted to determine which drilling applications are compatible with the sonic drilling method. These tests may be performed for the Environmental Restoration (ER) or Waste Management (WM) programs. Tests may involve angle or vertical wells or borings, or the removal of stuck drill casings from other drilling operations. The goal of this sonic drilling technology development program is to transfer this technology to the Expedited Response Action (ERA), and other ER and WM programs at Hanford, and other U.S. Department of Energy (DOE) facilities.

1.2 BACKGROUND

1.2.1 Sonic Drilling System

The DOE-Richland Operations Office (RL), tasked Westinghouse Hanford Company (WHC) with developing, testing, and demonstrating drilling methods that are environmentally acceptable, safe, more efficient, and cost effective, than the cable-tool method when drilling and sampling in hazardous and radioactive waste sites. The sonic drilling system was tested in FY 1991-1992 under the Drilling Technology Development Program and the ER Program. The Drilling Technology Development Program is administered and funded through the Office of Technology Development.

The *Integrated Test Plan for Demonstration of a Sonic Drilling System and the SEAMIST System* (Rohay and McLellan 1992) specified that the sonic system would be used to drill three deep vadose zone wells near the carbon tetrachloride disposal sites in the 200 West Area. Because of equipment problems with the contractor's sonic drilling system, only one deep vadose well was drilled. The remaining two wells were drilled with the cable-tool method.

In addition to the 200 West Area Carbon Tetrachloride ERA drilling, the sonic drill was used to collect site characterization data at several other sites including: 1) the 100-D Area Resource Conservation and Recovery Act (RCRA) site; 2) the 300-FF-5 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Operable Unit; 3) the 300 Area Underground Storage Tank Program; and 4) the Hanford Waste Vitrification Plant Baseline Characterization Program (see Figure 1).

Field testing of the sonic drilling method was initiated at the 300-FF-5 Operable Unit in September 1991. The services of the sonic drilling contractor, Harrison Western Drilling, Inc. (HWD), of Lakewood, Colorado, were obtained through a subcontract. The testing was conducted using a trailer-mounted 1976 model of a Hawker-Siddeley sonic drill owned by HWD.

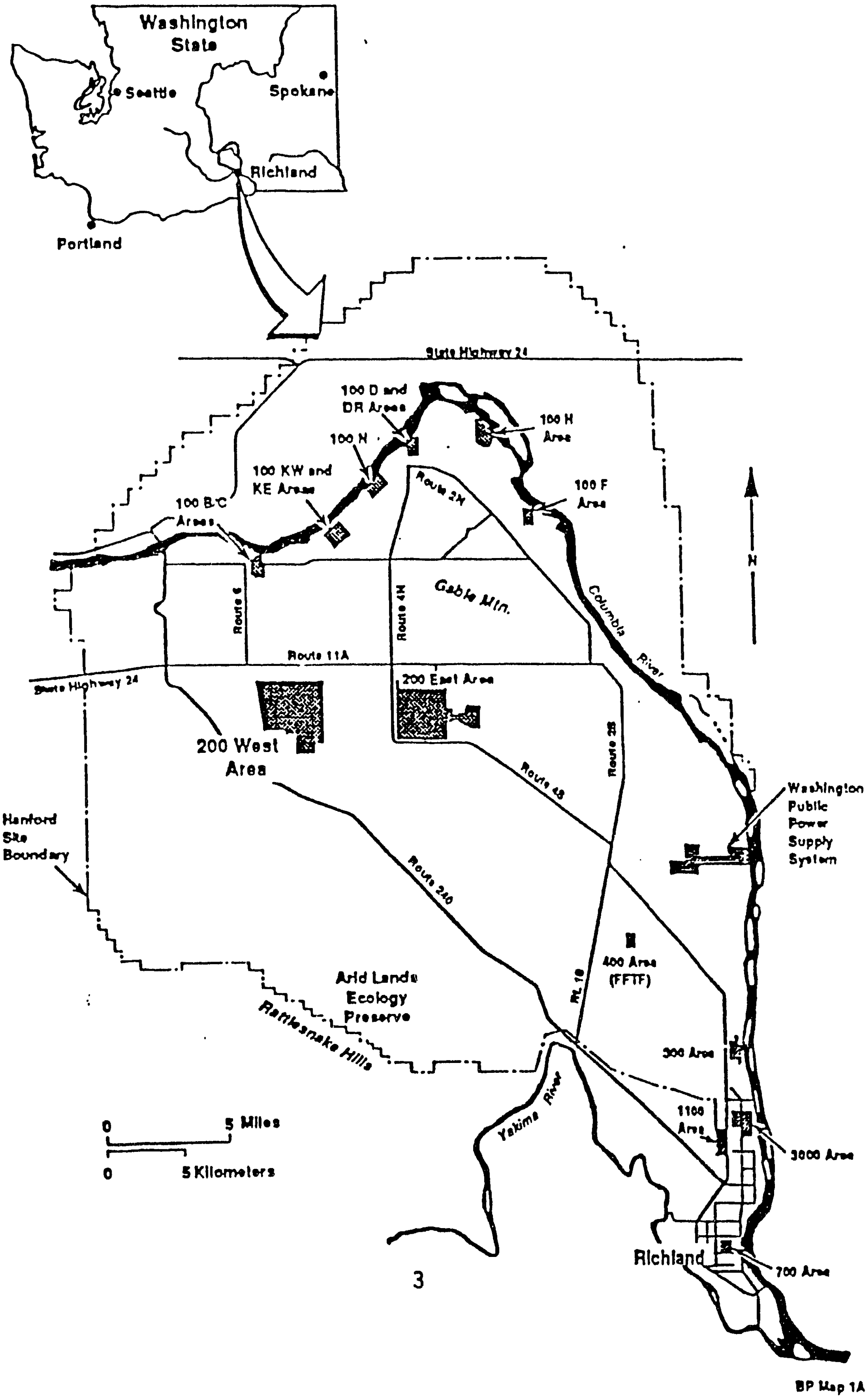
The sonic system was utilized to drill and complete eight groundwater wells, one carbon tetrachloride vapor extraction/monitoring well, and two vadose characterization boreholes. The wells/borings ranged from 30 feet to 227 feet in depth and were drilled in the 100-D, 200 East, 200 West, and 300 Areas of the Hanford Site.

Comparisons were made using the average of 11 wells and borings drilled with the sonic method versus ten nearby wells completed using the cable-tool method. Penetration rates with the sonic drill were approximately two times the rate of the cable-tool drill. In addition, less soil was required to be drummed since the sonic drill used no fluid or air for drilling. The sonic drill system experienced pipe failures and drill head failures which limited its performance. Downtime due to equipment related failures averaged 28 percent for the sonic rig versus four percent for cable-tool. However, even after including all downtime the sonic method still reduced drilling costs by approximately 20 percent (Volk, McLellan, and King 1992).

Following the test program, a Lessons Learned Meeting, and the completion of the report, it was collectively agreed to by the DOE and WHC that further equipment component enhancements to this drilling method were required prior to performing further operational support drilling to cleanup projects, and the possible purchase of a sonic rig. The preferred process to develop and test these improvements would be through a Cooperative Research and Development Agreement (CRADA) with an industrial partner. A CRADA, approved by DOE, was established in February 1993 between Pacific Northwest Laboratories (PNL) and industry sonic contractor Water Development Corporation (WDC) of Woodland, California. Subsequently, PNL designated WHC as the technical manager of the CRADA.

During the past three years WDC has been the leader in developing upgrades and more reliable components for the sonic system. The CRADA is structured around joint contributions from the DOE and WDC. The first phase of this agreement will focus on improvements to sonic drill pipe, the drilling head, soil sampling equipment, drilling bits, and the evaluation of alternative uses of the sonic method to support characterization and remediation projects. If improvements in the sonic system components can be made, the system will become a more viable method for drilling and sampling at waste sites.

Figure 1. Hanford Site Map.



Work conducted under this CRADA will be integrated with activities related to sonic drilling currently being performed by WDC at Sandia National Laboratories. Drilling results from both sites will be evaluated to assess the effects of various geologic conditions on the longevity and performance of drilling components such as drill pipe, drill bits, sampling equipment and the sonic drill head. Analysis of component failures is one area under consideration for joint interaction between the DOE sites.

1.2.2 Volatile Organic Compound-Arid Site Integrated Demonstration Project (VOC-Arid ID)

This demonstration is primarily being conducted as part of the VOC-Arid ID. The VOC-Arid ID is one of several DOE integrated demonstrations designed to support the testing of emerging environmental management and restoration technologies. The purpose of the VOC-Arid ID is to identify, develop, and demonstrate new and innovative technologies to support environmental restoration. These technologies may be used to characterize, remediate, and/or monitor arid or semi-arid sites containing VOCs (e.g., carbon tetrachloride) with or without associated metal and radionuclide contamination. Initially, the VOC-Arid ID activities will focus primarily on the carbon tetrachloride contamination and associated contamination found in the 200 West Area of the Hanford Site. Testing at other sites may be considered with the sonic method.

1.2.3 200 West Area Carbon Tetrachloride ERA

The ERA is currently ongoing in association with the carbon tetrachloride contamination in the 200 West Area. The ERA is being conducted by the DOE at the direction of the Environmental Protection Agency (EPA) and Washington Department of Ecology (Ecology). The ERA is a removal action under the CERCLA which allows expedited response to be taken where early remediation will abate imminent hazards or prevent significantly increased degradation that might occur if action was delayed until completion of a remedial investigation/feasibility study and record of decision.

The ERA is based on concern that the carbon tetrachloride residing in the soils underlying the 200 West Area is continuing to serve as a source of contamination to the ground water. Thus, the purpose of the ERA is to minimize contaminant migration within the unsaturated soils in the 200 West Area by removing the carbon tetrachloride. The proposed action for removing the carbon tetrachloride is to use soil vapor vacuum extraction with aboveground treatment, using a network of soil vapor extraction vadose wells.

1.2.4 ERA/VOC-Arid ID Coordination

The VOC-Arid ID and the ERA are separate projects, however, by using the ERA site for demonstrations of the VOC-Arid ID, both projects benefit. The ERA site provides a large source of contaminant at a controlled, characterized location. The VOC-Arid ID provides for additional characterization of the contaminant site as well as better, faster, and/or cheaper remediation technologies. By combining these two projects, the efficiency and cost effectiveness of each project increases significantly.

1.3 SITE SETTING

This demonstration will be conducted near the 216-Z-9 Trench in 200 West Area, the Drilling Technology Test Site (DTTS), north of the 200 East-West fire station and other sites depending on the performance of the method. Figures 2 and 3 identify the initial locations for this demonstration. Other locations, both at the VOC-ID site and elsewhere, may be used depending on the performance of the sonic system.

The upper geologic unit of the Hanford formation beneath the 200 West Area consists of two facies: 1) coarse-grained sand and granule-to-boulder gravel from which matrix is commonly lacking, and 2) fine-to-coarse-grained sand and silt that commonly display normally graded rhythmites a few centimeters to several decimeters thick. In general, this unit is composed of approximately 50 percent sand and gravel, 45 percent cobble, and five percent boulder, and ranges in thickness from 6 m to greater than 60 m. It is underlaid by 1.5 to 18 m of silts and fine sands, which in turn are underlaid by another gravel unit. Figure 4 represents a general cross-section of the geology on the Hanford Site.

Carbon tetrachloride vapor concentrations observed during drilling throughout the 200 West Area since 1987, range from less than detectable, to several hundred parts per million in unsaturated zone. Observed concentrations are highest in the vicinity of, and west of, the three sites (216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib) where the carbon tetrachloride was discharged to the soil column. In situ soil gas samples from wells being drilled near 216-Z-9 Trench in 1992 reached greater than 5,000 ppm carbon tetrachloride. Baseline monitoring of well heads of wells greater than 20 m deep and soil gas probes installed in 1992 indicate carbon tetrachloride concentration greater that 10,000 ppm at 216-Z-9 and greater than 1000 ppm at 216-Z-18 (Last and Rohay 1993).

Carbon tetrachloride breakdown products, chloroform and methylene chloride, also have been observed in soil samples in trace amounts. Other substances which have been identified, in trace amounts, in at least one soil sample from the 200 West Area include: benzene, fluoromethane, 1,1-dichloroethylene, trans-1,2-dichlorethylene, trichlorofluormethane, methyl isobutyl ketone, and toluene (DOE-RL 1991a).

The carbon tetrachloride coexists at different depths with radionuclides. The primary radionuclide components of the aqueous and organic liquids discharged to the three carbon tetrachloride disposal sites were plutonium and americium. The plutonium contamination extends approximately 30 m beneath the 216-Z-1A Tile Field; the lateral spread is limited within a 9-m-wide zone around the perimeter of the tile field. Other radionuclides, such as radioactive isotopes of cesium, cobalt, hydrogen, iodine, strontium, and technetium, have been discharged to the soil column beneath the 200 West Area. In addition, radon gas occurs naturally in Hanford Site soils and as daughters of uranium.

Figure 2. VOC-Arid Integrated Demonstration Site - Sonic Well Locations.

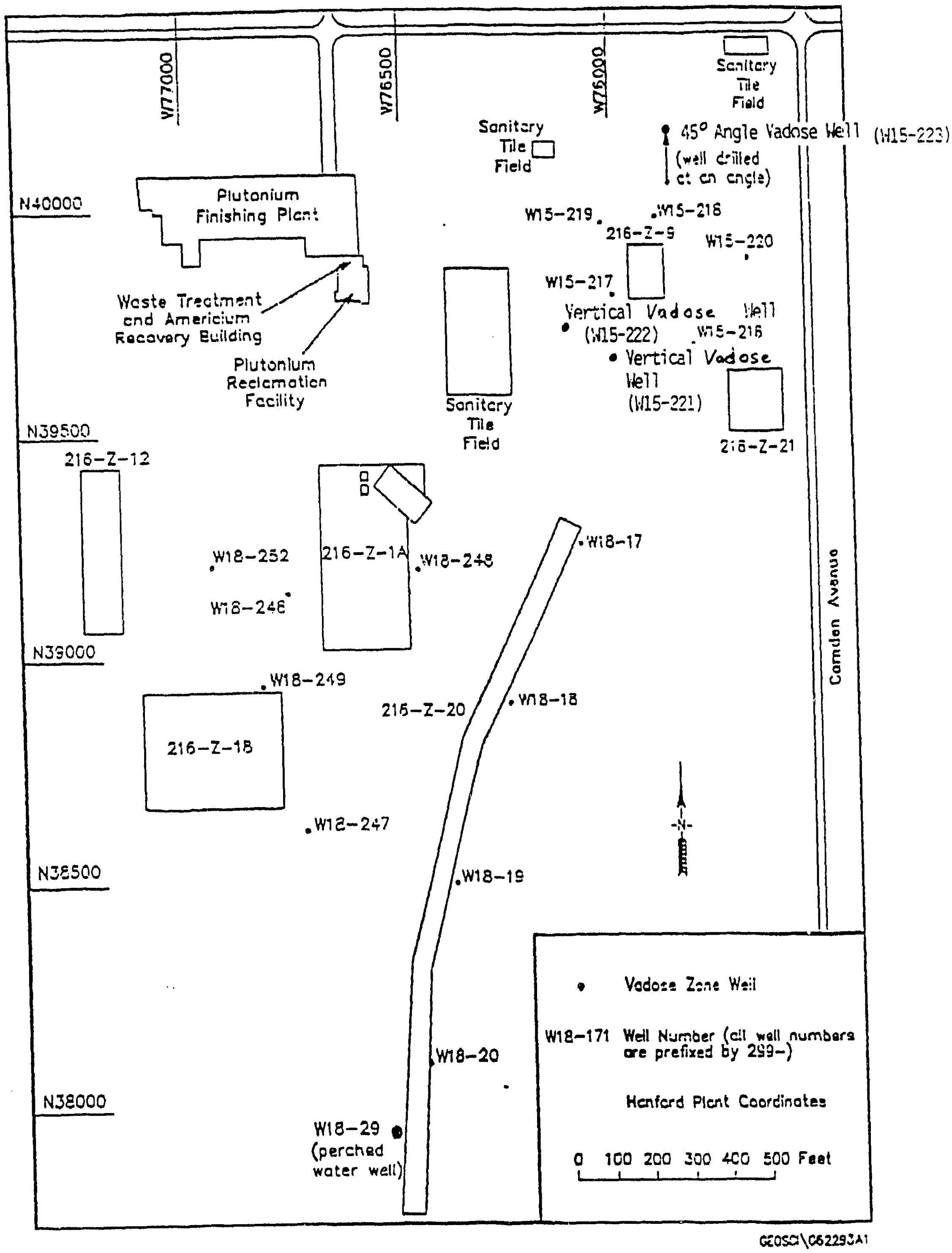


Figure 3. Drilling Demonstrations Test Site Location.

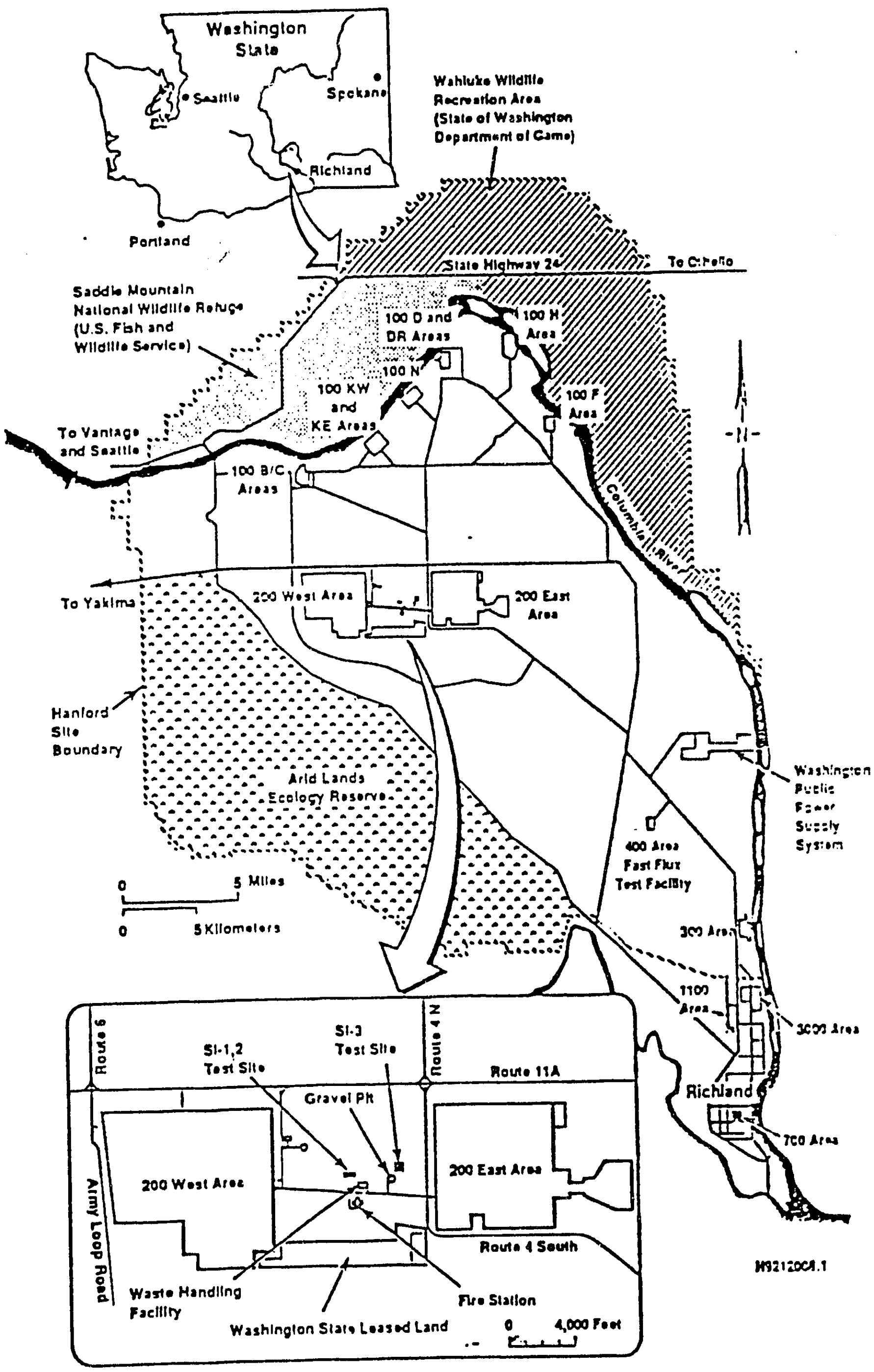
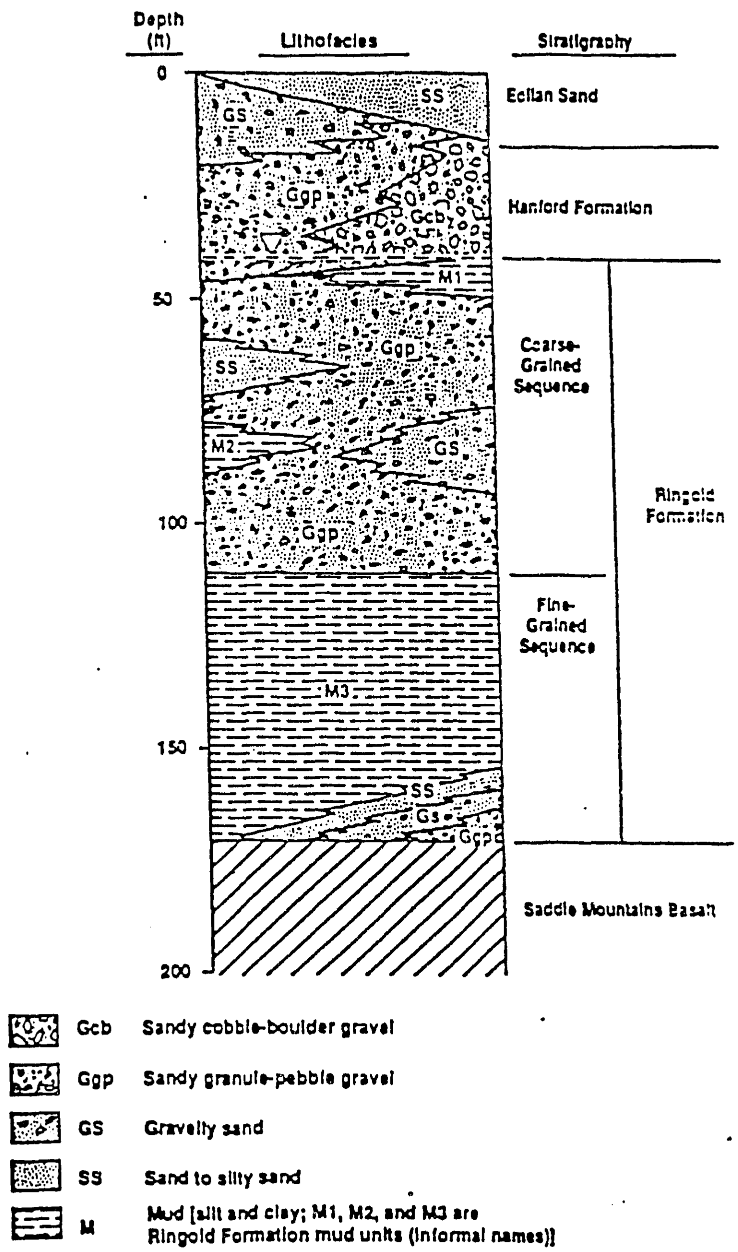


Figure 4. General Geologic Cross-Section of the Hanford Site.



2.0 TECHNOLOGY DESCRIPTION

The WDC sonic drilling system (Figure 5) uses a combination of mechanically generated vibrations and rotary power to penetrate the soil. The oscillator or drill head consists of two counter-rotating rollers that cause the drill pipe to vibrate. The rollers are synchronized to ensure that the vertical force component is transmitted downward through the drill pipe or core barrel (Figure 6). The vibrations are isolated from the rig structure by the use of an air spring. When the drill pipe is in resonance, the maximum displacements (elasticity) of the pipe are occurring. Resonance is the term used to describe the condition when the frequency of the vibrations is equal to the natural frequency of the drill pipe. The vibration of the drill pipe, coupled with the weight of the drill pipe, and downward thrust of the drill head, allows penetration of the formation. Concurrent with the resonant energy, the drill head can be rotated to assist in formation penetration and to ensure that the formation is always adjacent to the cutting surfaces of the drill bit. The vibrations generated in the drill string by the sonic drill range from 0 to 150 hertz and create up to 48,000 pounds of force (when using a 200 hp input).

With the rotational and vibrational energy being generated, the drill pipe is advanced into the ground, since the vibrational component literally causes the formation to yield beneath the drill bit. The drill string is advanced using minimal weight that is applied hydraulically with the drill head. The drill rig can generate a maximum of 10,000 pounds thrust, however, rapid penetration rates are commonly achieved with less than 1,000 pounds of downward thrust. The resonant energy emitted along the length of the drill pipe, substantially reduces the amount of friction between the drill pipe and the borehole wall. The method also has proven to be successful in extracting previously stuck drill pipe from other drill methods including cable-tool. During the 1991-92 sonic drilling program, stuck casing in a cable-tool drilled hole (150 feet, 10 inches diameter) was removed and the well was successfully completed using the sonic method.

As the hole is advanced, additional sections of drill pipe (typically five or ten foot lengths) are added and drilling continues. The soil enters the drill string through and open-face (core-type) drill bit and is contained in an inner core tube that rests on the inside shoulder of the bit (Figure 4). A weight assembly assists in keeping the core tube in contact with the drill bit without the use of a latching system. When the core tube is filled with soil, as revealed by slack in the attached wireline and a position indicator in the drill rig mast, the core tube is removed with the wireline retrieval system.

Figure 5. Sonic Drill Oscillator.

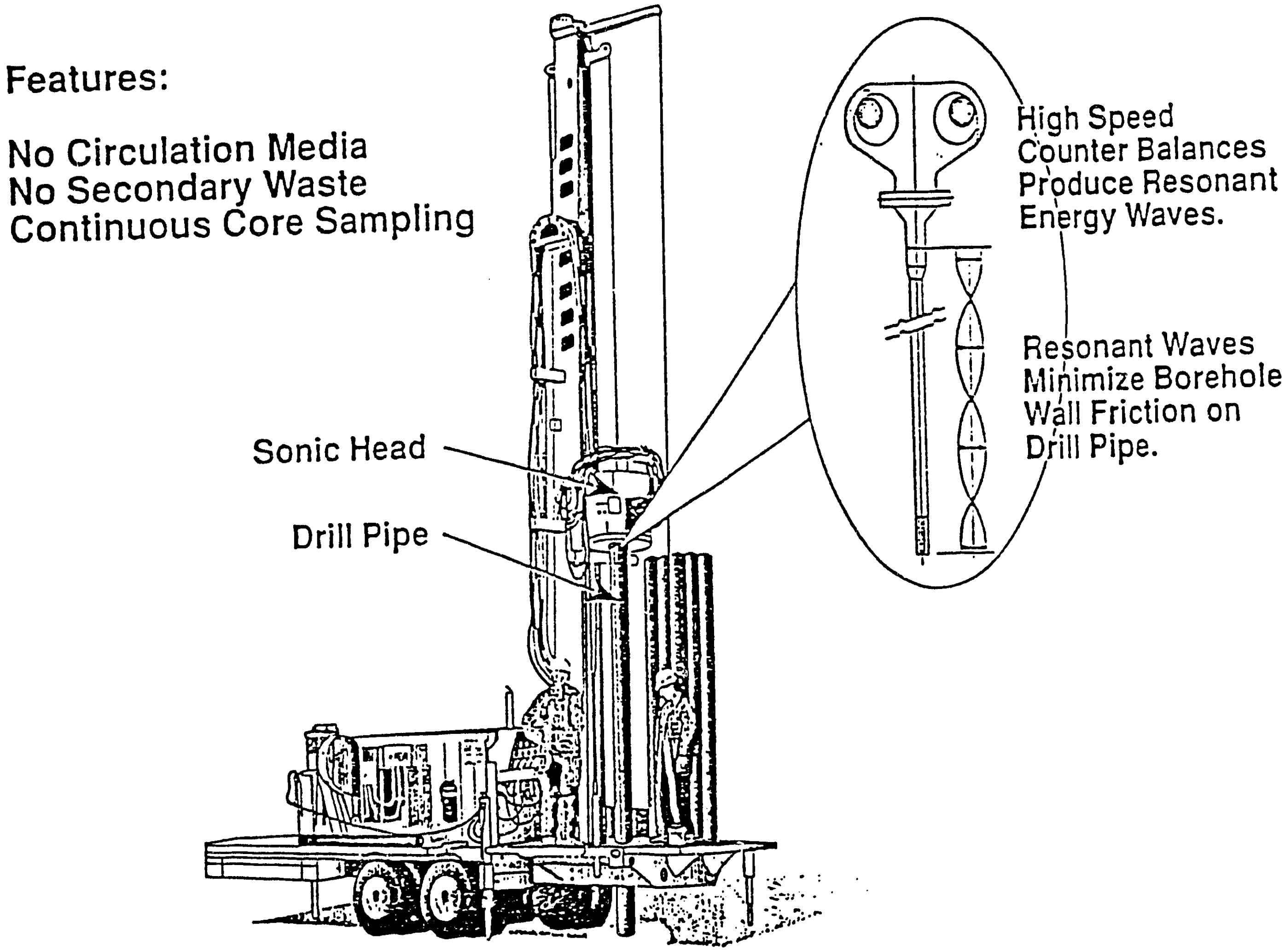
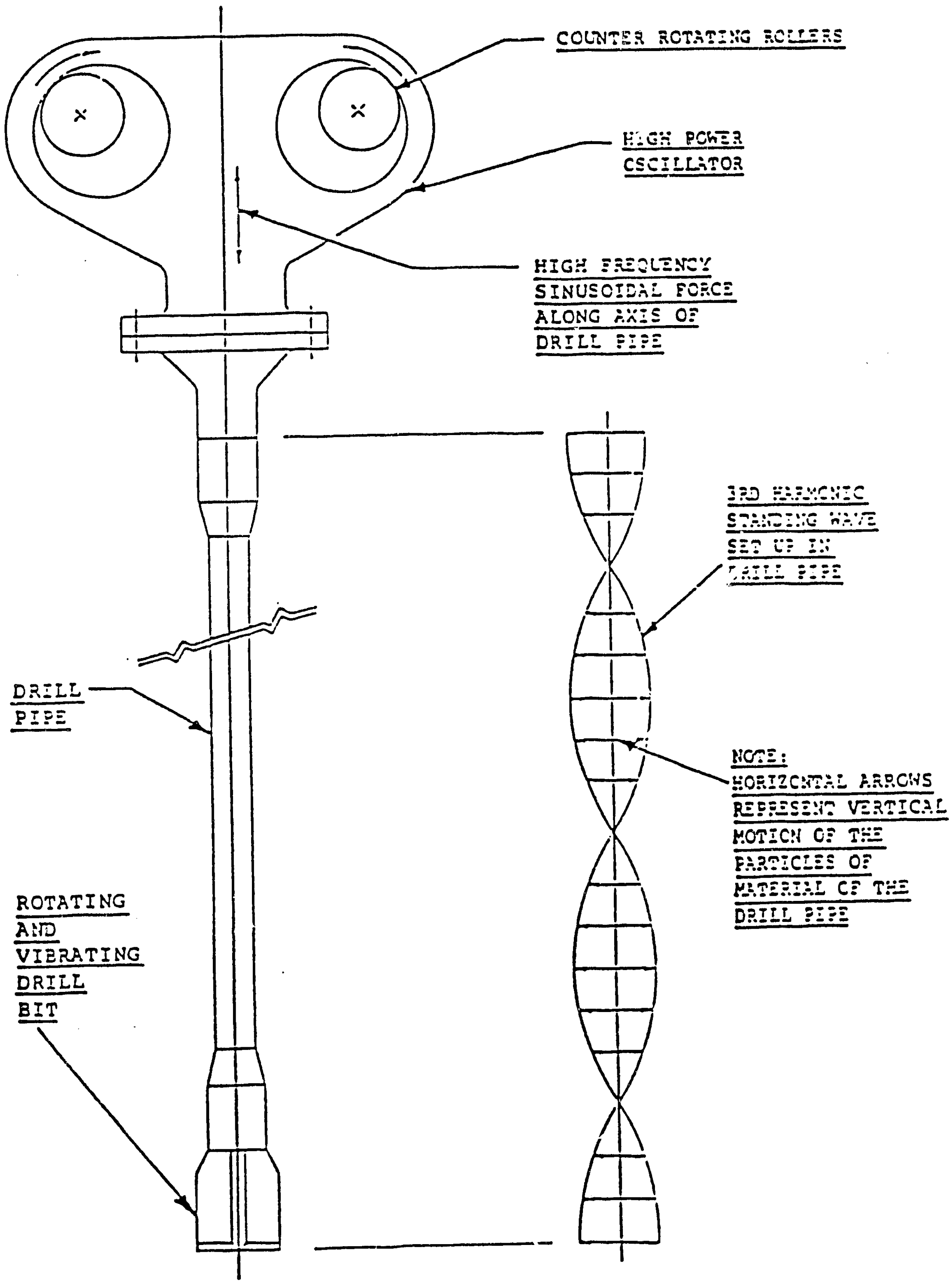


Figure 6. Sonic Drilling System.



A continuous core of the formation is obtained without the use of a circulation media (e.g., fluid or air). As is common with a core drilling process, the length of core retrieved each time is dependent on the stability of the formations encountered. With the sonic method, frequently the amount (feet) of core retrieved is greater (core growth) than the distance drilled, due to the displacement of the soil to the path of least resistance. Borehole integrity is maintained by the threaded carbon steel drill pipe, which remains in the ground while the core tube is removed.

WDC uses an internal drill string rather than the weighting system to secure the core tube in the drill bit. The key advantage to this method is the elimination of the tube lifting out of the bit when core resistance occurs, which may result in short core runs, grinding of the sample, and core loss. Different coring systems may be tested depending on the performance of the WDC system.

3.0 DEMONSTRATION OBJECTIVES AND MEASURES OF SUCCESS

3.1 OBJECTIVES

Testing of the sonic drilling method will involve an expansion of previous field testing initiated during the FY 1991-1992 test. The strategy is to improve the performance and reliability of various components in the sonic drilling system including the drill head, drill pipe, drill bits and sampling tools. An instrumentation system, developed by WHC Engineering Laboratory, will be installed on the rig to monitor various parameters. In parallel with the field testing effort, ongoing laboratory analyses will continue in the areas of metallurgical analyses, fatigue testing, and thread configuration to determine alternate drill pipe configurations for field testing later in this project. Testing will involve both vertical and angle boreholes. Performance objectives are as follows:

1. Demonstrate the efficiency and reliability of the sonic drill head in penetrating variable geologic conditions.

2. Demonstrate angle drilling capabilities with the sonic method and determine areas for improvements.

3. Develop and install an instrumentation system on the sonic drill to electronically record the resonant drilling process.

4. Correlate recorded drilling measurements with geology encountered.

5. Test and evaluate sampling equipment and sample handling methods to determine acceptable systems for both vertical and angle drilling modes.

6. Demonstrate that sonic drilling can meet safety standards at Hanford for drilling operations.

7. Demonstrate the ability to maintain contamination control and minimize generated waste so the drilling system could be used for vadose zone characterization borings.

8. Demonstrate compliance with Ecology regulations for completion of wells (e.g. filter pack, annular seals, etc.)

9. Demonstrate the ability to maintain minimal disturbance (comparable to cable tool) to soil samples during drilling and demonstrate the ability to achieve borehole depths and diameters consistent with project requirements.

10. Evaluate cost effectiveness of the sonic drill versus cable-tool drill when used for characterization of hazardous waste sites.

11. Determine the radial distance from the borehole of vibrations generated by the resonant sonic method.

12. Drill and install multi-screened interval four inch vapor extraction well.

3.2 MEASURES OF SUCCESS

3.2.1 Sonic Method

1. Achieve penetration rates which exceed performance recorded during 1991-1992 sonic test. Achieve equipment downtime rates equivalent to cable-tool drilling. Document downtime specifics including component description and repair/replacement action.

2. Drill a 45 degree angle hole, and complete as a three-inch vapor extraction well to approximately 160 feet. Maintain directional control within plus/minus two of stated angle requirements. Record operational activities with angle hole drilling including time cycles for drill pipe handling, sample retrieval, penetration rates, performance of the sonic drill head, containment of contaminants, and secondary waste generated.

3. Record defensible (calibrated instrumentation and recording devices) performance outputs from the sonic drilling head including rotational speeds, thrust, and vibration levels, and wave amplitude and velocity, to assist in drill pipe design and improve the reliability of the drill head.

4. Obtain soil samples of equivalent quality as cable-tool samples, and consistent with requirements noted in Sampling Plans (WHC-SD-EN-AP-109, Rev. 2 for the angle well and WHC-SD-EN-AP-114 for the vertical wells).

5. The measurement of success will be the selection of viable alternative sampling equipment and methods. Test sampling equipment and core retrieval and handling methods. Record performance data including sample quality, length of runs versus soil type, average run length, ease of handling, contamination control, retrieval and handling times, and evaluation of sampling equipment and handling methods, to determine acceptable systems for both vertical and angle drilling.

6. Achieve a target of zero reportable accidents. Evaluate the safety of both angle and vertical drilling operations, record and correct any potential hazards, near misses and safety related occurrences.

7. Achieve containment and generated waste performance which improves upon the current baseline for drilling operations. Document and control waste containment related items and waste generated. Note drilling formations versus waste generated, rinsate volumes from decontamination processes, total waste from drilled holes (including well/boring depth, diameter and core sample size). Collect data from adjacent cable-tool wells for comparison.

8. Perform and document the completion of holes consistent with Washington Administrative Code (WAC) 173-160. Conduct drilling, completion, and abandonment activities in compliance with the WAC.

9. Maintain and record core sample temperatures which prevent degradation to volatile organic compounds with levels of core growth. Meet depth, dimensional, and angle drilling requirements for each project. Document bit performances (including wear rates and temperature data), sonic impacts to sample quality.

10. Record times for sonic drilling and well completion process including but not limited to: drilling rates, drill pipe handling times, sample retrieval times, operational downtime due to equipment failures, and downtime from Hanford Site impacts (note organizational discipline imposing delay, specifics of issue to resolve, and interim and/or final resolution). Achieve drilling cost performance which exceeds previous sonic test (1991-92) rates by 20 percent.

11. Successfully record data via a radial array of subsurface sensing devices (using the sonic method to install sensors), the distance and respective levels of vibrations transmitted from the drill pipe to the surrounding soils.

12. Completion of regulatory compliant groundwater well to greater than 200 feet, in comparable time as cable-tool drilled well.

4.0 REGULATORY COMPLIANCE

This section identifies the regulatory compliance requirements for this field demonstration. The major requirements for the demonstration are derived from the National Environmental Policy Act (NEPA), the CERCLA, and the RCRA. Because of the limited nature of residuals from this demonstration, no requirements under the Clean Air Act, Clean Water Act, or other federal or state environmental laws are specifically applicable.

4.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

The NEPA, 42 USC 4321, is the basic federal charter for protecting the nation's environment. NEPA's focus is to ensure that federal agencies such as DOE give appropriate consideration to environmental impacts in their decision-making.

On December 4, 1992 DOE determined that characterization and environmental monitoring activities on the Hanford Site fit within a typical class of action currently available for Categorical Exclusion (CX) in Subpart D of the DOE's NEPA Implementing Procedures, 10 CFR 1021. The sonic drilling demonstration as part of this test is within the scope of activities in the CX approval. The sonic drilling work covered under this plan is one of the drilling methods for characterization wells that is discussed in the Information Bulletin supporting the CX approval. While the test activities will be used to demonstrate the sonic drilling method, these activities will also produce data that will be useful for the characterization of the Hanford Site, which is the primary purpose of the activities for which the CX was approved. The minimal impacts to the environment that will be caused by this test are clearly within the range of impacts assumed in DOE's CX approval. Accordingly, no further NEPA compliance documentation is required for demonstration of the sonic method.

4.2 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA)

The CERCLA, 42 USC 9601, is designed to manage the unplanned, uncontrolled releases of hazardous substances. In particular, CERCLA is the governing framework for the ERA being conducted in the 200 West Area at Hanford removing carbon tetrachloride from the soil vadose zone. The testing and demonstration of the sonic drilling system will be conducted in a manner that is consistent with the objectives and standards established for site characterization activities conducted for the ERA and described in the ERA site characterization work plan.

4.3 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

Subtitle C of RCRA, 42 U.S.C. 6921-6939b, establishes a comprehensive program to regulate newly generated hazardous waste. Administered by Ecology and EPA, RCRA Subtitle C requirements are contained in Chapter 173-303, WAC, and in 40 CFR Parts 260 through 272 and apply to the generation, accumulation, treatment, storage, and disposal of hazardous waste. In the event such wastes are generated, they will be managed in accordance with applicable waste requirements, including WHC Environmental Investigation Instruction (EII) 4.2, *Interim Control of Unknown, Suspected Hazardous, and Mixed Waste*. A waste contingency plan will be in place.

4.4 WASHINGTON ADMINISTRATIVE CODE

Chapter 173-160 of the WAC establishes minimum standards for the construction of wells. Well completions will be designed to meet applicable well construction standards or variances will be obtained from Ecology prior to drilling.

4.5 DAVIS-BACON PLANT FORCES WORK REVIEW

A Davis-Bacon Plant Forces Work Review to cover the testing of the sonic drilling system was prepared and submitted to the Labor Standards Board (LSB). The LSB determined that the Davis-Bacon Act (DBA) is applicable to site preparation work. The LSB also determined that the DBA is not applicable to the work associated with the mobilization, drilling operations, and demobilization of the sonic equipment for this test program.

4.6 CULTURAL RESOURCES REVIEW

The planned test sites were determined to have no historic properties as discussed in Cultural Resources Review (89-600-014). Cultural Resource Reviews have been completed for the 200 West Area ERA site and the DTTS.

5.0 HANFORD COMPLIANCE

5.1 SAFETY

The sonic method activities will be conducted in accordance with WDC's, Standard Operating Procedures and Safe Work Practices. WDC will conform to the Hanford Site requirements for access, on-site training, safety preparations, and equipment inspections prior to use.

A site-specific Hazardous Waste Operations Permit (HWOP) will be written for this task in accordance with the EII 6.7 Drilling Planning Requirements List. The document will include such items as expected hazards, mitigation of hazards, monitoring requirements, action levels, and personal protective equipment and emergency response.

5.2 QUALITY ASSURANCE

All work on the Hanford Site is subject to the requirements of DOE Order 5700.6C, *Quality Assurance* (DOE-RL 1991b), which establishes broadly applicable QA program requirements.

To ensure that the field demonstration activities are consistent with DOE-RL Order 5700.6C, *Quality Assurance* (DOE-RL 1991b), all work will be performed in compliance with QA Manual, WHC-CM-4-2 (WHC 1988) and with applicable procedures outlined in the QA Program Plan, WHC-EP-0383 (WHC 1990). This QA Program Plan describes the various plans, procedures, and instructions that will be used by WHC to implement the requirement of DOE-RL Order 5700.6C (DOE-RL 1991b).

The objective of the test plan is to ensure that the data obtained and the conclusions drawn are sufficiently accurate and reliable to support decisions associated with the evaluation of the subject technology. The Field Team Leader (FTL) or his delegate will document all activities per WHC-CM-7-7 (Brown 1988). All assigned delegates shall periodically update the Principal Investigator (PI) on the status of testing.

5.3 TRAINING

Personnel who need to enter the control zone around the rig will be required to have current OSHA (29 CFR 1910) 40-Hour Hazardous Waste Worker's Training. WDC's personnel will conform to Hanford Site requirements concerning training and safety.

Safety training requirements are listed in the HWOP. Security requirements are consistent with those needed for visitor access to the test site (McNamar 1993).

5.4 SAMPLING OBJECTIVES

Sampling activities during this test are focused on the unsaturated zone and groundwater directly beneath the carbon tetrachloride disposal site in the vicinity of the Z-9 Crib. The primary uses of sampling analysis data from these wells is: 1) to refine the conceptual model of the site, 2) assist in the development of sampling and sensing equipment for the sonic system, and 3) optimize the removal of the carbon tetrachloride. Sampling activities for the angle well will be conducted in accordance with requirements noted in WHC-SD-EN-AP-109, Rev. 2. Sampling activities for the vertical well will be conducted in accordance with WHC-SD-EN-AP-114, Rev. 1.

5.5 RECORDS

Records generated from drilling will be processed per WHC-CM-7-7 (WHC 1988). Final test reports will conform with the terms and conditions of the CRADA, and require the endorsement of PNL, WHC and WDC prior to issuance.

6.0 ORGANIZATION AND RESPONSIBILITIES

General roles and responsibilities specific to this field demonstration are delineated below (Figure 7). The demonstration will be performed by Demonstration Operations of the VOC-Arid ID and the PI. Demonstration Operations is responsible for site characterization, engineering and conduct of field activities, and regulatory and DOE-RL compliance. The following sections address responsibilities of principal field team members.

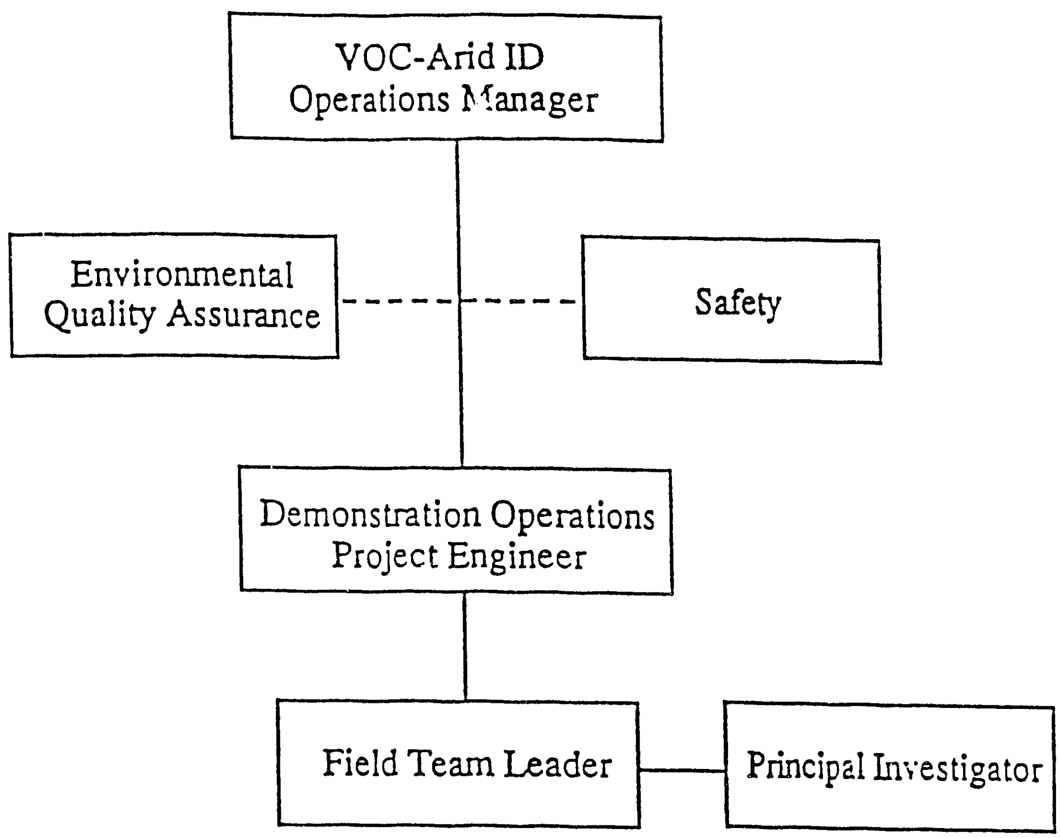
6.1 DEMONSTRATION OPERATIONS MANAGER

The Demonstration Operations Manager is responsible for: 1) ensuring that this demonstration is conducted in a safe and controlled manner and that all compliance issues have been resolved, 2) ensuring proper funding support for the preparation and field operations of this demonstration, and 3) ensuring necessary support for the demonstration by coordinating with involved management functions.

6.2 PROJECT ENGINEER

The Project Engineer is responsible for: 1) providing the PI with site information as needed, 2) coordinating site access including use of demonstration site and PI badging, 3) coordinating site services including utilities, transportation, facility space, and equipment and materials needed for this demonstration, and 4) conducting site preparation as needed in preparation for this demonstration.

Figure 7. Sonic Development Test Organizational Chart.



6.3 PRINCIPAL INVESTIGATORS

WHC is the PI for drilling technologies. The PI's responsibilities include:

- Ensure that the test objectives are met.
- Conduct the field activities through coordination with the FTLs.
- Provide all monitoring equipment to be tested.
- Provide personnel to set up the equipment, perform the test, and analyze the results.
- Prepare a performance evaluation report that reviews the test results related to the objectives.

6.4 FIELD TEAM LEADER

The FTL is responsible for overall technical field management of the project and control off on-site access. All on-site personnel will report through the FTL to accomplish their work. The FTL is supported independently by health and safety personnel and health physics technicians monitoring for potential radiation.

6.5 SITE SAFETY OFFICER

The Site Safety Officer (SSO) is responsible for the generation of the HWOP. The SSO has the final authority with regard to safety related issues in the field. Although personnel on-site are obligated to conduct activities in a safe and professional manner, the SSO is ultimately responsible for approving corrective actions should an unsafe condition arise.

For safety related issues in the field, the SSO and FTL are authorized to make reasonable and appropriate changes in procedures designated in the HWOP. These changes are contingent upon verbal authorization from the Health and Safety Officer.

6.6 OTHER PARTICIPANTS

The test locations will be prepared and located by Hanford Site personnel. WDC's personnel will mobilize the sonic equipment to the Hanford Site. Westinghouse Hanford Company will be responsible for decontamination of equipment waste disposal, and instructing of WDC on well completion activities which are in compliance with existing state standards or specific variances granted by the state.

7.0 DEMONSTRATION SCHEDULE

Sonic method testing will be initiated during the fourth quarter of FY 1993 and continue in FY 1994. It is anticipated that two sonic rigs will be involved under the CRADA. A Simco rig with a 300 series sonic head and angle drilling capability will begin work in late July at the DTTS. The angle hole adjacent to the Z-9 Trench in 200 West Area will begin in late August 1993. The second WDC sonic rig, a sonic 750 drill with angle drilling capability, will begin work during August 1993. Only one rig will be tested at a time, with rig selection based on individual project requirements.

8.0 DEMONSTRATION TASKS

The following activities will be conducted to test the capabilities of two different sized sonic drilling systems, beginning in late July 1993. A Simco rig with a 300 series sonic drill head will initially install two angle holes (first at the DTTS and later at the VOC-ID site). These wells will be inclined at 45 degrees and completed to a depth of 120 feet below ground surface, as the three-inch vadose zone vapor extraction wells, with one 20-foot screened interval. The angle well at the DTTS will be installed as a dry run activity in a clean site, to establish the operational protocols for completing the VOC-ID angle well.

A second WDC sonic rig with a 750 series head will arrive in August. Following the completion of the second angle hole, an operation start-up test will be conducted with the 750 sonic rig at the DTTS, followed by the installation of two vertical vapor extraction wells adjacent to the Sanitary Tile Field near the Z-9 Crib (VOC-Arid ID site). The vertical groundwater wells will be four-inch completions with two screened intervals, with the upper screen located approximately 85 to 100 feet below ground surface and the lower screened interval at approximately 170 to 185 feet. Screen lengths in the vertical holes are 15 feet.

The DTTS will serve as the testing ground for both drill rigs, both before and after the installation of wells at the VOC-ID site. Following the completion of the two vertical wells, a series of instrumented tests will be performed at the DTTS including, but not limited to, the following objectives:

1. To determine the operational parameters of the sonic rig to identify the energy loads imposed on the drill pipe. Data collected will form the basis for failure analysis and alternative material selections.

2. Determine the level of energy dispersed to the soils versus the distance from the drill pipe. The second activity will involve the installation of a series of small diameter holes, instrumented

with detection devices. These borings will be installed in a radial configuration surrounding a larger diameter hole which will be drilled once the vibration sensing equipment installation is completed.

Placement distances for the vibration monitoring array holes is currently being assessed and will be incorporated via an Engineering Change Notice when a final configuration is determined.

At selected locations, temperature monitoring of core samples will be conducted to assess the thermal effects from sonic drilling on the chemical characteristics of the soil samples. Heat sensing tape attached directly to the sampling tubes and/or temperature monitoring probes for installation into the cored sample will be used. Temperatures and a geologic description of the formation drilled will be recorded.

During the drilling of the angle hole an inclinometer will be used to determine the accuracy of the well.

Instruments and monitoring/recording equipment used to support these tests will be operator calibrated per EII 3.2. Equipment which will be calibrated includes load, displacement, vibration, and rotation sensing devices.

8.1 SITE PREPARATION

The DTTS was previously prepared to support prior vertical and horizontal drilling tests, therefore no site preparation is required. Drilling locations at the VOC-Arid ID site involve the angle hole and two vertical holes. All locations will require some site preparation work.

8.2 SYSTEM TESTING AND PROCEDURES

8.2.1 Sonic System

Testing, sampling, and analysis will be conducted in accordance with standard WDC's operating procedures and applicable EII's. Calibration of measuring and analytical equipment installed on WDC's equipment will be maintained by WHC in accordance with operator/owner manuals or by applicable standard analytical methods.

As necessary, the procedures of both companies will be modified by WHC's FTL for application to the Hanford Site and these modifications documented. All test procedures will be subject to WHC review and approval.
In particular, every effort will be made to minimize the generation of liquid and solid waste. Decontamination of equipment will be performed during back-pulling of the drill pipe assembly. Any rinsate will be controlled and

dispositioned by WHC personnel per EII 4.3. All sonic drilling and related testing activities will be performed in compliance with the *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, or WDC procedures approved by WHC QA.

Monitoring well and vapor injection/extraction wells will be placed according to WAC-173-160, *Minimum Standards For Construction and Maintenance of Wells*, or appropriate variances. A variety of well configurations may be used to achieve the objectives. The wells will be installed per WHC-S-014, Groundwater Monitoring Well-Generic Well Specification, Rev. 7. NOTE: The following sections do not apply because these are vapor extraction, not groundwater wells: Sections 4.2.3, 4.2.10, 5.3.1, 5.3.2, 5.3.3, 5.3.4, and 6.3; Appendices A and B also do not apply.

Each temporary well or boring will be abandoned to ensure protection of the groundwater resource and to prevent contamination of the resource (WAC 173-160-560). If abandonment regulations cannot be met, a variance will be obtained from Ecology.

8.3 TEST SITE RESTORATION

The test site(s) will be restored after testing. Restoration will include the removal of all equipment and temporary services not necessary for other activities either ongoing or anticipated at the test site. Test holes will be completed as appropriate.

9.0 SITE SERVICES REQUIREMENTS

WHC organizations that will provide support to this demonstration include: Regulatory Analysis, Industrial Safety and Fire Protection, Quality Assurance, Environmental Protection, Health Physics, Environmental Safety Assurance, Inactive Facilities Surveillance and Maintenance.

All sites located for the sonic equipment should be stable enough for the sonic drill rigs to be moved on and off. The maximum weight of the large sonic drill rig is 75,000 pounds (truck length approximately 40 feet). If the sonic rig works into the evening hours, portable lights with adequate lumination will be provided for safety around the vehicle.

10.0 DELIVERABLES

This demonstration will culminate with a written report on the sonic system. A Lessons Learned Meeting will be conducted, documented, and included as an addendum prior to issuing the written report. The PI is responsible to the VOC-Arid ID Technology Coordinator for reporting results of this demonstration.

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